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TECHNOLOGY AND EQUIPMENT MARKETS*

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INTRODUCTION

Technological developments exert a profound influence on the equipment and its manufacturing industry and consequently on the equipment market dynamics. The process is rather complex and the effects are for reaching particularly in the case of basic capital goods industries. The subject paper presents a case study in the machine tool industry, and discusses the technological developments in the machine tool industry in the coming two decades, their influence on the equipment, the share of the new equipment that is expected and the structural shifts that are anticipated in the markets. In the light of this process, recommendations are given for the development of the machine tool industry in the developing countries.

With the advent of the Numerical Control and computer technology, the nature of the equipment, namely the machine tools, has witnessed unprecedented changes. The present trends of computer numerical control, direct computer control and the industrial robots, are pointing to complete automation of the production processes leading to automatic factories. The machine tool manufacturing industry in the developed countries is fast giving up the production of the conventional general purpose machine tools. But since this equipment is expected to remain in application, although in an ever decreasing quantity, the market demand continues. However, in order to compete with the high productive NC machines and machining centres, the conventional machine tools are designed with higher productivity. The construction is also expected to change to modular unit type machines in order to lend them suitable for manufacture on the automatic flexible manufacturing systems based on group technology.

With the projected total production of machine tools in the developed countries exceeding 25 billion dollars by 1990 and 35 billion by the year 2000 (at current prices) and the share of the sophisticated computer controlled machine tools and systems reaching 35% by 1990 and 50% by 2000; the planned 50 to 60% exports during the 1980s and perhaps higher in the 1990s, would have to find the necessary markets.

The conventional machine tools that are being produced in some of the more advanced developing countries would face stiff competition, both in price and quality, in the face of the high precision, high productivity modern design general purpose machines, that are emerging in the market from the developed countries. The machine tool industry in the developing countries has to be geared up to the situation. This would also become necessarey to find the markets for the sophisticated equipment of the coming years.

CHAPTER 1

TECHNOLOGICAL DEVELOPMENTS IN THE MACHINE TOOL INDUSTRY - A CASE STUDY

For the sake of clarity and completeness, the past evolutionary stages in general and the present state-of-art and the tendencies in the field of machine tool technology are presented below in brief.

1.1 METAL WORKING

Metal working developed into two distinct processes namely the metal-cutting and the metal-forming, employing two different categories of equipment, the metal-cutting machine tools and the metal-forming machine tools. In order to transform the metal into a part of a required shape, size and finish, the metal cutting process utilizes mechanical energy to 'cut' the metal in solid state at normal temperature by means of a tool of harder material, (with the exception of certain processes where local heating in the cutting zone is applied); and the metal forming process utilizes mechanical and heat energies on the metal in solid state either at normal temperature (stamping, cold forging, cold drawing, cold extrusion) or at elevated temperatures (hot forging, drawing, extrusion), and in liquid state, naturally at elevated temperature, (casting, pressure die-casting) and also in powder or granular form making use of forms, dies and moulds of materials of higher hardness and/or higher thermal stability. There are other special processes utilizing electrical energy (electro-erosion, electro-discharge) chemical energy (chemical machining), sound energy (ultrasonic-machining) and light energy (Laser beam machining) used in a limited application.

1.2 METAL CUTTING MACHINE TOOLS

In the case of metal cutting process, to generate different surfaces in the required configuration and the specified dimensional accuracy, a vaiety of operations are performed by different machine tools namely the lathes, milling, drilling, boring, shaping, planning, slotting and grinding machines using single point, multipoint cutting tools and abrasive grinding wheels.

The basic structure of the machine tools has changed very little over the years. But with the ever increasing cutting speeds and the demand for higher working accuracies, substantial advances have been made in the design of machine tools to increase the geometrical accuracy, the static rigidity and the dynamic and the thermal stabilities of the machine tools. Progress has also been achieved in the materials that are used for the construction of the elements of the machines. Considerable developments have been made in raising the productivity of each machine by mechanical and electrical programming and also by the automatic transfer lines for the large series production of components.

1.3 THE CUTTING TOOL

In the area of cutting tools, new and harder materials and wear-resistance coatings have been developed. The gradual development, from high speed steels, of harder cutting tool materials such as cemented carbides, the ceramics has brought up the cutting speeds on constructional steels up to 600 metres/minute, increasing the productivity by 4 to 5 times. Wear resistance coatings on high speed steels and cemented carbides have increased the tool life by 2 to 3 times, similarly in the case of grinding speeds beyond 100 metres per second have been reached and together with improoved methods of keeping the cutting surface of the wheel clean, the productivity is raised up to 3 to 4 times.

1.4 NUMERICAL CONTROL

The most significant technological developments have taken place in the area of control of machine tools with the advent of the numerical control concept in the early 1950s, and revolutionised the whole production process. The numerical control (NC) is the operation of machine tools by a series of coded instructions. The control commands range from the positive positioning of the tool in relation to the workpiece to other auxilary functions such as selection of tool/tool station and controlling the speed and direction of the tool or workpiece rotation and other secondary functtions. The commands are logically organized comprising a programme to direct the machine tool to perform a sequence of operations and thereby accomplish the specific task of machining a workpiece.

1.4.1. THE MACHINING CENTRE

The NC led to certain developments in the machine tool. The conventional machine tools have been redesigned to suit the NC operation. Several operations like drilling, boring, milling, etc. have been combined in a machine with considerable time saving in set-up times. The most important development had been the concept of the machining centre, where a number of different machining operations are performed in a single setup, on several surfaces of the workpiece; with the ability to automatically select the required tool from a tool magazine, insert it into the spindle, and remove after the operation and return it to the magazine.

1.4.2 COMPUTER NUMERICAL CONTROL

The programme is prepared with or without the assistance of a computer and is put in a suitable medium, which is mostly a perforated tape; and the machine control unit, which is the bridge between the programmer and the machine tool, converts the programme commands into signals for the electrical or hydraulic servomechanisms of the machine tool to obtain the actual motions of the various elements of the machine tool. The machine control unit witnessed the most rapid evolutionary development from the bulky tube type units of the early 1950's to the present day computer Numerical Control (CNC) making use of the micro-processor technology. It was in the late 1970's the full CNC concept has emerged.

The Computer (Computerised) Numerical Control (CNC) is a numerical control system wherein a dedicated, stored programme computer is used to perform some or all of the basic numerical control functions in accordance with control programmes stored in the computer's memory. The computer usually a mini-computer is dedicated to one specific machine tool or two or three simple machines. The computer is not utilized for work-piece programme generation, but a programme that is already generated is stored in the computer and is read in the execution of the programme to machine a work-piece. The executive programme can be modified at anytime and new operations introduced by simply reading them into the executive position of the control unit computer. This is usually done with a punched tape. With manual data entry is also possible to make changes in the programme that is stored in the computer, without involving the original programme tape.

1.4.3. THE ADAPTIVE CONTROL

The speeds and feeds for a machining operation are normally determined by the programmer, in accordance with the material, tool and the machine para-metres, together with certain factors of safety against unexpected adverse cutting conditions. These speeds and feeds may not always result in the optimum productivity and accuracy due to variable factors of static and dynamic rigidities, thermal stability of the machine. The concept of Adaptive Control is developing, to change the speeds, feeds and depths of cut in order to compensate for the variable system para-metres affecting the productivity and accuracy, by sensing torque, deflection, vibration and thermal deformations during the actual cutting process and giving feed-back singals for the appropriate changes in the machining parametres.

1.4.4 DIRECT NUMERICAL CONTROL (DNC)

The present day growing phenomenon in the numerical control is the extensive use of computer control, ranging from the control of a simple two-axis machine to an entire factory involving complex machining centres. The Direct Numerical Control (DNC) is a system connecting a set of numerically controlled machines to a common memory for part programme or machine programme storage with provision for on-demand distribution of data. The direct computer control system may actually be in three different levels. A large central computer, at the first level, capable of handling programming several hundred machines, hierarchies of smaller computers, at the second level, to interpret and disseminate the logic from the central computer and capable of handling groups of lines of machines and then the individual mini-computors dedicated to individual machines, with provision for remote communication with the central computer.

1.4.5 FLEXIBLE MANUFACTURING SYSTEMS

In the area of organization of the production process, the technological development is in the direction of complete automation. For the automation in small and medium batch production, in order to accommodate frequent changes in the product component, Flexible Manufacturing System (FMS) with the direct computer control are presently being developed. The system consists of a group of machine tools on CNC, with automatic feeding and transportation of the workpiece from point to point and the system is capable of programming the sequence of operations, selection of the machine tool stations, selection of tools, selection of optimum cutting speeds and feeds, inprocess dimensional control. The auxilary operations are automated by robots.

1.5 COMPUTER AIDED MANUFACTURING (CAM)

The direct computer control in concept represents the very frontiers of manufacturing technology. The real breakthrough in manufacturing is emerging - the completely computer aided manufacturing (CAM). The concept would apply not only to manufacturing but to the interrelated processes of product design (computer aided design : CAD) and marketing. In computer aided manufacturing, the computer control would be applied to all the functions in a manufacturing process, such as inventory, tooling, production planning, scheduling, machine control, inspection, quality control, storage and so on; leading to completely automatic factories. The interrelated production functions and processes will be controlled in such a way that any action in one function, affecting any other will be sensed and corrective actions taken resulting in an optimum operation of the whole process.

1.6 METAL-FORMING MACHINE TOOLS

In the case of metal forming, in order to bring the metal into the required shape and size a variety of operations are performed by different machines. These are punching, cold forging, rolling, drawing, extrusion, hot forging,rolling, drawing; die casting, powder metallurgy, etc. on different presses and machines making use of particular types of dies, moulds and forms.

The essential features in metal forming may be said to be its high productivity and minimal metal consumption. The forming techniques are being developed as finishing operations replacing a number of conventional metal cutting operations and thereby reducing the number of metal cutting machine tools required in a production process, cold rolling for bearing races, gears, etc, cold forging and stamping of a variety of components in the automobile and agricultural machinery industries and die casting in a number of industries are coming out as more economical and productive technologies, producing higher quality workpieces.

Over the past two decades the construction of the presses has not experienced any basic changes. The principal directions of their development are: increased productivity by rationalising and automatising the auxilary operations of loading and unloading or feeding of the work material, change of dies, and simplification of setting, etc; increased speeds of operation, enhanced safety with a number of interlocks, diagnostic systems, etc. The most important technological development is the NC control of the presses and completely automatic lines, integration into production lines together with metal cutting machine tools, computer controlled production lines, etc.

1.7 METAL WORKING INDUSTRY - APPLICATION OF TECHNOLOGY

It needs no elucidation to recognize the fact that the metal working machine tools play the most important role in the metal working industry and consequently, in all the industrial sectors in general. The overall productivity of the metal working industry is a function of the productivity of the machine tools used and the quality of the product directly depends upon the quality of the machine tools employed. They also determine the level of the mechanization and automation in the industry and bear a relationship to the skills required of the labour.

1.7.1 FACTORS AFFECTING THE APPLICATION

The developments in the machine tool technology and their application in the industry, to a large extent, are determined by various factors such as the industrial sector where the machine tools are used, the product, the type of the process and the manufacturing technology employed, the production technology and the quantities involved, the nature of the raw materials that are to be worked, etc. Each one of the above factors or a combination of them demand different and specific types of machine tools: for example, heavy engineering equipment industry requires heavy and unique and specialised machine tools, the instrument industry needs high precision machine tools, generally smaller in size, bearing industry high precision, and automatic lines, and similarly the automobile, tractor industries demand special purpose, automatic lines.

1.7.2 THE TYPE OF INDUSTRY

The application of NC technology is varied in different industries, each characteristic of a certain type of production technology. For example in the automobile industry, where mass production and very large series production is employed, the advantage of the NC over other means of automation is not appreciable. In the industrialized countries of the world, NC machines found most of their application in the general machine bulding and aviation industries, particularly in the industries producing machine tools, internal combustion engines, turbines, etc.

1.7.3 THE MANUFACTURING TECHNOLOGY OF THE INDUSTRY

The manufacturing process exerts a great influence on the type of machine tools required. Developments in the process technologies and changing over to new processes lead to major shifts in the requirement of machine tools. Some of the developments such as die casting of parts both in non-ferrous and ferrous metals and powder metallurgy have led to certain overall reductions in the demand for conventional metal cutting machine tools. Similarly introduction of cold rolling and forging of ball bearing races, certain gear wheels, etc; pressing, stamping, hot and cold forging of a variety of parts in the automobile and related industries have,either eliminated or reduced to a minimum, a number of metal cutting operations and the machine tools required for them.

1.7.4 THE PRODUCTION TECHNOLOGY OF THE INDUSTRY

It is worthwhile dwelling briefly on the influence of the production technology employed in an industry in order to assess the application of the various technological developments in the machine tools individually and in their organization for increasing the productivity.

Automation in its early stages was essentially developed for the mass production of components. Machines were developed to perform single operations and the workpieces were transposted by mechanized means from point to point and together with the necessary automatic control of dimensions, formed complete automatic lines.

Small batch production, involving a variety of components and frequent change in the product require different means of production employing semi-automatic, automatic multiposition, multitool, special purpose, unit machines, NC machines, in semiautomatic or fully automatic production line, including metal forming presses where required. These lines are capable of change over from one component to another. The machining centres can constitute the basic elements of such automatic lines. The workpieces are fixed on to pallettes and moved from point to point.

The utilization of these automatic lines, in practice, may often be below their capacity due to various factors related to the organisation of the production process. The computer control of such automatic lines vastly improves the utilization.

The difficulty in the automation of auxilary operations, particularly in the batch production, is successfully solved by employing industrial robots with computer controls and considerable improvements in productivity have been achieved. The ease of operation with robots leads to complete automation of production lines for batch production.

1.7.5 THE MATERIAL TO BE WORKED

More and more different metals and materials are being used for a variety of equipment operating on extreme working conditions. Metals that withstand very high temperatures are used in the construction of gas turbines, rockets, space craft, nuclear energy equipment, etc., similarly high tensile, heat-resistant metals are used in making dies employed in high pressures, impacts and temperatures. These items often require extremely complicated shapes to be generated and high precision machining to be performed. These machining operations tend to be either impossible with, or lend themselves to be impracticable on the conventional machine tools. It is in these areas the electro-physical, electro-chemical and laser beam machining are employed.

CHAPTER 2

THE EFFECT OF TECHNOLOGICAL DEVELOPMENTS ON THE MACHINE TOOL MARKETS

The technological developments in the field of machine tools have greatly influenced the markets. The nature of these influences can be ascribed to different aspects of the technological developments and are prompted by a number of reasons. Some of these effects on the market, as they are happening in the industry are presented in the following paragraphs.

2.1 The effects, on the market, of the developments in process technology

2.1.1 Process technology related to materials for products

With the increasing use of new constructional materials such as zinc based alloys, aluminium alloys and plastics in a variety of products from household gadgets to automobiles, the production processes as applied to the processing of these materials are taking over the conventional metal working operations and consequently the demand for the machine tools in such areas is either decreasing or shifting to other types. 1/

Similarly in the automobile industry, it is a known fact, that the content of aluminium parts which was hardly about 5 kg by weight in an automobile in the 1940s has increased to more than 50 kg in the present day, a tenfold increase; and is expected to exceed a 100 kg towards the end of the 1980s. The content of plastics, which was about 10 kg in the 1950s has presently reached more than 80 kg and is on the increase up to 200 kg towards 1990. 2/ The components in aluminium and zinc alloys are made by die casting and those in plastics by plastic injection moulding and other plastics processing equipment, displacing in increasing proportions, the machine tools used for processing the conventional metals in the automobile industry.

1/ For example the Singer Company has reduced the metal cutting operations by about a quarter by a change-over to die casting, powder metallurgy and plastic injection moulding of some of the parts of the sewing machines of their new series.

2/ "American Machinist", January 1978.

to certain components that lend themselves for such forming and would be, in general, applied for parts required in the automobile, tractor and similar industries. It is expected that in the next two decades the shares would reach: 25 per cent metal forming and 75 per cent metal cutting.

Within the metal forming techniques the cold forming is gaining in application. In view of considerable loss of metal in hot forming and the energy expended on it, the cold forming is more economical from the point of energy saving. It is expected that, towards 1990 the cold forming methods would have a share of 50 per cent of the hot forming operations in the 1970s.

2.2 Market effects due to development in the machine tool

The most significant development in the machine tool field had been the concept of the numerical control. The advent of NC has set off an unprecedented series of developments in the machine tools and is responsible for the remarkable and far-reaching effects that are experienced in the market and seems destined to bring about in future equally profound changes, together with the developments in the computer technology.

2.2.1 The displacement in production of general purpose machines by the numerically controlled

In the 1970s, as the production of NC machines increased, the machine tool manufacturers in the developed countries have been progressively giving up the manufacture of general purpose universal machine tools with conventional controls. 1/ Several factors are responsible: the GPMs of the traditional designs are less productive than the NC machines, they face severe competition from manufacturers that concentrate on GPMs, the demand for the NC machines with their ultimate economies tends to rise etc.

1/ As production of MC machines increased, over the period 1972 to 1976 M/S Cincinnati Milacron have dropped 32 models of conventional machines.

2.2.2 The displacement in GPMs due to developments in NC machines

With further developments in the design of NC machines, for example, the machining centres that combine operations such as milling, drilling and boring etc, the production of conventional machine tools in the milling, drilling and boring machine groups has fallen. This has resulted in another phenomenon, namely, the increase in the productivity of these machines. The manufacturers that produce exclusively these machines have increased the productivity and versatility by means of additional accessories and also by introducing numerical controls and a new set of modern, high productive machines are on the market.

At the same time, the production of turning machines, high productive machines like single-spindle and multi-spindle automatic machines, with automatic cycles and with NC have gone up in production.

2.3 Effects on the market due to developments in production technology

2.3.1 Effects of the production technology in the manufacture of the machine tools

In order to rationalize the production technology in the manufacture of machine tools, the variety of the GPMs is being reduced and more specialized multioperational GPMs are produced with machine construction modified to lend themselves for production on automatic lines. The designs are being rationalized to be in modular construction such that the unit elements can be assembled to form different variants by specification.

The concept of standardization of the unit elements of machine tools including the NC machines is expected to develop extensively. This would make possible the manufacture of the machine tools on completely automatic flexible manufacturing systems with overall economy.

2.3.2 The effects of the production technology as applied in the user industries

As already mentioned in the previous chapter in the industries such as the automobile, tractor and other similar industries, where large batch or mass production technologies are employed, the manufacturing lines are completely automatic, specially set for a particular product and were rather 'rigid'. In the small and medium batch production, as is the case with a variety of small and medium scale industries, the production lines have to be 'flexible' to accommodate a large variety of components, characteristic of a wide range of cutting parameters and composite operations. This requirement has led to the creation of flexible manufacturing systems capable of quick and easy resetting. The NC machining centres constitute the basic elements of the system and is controlled by a computer for process optimization. The difficulty in the automation of the auxilary operations is resolved by employing automatic industrial robots. The concept of the flexible manufacturing system is being introduced even in the large batch production industries.

CHAPTER 3

THE DYNAMICS OF THE MACHINE TOOL MARKET IN THE COMING DECADES

An analysis of the general present day utilization of the various technologies in the industry and the present trends would reveal the broad future tendencies and the technological perspectives and help assess the implications for the developing countries.

3.1 THE SHARE OF NC

Although the rate of increase in the utilization of NC machines in the 1970s is considered to be high, the percentage of absolute numbers of these machines in the total park of machine tools in various countries at present, is relatively very small: in Japan 1.4 per cent, USA 1.3 per cent, UK 1.1 per cent, FRG 0.6 per cent. Numbers do not convey the share, as one NC machine is equivalent to 3 to 8 and one NC machining centre is equivalent to 8 to 10 conventional machines, a more appropriate index would be the share by productive capacity. The present share in the total productive capacity is approximately: USA 10-13 per cent, Japan 9-10 per cent, UK 7-9 per cent and FRG 4-5 per cent. 1/

By the machine tool census of various developed countries, there was about 100,000 total NC machine park in 1977, with an average rate of increase of about 19 per cent per annum over the period of 1967 to 1977 2/

1/ Source: A.C. Kosminin, "The capitalist market of metal working equipment and prospects forits growth"; Bulletin of Foreign Commercial Information, No.1, 1980; USSR Market Research Institute (VNIIKI), Moscow.

2/ Source: "L'Usine Nouvelle", 15 December 1974, "Machine Outil", May 1976, "Metal Working Production", 1976, "Il Parco Machine Utensile nell' industria Italiana", 1975, "Statistical Year Book" of the USSR, 1980.

The statistical data is presented in table 3.[1] Therefore, by very approximate extrapolation for the purposes of orientation, it may be said that the share of NC machine tools by productive capacity might be expected to be about 23 to 25% by 1990 and 67 to 70 percent by 2000 year. This indicates that by 1990, still 75 percent of the metal working would be done by conventional machines. However, by 2000 year, the share would be reduced to 30 percent.

The total production of machine tools in the developed countries in 1978 was approximately 16 billion Dollars growing at an average annual rate of about 10% over the period of 1960 to 1978. Rough projections indicate that the production will exceed 25 billion dollars by 1990, 35 billion dollars by 2000 year. The statistical data is brought out in table 4. The production figures of NC machines by some of the developed countries is given in the table 5. Judging by these figures a very approximate indication may be made that the production of NC machines would have a 35% share by value by 1990, and 50% by 2000 in the total machine tool production. (Annexure 1-A and 1-B)

Table 3
NC MACHINE PARK
(pieces)

	1976	1970	1975	1976	1977	Average rate of Annual Growth (%)
USA	12,000	20,376	36,000	40,000	45,000	14
JAPAN	500	800	8,560	12,000	15,500	38
U.K.	1,500	3,100	7,000	9,500	11,500	22
FRG	730	2,200	6,300	8,000	10,000	30
ITALY	160	848	3,290	3,960	4,780	36
FRANCE	630	1,050	2,950	3,500	4,000	23
Total:	15,510	28,376	64,600	75,960	90,780	19

1/ Source: "l'Usine Nouvelle" 15 Dec. 1974, "Machine Outil", May 1976, "Metal Working Production", 1976, "Il Parco Machine Utensile nell' industria Italiana", 1975, "Statistical Year Book" of the USSR, 1980.

Table 4

PRODUCTION OF MACHINE TOOLS IN DEVELOPED COUNTRIES *
(Million Dollars)

	1960	1965	1970	1975	1977	1978	Average rate of Annual growth(
FRG	582.9	851.0	1,479.0	2,349.0	2,635.8	3,287.4	10.7
USA	777.7	1,457.7	1,443.1	2,406.1	2,426.9	3,050.0	8.4
USSR	608.0	887.8	1,360.0	1,931.1	2,768.0	3,020.0	9.3
JAPAN	74.1	289.7	1,109.4	1,098.2	1,608.8	2,330.0	22.5
ITALY	109.6	112.0	433.6	748.0	878.6	980.0	13.7
SWITZERLAND	106.3	153.5	240.0	540.0	581.9	790.0	12.5
U.K.	265.7	395.6	476.9	723.0	587.8	760.0	6.4
FRANCE	158.6	226.5	316.5	554.0	591.6	716.0	9.3
SPAIN	14.5	58.1	90.2	212.0	193.1	220.0	17.3
SWEDEN	31.6	48.7	66.0	146.0	146.3	135.0	8.9
BELGIUM	17.7	27.2	33.1	91.0	106.4	124.0	12.1
OTHERS	102.3	200.0	261.4	402.7	607.8	552.6	10.4
Total:	2,849.0	4,708.0	7,310.0	11,201.0	13,133.0	15,965.0	10.0

Table 5

NC MACHINE PRODUCTION IN SOME DEVELOPED COUNTRIES* (METAL CUTTING)
(Million Dollars)

	1965	1970	1975	1976	1977	Average rate of Annual growth (%)
USA	136.6	190.1	504.7	501.0	496.7	12.4
JAPAN	1.1	78.7	134.1	173.2	301.6	35.0
U.K.	11.8	37.7	50.8	45.8	58.7	15.7
ITALY	3.0	-	-	102.3	129.0	35.0
FRANCE	1.4	10.9	91.2	81.6	93.7	35.0

* Source: Calculated from industrial statistics of the countries.

It is expected that in the early 1980's completely automatic machine tools and flexible manufacturing systems with computer control and process optimisation will be used; and in the late 1980's they will constitute about 35% by value of the total production of machine tools and executing 25% of the metal working operations. In the early 1990's completely automatic factories with robots would be operating. The share of all the systems reaching 50% by value of the total production and contributing 70% of the metal working capacity by the year 2000.

3.2 STRUCTURAL SHIFTS WITH NC MACHINES

As the production of NC machines increases and that of general purpose decreases, with a view to rationalize the technological manufacturing processes, the latter would be modified more towards unitised modular construction to lend them for manufacture on special purpose automatic lines based on group technology and they would fall some where between universal and special purpose machines.

As the production of machining centres increases, that of the conventional machines of the milling, drilling and boring families will be reduced, but their productivity and versatility will be greatly enhanced, (as it had already started happening). Their configuration would also be modified to make them suitable for operation with robots.

With the increase in production of the NC machines, that of the turning group has also increased to a considerable extent, particularly in the turret, single and multispindle automats. High productive and high precision turning machines will be produced. Universal machines for roughing operations will drastically fall.

In view of the above, it is expected that the future universal machines will be high productive, high precision, versatile machines in modular construction

The NC machines will further develop in their construction. As individual machine tools, they will develop into large size machine for machining large and complicated workpieces and as small, compact and inexpensive machines for simpler operations on smaller workpieces. The past years have indicated the development mainly into machining centres and turning machines. The NC turning machines will further develope in their versatility combining more operations other than turning.

As elements of flexible manufacturing systems and completely automatic factories, the NC machines will be developed into unit modular construction as the production of such systems will reach 50% of the total. It is expected that about 75% of the total manufacturing technology would be based on group technology by early 1990's.

The application of industrial robots for the automation of auxilary operations and assembly operations, in the completely automatic manufacturing systems and factories, would be extensive.

It is likely that industrial sectors like the automobile industry may also apply flexible manufacturing systems.

CHAPTER 4

THE IMPLICATIONS FOR THE DEVELOPING COUNTRIES

With the exception of some of the developing countries in Europe and Brazil, India, Argentina and Mexico amongst the rest and a few others; the machine tool industry is in a very low level of development. The existing machine tool park is mostly of obsolete design, very old and of low productivity. The metal working industry is in general oriented for repair and maintenance work for other equipment in transport and agriculture and partly for the manufacture of spare parts for the same. The public sector and the organized and unorganized private sector firms engaged in the manufacture of engineering equipment and machinery are acquiring considerable skills in metal working. The economic development plans of the developing countries in general stress the importance of the metal working and machine tool industries as the sector for the development of other sectors and for the overall economic development. Presently, the most part of the required machine tools are imported. The indigenous development of machine tool industry to a large extent would depend on the capital goods and engineering industries, in particular those for the manufacture of automobile and other transport equipment, agricultural machinery, household goods, construction equipment, earth moving equipment, mining and metallurgical equipment.

Machine tool industry is the basic industry for the development of all engineering industries and other basic industrial sectors. The developing countries therefore should develop this industry on a sound and firm basis.

Some of the more developed countries among the developing have made appreciable progress in the field of machine tools. The production of machine tools in Brazil, India and Argentina is given in table 6. Over the period 1965 to 1978, the average rate of annual growth was: Brazil 14.1%, India 6.1% and Argentina 7%. In relation to the machine tool industry, the developing countries may be divided into two groups, the one having a machine tool industry base and the others that have yet to develop it.

Table 6

MACHINE TOOL PRODUCTION IN BRAZIL, INDIA AND ARGENTINA*
(Mill. Dollars)

	BRAZIL			INDIA			ARGENTINA		
	Total	Metal cutting	Metal forming	Total	Metal cutting	Metal forming	Total	Metal cutting	Metal forming
1965	30.0	30.0	-	53.0	34.0	19.0	25.8	15.5	10.3
1970	33.8	19.6	14.2	66.0	43.0	23.0	32.4	18.0	14.4
1975	137.0	95.0	42.0	93.0	70.0	23.0	42.0	21.0	21.0
1976	175.0	122.1	52.9	96.1	72.8	23.3	56.0	30.0	26.0
1977	132.0	92.4	39.6	89.5	68.7	20.8	60.0	32.0	28.0
1978	146.0	102.0	44.0	108.0	82.0	26.0	58.0	29.0	29.0

* Source: "American Machinist", January 16, 1967; January 24, 1972; February 1978; February 1979.

In the light of the technological developments in the coming two decades and taking into consideration the two groups of the developing countries, the implications may be viewed in two aspects, namely in meeting the domestic requirements by way of imports and establishing and developing their own machine tool production.

Considering the domestic requirements, in the initial period the need for simple general purpose universal machines would continue to grow, whereas the supply from the industrialized countries is either highly sophisticated automatic machines and systems or modern, highly production oriented, general purpose machines. This situation may be restored by the supplies from the more developed among the developing countries.

The more important aspect is the development of the machine tool industry in the developing countries.

The foremost question would be what type of machines the DCS should manufacture, whether the sophisticated machines or the GPMs. In view of the fact that GPMs will continue and are expected to enjoy a share by value of 60 to 70% and 50% by 1990 and 2000 respectively; The DCS should take up or continue to manufacture the GPMs.

The next point would be what type of GPMs they should produce, since the GPMs required and produced in the industrialized countries would be of high productive, advanced modular designs. Logically, they should go in for GPMs of high productive modern designs. But the process is not an easy one. For one reason, the designs may not be existing with them and it takes long time to develop them by themselves and secondly, they may not be readily made available to them from those that have them. There seem to be two approaches: the group one should go in for the production of the modern GPMs. The task would be easier and also difficult at the same time - easier because they already have a base for the manufacture of simple and conventional GPMs and for the same reason that they have the base, it would also be difficult since the manufacturing capacities are based on conventional production technology. However, it is necessary that they should gradually develop the modern machines, machines of modular designs; for, this would also help them in the production of special purpose machines (SPMs) that form the elements of transfer lines which would be any way required for mass and large batch production industries. For the second group of the developing countries, that do not have a manufacturing base for machine tools, the industry should be introduced. They may have to go through the same process of the three phase development of the 'technology induction' from outside sources by way of technical collaboration, 'technology assimilation' by consolidating the acquired technology and skills in the industry and then the 'technology development' on their own efforts; as some of the countries in the group one have successfully gone through. But with one exception that, in the present situation, the technology that is being introduced into these countries should be that as required for the modern GPM's. The process can be initiated with simpler machines. One important aspect that is to be borne in mind would be the simultaneous development of other industrial sectors such as the automobile, agricultural machinery, electrical machinery and other machine building industries that are interrelated and interdependent with the machine tool industry and are so essential for and instrumental in the development of the same. The developed countries would be willing to share their technological know-how, or even it may become necessary, in order to create markets for their exports, that they aspire would reach 50 to 60% of their production in the 1980's 1/

In the development process of the machine tool industry, for the production of GPM's, in the developing countries, those more advanced among the DCs, that have established the industry in an environment of investment and infrastructure constraints, would be better equipped to impart the necessary manufacturing skills and management abilities and introduce the culture of machine tool building by sharing their own experience. It may also be advantageous to take up a certain specialization in particular areas and types of machine tools for specific countries, instead of attempting development of all types of machines, particularly in the smaller countries and in the initial stages. To make the machine tool industry in the developing countries self-sustaining and for the sake of mutual benefit, the industrialized countries should be able to import the GPMs from the DCs.

Perhaps, it may be worthwhile to consider the possibility of international standardization of the design of basic general purpose machine tools according to types (operation wise), sizes, quality (classes of accuracy) tools and the accessories. Basing the desings on modular construction, it may even be possible to standardise the production processes and the equipment that is required for them. Basic machine tools are basic machine tools. They are required to perform basic machining operations. There is no reason why they should not be standardized. The concept is sound and has abundant common good to all. The designs, evolved through international co-operation, can be given to any country that wants to produce them.

1/ The total exports of the developed countries in 1978 was about 6.5 billion dollars. 50 to 60% of exports by 1990 would be approximately 13 to 16 billion dollars.

THE SOPHISTICATED TECHNOLOGY

The other important aspect is whether the DCs should take up the manufacture of sophisticated NC machine tools and computer controlled systems. From the view point of not perpetuating the technological gap between the developed and developing countries, and in order to make the DCs to partly meet their domestic requirement of the davanced and sophisticated machine tools and to establish a base for further development, it is necessary for them to take up the development and manufacture of the NC machines and other computer controlled manufacturing systems. In this area, it is evident that the technology transfer has to take place from the developed to the developing countries through technical collaboration. But acquisition of a technology for the sake of acquiring it, will have no consequence on the more important dimension of development. Similarly, mere assembly or manufacture of the machines with imported control systems, without initiating action for balanced growth in the other infrastructural support industries, particularly, in the electronics industry, can lead to another situation - perpetual imports, with limited effect on the development, limited to the manufacture of only the mechanical systems in the NC machines. Lack of internal demand in the industry can result in a dangerous situation of not enough domestic market, and not competitive in the export market as the prices can be high due to the heavy import content. Therefore, it is imperative that utmost caution has to be exercised and a judicious approach adopted to consider all these aspects.

The group one countries that have the necessary inputs can start or intensify their efforts in the development of the NC machines. Judging by the present and future development trends in the developed countries, the individual NC machines seem to be coming off essentially into two types, namely the NC lathes and the NC machining centres that combine milling, drilling and boring. In the case of flexible manufacturing systems, perhaps it is more suitable for the domestic industry to develop semi-automatic FMSs. The controls may be more advantageously based on microprocessor technology. Development activity should also be initiated on CAD/CAM.

The group two countries probably would need some time before they can embark on the development of NC. It may require initially about 10 to 15 years, depending on the present potential and the pace of development in a country to acquire and assimilate the machine tool technology as required for the manufacture of quality GPMs, as it had been the case with the group one countries. Towards the end of this period it would be the appropriate time to start the development of the more sophisticated NC machine tool technology.

In all the cases, constant R and D effort is essential. The sense of precision and productivity is important. Continuous development activity is needed in the areas of cutting tool materials, optimum machine tool designs with respect to stiffness, dynamic and thermal stabilities for high working accuracies, finishes and productivity, design of basic elements such as bearings, spindle units, guideways, etc. for higher accuracies, higher speeds and forces, automatic controls, new manufacturing processes, new production techniques and organization of the production processes.

The activity of development advocated for the DCs, in the foregoing paragraphs, constitutes a dual approach, a two pronged action namely simultaneous development of the common technology as well as the sophisticated. Both are needed. Both have their application in the relevant sectors of industry

This approach is also necessary for the mutual benefit of both the developing and the developed countries.

International co-operation is required in the spheres of standardisation, technology transfer, development of industrial infrastructure, trade; between developed and the developing countries and amongst the developing countries themselves, UNIDO's assistance in negotiation, technology transfer, development of infrastructure, establishment of production capacities and manpower development; and together with UNCTAD in trade, would continuously be needed.

CHAPTER 5

CONCLUSIONS

Following are the conclusions and projections.

1. New and high productive finish metal forming processes, particularly the cold forming techniques, are increasingly replacing metal cutting operations. It is expected that the metal forming will reach about 25 per cent of the total metal cutting operations by the year 2000; and the cold forming methods to take a share of 50 per cent of the present hot forming operations by 1990.

2. The general purpose machine tools would continue to be, but in modern high productive versatile designs and probably in modular unit construction to lend themselves for production on automatic flexible manufacturing systems based on group technology. By value they are expected to be approximately about 60 to 70 per cent and 50 per cent of the total machine tool production by 1990 and 2000 respectively. The total production in the developed countries is expected to exceed 25 and 35 billion Dollars by 1990 and 2000 respectively.

3. The numerically controlled machines, as individual units, would be on computer numerical control (CNC) based on micro-processor technology. Flexible manufacturing systems (FMS) under direct numerical control(DNC) and adaptive control (AC) for process optimization together with robots, for the automation of auxilary operations, will be increasingly used for the small and medium batch production industries, that are characteristic of frequent product change. By 1985 it is expected that about 30 per cent by value of the total metal cutting machine tools produced in the developed countries would be NC machines out of which 35 per cent would be computer controlled. The 1980s would bring in extensive use of FMS and the 1990s would herald the automatic factories.

4. Metal working methods such as electro-discharge, electro-chemical, ultrasonic, laser beam machining etc. would be applied in specific areas and for special materials and would reach about 1 to 2 per cent of the total metal working operations in the coming decade and perhaps would remain so in the next.

5. In the light of the technological developments in the field of machine tools, the developing countries should develop their machine tool industry both in the common technology of GPMs as well as in the sophisticated technology NC machines adopting a two pronged development strategy.

6. Machine tool industry is the basic industry for the development of all other industries. The machine tools are the essential equipment in the metal working industry. The technological developments indicate that the machine tools are going to be modern GPMs and automatic NC machines and computer controlled manufacturing systems. The developing countries should manufacture the GPMs for their small and medium scale industries and the NC machines for the large scale industries. The NC machines are also advantageous for the small and medium scale industries due to their overall economy, provided the initial investment is made possible. The machine tool industry in the developing countries should produce the machine tools required for specific industries like the agricultural machinery, the transportation equipment, and other specific industries, drawing from the technologies as developed in the field of machine tools and the equipment made available in the markets.

ANNEXURE 1-A

MACHINE TOOL PRODUCTION IN THE DEVELOPED COUNTRIES AND PROJECTIONS FOR 1990 AND 2000 YEARS
(Value : Million Dollars)

ITEM	1960	1965	1970	1975	1977	1978	1980	1985	1990	1995	2000
Machine tool production in Developed market economy countries	2,241.0	3,820.0	5,950.0	9,270.0	10,365.0	12,945.0	11,800.0 (1)		21,500.0 (1)		
Machine tool production in the USSR	814.0	1,265.0	1,478.0	2,412.0	2,548.0	2,560.0	2,645.0 (2)		4,860.0 (3)		
Tot. machine tool prod. in developed countries	3,055.0	4,085.0	7,428.0	11,682.0	12,913.0	15,505.0	14,445.0		26,360.0 (3)	31,000.0 (3)	35,500.0 (3)
NC machine tool production in developed market economy countries (metal cutting)	-	154.0	343.0	856.0	1,080.0	1,334.0					
NC machine tool production in the USSR (metal cutting)	-	4.0	178.0	677.0	726.0	816.0					
Total NC machine tool prod. in developed countries (metal cutting)	-	158.0	521.0	1,533.0	1,806.0	2,150.0		6,510.0 (4)	10,000.0 (3)	13,000.0 (3)	16,000.0 (3)
NC metal forming (approximate projection)									(1,000.0)		(2,000.0)

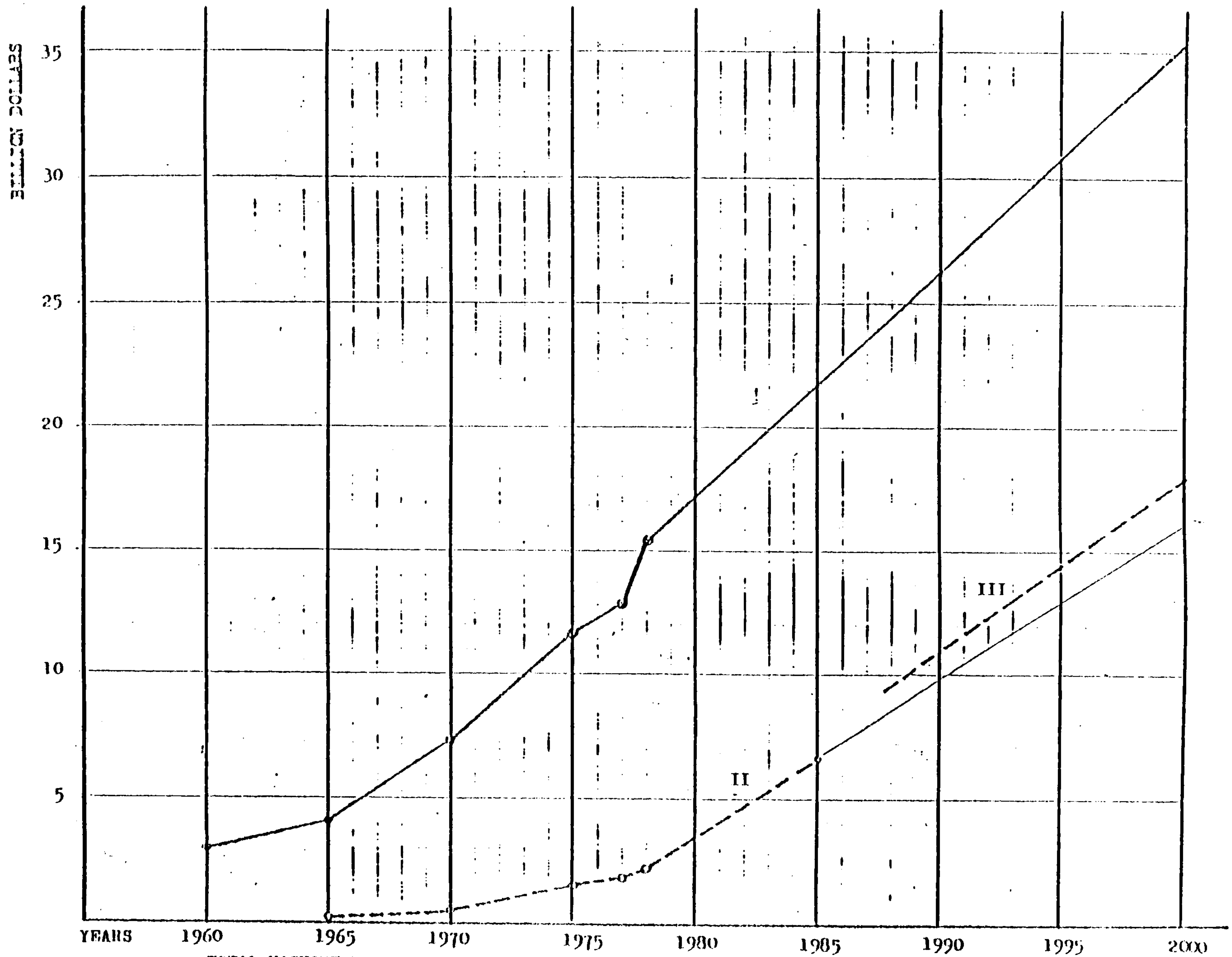
Sources: - Machine tool production and NC production figures are from published statistics of the developed countries for the period 1960 to 1978.

(1) Estimated production from A.G. Kosminian, "The capitalist market of metal working equipment and prospects of its growth", Buletin of Foreign Commercial Information; Vol. 1, 1980; The USSR Research Institute VNIIKI.

- Machine tool and NC production for the period 1960 to 1978 taken from the Statistical Year Book 1980: 'Peoples Economy of the USSR 1979'. Values calculated from corresponding prices in the developed countries of the market economy.

(2) Targets
(3) Projected by extra polation at current prices.
(4) Expert opinion

Annexure 1-B



TOTAL MACHINE TOOL AND NC MACHINE PRODUCTION AND PROJECTION IN DEVELOPED COUNTRIES
I TOTAL MACHINE TOOL PRODUCTION, II NC METAL CUTTING MACHINE TOOLS, III APPROXIMATE METAL FORMING NC INCLUDED.

MOD 6 *

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UNITED NATIONS CONFERENCE ON TRADE AND DEVELOPMENT

The role of small and medium-sized enterprises in the international transfer of technology: issues for research

Study prepared, at the request of the UNCTAD secretariat, by Mr. Eduardo White, with the collaboration of Mr. Silvio Feldman

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STRENGTHENING THE TECHNOLOGICAL CAPACITY OF THE DEVELOPING COUNTRIES INCLUDING ACCELERATING THEIR TECHNOLOGICAL TRANSFORMATION: ISSUES IN INDIVIDUAL SECTORS AND OTHER AREAS OF CRITICAL IMPORTANCE TO DEVELOPING COUNTRIES

The role of small and medium-sized enterprises in the international transfer of technology: Issues for research

Study prepared, at the request of the UNCTAD secretariat, by Mr. Eduardo White, Centro de Estudios Jurídico-Economicos Internacionales, Buenos Aires, Argentina, with the collaboration of Mr. Silvio Feldman */

*/ The views expressed in this study are those of the authors and do not necessarily reflect those of the UNCTAD secretariat.

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Prefatory note by the UNCTAD secretariat

(i) At its fifth session, the United Nations Conference on Trade and Development, in resolution 112 (V), paragraph 26(c), requested the Secretary-General of UNCTAD to undertake, in co-operation with other relevant United Nations agencies, a study on the possibilities of an increased involvement by small and medium-sized enterprises as sources and receivers of technology in international transfer of technology.

(ii) Pursuant to this request, the UNCTAD secretariat commissioned the present study for the purpose of identifying and discussing the issues which arise when considering the participation of small and medium-sized enterprises in the transfer of technology to developing countries, as well as for the purpose of preparing a programme of research and study that will contribute to the identification of main areas of action and to the achievement of practical solutions in this field.

(iii) The study was prepared by Mr. Eduardo White of the Centro de Estudios Jurídico-Económicos Internacionales, with the collaboration of Mr. Silvio Feldman. The views expressed in the study are those of the authors and do not necessarily reflect those of the UNCTAD secretariat.

INTRODUCTION

1. Almost all of the many studies on foreign investment and transfer of technology undertaken during the past decade have focused their analysis of the actors in this process on the large transnational enterprises of the industrialized countries, which undoubtedly comprise the bulk of the international mobilization of productive resources. The identification of the process with this one basic actor was both a vision that in many ways fitted the facts of the case and a practical method for dealing with the main issues and problems arising out of the relationships between States and enterprises. Thus it was that efforts to gather information were directed to the flows of resources originating in the main industrialized countries, and the foreign investment and technology transfer statistics were considered to reflect nothing other than the expansion of transnationals. At the same time, the initiatives for adopting international rules or standards to regulate the transfer of productive resources were aimed, explicitly or implicitly, at the conduct of transnational corporations.

2. However, the gradual maturing of the debate and the research on the effects of transnationals, as well as the emergence of new issues in the efforts to establish a new international economic order, gave rise to a progressive "unpackaging" of the phenomenon which led to methods for narrowing down the subject of analysis. In this manner, the focus of interest turned to the way in which corporate performances varied according to sectoral criteria and to countries of origin. Attention to the geographical diversification of the sources of technology focused first on the differences between United States transnationals and the "other" transnationals (i.e. European and Japanese), then on transnationals of smaller countries and socialist countries, and finally on the "third world transnationals". 1/ The evidence collected in such studies revealed that, as a result of the continuous shrinking of the space for international economic relations and the increasing competition among countries, there is a growing number of participants of different kinds and origins in the process of technology transfer, which can by no means be considered any longer as the exclusive preserve of transnational corporations.

3. This new emphasis on differentiation has recently led to small and medium-sized enterprises, particularly those of developed countries, being regarded as a means of technology transfer. Although related in some ways with the phenomenon of geographical diversification, the case of these enterprises goes further. In considering the role of small and medium enterprises the basic assumption is that size can determine different kinds of corporate behaviour with respect to the transfer of technology.

4. The interest shown in the smaller enterprises derives not only from the evidence of their increasing involvement in international operations, but also from the expectations of both the home and recipient countries with regard to the role that such enterprises could play. Major significance is attached to the way in which small and medium enterprises could become an efficient alternative or complement to transnational corporations as sources of technology for developing countries.

1/ See United Nations, Transnational corporations in world development: a re-examination (E/C.10/38 and Corr.1), United Nations publication, Sales No.E.78.II.A.5, para. 171 et seq.

5. In effect, the expectations on the advantages of smaller firms derive, on the one hand, from criticism of the transnationals' performance in terms of the transfer of inappropriate technologies, the abuse of dominant market positions, the reluctance to share their monopolistic advantages, the concentration of their activities on the more developed markets, and other aspects related to the size and power of large transnational corporations. Smaller firms, on the other hand, are assumed to be less likely to give rise to such problems and, moreover, to provide channels for additional benefits, such as intermediate technology, higher competition, new markets, projects for the least developed and the smallest countries, and so on. In this sense, the emerging rôle of the small and medium enterprises matches the developing countries' own efforts to seek alternative suppliers of productive resources, to improve their negotiating strength and, in general, to become more active and less defensive in the face of foreign factors of production. It also coincides with the various programmes for promoting the development and supply to developing countries of small-scale, low-cost appropriate technology.

6. In contrast to other aspects of the subject there is almost no available information on the actual involvement of small and medium firms of developed countries in the international transfer of technology. The ignorance is almost total with regard to the factors, motivations, modalities and, of course, the impact of their performance in developing countries. 2/ Thus the main objective of this study is to undertake a first exploratory analysis and to identify the issues arising out of the experience of small and medium-sized firms in the transfer of technology to developing countries, having in mind a possible programme of research on the subject.

7. As mentioned above, the subject of analysis is concentrated on the smaller firms of <u>developed</u> countries. Although they share some common features with other "outsiders" on the international investment scene, it seems necessary at this preliminary stage to distinguish them from other "non-transnational" actors, such as international firms of developing countries. The available evidence indicates, among other things that most firms of developing countries that move abroad, although small in the international markets, are not exactly small in their home markets. 3/ At a second stage of study, the characteristics of both types of firm should be identified and compared.

2/ In the following pages a few recent studies and documents on the subject which furnish direct or indirect evidence on partial aspects of the phenomenon, will be cited.

3/ See the works presented in the conference on "Multinationals from the Third World", Hawaii University, East West Center, September 1979 (publication forthcoming); E. White, J. Campos and G. Ondarts, <u>Las empresas conjuntas latinoamericanas</u> (INTAL 1977); and the articles of Louis Wells, "The industrialization of firms from the developing countries ", in T. Agmon and H. Kinderberger, <u>Multinationals from small countries</u> (MIT., 1978), and C. Diaz Alejandro, "Foreign direct investments by Latin America", in Agmon and Kindleberger, <u>op.cit</u>.

8. A conceptual problem is posed by the definition of what constitutes a small or medium-sized firm. The literature, as well as the laws and practices of countries, reveal a great diversity of opinion that reflects the essentially relative nature of the concept and its dependence on the geographical and sectoral context to which the firms belong. Thus, firms that are considered small or medium in industrialized countries would be classified as medium or large in developing economies; the same would apply within a country, if account is taken of regional differences and if the comparison is between firms operating in different sectors or branches. Moreover, laws and policies usually apply ad hoc definitions of small and medium enterprises, adjusted to various objectives: different definitions may thus be used for the purposes of credit policies, tax regulations or export incentives. In any case, the literature and the laws have not yet developed or proposed a definition of small and medium firms that is suited to their action in the field of investments abroad and transfer of technology. In effect, the definitions available in the national settings are clearly focused on domestic activities, and sometimes on exports, and it could be assumed that international operations tend to involve or require structures and organization well beyond the limits needed for purely local activities.

9. In view of this, and bearing in mind the subject and objectives of this study, it seems reasonable to consider as small and medium-sized firms those that, being independent, in the sense that they are not linked to other firms or groups, do not have a significant position in the market of their country of origin, although they might be regarded as large in the recipient countries. Yet this criterion needs to be interpreted with a good deal of flexibility, because some typically small and medium firms are producers of highly specialized goods and services and appear as leaders in their specific product markets. For the purposes of empirical research, certain quantitative criteria could be applied: for example, most developed countries seem to agree on a maximum limit of 500 employees. On the other hand, from the standpoint of increasing the technological alternatives of developing countries, it is convenient to adopt an inclusive criterion, which will leave aside only those firms which could be defined as transnational corporations and those which, because of their leading positions in their respective sectors, are in a better position to operate internationally.

10. The content of this study is as follows: chapter I outlines the significance of small and medium enterprises in the home economies of developed countries and deals with the involvement of such firms in the process of transfer of technology. Evidence about the outflows from certain developed countries, the geographical distribution and the sectors involved, with particular reference to some developing countries, is analysed. Chapter II is a discussion of the main factors - the present trends in the international economy, the structural changes taking place in developed and developing countries - which seem to underlie the process of expansion of smaller firms. Chapter III is devoted to an analysis of the modalities of participation of small and medium firms, including their motivations, their decision-making processes and the organizational structures affecting the

technology transfer. Chapter IV discusses the diverse effects of an increased involvement of small and medium firms of developed countries in the transfer of technology to the developing countries - effects which should be taken into account in formulating new policies on this subject. Chapter V deals with the present institutional and legal framework affecting the international involvement of smaller firms, with particular emphasis on the incentive measures taken by home and host countries as well as on the programmes of international organizations. Finally, in chapter VI proposals are made for a programme of research in order to arrive at practical solutions and to identify the main areas for future action in this field.

11. The present study is based in part on current research by the author for the Institute for Latin American Integration, concerning the co-operation of smaller firms of European countries in industrial projects of Latin American countries.

Chapter I

THE PRESENCE OF SMALL AND MEDIUM-SIZED ENTERPRISES IN THE INTERNATIONAL TRANSFER OF TECHNOLOGY

A. Significance of small and medium firms in the economies of developed countries

12. Despite the general trend towards increasing levels of industrial concentration, small and medium firms account for an important part of the productive structures in developed countries. The significance of such firms is visible in their very number - in almost every industrialized country the small establishments account for more than 90% of the total - and in terms of their high impact on employment, ranging from 30% to more than 60% of the total employment. 4/; the percentage is even higher in certain countries. 5/ They participate significantly in most industrial sectors, particularly in certain branches such as metal-working and capital goods, textiles and clothing, food, furniture, ceramic products, non metallic minerals, printing and publishing. 6/

13. The bulk of small and medium enterprises is concentrated on domestic activities and, in fact, the export business continues to be dominated by large enterprises. Yet in recent times, the share of smaller firms in total exports seems to be increasing in most developed countries. Such firms played an important part in the external sales of Japan during the last stages of the recent period of high economic growth. 7/ In France, companies with less than 500 employees in 1978 accounted for 27.5% of the exports; 8/ whereas in the United Kingdom, small and medium firms of certain areas of the country had a predominant share in exports, 9/ and in Italy the growth of exports of smaller firms was higher than the average. 10/

4/ By the mid-1960s, small industrial establishments were responsible for 60% or more of the total employment in Switzerland and Norway; more than 50% in Japan, France and Sweden, 47% in Canada; and more than 30% in United States, West Germany and the United Kingdom. See J.E. Bolton, Small Firms - Report of the Committee of Inquiry on Small Firms (London, Her Majesty's Stationery Office, 1972).

5/ By the early 1970s, the employment contribution of small firms was 69% in Japan, 58.9% in the Federal Republic of Germany and 61.3% in France. See Ministry of International Trade and Industry (MITI), White Paper on Small and medium enterprises (Tokyo, 1975).

6/ By the late 1960s, small firms in metal-working, machinery and equipment production contributed 30% to 36% of the value added in such sectors in the United States, United Kingdom, Japan, France and the Federal Republic of Germany; in the textile and clothing sectors, the percentages ranged from 11% (US) to 22% (Japan); in food production, from 5.5% (United Kingdom) to 23% (Federal Republic of Germany). Small firms are important in the furniture business, ceramics and non metallic minerals in countries such as the Federal Republic of Germany (9.2% of the value added), and in print ng and publishing activities in the United States and United Kingdom (about 8%). See MITI, op.cit.

7/ See MITI, White paper on small and medium enterprises, (Tokyo, 1976).

8/ About 1,000 small and medium French firms export 60% of their sales; see Ministère de l'Industrie, Les transferts de technologie aux pays en voie de développement par les petites et moyennes entreprises, (Paris, 1979), p. 33.

9/ A survey of firms in the North-East area in 1969 revealed that 62% of the exporting firms were small or medium-sized. See J.E. Bolton, op.cit., p. 37, et seq.

10/ The share of small and medium Italian firms in total exports increased from 9.5% in 1961 to 12.3% in 1965. See O.P. Jain, Small industry exports (S. Chand & Co. Ltd., New Delhi, 1971).

14. Moreover, small and medium-sized firms have made important contributions to technological development in certain sectors such as scientific instruments, machinery and electronics. Although innovation has been dominated by large firms, it has been found that in some industries of the United Kingdom, France, Federal Republic of Germany and the United States small or medium-sized firms had more intensive research activity than did large firms, and also that, in general, the innovative efficiency of small companies may be greater. 11/

15. Against this background, it would be reasonable to expect some participation of smaller firms in international activities. The focus of attention on the big transnational corporations and the habit of regarding small businesses as inherently domestic explain why little or nothing is known about the foreign involvement of the latter. The present study attempts to cast some light on this subject, on the basis of information from various sources and new evidence furnished by recent research projects.

B. Investments abroad by small and medium firms

16. There is no doubt that the international flow of productive resources is predominantly in the hands of large transnational corporations. 12/ However, if, instead of the volume of investments, the number of firms is taken into account, the presence of smaller firms operating abroad is seen to be more important. The information available is neither systematic nor easily comparable, but it serves to indicate the existence and dynamism of this presence.

17. In the United States of America, a survey on manufacturing companies with total sales of over $20 million in 1975 revealed that 85 firms accounting for 29% of the firms with sales volumes ranging from $20 million to $50 million, and another 135 firms, representing 41% of the firms selling between $50 million and $100 million, had subsidiaries in one or more foreign countries. 13/ In Japan, investments abroad by small and medium-sized firms were a dynamic trend during the 1970s. From 1951 to 1974, 1,280 projects of small and medium firms were authorized, accounting for 42% of the total number of authorizations. Since 1971, the number of authorizations granted to such firms has grown significantly. 14/ In the Federal Republic of Germany,

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11/ See C. Freeman, The Economics of Industrial Innovation (Basic Books, 1974), chapter 6.

12/ In the case of the Federal Republic of Germany, for example, 82 corporations control over 70% and the nine largest investors control 37% of total direct investment abroad (see H. Steinmann et al. Internationalization of German medium sized enterprises in Brazil - Process and success factors, (Nurnberg, 1979). In 1973, only 92 firms in the Federal Republic of Germany accounted for 85% of all licence receipts; see G. Koopman and K. Matthies, "Transfer of technology by German firms", Intereconomics September/October 1979 (Federal Republic of Germany), p. 239. In Switzerland, 32 transnational enterprises concentrate the bulk of investments abroad. See Institut universitaire d'Etudes du Développement, Genève, Notes sur les relations économiques Suisse-Tiers Monde, (Geneva, May 1979), p.22.

13/ See United Nations, Transnational Corporations in World Development ..., op.cit., p. 222.

14/ In the period April-December 1973, 325 authorizations were granted to small and medium firms. See MITI, White paper on small and medium enterprises, (Tokyo, 1974); and idem, 1975.

about 400 small and medium firms have investments abroad located in a group of seven host countries, including developed and developing economies. 25% of the Federal Republic's firms established in the United States are small and medium, 15/ and 36% of those established in developing countries are, according to a recent survey, subsidiaries of Federal Republic firms with less than 500 employees, whereas 22% belonged to parent companies with 500-1,000 employees. 16/ The same survey reveals that the trend is growing: in effect, companies with less than 500 employees accounted for 56% of the group of firms with investment plans in developing countries. In Switzerland, a study on the trends of industrial redeployment to developing countries showed that 9% of the responding small and medium firms (up to 1,000 employees) had redeployment experience, and 28% planned to do so in the future. 17/ The same phenomenon can be observed in other industrialized countries for which fragmentary information is available. A study of British direct investment in 8 recipient countries revealed the presence of 43 manufacturing subsidiaries of small and medium firms. 18/ And in Canada, 20 small and medium firms from Quebec, accounting for 20% of the firms surveyed for a study on manufacturing exports, had foreign subsidiaries. 19/

C. The expansion of small and medium firms to developing countries

18. Small and medium firms seem to follow patterns of geographical location not very different from those of transnational corporations. According to the data for a few developed home countries, smaller firms have the same tendency to seek out the markets that most closely resemble the home economies for which they first developed their products. In fact, most of the flows go to other developed countries, and the expansion to developing countries is clearly concentrated in the more advanced economies of the third world. Such is the tendency, for example, of the small and medium-sized firms of the Federal Republic of Germany and of Switzerland. Firms of smaller size in the Federal Republic are showing a growing interest in developing countries, 20/ but the trend is oriented to the largest, fast-growing and semi-industrialized areas, such as the large countries of Latin America. Furthermore, smaller firms seem to be even more inclined than large companies to concentrate their operations in those host countries that have the largest shares of Federal Republic investment abroad. In the case of Switzerland, smaller firms reveal a particular interest in Brazil and other large Latin American countries; the oil-producing countries in the Middle East, as well as Indonesia and Nigeria; and some countries

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15/ See Steinmann et al., op. cit.

16/ The results are based on a survey of 1,850 firms in the Federal Republic of Germany. See A. Halbach, Deutsche Direktinvestionen in Entwicklungsländern unter besonderer Berücksichtigung der industriellen Verlagerung (IFO Institute for Economic Research, Munich, 1979).

17/ See UNIDO, Industrial redeployment tendencies and opportunities in Switzerland (UNIDO/ICIS.115).

18/ See P.J. Buckley, G.P. Newbold and J. Thurwell: Going international: The foreign direct investment behaviour of smaller UK firms, Business Studies No. 31, (University of Reading, United Kingdom, 1978).

19/ See G. Garnier, Characteristics and problems of small and medium exporting firms in the Quebec manufacturing sector with special emphasis on those using advanced production techniques. (Office of Science and Technology, Department of Industry, Trade and Commerce, Ottawa, Canada, 1974).

20/ While only 36% of the firms included in the IFO Institute for Economic Research survey (see foot-note 16) with investments in developing countries had less than 500 employees, this category accounted for 56% of the total number of firms with plans in that respect.

in North Africa (Egypt, Algeria, Morocco and Tunisia). But the main markets are those of the other European countries, including the less developed economies of Southern Europe. 21/

19. On the other hand, Japanese small and medium firms are oriented, in a higher proportion than large firms, towards the neighbouring developing countries of South-East Asia, especially the economies with a larger industrial base, higher growth rates and export expansion trends. 22/

20. The results obtained from a current study on the experience of small and medium firms of Europe operating in Latin America provide the first systematic empirical evidence with regard to the degree and characteristics of the participation of such firms in developing countries. 23/ The results in general corroborate the above-mentioned trends. Firstly, they reveal that, although the share of small and medium firms in the total volume of resources transferred to Latin America is low, the number of firms involved in direct investment and transfer of technology operations is very significant. The data on Mexico (table 1) are particularly interesting: smaller firms account for important percentages of the total number of parent companies. The share of companies with less than 500 employees in the home countries varies from 7.7% (Holland) and 8.3% (France) to 25% (United Kingdom), 22.6% (Switzerland) and 18.2% (Federal Republic of Germany) of the total number of firms from each home country. In terms of the volumes invested, however, the weight of small and medium firms is not significant: only in the case of France, the share of smaller firms accounts for more than 2% and in only two more home countries (Sweden and Federal Republic of Germany) they represent more than 1% of the total investment of the respective country. 24/

21/ See UNIDO, Future structural changes in the industry of Switzerland, (UNIDO/ICIS 116).

22/ 84% of the investments abroad of small and medium firms authorized in the period 1971-1974 went to Asia, in comparison with 71% in the case of large firms. The Republic of Korea (96%) was the main destination. See MITI (1975), op.cit., table 9.

23/ The study is prepared by the author of this report for the Institute for Latin American Integration (INTAL). It covers information on the size of each of the parent companies and licensors of technology agreements in several Latin American countries, including Brazil, Mexico and Venezuela, which are recipients of the largest share of direct investments and technology. On the basis of listings of registered firms provided by the government agencies (except for Brazil where the sources were private information agencies) the parent companies were classified according to their size (defined by the number of employees and taking into account independent companies as different to those which appeared as subsidiaries or holdings in their home countries). The data were collected from a variety of information services (Kompass for each European country, Dan & Bradstreet Principal International Business, and several sectorial registers for a number of countries).

24/ More than 92% of the total amounts invested by European companies belongs to parent firms, independent and subsidiaries, with more than 5,000 employees in their home countries, with the exceptions of France (75%) and Sweden (76%). The significant differences between the very high share of all identified companies in the total capital invested and the share of the same companies in the total number of companies registered seem to suggest that the real share of small and medium parent companies among the total listed in the Mexican foreign investment register is in fact higher than what the percentages in table 1 indicate for the identified ones, owing to the lower representation of small firms in those business information repertories which have provided data on the size classification.

Table 1

THE PRESENCE OF SMALL AND MEDIUM-SIZED FIRMS AMONG FOREIGN INVESTORS IN MEXICO

Percentage structure of the number of European parent companies and of their investment volumes. a/ classified by country of origin and size of the parent companies (1978)

Country of origin		Parent companies with identified size: Independent firms with size of employment: < 500 %	500 - 1 000 %	1 000 - 5 000 %	>5 000 %	Subsidiaries or holdings %	Total %	Total Absolute figures a/	All parent companies Absolute figures a/	Parent companies with identified size as percentage of all parent companies %
Germany, Fed.Rep.	No.firms	18.2	18.2	20.7	36.4	6.5	100.0	77	109	70.6
	Volume	1.8	2.2	3.7	89.8	2.5	100.0	2 747 494	2 799 384	98.1
France	No.firms	8.3	19.4	22.2	36.2	13.9	100.0	36	44	81.8
	Volume	2.3	9.6	13.1	68.0	7.0	100.0	568 633	574 612	99.0
United Kingdom	No.firms	25.0	5.0	15.0	40.0	15.0	100.0	20	53	37.7
	Volume	0.7	0.02	3.5	85.3	10.5	100.0	889 608	1 704 795	52.2
Netherlands	No.firms	7.7	15.4	38.4	23.1	15.4	100.0	13	20	65.0
	Volume	0.1	1.3	5.2	90.8	2.6	100.0	364 511	491 703	74.1
Italy	No.firms	16.8	8.3	8.3	33.3	33.3	100.0	12	24	50.0
	Volume	1.0	4.1	1.4	74.1	19.4	100.0	415 751	443 880	93.7
Sweden	No.firms	10.5	-	21.1	52.6	15.8	100.0	19	22	86.4
	Volume	1.8	-	22.2	72.8	3.2	100.0	939 836	943 127	99.7
Switzerland	No.firms	22.6	9.7	16.1	38.7	12.9	100.0	31	65	47.7
	Volume	0.9	3.8	3.0	89.9	2.4	100.0	1 532 765	1 683 173	91.1
Total firms b/	%	18.5	15.0	20.6	35.2	10.7	100.0	-	-	48.9
	Absolute figure	43	35	48	82	25	-	233	476	-

Source: List of Mexican companies with foreign capital registered by the Comisión Nacional de Inversiones Extranjeras y Transferencia de Tecnología as to end 1978.

a/ Volume in thousands of Mexican pesos.

b/ Total firms include parent companies of other European origin, not listed here.

21. The significance of small and medium firms is also visible in the case of other Latin American countries for which information is presented in table 2. Furthermore, the share of smaller firms present in Brazil is higher than in Mexico. On the other hand, in the smaller and less diversified economies of Peru and Venezuela, the relative participation of such firms is clearly lower.

22. Finally, the dynamic participation of small and medium foreign firms in Latin America can be observed in the field of technology transfer through licensing agreements, as revealed by table 3.

D. Sectoral diversification

23. The overseas activities of small and medium firms correspond in general to the pattern of sectoral diversification in the home economies, although it seems that greater dynamism is associated with the highly specialized, relatively sophisticated branches with innovative and competitive companies. For example, 36% of the total investment abroad by Japanese small and medium firms is concentrated in the capital goods sector, as against 13% in textile investments, mostly for subcontracting in South-East Asian countries, and 9% in steel and metals. 25/ In the case of Switzerland, smaller parent companies with investment projects in developing countries are concentrated in precision industries - e.g. watches, scientific instruments, electronics, special mechanic products (39%) - and in machinery and equipment (24%). 26/

24. No detailed information is available about the sectoral diversification of smaller firms within developing countries. However, the information obtained for Mexico concerning the technology contracts of small and medium firms of Europe 27/ indicates that the sectors concerned are metallic products, machinery and equipment, and chemical products. 28/

25/ See MITI, (1974), op.cit.

26/ See UNIDO Future structural changes in the industry of Switzerland, op.cit.

27/ Information from the study for INTAL, mentioned earlier in foot-note 23.

28/ Technology contracts of small and medium-sized firms in the Federal Republic of Germany are concentrated on metallic products, machinery and equipment (41%) and chemicals (33%); the French firms have contracts for non electric machinery (5.6%), chemicals (55.6%), and beverages (11%). Contracts with British firms relate to metallic products, non-electric machinery and transport equipment (29.6%) and chemicals (30%).

Table 2

Small and medium sized parent companies of European countries with subsidiaries in Brazil, Mexico, Peru and Venezuela

Percentage number of independent */ parent companies with up to 500 and 1000 employees in respect of the total of parent companies with available information on size, classified by country of origin and recipient country

Home countries / Recipient countries	Brazil a/		Mexico		Peru b/		Venezuela b/	
	500 **/	1000 **/	500 **/	1000 **/	500 */	1000 **/	500 **/	1000 **/
Germany, Fed. Rep. of	27.9	41.5	18.2	36.4	0.0	33.3	10.5	15.8
France	29.4	42.6	8.3	27.7	50.0	50.0	25.0	43.8
United Kingdom			25.0	30.0	10.0	20.0		
Netherlands			7.7	23.1			0.0	0.0
Sweden			10.5	10.5				
Switzerland			22.6	32.3				
Total	28.3	41.8	18.5 c/	33.5 c/	13.9 c/	27.8 c/	14.0	23.3
(In absolute figures)	(177)	(261)	(43)	(78)	(5)	(10)	(6)	(10)

Sources:

Brazil: The listing of German parent companies from the Institut für Iberoamerika Kunde, Hamburg, 1979 "Beteiligung deutscher Unternehmen in der brasilianischen Wirtschaft". The list of French firms has been published by the Brazilian-French Chambers of Commerce, 1979.

Mexico: List of Mexican firms with foreign capital registered by the Comisión Nacional de Inversiones Extranjeras y Transferencia de Tecnologia up to end of 1978.

Peru: List of parent companies with direct investments registered between 1974 and 1978, provided by CONITE.

Venezuela: Parent companies registered by the Superintendencia de Inversiones Extranjeras up to end of 1978.

*/ Not listed as subsidiaries of other companies or holdings in the repertories utilized.

**/ Number of employees.

a/ In Brazil reasonably exhaustive information on parent companies was obtained only for German and French companies.

b/ Peru: information covers only German, French and United Kingdom parent companies. Venezuela: only German, French and Dutch companies (the other home countries are not significant because of the small number of firms registered or whose size was possible to determine).

c/ Totals include parent companies of other European origins with a small number of firms registered or with identified size.

Table 3

Small and medium European firms with licensing agreements in Brazil, Mexico, Peru and Venezuela

Percentage number of independent */ small and medium firms with up to 500 and 1,000 employees, in respect of total number of firms of the same origin with information available on their size, classified according to their size, country of origin and recipient country

Country of origin \ Recipient countries	Brazil		Mexico		Peru a/		Venezuela a/	
	<500**/	<1000**/	<500**/	<1000**/	<500**/	<1000**/	<500**/	<1000**/
Germany, Fed. Rep.	34.2	44.7	22.0	32.5	28.6	35.7	9.1	27.3
France	27.3	27.3	37.5	43.8	83.3	83.3	28.6	42.9
United Kingdom	17.6	29.4	24.6	30.4	0.0	20.0		
Netherlands	25.0	25.0	40.0	45.0				
Italy	33.3	33.3	39.4	63.6				
Sweden	33.3	33.3	11.1	16.6	33.3	33.3		
Switzerland	25.0	50.0	34.9	44.2				
Total b/	30.0	37.8	20.3	26.9	29.2	35.4	13.5	27.0
(In absolute figures)	(27)	(34)	(133)	(176)	(19)	(23)	(5)	(10)

Sources:

Brazil: Instituto Nacional da Propriedade Industrial (INPI). Technology contracts approved in 1978 (excluded technical services agreements).

Mexico: Lists of contracts registered in the Comisión General Nacional de Inversiones Extranjeras y Transferencia de Tecnología, as to end 1978.

Peru: List of licensors with technology contracts registered during the period 1975-1977 (Comité de Inversiones y Tecnologías Extranjeras).

Venezuela: Superintendencia de Inversiones Extranjeras, Contracts registered between 1977 and 1979.

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*/ Not listed as subsidiaries of other companies or holdings in the repertories utilized.

**/ Number of employees.

a/ Peru: Information covers contracts of German, French, United Kingdom and Swedish companies. Venezuela: German and French contracts (the other countries of origin have not significant number of contracts or the size of the respective licensors was impossible to determine).

b/ The totals include firms belonging to other European countries, with a small number of firms registered as licensors of whose size was identified.

Chapter II

FACTORS INFLUENCING THE TRANSFER OF TECHNOLOGY THROUGH SMALL AND MEDIUM FIRMS

25. The present international scene is characterized by a number of significant transformations which have taken place during the 1970s. The rapid growth of foreign investments, the expansion of transnational corporations, the development of new forms of productive collaboration across frontiers, the narrowing of the technological gap between United States of America and the other industrial countries and the emergence of a new group of developing countries - the new industrialized countries - have given rise, among other factors, to an increasing level of economic interdependence. The traditional trade pattern is being replaced by new trends in the international division of labour and a process of redeployment of industrial activities; at the same time, the economies of developed countries have suffered a series of setbacks leading to a slower overall growth and recessionary pressures and having serious international implications.

26. It is in this context that new circumstances are having a direct or indirect effect on the international mobilization of small and medium firms, particularly in respect of their operations in developing countries. Most of the new circumstances do not affect smaller firms exclusively, but several could be influencing their situation specifically.

27. The emergence of small and medium enterprises on the scene of international investments and technology transfers can be explained by several factors grouped under three main headings: (a) the internationalization of the world economy; (b) structural changes in developed countries; and (c) changes in developing countries.

A. The internationalization of the world economy

1. The consolidation of an international infrastructure encouraging international business transactions

28. The spectacular development of the transport and communications systems, the increasing diffusion of specialized information throughout the world, the expansion of world trade, and the diversification of firms and organizations specialized in the supply of services of great importance for international investment operations, such as trading companies, banks and insurance companies, engineering firms, etc.,29/ have created a stimulating environment for more and more firms. The "shrinkage" and higher transparency of the international economic space and the availability of services which smaller firms could not provide for themselves are of fundamental importance in the foreign expansion of these companies. Besides, an increasing number of small and medium-sized firms have been accumulating significant experience through export activities, as was noted in the preceding chapter. Such background is not only an important step in the process of internationalization of smaller firms, but also a possible factor for success in foreign ventures.30/

29/ Since the early 1970s, the share of commercial activities and services in the stock of foreign investments abroad of the large industrialized countries has significantly increased. See OECD, Comité de l'investissement international et des entreprises multinationales, Tendances récentes des investissements directs internationaux (notes du secrétariat), mimeo, Paris, 13 February 1980.

30/ See Buckley et al., op. cit.

2. The competitive advantages of many small and medium firms

29. The complex fabric of inter-firm relations tends to obscure the fact that, despite the existence of small and medium firms struggling for survival in subordinated or marginal situations, there are many highly efficient smaller firms enjoying positions of leadership in their respective sectors and competing with larger companies on the basis of technological advantage and specialization strategies. Hundreds of examples of successful small firms could be found in the capital goods sector - especially in the production of special equipment and non-standardized goods - as well as in the chemical industry. Many of these firms, thanks to the positions they enjoy in their markets, could be qualified as "differentiated oligopolies". For such firms, once a certain level of expansion has been reached, the possibilities for continued growth and preservation of their positions are more and more linked to the conquest of external markets, which are frequently available for the high quality, "unique" products in which they specialize. This aspect is dealt with in subsequent chapters.31/

3. The increasing attractiveness of the markets of certain developing countries

30. During the period 1973-1978, the rate of growth of foreign investment in developing countries has exceeded that in developed countries.32/ Small enterprises may have been attracted just as much as transnational corporations by the opportunities offered by some of the more advanced developing countries, as the data presented in chapter I suggest. Such countries have placed emphasis on the development of a large and diversified industrial base with increasing levels of specialization, which offers international market opportunities for the smaller firms to exploit. Moreover, the import substitution policies introduced in most newly industrialized developing countries to protect the take-off of their own industries are creating classical incentives to invest, specially for those smaller firms that are serving those markets through exports.33/

4. The incitement by transnational corporations

31. The continuous expansion of transnational corporations and their talent for adopting new ways of maximizing profits and minimizing risks probably explains in part the international mobilization of small and medium firms. In fact, many small firms are linked to large transnationals in their home countries in "contract markets", as suppliers of specialized products or services. In such cases, small and medium firms may be incited or compelled by their large clients to follow them overseas, in order to assure the supply of goods or services that meet with certain technical and quality standards.34/

31/ On the presence of specialized smaller firms among those with experience in international expansion, see Buckley *et al.*, *op. cit.*, A.D. Little Inc. *Technology transfer to Latin America from small and medium sized U.S. firms; broadening the channels* (Report of a study for the Department of State, United States, 1978), Steinmann *et al.*, *op. cit.*, Ministère de l'Industrie, (France), *op. cit.*

32/ See OECD, *op. cit.*, p. 13, UNIDO, *Industrial redeployment in Sweden: Prospects and obstacles*, UNIDO/ICIS 54 (Vienna, 1978).

33/ See for example the concerns of the French government in Ministère de l'Industrie, *op. cit.*

34/ For the case of Volkswagen in Brazil and how smaller subcontracting companies of the Federal Republic of Germany were made to follow it, see E. Springmann, "Europe's medium-sized industrial companies as partners in Latin America's industrial development". Paper presented to the Latin American-European Business Co-operation Symposium, Montreux, 22 November 1979.

32. The following sections discuss the implications of factors more specifically pertaining to the economies of developed and developing countries.

B. Structural changes in developed countries

1. Slower growth

33. During the past decade, slower rates of growth, greater levels of competition and increasing efforts for improving productivity through rationalization and technological innovation have characterized the evolution of the industrial sectors in developed countries.

34. Such trends, and the resulting higher economic concentration, tend to affect small and medium enterprises in the first place. Yet the impact may vary according to the different types of small and medium enterprises. On the one hand, the successful firms with high-quality products and a significant market position will be primarily affected by the stagnation of local demand and the pressures of international competition; they will be impelled to expand internationally in order to assure their survival in the long run. On the other hand, the smaller firms in structurally weak sectors - for example, textiles and clothing - face the additional challenge of imports from a number of "new industrial countries", having competitive advantages deriving from their significantly lower labour costs. The process of the international redeployment to these countries of certain stages of highly labour-intensive production was initiated by the largest firms, which in this way have increased their competitive advantage and the trend to higher concentration in the home countries. In these circumstances, small and medium-sized firms may be compelled to adopt similar business strategies in order to avoid further setbacks and to preserve their market positions.35/

2. Higher labour costs

35. The problem of higher labour costs in developed countries has grown in importance in the present climate of slow growth and increasing international competition. However, this problem had already emerged at the start of the 1970s with the changes occurring in the exchange rates of some countries36/ and the increase in the wage levels. This factor obviously affects primarily the labour-intensive activities and, in particular, those sectors exposed to the competition of imports from developing countries. There are reasons to think that the rising labour costs are affecting more seriously the smaller firms: first, such firms represent a high proportion of the firms engaged in labour-intensive industries; second, they tend to use less capital-intensive technology than do larger firms in the same branches. Not surprisingly, therefore, lower labour costs available in other countries are an increasingly important factor in the decisions of smaller firms to invest abroad. For example, a study revealed that 42% of the Swiss smaller firms interested in redeploying activities to developing countries mentioned the greater use of cheap labour among the reasons to move abroad.37/ Such factors seem to be particularly

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35/ For the case of the clothing industry in the Federal Republic of Germany, see V. Schwarting, "Strategies for survival: the example of the clothing industry", Inter-economics, January, February 1979, p. 15 et seq.

36/ With the introduction of floating rates, the competitiveness of products of countries with strong currencies tended to diminish.

37/ See UNIDO, Industrial redeployment tendencies and opportunities in Switzerland, op. cit. Lower labour costs were ranked as the third reason for redeployment by the firms surveyed, after "easier access to the market" and "revaluation of the Swiss franc". A similar pattern was found in large enterprises.

decisive in the textile, clothing and footwear industries. The same trend has been observed among the Belgian firms of the less capital-intensive branches (typically smaller) which had experience of or plans for investment in developing countries38/ and, to a lesser extent - but very important in the case of the clothing industry - among small and medium firms in the Federal Republic of Germany.39/

3. Other trends in the labour market

36. Demographic trends suggest a diminishing supply of labour in many developed countries by the end of the 1990s. In some European countries, the growth of employment as a result of post-war expansion required the "importation" of workers, so that several industrial branches - particularly the labour-intensive ones - became employers of a higher share of immigrant workers. Rapid technological development and low overall growth in recent times have lessened concern at the shortage of labour, and brought to the fore in contrast the problem of unemployment. However, the prospect of a future shortage of labour, illustrated by the experience of certain countries such as Switzerland after the restrictions imposed on immigration in the early 1970s, has led to a renewed interest in the redeployment of production to overseas markets, particularly to those offering an abundant supply of labour. The case of Switzerland suggests that this factor has significantly influenced the decisions of companies to invest abroad, particularly in the case of small and medium firms.40/

4. Rising raw material costs

37. In the wake of the crisis caused by the dramatic evolution of the oil market, the need to ensure access to raw materials has been more keenly felt and has become a factor of general importance in stimulating the foreign investments of a growing number of developed countries. This motivation seems to be present also in the case of small and medium firms.41/

38/ See UNIDO, Industrial redeployment tendencies and opportunities in Belgium, (UNIDO/ICIS 131, Vienna, 1979).

39/ See Halbach, op. cit., and Springmann, op. cit.

40/ Detailed research on business strategies with respect to the shortage of labour reveals that this factor has been particularly decisive in the case of smaller firms. While only 10% of TNCs indicated the "shortage of labour in Switzerland" and another 5% mentioned the "availability of abundant labour supply" as reasons to invest abroad, enterprises defined as "non transnationals" put more weight on the same factors (20% and 13% respectively). See C. Jeanrenaud, D. Maillat and J. Widner, Le comportement de l'entrepreneur face à la pénurie de la main d'oeuvre (Université de Neuchatel, 1979). Similar results were obtained in another survey for UNIDO, Industrial redeployment tendencies and opportunities in Switzerland, op. cit.

41/ 10% of the Swedish firms interested in redeploying activities abroad indicated the "access to raw materials" as the major factor; see UNIDO, Industrial redeployment in Sweden, op. cit. The same factor was mentioned by 15.5% of firms in the Federal Republic of Germany with redeployment experience and 38.5% of those with redeployment plans; see Halbach, op. cit. For Belgian firms see UNIDO, Industrial redeployment tendencies and opportunities in Belgium, op. cit.

5. Government intervention

38. During the last decade, the process of corporate expansion in the economies of developed market-economy countries has created the need for increasing government intervention. Some of the measures taken by governments, although intended primarily to control the action and impact of large enterprises, may have indirectly placed heavier burdens on small and medium enterprises. The following may be mentioned: (a) Environment protection measures: the heavy costs of complying with governmental requirements seem to have created a new incentive for investing abroad, particularly in developing countries.42/ (b) Labour legislation: the increasing trend of encouraging workers' participation and other aspects of social legislation in developed countries may imply a series of adjustments in business organization for which smaller firms are not always well equipped, owing to their family structure and inadequate administrative structure. Developing countries may be perceived as safer environments by such firms.

39. On the other hand, the concern of governments of developed countries about the impact of the economic crisis on small and medium-sized firms has motivated the granting of certain fiscal and financial advantages. Several government agencies have also declared the need to help smaller firms to expand into foreign markets, particularly to those of developing countries where they are deemed to enjoy certain competitive advantages.43/ In this way, new mechanisms have been adopted to encourage the transfer of technology and foreign investments by such firms. Chapter V below describes briefly the main incentives and advantages granted by developed countries which may have played a part in encouraging smaller firms to develop their operations abroad.

C. Changes in developing countries

40. Since the early 1970s the economies of a number of developing countries have progressed in a dynamic manner that contrasts with the troubled situation of most developed countries. Such developing countries have thus become an attractive location for industrial activities.

41. Throughout the 1970s, the semi-industrialized developing countries experienced rates of growth which were double those of industrialized countries.44/ According to current forecasts, this tendency will persist for at least another decade;45/ moreover, the less advanced developing countries should grow at a faster rate than the developed countries.

42. Many developing countries offer to companies of the industrialized nations an abundant supply of cheap labour, sources of raw materials, lower energy costs and an

42/ 9% of the firms in the Federal Republic of Germany with redeployment activities in developing countries and 12.8% of those planning to do the same indicate such measures among the reasons for investing in developing countries. See Halbach, op. cit.

43/ On the advantages of an increasing international involvement of smaller firms, see A.D. Little, op. cit. and Ministère de l'Industrie (France), op. cit. About 20% of Federal Republic firms included in the IFO Institute survey with investments in developing countries indicated the home country incentives as one of the motivations. See Halbach, op. cit.

44/ While the rate of growth in middle-income developing countries in the period 1970-1977 was 6.1%, that of industrialized countries was only 3.1%. See World Bank, World Development Report, 1979.

45/ In fact, according to the World Bank forecasts, the average growth rates will be 6.8% for middle-income developing countries and 4.9% for industrialized countries in the period 1980-1990. Under the hypothesis of slower growth, the rates would be 4.9% and 3.5% respectively (ibid.).

improving physical and productive infrastructure. It is, however, in the rapidly growing markets of the semi-industrialized developing countries that the main location advantages seem to be found, particularly for the small and medium enterprises entering the field of transfer of technology for the first time.

43. Such countries are characterized by an increasing diversification of their industrial structure,46/ and the objective of achieving a more specialized and sophisticated productive pattern, stronger vertical and horizontal linkages and greater levels of technical and managerial skills. In this context, the industrialization process is revealing the existence of a number of segments or "niches" which are not adequately served by the existing economic actors, in particular by transnational corporations dedicated to the development of the heavy industries and the exploitation of the markets of durable consumer goods. Moreover, many developing countries have expressed concern about the small contribution of their import substitution strategy to the solution of structural problems, in particular the problem of unemployment. Accordingly, more emphasis is placed on the use of labour-intensive techniques and the modernization of local small and medium-sized enterprises. The capital goods sector and metal-working industries in general are given priority in many such countries, together with export-oriented industries. Some of the new markets, opportunities and priorities thus established can be matched with the middle-sized industries of most developed countries, where the smaller firms are located.

44. Furthermore, in the more advanced developing countries there is a significant sector of nationally-owned enterprises which have matured during the earlier phases of the import-substitution period and which participate in a diversified range of activities. Domestic companies are in general to be found in traditional branches such as textiles and food, but they are also active in the manufacture of machinery and equipment, electronics, and chemicals. The presence of a class of local entrepreneurs in many of the sectors where the small and medium firms of developed countries have concentrated their activities constitutes another significant attraction for the transfer of technology to the more advanced developing countries.

45. Finally, many developing countries have modernized their institutional frameworks through laws and mechanisms for encouraging industrial development and the import of foreign productive resources. Some of the countries which in the early 1970s imposed strict controls on the inflow of foreign investments are now adopting more flexible criteria for the evaluation, selection and negotiation of technology. Without abandoning the principle of governmental intervention, more emphasis is put on new ways of selectively attracting foreign companies. These trends are discussed in more detail in chapter V.

46. It is thus obvious that the degree of industrialization, the improved institutional and physical infrastructure and the consolidation of a domestic entrepreneurial class in a number of developing countries are important factors making for complementarity between such countries and many small and medium-sized enterprises of developed countries. An important question remains, however, concerning the prospects of the least developed countries for benefiting from the co-operation of such firms. In view of the structural limitations and decision-making problems which beset small firms that engage in international operations (which are discussed in chapter III), there seems to be no alternative here for the near future to bridging the gap through international co-operation in order to provide the elements which market forces fail to supply.

46/ The share of the industrial sector in the productive structure of middle-income developing countries increased from 32% in 1960 to 37% in 1977. For low income countries the same percentages were 17% and 24%, respectively (ibid.).

Chapter III

THE TECHNOLOGY TRANSFER PROCESS AND SMALL AND MEDIUM FIRMS

A. Characteristics of the small and medium firms

47. The modern study of international investment and the technology transfer process has focused on the corporate characteristics of transnational corporations, their organizational structures and business strategies. In consequence, the analysis of the special features of small and medium firms as "non-transnational" actors has suffered from a tendency to regard such firms as residual categories. The notion of "smaller international corporations" has occasionally appeared in the literature 47/ but in a very general manner and only in the light of the transnationals' phenomenon. 48/

48. Given the present definitional vacuum, and notwithstanding the risk of generalizing in this field, it is necessary to try to identify certain basic characteristics of small- and medium-sized firms that affect the modalities, motivations and strategies for the transfer of technology to developing countries. In this connection, the following specific features can be identified as being in general typical of small- and medium-sized enterprises:

(a) They are managed by their owners, who are often family members; the decision-making system is highly flexible, informal and dependent on the personal drive of one or two executives;

(b) They are devoted to a narrow range of activities (products or services) on the basis of very limited capacities and resources, i.e. specialized know-how, equity and borrowing capacity;

(c) They have a simple and relatively unsophisticated management structure and apply a limited range of administrative procedures; their productive knowledge is often embodied in the managers and technicians rather than formalized in blueprints, manuals and designs;

47/ See, for example, J. Stopford and L. Wells, Managing the multinational enterprise (Basic Books, New York, 1972), and J. Tomlinson, The joint venture process in international business: India and Pakistan (MIT Press, Cambridge, 1970).

48/ On the other hand, the information on smaller companies operating within the national economies is of little value not only because no attention is given to international operations, with the possible exception of exports, but because the categories used to define small and medium firms are dependent on the formal-legal criteria applicable for domestic activities. As will be seen in chapter V, the very few concepts so far stemming from government experience in stimulating investments abroad by smaller firms are still too vague and impressionistic, and in general cover all types of "non large" transnational corporations.

(d) They have a low tolerance for risk and are particularly sensitive to changes in the socio-economic context as well as to the impact of barriers and incentives deriving from the economic and institutional system;

(e) Very often they are new-comers to the sector 49/ and are relatively inexperienced and unprepared for international business;

(f) They are not in general market leaders, although they may enjoy a dominant position in a very specialized segment of a particular market - very often in a subcontracting context.

49. It is in the light of such corporate characteristics that the particular patterns of international behaviour of smaller firms can be explored.

B. Motivations for the technology transfer

50. The preceding chapter discussed the main factors and forces underlying the process of direct investment abroad and export of technology by small and medium enterprises. Such analysis should be complemented by a discussion of the specific motivations of firms engaging in international operations.

51. There is no reason to assume that the basic purposes of small and medium firms for going abroad are substantially different from those of transnational corporations. The pressures of competition in both domestic and foreign markets are just as strong on smaller companies as they are on the transnationals. For those firms engaged in exports the threat of protectionism in third countries is an important reason for establishing production facilities abroad. The need to assure a stable supply of raw materials, the advantage of lower labour costs in foreign locations, the opportunity of capitalizing on an innovative advantage and the will to diversify risks may be also present in the package of motivations of small and medium firms. 50/

52. It is nonetheless possible that a comparative analysis of the motivations and purposes of companies of different sizes investing and licensing abroad would reveal certain differential patterns. The objective of broadening their market could be particularly crucial for small and medium firms suffering from the pressures of concentration in their domestic economies and lacking the capacity for product diversification possessed by most large firms. Similarly, for many highly specialized smaller firms in modern sectors, whose products are manufactured in accordance with the specifications of particular buyers, the decline of local demand in the home country and the technical difficulties involved in exporting such goods may leave them no alternative but to develop other markets in other countries and to establish facilities there. In the case of other specialized firms, the export trade has come to represent a significant part of their total sales and the combination of protectionist and competitive forces may create stronger motivations for investing abroad.

49/ In the sense that the failure rate is higher in the case of small business, there is in fact a high turnover of such firms. See J. Steindl, Small and Big Business (Oxford, Blackwell, 1945), p.8.

50/ See the series of UNIDO papers cited in the preceding chapter, and also Buckley et al., op. cit., A.D. Little, op. cit., Janrenaud et al., op. cit., V. Schwarting, op. cit.

53. At the same time, the objective of obtaining lower labour costs in foreign locations could be a stronger motivation for smaller firms, which tend to be more present in most labour-intensive industries, than for transnational corporations.

54. Apart from such motivations, which are influenced by sectoral factors, other plausible reasons for moving abroad, of a clearer size-specific nature, can be identified. There is one important distinctive feature in the way that smaller firms try to capitalize on their innovative advantages through transfer of technology transactions. Such firms, although highly innovative in several sectors, normally lack sufficient resources and organization to protect their advantages through the international patent system or to exploit the innovation directly. Their competitive edge cannot be easily maintained for a long time through permanent research and development efforts and the utilization of the international patent system. It follows that they may be willing to transfer their technology at an earlier stage, moving ahead of the competition of larger competitors. 51/

55. Another type of motivation, which may weigh more heavily in the case of small and medium firms, is the desire to spread risks as a result of changing social and political circumstances in the home country. The concern engendered by the growth of social policies or by increasing governmental intervention in many fields - e.g. price controls and environment protection legislation - may represent, in addition to market forces, a major incentive to move abroad for enterprises that hitherto have kept all their eggs in one basket.

56. Finally, small and medium firms may be more sensitive to programmes and measures adopted by governments to encourage investments abroad. The direct support provided by home governments and by host governments in the form of incentives may be a way of creating the confidence and providing the resources normally lacking in smaller firms. This subject is dealt with further in chapter V.

C. Origin of the initiative

57. One important aspect of the transfer of technology by small and medium firms, which has practical implications, is that of the initiating forces leading to the decision to move abroad. The planning of international business is not a characteristic of such firms, which have neither time nor resources for permanently scrutinizing foreign opportunities and developing long-term expansion plans. Thus, in the case of smaller firms it is possible that external rather than internal incentives play a decisive role. The external forces can take a number of forms:

1. Governmental initiatives

58. As mentioned earlier, the programmes of home governments for actively encouraging investments abroad may have a strong impact on small- and medium-sized enterprises; also campaigns launched by potential recipient countries to attract direct investments from other countries could have similar effects. 52/

51/ See J. Sweeney, "A small company enters the European market", in Harvard Business Review, Sept.-Oct. 1970, p.127.

52/ See Steinmann, et al., op. cit., p.8.

2. Proposals by other firms

59. In view of the usual conservatism of smaller firms with regard to international business, it is possible that decisions to invest or transfer technology abroad will be triggered by requests or invitations of other firms. One case would be that of large firms established abroad that need the subcontracting co-operation of the same smaller firms with which they operate in the home country. Another case could be that of importers or distributors abroad who draw the attention of exporting small- and medium-sized firms to an interesting opportunity or a competitive threat arising in the local market. Finally, smaller firms may be trailing other firms of the same nationality and size which have successfully established themselves abroad earlier or which need the former's co-operation, for example, in order to broaden their product line once the initial market is developed.

D. The selection of the host country

60. A crucial aspect of the transfer of technology to developing countries by small and medium enterprises is the way in which the decision to invest or to export technology to a particular country originates.

61. The sketchy evidence about the direction of the flows of investment and technology of smaller firms presented in chapter I suggests that these firms tend to initiate their foreign expansion in other industrialized countries, although more recently the markets of semi-industrialized and more advanced developing countries have become increasingly attractive to such firms. However, one of the main comparative advantages of developing countries which could be considered of special interest for smaller firms - namely, lower labour costs - does not seem to have played a decisive role in orienting the flows to such countries. The exceptions are the South-East Asian developing economies, which have become desirable locations for many enterprises, particularly, but not only, for small and medium Japanese firms. In broad terms, decisions to move to a particular country are primarily influenced by the main motivation of smaller firms: broadening their markets.

62. The empirical analysis of the reasons behind the location decisions of small and medium enterprises should also take into account their business characteristics as outlined above, and in particular their limited range of activities, shortage of resources, personalized management, high risk sensitivity and lack of experience.

63. The fact that smaller enterprises usually operate with a limited range of products and know-how tends to limit the range of possible locations abroad. 53/ Moreover, in view of the limited resources, individualistic management style and risk aversion of these firms, there will be a tendency to move to countries where the business environment and the industrial structures are similar to those of the home economies. In this sense, some of the more advanced developing countries

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53/ See Steinmann *et al.*, *op. cit.*, p.9.

of Latin America and South-East Asia have come to be viewed as offering favourable economic conditions for the collaboration of medium-sized firms of developed countries, whose specialized know-how and ability to operate in small markets are well suited to the increasing diversification and developing infrastructure of the industrial patterns of the recipient countries. Again, the shortage of management and other human resources, as well as the influence of the cultural patterns of the country of origin, may orient location decisions to countries where certain elements of the home culture are present. In this respect, smaller firms of the Federal Republic of Germany operating in Brazil, French firms in several African countries, and Japanese firms in South-East Asia are probably motivated by such cultural relationships arising from earlier immigration, political links, or similar living styles.

64. Finally, in view of the importance of exogenous driving forces in the decision process of small and medium firms, it is quite probable that the efforts of the home countries, as well as those of specific host countries, to attract foreign investors to certain areas are a major factor in the decision process. Frequently the incentives of governments - for example, the efforts within the European Economic Community, French programmes to encourage business ventures in Africa, or the campaigns conducted by Brazil, Singapore and other developing countries offering advantages and facilities to investors from developed countries - will stand in place of the internal process of screening and evaluation of alternative sites. This last characteristic could be an important practical consideration in evaluating the potential role of smaller enterprises in the transfer of technology to the least developed countries.

E. The transfer of technology mechanisms

65. The process of transfer of productive resources through business transactions is currently characterized by a high degree of technical complexity and diversity of forms and organizational structures. This is attributable to the combined effect of the activities of transnational corporations, seeking new patterns of management control and geographical and product diversification, and of the policies and regulations of home and host governments trying to promote or control the performance of the transnationals. As a result, institutions and techniques are adapted to a number of channels for the transfer of technology which have not taken into account the participation of actors other than the transnational corporations.

66. The well-known basic mechanisms for the transfer of technology are founded on external or market transactions between independent firms, or on internal or intra-firm transactions through foreign investment. Technology can be transferred separately or in a package form together with other resources, as in the case of most intra-firm transactions.

67. An important consequence of the existence of several transfer modes is the different effect that each such channel may have on the extent and form of the technology transmitted: the control, the price, and the distribution of benefits of the transactions. From the viewpoint of the firm, each mode may involve different costs in terms of negotiation, administration, enforcement and risk. Each channel may involve different preconditions and requirements and imply different commitments and efforts on the part of the participating firms.

68. In view of the limitations which encumber the smaller firms, it is possible that not all the transfer of technology channels are equally suitable for them. Such firms could find some types of operation very difficult or impossible to carry out.

69. It is generally assumed that foreign direct investments are easier for larger firms. The establishment of subsidiaries or joint ventures abroad are capital-intensive and management-intensive operations involving not only financial resources but also the time and skill to plan, evaluate and manage foreign projects on a permanent basis. In fact, some empirical evidence indicates that the propensity to invest abroad is strongly influenced by corporate size and that, depending on sectors, there is generally a "threshold level" for engaging in such operations. 54/

70. Yet apart from such broad considerations, most small and medium firms engaging in the transfer of technology will be in a position to take into account all possible alternatives on the basis of a combination of different factors, including on the one hand internal aspects such as the human resources available, the financial situation, the nature of the technology to be transmitted, the degree of risk that the firms are willing to take, the returns expected, the previous experience of the firms; and on the other hand, external aspects such as the nature of the project, the prospects of obtaining complementary co-operation, the governmental policies in the home and recipient countries, and the characteristics and requirements of the recipient parties.

71. With respect to the technology transfer process, the existing literature on organizational forms has not dealt with the specific situation of small and medium firms. Further basic research in this field should try to identify the specific corporate characteristics of such firms influencing the selection of particular mechanisms of technology transfer and the relative costs and benefits of each form. Certain characteristics of smaller enterprises seem to be particularly relevant in this respect, a point which is discussed in the following paragraphs.

72. Because of the larger financial commitments and higher risks involved in the equity forms of technology transfer, it could be expected that smaller firms would prefer to take less costly routes, such as licensing and technical assistance contracts. However, small and medium firms may not always have sufficient flexibility to adopt such forms. The need to maintain control over, and to prevent the diffusion of, their very specific and unique know-how - which is typical of many smaller firms - may preclude the less secure contractual mechanisms and orient the choice to the intra-firms approach, which in addition offers higher returns. Moreover, it may be difficult to find a local buyer with the necessary experience to make use of the specialized knowledge. As a test of the reliability of technology-supplying small enterprises, which

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54/ For example, a study on the clothing industry firms of the Federal Republic of Germany investing abroad revealed that such threshold level was in the group of firms with 100-199 employees. See V. Schwarting, op. cit., p.15. Also the experience of the Kreditanstalt bank in the Federal Republic of Germany in financing investment abroad suggests that very small firms are not in general interested in such opportunities (see chapter V below).

normally do not have international renown, potential recipient parties in host countries may wish to ensure the strongest possible commitment of these firms through equity participation. On the other hand, despite the weaker commitments involved in the transfer of technology through contractual mechanisms, such mechanisms require an effort to formalize the smaller firms' knowledge, often embodied in the experience of the owners and technicians, which may be difficult for such firms. Finally, other obstacles to contractual forms may be raised by government rules and interventions. For example, in several developing countries, such as Brazil, technology agreements are subject to more severe requirements and proceedings than are foreign investment projects. Also, government incentives in certain home countries may be biased in favour of foreign-investment forms of technology transfer to developing countries. As is shown in chapter V, certain agencies promoting the collaboration of medium-sized firms in developing countries normally insist on joint venture arrangements implying equity participation.

73. In addition to the classical forms of foreign investment and licensing, another mechanism which seems to be particularly interesting for smaller enterprises is international subcontracting. Although engineered by transnational corporations, there is some evidence of the increasing participation of small and medium firms in such arrangements, particularly with the purpose of redeploying labour-intensive activities to lower-cost foreign locations. 55/ In such cases, a local firm in the host country is contracted to process raw materials, components or semi-finished products supplied from the home country, obtained in the processing country or imported from a third country, and to ship the processed product to the principal - i.e., the small or medium firm - which takes care of the commercialization. The decentralization of production to foreign factories can make a decisive contribution to the survival of enterprises in weak sectors through the spreading of overhead costs and the filling out of product ranges. Subcontracting arrangements could be combined with equity participation - i.e., the principal investing in the host country's firm - or be limited to import-export arrangements coupled with technical assistance and the delivery of specific product designs.

74. A final relevant aspect of the transfer of technology mechanisms needing research is the strategy of entry of small and medium firms into developing countries. In view of the lack of international experience and the risk sensitivity of these firms, it is reasonable to expect a preference for small steps and a gradual engagement. A slow pace of penetration - i.e., through foreign distributors of exports, sales subsidiaries, licensing contracts, production subsidiaries - may have important advantages in terms of learning and risk minimization.

55/ See, for the case of Switzerland, Jeanrenaud et al., op. cit., p.30; for the case of Japan, MITI (1974), op. cit., p.54, for the Federal Republic of Germany, V. Schwarting, op. cit., p.15.

F. Obstacles to the technological co-operation of small and medium-sized firms in developing countries

75. The preceding discussion on the main components of the process of technology transfer by small and medium firms has indirectly served to suggest the main constraints encountered by such firms. Such constraints may derive from intra-firm limitations or external, environmental factors related to conditions in the home and the recipient countries.

76. A recent report on present trends of industrial redeployment to developing countries suggests that the main obstacles faced by smaller enterprises are related to two corporate limitations - namely, lack of relevant information and lack of finance - and a set of host country constraints, nemaly, lack of skilled workers, low productivity of labour, socio-political conditions, import restrictions and supply problems. 56/ In part, these obstacles are characteristic of the typical redeployment operation - also dealt with in the above-mentioned study - that has the purpose of re-exporting to the home country or other countries. According to another report on the experience and trends of small and medium United States firms with regard to the transfer of technology to Latin America, 57/ the main problem has been the lack of information, but the declared concerns also indicated as major constraints the lack of market size and structure, along with a low level of consumer sophistication; political risks and instability; bureaucratic obstacles; legal constraints; and the problem of finding a suitable partner.

77. Further research through case studies of the main types of smaller firms engaged in transfer of technology to developing countries should clarify the impressionistic information available at present of the specific obstacles faced by these firms. The research should be addressed to the three interrelated areas of finance, management and information. It should be borne in mind that the fundamental obstacle facing such firms is lack of knowledge. Knowledge for identifying and evaluating opportunities, for screening and managing the risks in unknown areas, for working within the limits of legal and administrative restrictions, for overcoming the difficulties of communication with foreign parties, for organizing and negotiating the transfer of technology.

56/ See UNIDO, Structural changes in industry (UNIDO/ICIS/136), p.123.

57/ A.D. Little, op. cit., p.29.

Chapter IV

THE IMPACT OF AN EXPANDED PARTICIPATION OF SMALL AND MEDIUM ENTERPRISES IN THE TRANSFER OF TECHNOLOGY TO DEVELOPING COUNTRIES: MAIN ISSUES

78. The postulation of smaller enterprises as a new alternative channel for the transfer of technology to developing countries is based on the assumption that such enterprises may offer a number of advantages in comparison with transnational corporations. The main advantages of the smaller firms are said to be as follows: 58/

(a) Their technologies may be in many cases more suited or easier to adapt to the industrial needs of developing countries; they may utilize more labour-intensive technology, and even if the technology is capital-intensive and sophisticated, it tends to be appropriate for smaller-scale operations.

(b) They are in general more disposed to engage in minority joint ventures than are the large enterprises; and to associate with other smaller firms rather than with larger firms of developing countries.

(c) Their bargaining power and management style is likely to be much closer to and compatible with those of the majority of developing countries' firms of similar size.

(d) They do not create the problem of great economic and political power stemming from transnational decision systems.

(e) The financial conditions related to their participation are less likely to include transfer pricing and other restrictive arrangements.

(f) A move towards smaller enterprises could be at the same time a move towards diversifying sources of foreign resources, and particularly towards smaller developed market-economy countries.

79. In many ways, the advantages seen in smaller enterprises are associated with the virtues of so-called "appropriate technology" for developing countries. Appropriate technology is a relative concept which in general refers to methods of production that match the developing country's circumstances, environmental conditions, productive structure and resource endowment; and which is concerned with the creation of employment opportunities, the origin of the factors of production and the distribution of returns, the degree of dependence on foreign inputs, locational and organizational requisites and other criteria. Against this broad background, smaller enterprises appear - very much as a result of the disappointment felt with regard to large transnational corporations - as an existing but so far under-employed channel for the tranfer of appropriate technology.

58/ See, for example, UNIDO, Structural changes in industry, op.cit., p.23; UNIDO, Industry 2000: new perspectives, ID/CONF.4/3 (Vienna, 1979), para.6.5.2.; A.D. Little, op.cit., p.19; Ministère de l'Industrie (France), op.cit., p.25.

80. Yet the virtues so claimed for smaller enterprises are far from being demonstrated. Most arguments in their favour are based on "wishful thinking" or on simplifications of the alternatives suggested by the criticism of the transnational corporations model, or on rough associations of concepts or extrapolations from the national economy experiences. It is thus necessary at the outset to found the analysis of the role and impact of smaller enterprises on some fine distinctions - to differentiate - in order to avoid the mistakes initially committed in the treatment of transnational corporations as a global phenomenon. There are probably as many types of smaller firms engaged in international activities as there are types of transnationals. In addition to the main factors explaining diverse effects of foreign involvement - for example the sector, the nature of the business, the characteristics of the home and host countries, the management strategies - there is here the problem of assessing the various implications of a vast range of sizes not clearly delimited. If the qualification of one particular enterprise as a transnational may be a matter of discussion, the definition of a firm acting internationally as a "smaller" or non-transnational company may be a still more difficult problem. For example, a "medium-sized" firm could be in many respects more similar to a transnational corporation than to a "small" firm.

81. Whatever the methodological difficulties and the impossibility of generalizing, it is necessary to explore the existence of certain advantages in the transfer of technology by small and medium enterprises, focusing the analysis on areas in which differential performance is most apparent. In broad terms, the issues to be explored concern the type and mode of transfer of technology, the impact on the industrial structures, local integration and trade, and ownership and control aspects.

A. Appropriate technology transfer

82. One of the most important aspects to be explored is the extent to which an expanded participation of small and medium-sized firms could contribute to a greater availability of products deemed appropriate for developing countries. Transnational corporations have been criticized for concentrating on the production and marketing of sophisticated and expensive durable consumer goods, based on modern marketing techniques and destined for the high-income people in the developing countries.

83. The question of a possibly greater involvement of smaller foreign investors or technology licensors in the manufacture of basic-need goods could be settled through empirical research. In principle, smaller firms tend to be concentrated in certain sectors that match the general conditions of less developed countries, i.e. traditional industries such as textiles, food, leather, and dynamic or modern products such as capital goods and mechanical engineering. The first type of industry, involving mature technologies, could be of particular interest to less developed countries in their early stages of industrialization; and also for more advanced developing economies that need opportunities for diversifying the industrial structures in the context of small markets. The second type of industry could meet the needs of large intermediate developing countries that need to fill the gaps created in their production patterns by the rapid development of the heavy industries sector, as well as the needs of less developed countries initiating the establishment of the physical infrastructure. 59/

59/ See, for example, the experience of several small and medium French firms with projects in Africa, ranging from water drilling to sub-marine works, in MOCI (Moniteur du Commerce International), No. 288/3, Paris, April 1978.

84. At the same time, products offered by smaller firms may have certain drawbacks which derive from the corporate characteristics of these firms. In fact, their high degree of specialization - particularly in the capital goods sector - may require inputs, or be linked to end-products, which are not always available in developing countries. Many of these products have been specially adapted to the demand in developed countries and are not necessarily suited to the less sophisticated consumer preferences or possibilities in the developing countries. 60/ Besides, the lower price mass markets may not be to the comparative advantage of small firms of developed countries. 61/ According to Buckley, a high price/quality strategy seems to be most suitable for small foreign investors, because costs of doing business abroad will be more easily absorbed and returns can be earned from a lower volume, which could be crucial in the early stages of operation abroad.

85. On the other hand, it is not impossible that smaller enterprises in industrialized countries have developed products appropriate for developing countries but not produced there. The reason could be the lack of interest shown by transnationals in the diffusion of these products to developing countries, or simply the lack of knowledge in developing countries about their existence, or again the lack of motivation (cf. chapter III) on the part of the smaller firms to undertake the efforts of a technology transfer. In other words, the absence of international information networks, which are usually concentrated on the circulation of modern technologies, may repress the wider availability of appropriate products, the manufacture of which is in the hands of smaller enterprises of developed countries.

86. A second area of analysis concerns the contribution of smaller enterprises to the choice of techniques in developing countries.

87. One of the strongest criticisms of the transnational corporations concerns the introduction of highly capital-intensive techniques that are not adapted to the factor endowments of developing countries (i.e. abundance of labour and shortage of capital and skills). Hence, it may be argued that smaller firms are a better instrument of technology transfer, because they tend to operate with small-scale and more labour-intensive techniques. 62/

88. Despite the trend in some quarters to proclaim the absolute advantages of low-cost, intermediate and small-scale technologies for developing countries, there is a general recognition of the need to take into account other considerations, such as economies of scale, export potential, profitability, etc. The lower

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60/ Most United States small and medium firms interviewed during the study for the United States State Department mentioned the fact of their products requiring sophisticated and well-developed consumer preferences, which are not yet widespread enough in Latin America, as a primary constraint for the transfer of technology. See A.D. Little, op.cit., p.26.

61/ See Buckley et al., op.cit., pp.11-12.

62/ See A.S. Bahlla, "Small industry, technology transfer and labor absorption", in OECD, Transfer of technology for small industries, (Paris, 1975), p.107, et seq.

investment costs and greater employment impact of small-scale techniques may be offset by higher production costs, inferior quality, lower profitability, etc. In many cases, there may be no available alternatives to the application of large-scale, capital-intensive technologies. On the other hand, the selection of small-scale technologies depends on the national priorities and development objectives of developing countries, and in particular on the introduction of employment as a real objective of the economic policies. 63/

89. Against this background, it is increasingly clear that for many industrial products there are many alternative techniques available - ranging from traditional, unmechanized, labour-intensive methods to sophisticated, automated and large-scale technologies.

90. The existence of alternatives raises the possibility of opening up the spectrum and choosing solutions that are better suited to local conditions. In this context, there are several reasons to think that smaller enterprises will be more likely channels for the transfer of small-scale technology.

91. It is true that small and medium enterprises may not be the exclusive sources of technology adapted to the needs of developing countries, nor the authors of the most important small-scale developments of such a nature. There are many examples of new technologies developed by large corporations which could be considered as particularly appropriate to developing countries. 64/ Besides, transnational corporations sometimes adapt the technologies transferred to their subsidiaries in developing countries to the local conditions, using older or simpler techniques. Yet, on the whole, and other things being equal, the prospects would seem to be better for obtaining small-scale and labour-intensive techniques from small firms than from the large corporations of developed countries.

92. Firstly, small and medium enterprises are in general able to work efficiently in low-scale operations. They are usually to be found in sectors with a low density of physical capital and low concentration levels. The markets in which they operate may be relatively large, as in the case of certain traditional industries where economies of scale are not very significant and where they have developed efficient low-scale production methods. On the other hand, smaller firms are also commonly found in certain narrow, very specialized modern industrial markets, such as the production of capital goods for which economies of scale are also not relevant. Here they often enjoy positions of leadership.

93. Thus the advantages of small and medium firms for developing countries could be viewed not only in terms of the technology that they possess but also in terms of their natural inclination to operate in small markets. In contrast with transnational corporations, which tend to orient their projects according to their absolute size rather than to the rate of the profits expected, smaller firms may be

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63/ See OECD Development Centre, Appropriate technology. Problems and promises (Paris, 1976), p.7.

64/ Ibid., p.37.

willing to take the opportunities offered by the small markets of developing countries. 65/ Such advantages, however, are counterbalanced by the organizational and financial barriers for investing abroad faced by smaller enterprises.

94. The smaller scale, simpler and more labour-intensive technologies transmitted by small and medium enterprises could also be appropriate in terms of the capacity of absorption and learning of the recipient parties in developing countries. This is because of the more flexible organization of smaller firms, and their likely tendency to undertake projects on a gradual, step-by-step basis instead of beginning with highly integrated production programmes. Furthermore, the productivity of labour-intensive techniques increases through "learning by doing". 66/ At the same time, the less automatic equipment being used could be adequate for the production of short-run series of several products, as might be the case in the small markets of developing countries.

95. A third possible advantage of smaller firms concerns the mode of technology transfer. Although such firms may have certain difficulties and less flexibility than transnational corporations in choosing among different forms and negotiating arrangements for the transfer of technology (see chapter III), some of their characteristics, as well as weaknesses, may be beneficial for developing countries. Firstly, small and medium firms may be willing to transfer their technology at an earlier stage than transnationals. In some cases, this could be so because, as already noted, smaller firms normally do not have the means for managing a long-term marketing planning of their technological advantages. In other cases, the weaker market position of smaller investors may stimulate faster decisions to penetrate new markets ahead of transnational corporations. Secondly, the fact that smaller firms lack an integrated transnational production system makes less likely the imposition of restrictive practices such as tie-in clauses, export prohibitions, and transfer pricing mechanisms. 67/ Thirdly, smaller firms operating in sectors such as capital goods may be generally more flexible in the transfer of processes and production know-how than are the transnationals, which normally tend to limit the transfer to the designs and product technology. The transmission of software techniques, including experience, management and organizational forms, which are often the real bottleneck in developing countries, could be easier through direct

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65/ One example is the case of the French medium-sized firm Compresseurs Bernard (260 employees) which, after analysing the opportunities for producing compressors in Latin America, decided to move to Peru, in view of the fact that the larger markets of the region, such as Brazil and Mexico, were already in the hands of big United States subsidiaries. See H. Drouvot et H. Durán de la Fuente, "Activités internationales de l'entreprise et politique des états - Le cas des Compresseurs Bernard au Pérou", Papier de Recherche, 77-03, Centre d'Etudes et de Recherches Appliquées à la Gestion (Université de Grenoble II, 1977), p.16.

66/ Smaller firms in certain sectors are used to being in some type of "contract market" where they supply specialized products according to clients' specifications. Such experience may be of great value as a source of adaptability to the demands of developing countries.

67/ The study of Buckley et al. on smaller foreign investors of the United Kingdom revealed that, in general, the firms were unprepared on transfer pricing and financial policies.

contacts with the owners, managers and technicians of smaller firms. 68/ Fourthly, the lack or limited extent of a research organization at home, as well as the absence of bureaucratic procedures, may signify in general lower overhead costs for the transfer operations of smaller firms. 69/

B. Effects on industrial structure, domestic integration and trade

96. The entry of small and medium firms into the economies of developing countries could contribute to the creation of more pluralistic and less concentrated markets; in this sense, they may have positive effects on competition. However, such effects may vary significantly depending on the existing structure of industries in recipient countries. For example, in least developed countries with no firms operating on an industrial scale, the entry of a medium-sized foreign firm could lead to the establishment of barriers to future domestic and existing foreign competition. In more advanced developing countries, the effects on competition will be in principle negative if penetration is made through the acquisition of a local firm. Yet it seems that smaller enterprises prefer to set up new plants abroad rather than take over existing companies. 70/

97. But the addition of a new firm to the local market may not always have beneficial effects on competition in the case of smaller firms entering as a result of the appeal and direct subcontracting of large subsidiaries. In such cases, the effect could be to increase the dominant position of transnational's subsidiaries and to curtail the possibilities of domestic suppliers. Moreover, smaller firms may not suffice to foster competition in oligopolistic sectors characteristic of developing countries, where the creation of countervailing powers against existing monopolies may require the entry of other larger firms with sufficient economic strength.

98. Small and medium firms may have other diverse effects on the host countries. One important aspect is the degree to which they become integrated in the local economy. In the first place, it is very likely that, once they are engaged in foreign operations, their involvement will be substantially greater than in the

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68/ However, the transmission of capital-intensive technologies, such as in chemicals and oil refining, may have lower transfer costs than the labour-intensive techniques, such as in the production of machinery and equipment, due to the larger management and other human resources involved in the latter. For an empirical analysis, see D.J. Teece, "Technology transfer by multinational firms: the resource cost of transferring technological know-how", The Economic Journal, 87, June 1977, pp.242-261.

69/ However, negotiating technology agreements with smaller companies may involve additional costs stemming from the lack of flexibility and high risk perception of inexperienced firms.

70/ See Buckley et al., op.cit., p.101 for the British experience. Information supplied by the IFO Institute for Economic Research in the Federal Republic of Germany indicates the same tendency (see Halbach, op.cit.).

case of transnationals, which by definition distribute their operations in several locations. Subsidiaries of small and medium firms could equal or exceed their parent companies in terms of sales and number of employees. 71/ Hence a higher stability, deeper involvement, and stronger adequation to the local conditions could be expected from the projects of smaller firms. 72/ As the president of a small United States company with a subsidiary in Europe put it: "My answer was that, once committed, we should no more be thinking of ways to back out of Europe than of ways to dissolve the parent company". 73/ Moreover, the experience of certain developing countries seems to indicate that, after a certain period of time, smaller enterprises from industrialized countries tend to become national, resigning for example the right to repatriate capital and profits. 74/

99. Smaller firms may also constitute suitable partners for the new phases of import substitution being pursued by the more advanced developing countries. In countries such as Brazil, with most transnational corporations already there and few possibilities for further investments in basic industries, new market opportunities are being created which smaller firms may properly exploit, contributing to the adequate utilization of the plants' capacity, the improved specialization of local firms, the consolidation of the backward linkages needed by heavy industries, and the increasing differentiation of products and services.

100. Another way in which smaller firms could contribute to the narrowing of technological gaps within national boundaries would be through location in decentralized areas. Accustomed in their home countries to provincial sites, smaller firms may be more sensitive to incentives granted by host governments for that purpose, and in some cases they may even prefer not to be so near the central areas congested by large corporations. However, their limited resources may not suffice to cope with the usual problems, characteristic of developing countries, of centralized government activities.

101. A major issue to be explored concerns the impact of small and medium firms on trade and their contribution to the objectives of expanding exports and increasing self-sufficiency. One important difference between smaller firms and transnational corporations concerns the strategies of international integration. In principle, it might be expected that concern for international integration would vary in accordance

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71/ See Steinmann *et al.*, *op.cit.* p.3.

72/ Of course, from a different viewpoint, smaller firms could have a structural disadvantage in the sense that they are more subject to ownership and size changes in their home countries, via takeovers by other companies or expansions, not to mention their higher rate of failure.

73/ See J. Sweeney, *op.cit.*, p.128.

74/ A point dealt with in W. Konig, "Possibilities of industrial co-operation in North-East Brazil, Summary Report", unpublished paper (Brazil, 1978).

with the size of the parent company - i.e. larger firms are more likely to have a wider range of international operations to co-ordinate. 75/

102. In terms of the export contribution of smaller companies, it should be noted that: (a) aggressive firms having highly specialized products and motivated by market considerations will try to reap the opportunities offered by regional markets; 76/ (b) smaller firms participating in international subcontracting activities (see chapter III) naturally contribute to export promotion and could thus contribute to a less dependent and more flexible system of export-processing activities; (c) the lack of an integrated transnational system for smaller firms ensures the absence of territorial limitations and other export restrictions, as well as a more flexible response to the host government's incentives. On the other hand, a major drawback of smaller companies is that, in contrast with large transnationals, they do not control integrated marketing structures accomodating the developing countries' programmes for stimulating large exportation plans. 77/

103. On the side of imports, it is not clear to what extent smaller firms are likely to obtain their supplies in the host countries. However, labour-intensive methods and less sophisticated inputs would in principle serve to mobilize local raw materials.

104. Smaller firms may also have different effects with regard to financial aspects - e.g. remittance policies, transfer pricing, and local versus foreign borrowing - impacts on environment, relations with governments and other areas that should be investigated.

C. Ownership and control

105. The belief that smaller enterprises are more likely to accept joint venture formulas than are transnationals, and moreover to accept minority positions in projects in developing countries, seems to be, together with the issue of appropriate technology, one of the main reasons for the interest shown in them as alternative channels for the transfer of resources. Such expectations are based on

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75/ A study on the impact on trade of the relative size of foreign parents of subsidiaries in Latin America revealed that the subsidiaries of the largest parents tended to have the larger average import volumes and the lower export volumes. The smaller size categories of parents reported a positive net trade effect for their subsidiaries. See C. Vaitsos, "The role of transnational enterprises in Latin American economic integration efforts" (TAD/EI/SEM.5/2)(UNCTAD, 1978), p.28. Although this study concerns the role of transnational corporations, the results serve at least to formulate a hypothesis about a similar performance if the analysis is extended to non-transnational corporations.

76/ For the case of some French smaller agricultural machine firms in Latin America, see "IMA: récolte en Europe, semaille en Amérique Latine", in MOCI, No. 283/27, Paris, February 1978, p.13, et seq.

77/ However, as mentioned in chapter V, certain developing countries are starting to provide incentives for small exports.

conclusions of certain studies on the management and control strategies of transnational corporations: in fact, there seems to be an inverse relationship between the size of a transnational and its propensity to associate with local partners in recipient countries. 78/ The need for unambiguous control would be less and the facilities and resources from local partners would be more important in the case of smaller foreign investors. 79/ The lack of an integrated network of affiliates subject to central planning, the relatively unsophisticated nature of their technologies and their weaker bargaining capacities would be typical characteristics of small and medium-sized firms that would explain their expected propensity to engage in minority joint ventures. In this way, smaller companies would have a clear advantage over transnational corporations from the viewpoint of the mobilization and participation of local entrepreneurs, the absorption of technology, and other objectives of developing countries.

106. Leaving aside the still unclear issue of joint ventures as the appropriate form of foreign investment in developing countries, there seem to be various problems with the ideal vision discussed above of small corporations as natural participants in joint ventures. It is not certain to what extent the tendencies shown by the analysis of transnationals could be extrapolated for interpreting the attitude of small and medium enterprises. For example, the tendency of smaller transnationals to engage in joint ventures could be better explained by the weaker position that they have in their home country's respective sectors than by mere considerations of size. Moreover, in the case of smaller firms certain aspects which are taken for granted when dealing with transnationals may have crucial importance, for example, the capacity to organize control and to find local partners. Finally, to the extent that small and medium enterprises appear to be investing abroad in certain sectors, it may be more appropriate to analyse the implications of such activities and the nature of the business involved for the control strategies.

107. The available empirical evidence seems to indicate that so far there is not, in fact, any such inclination on the part of small and medium enterprises for joint ventures with large local ownership. On the contrary, the information on small parent companies in the United States, the United Kingdom and the Federal Republic of Germany reveals that they have clearly tended to favour wholly-owned subsidiaries or majority control systems. 80/ Also medium-sized French firms operating in Brazil

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78/ See for example J. Stopford and L. Wells, op.cit. According to L. Wells, "there are, apparently, some similarities in behaviour between the developing country investors and the small investors from the rich countries. Policies toward local ownership seem to be one such area.". See L. Wells, and V'Ella Warren, "Developing country investors in Indonesia", Bulletin of Indonesian Economic Studies, Vol. XV, No. 1, 1979, p.81.

79/ See J. Tomlinson, op.cit., p.139.

80/ According to the study prepared for the United States State Department, small and medium United States firms considering investments in Latin America placed majority control as a high priority requirement; see A.D. Little, op.cit., p.31. The results of a study on British smaller foreign investors revealed that 24 of the 43 firms interviewed had wholly-owned subsidiaries and only 9 had 50% or less of the capital of their subsidiaries abroad; see Buckley et al., op.cit., p.11. The information provided by the IFO Institute of Economic Research on small and medium firms in the Federal Republic of Germany with redeployment experience abroad revealed that 59% preferred to establish their own plants, and only 18% to take minority holdings (see Halbach, op.cit.).

are predominantly organized as 100% subsidiaries. 81/ There are certain factors which could explain such trend. Firstly, a high share of small and medium-sized firms belong to highly specialized sectors involving sensitive and sophisticated technology and leading to heavy emphasis on their having full control of management, quality control and use of the technology. 82/ Secondly, for smaller firms investing in certain branches of producer goods, their buyers are often limited to few clients and there is not much need for a local partner to contribute with the experience and knowledge of the local market. Thirdly, the advantages of systems of unambiguous, i.e. total or majority control, are clearer for smaller firms which, in contrast with transnationals, do not have the management resources and skills for organizing mechanisms of effective control through minority participations. Moreover, "it will be more difficult to convince the more person-oriented medium-sized firms of the benefits deriving from a partnership with indigenous establishments, due to their frequently differing mental attitudes". 83/ Fourthly, small and medium-sized firms may have more difficulty in finding local partners than do transnationals, which often have large public corporations at their disposal. Finally, despite the general rule that developing countries take a positive attitude to joint ventures, government pressures in this respect are often focused on strategic sectors such as basic industries - e.g. petro-chemicals, steel, or high-profile companies - rather than on the sectors and activities in which smaller firms tend to operate.

108. Hence there seem to be no decisive natural inclinations on the part of smaller firms to engage in minority joint ventures. Their attitudes in that respect may depend, as with other companies, on sector-specific situations. For example, 72% of small and medium-sized Japanese overseas investors in 1973 set up joint ventures in the recipient countries, but the bulk of such operations was located in the Republic of Korea and other South-East Asian countries for subcontracting purposes. 84/ The plans for future outward investment of enterprises in the Federal Republic of Germany operating in weak sectors give preference to minority participations and licensing agreements as ways of gaining entry to developing countries. 85/ The impact of local incentives for joint ventures in developing countries may increase to the extent that the projects of small and medium firms in the host countries tend to expand. 86/ Finally, account must be taken of the long-run tendency of many small and medium foreign firms to become national, thereby assuring most of the benefits sought through the formation of joint ventures.

D. Final considerations

109. There seems to be a strong case for studying small and medium enterprises as new channels for the transfer of technology to developing countries. In certain conditions, they could be a valuable alternative, or an adequate complement, to

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81/ See J.M. Burgard, "Brésil: l'adolescence d'un géant", MOCI, No. 378/24, December 1979 (France), p.61.

82/ See A.D. Little, op.cit., p.31.

83/ See E. Springmann, op.cit., p.3.

84/ See MITI (1974), op.cit., p.54.

85/ See Halbach, op.cit.

86/ For example, a medium-sized French firm in Brazil decided to take a local partner once a new project, 10 times larger than the original, was launched, in order to have better access to local credit, normally limited to joint ventures. See MOCI, "Brésil ...", op.cit., p.62.

transnational corporations, but further analysis on the impact of their involvement and particularly on the conditions under which they could have a significant beneficial effect, remains to be done. On the other hand, to the extent (i) that their present participation in the mobilization of productive resources is and will continue to be low for the foreseeable future, (ii) that their most meaningful contribution tends to be concentrated in certain industrial sectors and on a limited number of developing countries, and (iii) that their patterns of behaviour are not totally different from those of transnationals, it is clear that the smaller firms should not be viewed or proposed as exclusive channels for technology transfer to the developing countries. 87/

110. Furthermore, some of the "advantages" often associated with small and medium firms, such as their propensity to form joint ventures, should be carefully scrutinized. The degree to which they can contribute to the transfer of appropriate technology varies, as much as does the concept of appropriate technology itself, according to the particular country's circumstances, environmental conditions, productive structure or resource endowment. The way in which they could have positive effects on the market structures and industrial integration of developing countries, or contribute to a favourable trade balance, may depend on many factors which are not necessarily directly related to company size.

87/ For a warning about the North-South redeployment as a "residue of opportunities available to the South after they have been disposed of by the North", see A. Keramane, "Industrial redeployment by the North and development of the South" (UNIDO, ID/WG.315/7, November 1979).

Chapter V

THE INSTITUTIONAL FRAMEWORK

A. Policies and measures in developed countries

111. During the 1970s, the governments of several developed countries have adopted or improved mechanisms and measures for encouraging local companies to export technology and set up subsidiaries in other countries. In broad terms, such policies reflect these governments' increasing awareness of the present limitations of the traditional schemes based on the promotion of exports. The measures adopted range from financial and tax incentives to information and technical assistance services. They are, in principle, applicable to all kinds of national firms and to projects in all foreign countries. However, two aspects seem to have gained importance in the recent times: first, the adoption of instruments and measures specially envisaged for the expansion of firms to developing countries, and second, the promotion of the redeployment of small and medium enterprises. These two aspects are not always related and, in fact, they seem to reflect different objectives. On the one hand, the interest in developing countries is based on the concern of a number of industrialized countries about the relatively low participation of investments in the developing country markets, which are considered as increasingly important; on the other hand, the emphasis on small and medium firms is related to the double objective of helping such firms to face the present conditions and challenges of international competition, while enhancing their potential contribution to the home country through competition in foreign markets. Thus, in practice, the incentives for investing in, or exporting technology to, developing countries are in general not confined, nor necessarily adapted, to the activities of small and medium firms; and the promotion of small and medium firms is not restricted to their expansion to developing countries. It is nevertheless possible to discern certain incentives which are in principle primarily applicable to the redeployment of small and medium firms in developing countries, and also other measures which, despite their apparent neutrality, are, by their nature, destined to be of particular value for small and medium firms.

1. Development finance corporations (DFC)

112. During the 1970s a new kind of financial institution was created in a number of industrialized countries with the aim of promoting private investment in developing countries by providing risk and long-term loan capital.

113. Although they differ in terms of their legal status, size and methods, it is possible to include in this category the following institutions: the Commonwealth Development Corporation (CDC) in the United Kingdom; the Deutsche Entwicklungsgesellschaft (DEG) in the Federal Republic of Germany; the Industrialization Fund for Developing Countries (IFU) in Denmark; the Netherlands Finance Company for Developing Countries (FMO) and the Belgian Corporation for International Investment (SBI). The Caisse Centrale de Coopération Economique (CCCE) in France and the Swedfund (Foundation for Industrial Co-operation with Developing Countries) in Sweden could be partially assimilated to the DFC model.

114. The DFCs are owned or controlled by their respective States, but they tend to act as legally independent entities. With the exception of the SBI in Belgium, which also promotes business in other industrialized countries, their action is

confined exclusively to developing nations. 88/ Some of them are basically devoted to projects in certain areas of the third world: the geographical scope of the CDC in the United Kingdom and of the CCCE in France is basically co-terminous with the ex-colonies of these countries; and the action of Swedfund is directed to the poorest developing countries.

115. As a rule, the DFCs try to promote joint ventures between firms of their home countries and local enterprises in the developing countries, either by setting up new plant or increasing the capital of existing companies. 89/ Their means of action include equity participations, in general as minority shareholders; medium and long-term loans; debenture bonds; grants and performance bonds; financing of feasibility studies, etc. In addition, DFCs are involved in project identification, formulation and preparation, as well as, to a limited extent, in the search for partners. The DFCs have also taken participations in, and arranged co-operation agreements with, local development banks in developing countries of Africa, Asia and Latin America.

116. The DFCs are not confined by law or by their own policies to the promotion of the participation of small and medium enterprises in developing countries. The basic criterion for the selection of projects and partners is the soundness and profitability of the projects, as well as their general interest for the national economies of both sides. A certain emphasis is, however, given to the participation of not very large enterprises of the home countries. For example, the DEG scheme prefers firms in the Federal Republic of Germany which are not listed in the annual ranking of the 100 largest firms of the country. 90/ Only about 26% of the DEG's own funds are invested in joint ventures with large companies. On the other hand, the average total investment in DEG assisted projects is about $US 10 million. The SBI deals in general with medium to large Belgian firms (from about 150 to 2000 employees) with no great international experience. The IFU programme has recently emphasized the need to promote small-scale industries in developing countries, although the size of its projects normally ranges from $US 500,000 to $US 25,000,000 of total investment.

117. Despite their declared intention of co-operating in the development of third world countries, the DFCs tend to operate under strict commercial criteria and only exceptionally can the projects benefit from concessional interest rates. Although the financing is not tied to purchases in the home country, the effects of the projects on the home economy are an important evaluation factor. For example, the SBI selection criteria are closely related to the impact of the projects with regard to the export of Belgian products. 91/ Moreover, most of the DFCs request the

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88/ However, most DFCs include projects in some Southern European countries.

89/ Some of them, i.e. DEG, IFU, SBI, have developed a four-sided scheme of joint venture, formed by the DFC, a firm from the home country, a development company and a local firm in the developing country.

90/ According to this list, published by the daily newspaper *Frankfurter Allgemeine Zeitung*, the firm No. 100 had about 3,000 employees and reported sales of DM 1,245,000,000.

91/ According to the SBI annual report 1977-1978, p.10, it has been established that one franc invested by SBI fosters an average 20 francs in exports of goods and services from Belgium.

guarantee of certain economic and legal conditions in the host countries, such as adequate protection for foreign investments, an adequate profit margin and the participation of the private sector. Usually the DFCs impose a set of legal safeguards to protect their interests, such as standard financing and investment agreements, management contracts, minority protection clauses. Besides, they require a sound financial structure in the borrower's organization.

118. The significance of the DFCs activities varies significantly from case to case. As table 4 shows, there is a considerable gap between DEG of the Federal Republic of Germany on the one hand and the FMO, the IFU and SBI on the other, in terms of the number of projects promoted, the number of countries involved, and the financial resources committed. During 1978, DEG operations amounted to about $US 48 million, against $US 7.5 million for the SBI and $US 12 million for the FMO. These differences reflect in part the sizes and resources of the various organizations. The DEG's capital has been recently increased to about $US 430 million, whereas the paid up capital of the FMO, the IFU and the SBI is several times smaller. The DEG has more than 200 employees, whereas the SBI and the IFU staffs are nearly ten times smaller.

119. Regardless of their different capacities, the DFCs seem to provide a useful and increasingly important instrument for promoting the redeployment of non-transnational firms to developing countries. Their mobilization impact is illustrated by the case of the DEG, whose assisted projects at the end of 1978 represented an investment of DM 3.9 billion, which is nearly 20% of total direct investment of the Federal Republic of Germany in developing countries, and corresponds to a multiplier effect by DEG's own funds (DM 551 million) of 7 : 1. 92/

120. The main appeal of the DFCs appears to be the catalytic role played by the package of services that they provide. Apart from representing one of the few available sources of long-term finance and risk capital for projects in developing countries, they seem to be of particular value for enterprises which, lacking international experience, see in the complementary involvement of State entities of their home country a virtual form of diplomatic protection abroad. The recent experience of these institutions also indicates that they have gradually developed certain informative and technical assistance roles by, inter alia, receiving and promoting proposals for projects and investment opportunities from particular developing countries, by searching for partners for joint ventures, by counselling on the economic and legal aspects of projects, and by participating in negotiations with the authorities of the developing countries. From the viewpoint of developing countries, the significance of DFCs seems to derive - apart from their being specialized in mobilizing resources for these countries - from their capacity to broaden the alternatives for importing technology from the industrialized world and to improve the terms of the transfers. Some of the DFCs have recently been more active in sending industrial advisers to developing countries for analysing investment proposals and providing project management in the implementation phase. Apart from participating in local development banks, they have in certain cases arranged programmes for the joint promotion of projects with industrial promotion centres in developing countries, such as the agreements of DEG and IFU with the CENDES (Centro de Desarrollo) of Ecuador.

92/ From Deutsche Entwicklungsgesellschaft (DEG) Annual Report 1978, p. 23.

Table 4

The operations of the development finance corporations DEG, FMO, IFU and SBI up to end of 1978 */

	Number of enterprises supported	Number of countries involved	Total fund commitments ($US thousand)	Distribution by regions							
				Asia		Africa		L.A.		Others	
				No. Countries	% Funds	No. Countries	% Funds	No. Countries	% Funds	No. Countries	% Funds
DEG (1962-1978)	185	62	240 000	17	23	30	52	10	16	5	9
FMO (1970-1978)	36	16	32 000	3	30	10	59	2	6	1	5
IFU (1967-1978)	40	20	42 000	5	22	9	38	4	28	2	12
SBI (1974-1978)	33	14	14 000	Developing countries: 8	57			Developed countries: 6	43		

Source: Annual reports 1978 of DEG, FMO, IFU, and SBI.

*/ For an explanation of the abbreviations, see para. 113 above.

121. The reaction of developing countries to the role played by the DFCs has been positive in general. One example is the decision of the Andean Group Commission to include DEG and IFU in the list of entities enjoying the status of "neutral capital", i.e. not foreign, as investors in the framework of the Common Regimes for Foreign Investments.

122. There are, on the other hand, certain aspects of the ways in which DFCs act that should be evaluated further. First, it is not certain to what extent the DFCs effectively fulfil their proclaimed role of mobilizing small and medium enterprises rather than large corporations in their home countries. In practice, their selection criteria seem to be very flexible with the regard to the size of the investors; a review of the information available on the firms assisted showed the inclusion of many which were above the category of "medium". Second, although the philosophy underlying DFC action emphasizes the formation of joint ventures with local firms in the developing countries, a first look at some cases in Latin America revealed that the "indigenous" firms are sometimes subsidiaries or firms controlled by investors from the home country. Thirdly, the distinction between the dual roles played by some of the DFCs - i.e. as instruments of the government's international development co-operation policies on the one hand and as instruments of export promotion policies on the other - is not always made clear. A DFC that tried to fulfil both roles simultaneously could lead to certain bottlenecks. 93/ Fourthly, the geographical scope of some European DFCs is strongly concentrated on the ex-colonial territories of Africa and Asia; although, it should be added, that a growing interest in projects in Latin America has recently emerged. 94/ Finally, with few exceptions, most DFCs are still very small organizations, whose resources are too small to allow them to fulfil their multiple roles. In some cases, however, there are signs of expansion and increasing governmental support, as well as a growing interest on the part of other developed countries that still lack this kind of instrument, such as France or Italy, to create similar organizations. 95/

2. Financial incentives

123. A number of governments of industrialized countries have adopted credit programmes for facilitating the investments abroad of national firms. Some of these programmes, like those available in France and the Federal Republic of Germany, include special measures dedicated to projects of small and medium firms.

93/ For example, the FMO, which is obliged to apply both objectives, has been "repeatedly approached with proposals concerning activities which were either exclusively in the sphere of business and industry or exclusively in that of development co-operation. In such cases, it was impossible to help". Annual Report 1978, p. 10.

94/ Apart from the higher number of promotional activities of most DFCs in Latin American countries, it could be mentioned that the Commonwealth Development Corporation has undertaken operations in Latin American countries of the Caribbean area.

95/ See, for example, Ministère de l'Industrie (France), op. cit. p. 78.

124. In France there are two main sources of long-term loans for financing investments abroad. The first system, created in 1972 by the Crédit National and the Banque Française du Commerce Extérieur, is normally available for relatively large operations. The second, administered by the Union for the Financing and Expansion of International Trade (UFINEX), 96/ is available for industrial or commercial investments that are capable of generating large volumes of exports. In view of the problems of access to this programme encountered by small and medium enterprises, the Ministry of Industry and Research created, within the UFINEX programme, a special fund for helping firms with a turnover not exceeding $25 million. Mention should also be made of the financial help provided under the official aid programmes by the Caisse Centrale de Coopération Economique, devoted to investments in African countries and Overseas Departments and Territories.

125. On the other hand, some measures taken in the Federal Republic of Germany are directly concerned with the promotion of investments of small and medium firms in developing countries. The "E.R.P. subsidiary programme" of the Kreditanstalt für Wiederaufbau (KFW), a Development Bank for the promotion of the domestic and foreign expansion of the economy of the Federal Republic of Germany, started as early as 1953, provides long-term loans at subsidized rates 97/ to smaller firms willing to establish in developing countries. About 500 loans amounting to DM 246 million were granted in the period 1960-1978, concerning operations in 27 African countries (35% of the loans' volume), 15 Asian countries (15%), 15 Latin American countries (25%) and 9 European countries qualified as developing economies for the purposes of this programme (20%). The balance (5%) were for operations in New Guinea and Oceania.

126. Although only a small part of the Federal Republic of Germany's direct investment in developing countries is being promoted by the KFW loans, the total investment encouraged is a multiple of the funds committed under the programme. Such funds covered 39% of the long-term financial needs of the investing firms, and in this way, thanks to their long terms and cheaper interest rates, they have facilitated and rendered more attractive the investment decisions.

127. The KFW loans are primarily granted to companies with a turnover of up to DM 200 million, although exceptions are made for larger enterprises if the project concerned is of particular interest. However, only a few small enterprises are using this programme. On average, the borrowers are medium-sized firms considerably larger than the companies assisted under the domestic credit programmes for medium-sized enterprises. 98/

96/ A corporation formed by banks, insurance companies and professional groups.

97/ The interest rates are of 2.5% for investments in a list of 30 least developed countries, and of 3.5% for the other developing countries.

98/ The average borrowers in recent years were firms with a turnover of about $US 21 million, and the spread of sizes ranged from $US 210,000 to $US 220 million of turnover.

128. Several other industrialized countries have established financial programmes of a more limited scope, covering certain aspects or areas of investment abroad. 99/

129. On the other hand, most governments extend loans to firms investing in developing countries on the basis of their ordinary aid programmes, such as the above-mentioned French mechanisms (see paragraph 124). Several governmental programmes and entities, such as the Overseas Investments and Export Guarantee Act of the United Kingdom, the Canadian International Development Agency, the Overseas Private Investment Corporation of the United States, and the Swedfund in Sweden, offer financial support for pre-investment and feasibility studies related to projects abroad. These mechanisms are in principle destined to small and medium firms, but there is not much evidence available about the effective application and results obtained.

130. Such programmes are in general available for investments in developing countries by firms of all sizes. A recent exception is the United States Direct Investment Fund of the Overseas Private Development Corporation, whose loans are granted exclusively to smaller United States investors.

131. Most developed countries have organized official export credits to help finance equipment sales, which are of particular importance for private investments in developing countries. Most of these programmes are however related to large operations.

3. Tax incentives

132. Several industrialized countries have adopted measures exempting or reducing taxes on earnings abroad or offering credit against taxes paid on foreign income. However, such measures in general do not make distinctions between investments in developing countries and those made in other countries, nor do they include incentives specially designed to encourage investments abroad by small and medium firms. Moreover, several countries have introduced tax schemes designed to stimulate domestic investments in the context of employment, regional development and small-scale operations, which indirectly tend to discourage foreign investments by small and medium firms.

133. In general, industrialized countries have dealt with tax incentives for investments abroad in the context of bilateral agreements with developing countries, designed to avoid double taxation. Most agreements of this kind are based on the principle of taxation at source, which makes profits earned abroad not taxable in the home country.

99/ For example, in Spain there are financing facilities for investments abroad, without distinction between developed and developing countries, which may promote Spanish exports through sales subsidiaries, assembly and manufacturing facilities and foreign joint ventures in the fishing industry.

134. The Federal Republic of Germany is probably the most important among the few exceptions with regard to the general neutrality of the tax treatment of investments in developing countries. According to a special law governing this matter since 1963, and modified in 1979, investors in developing countries may establish reserves, at the expense of domestic profits, amounting to 100% of the acquisition or production costs in the case of investments in the least developed countries and to 40% in the case of other developing countries. If the investment has been made in a particularly labour-intensive enterprise - measured by the share of wages and salaries in the local company's output - there are additional facilities for utilizing the reserves. This provision may indirectly favour investments by certain types of small and medium firms in the Federal Republic.

135. The tax system in France also offers certain elements of interest. The general treatment allows firms to include, among the costs deductible for tax purposes, a reserve equal to the losses of the foreign subsidiary during the first five years of operation. In the case of investments in developing countries, French firms could be authorized to create a tax-free reserve up to a certain share of the capital invested. Small and medium enterprises, with a capital not exceeding $US 2.5 million and less than 500 employees, may benefit from important tax incentives when they establish a common subsidiary abroad for the joint promotion of exports.

4. Investment guarantee systems

136. Almost without exception, industrialized countries have adopted foreign investment guarantee programmes, covering the non-commercial risks of companies established abroad, i.e. expropriation, war risks and transfer risks. Most of the schemes are specifically confined to investments in developing countries in the form of subsidiaries, joint ventures, technology agreements, and so on.

137. Several programmes are linked to investment protection agreements negotiated with the host countries, providing usually for protection against legal and administrative action. Some of these agreements, like those concluded by the Federal Republic of Germany with nearly 50 developing countries, are very comprehensive and include a variety of measures designed to provide maximum legal safeguards for investors, such as the most-favoured-nation treatment, unrestricted transfers, international arbitration, full compensation in case of expropriation. The negotiation of these agreements, and consequently the applicability of the guarantee schemes, has been impossible in certain developing countries with strict regulations on foreign investments, as in Latin America. Moreover, the provisions of certain systems which make the guarantees conditional upon the acceptance by the host government of the subrogation of the insurer with regard to the rights of the foreign investors have been considered in Latin America as being against the national interest. For these reasons, a number of guarantee schemes have recently eliminated or modified such conditions.

138. The elegibility criteria normally do not make distinctions based on the size of the investing companies and, in fact, a number of systems seem to be implicitly beyond the reach of small and medium companies. For example, the French schemes take into account the international dimension of the project abroad and its contribution to the world reputation of French techniques, or are limited to those investments capable of carrying out a very strict export programme.

139. However, a few of these programmes have recently introduced measures to facilitate the participation of small and medium-sized companies. The Export Credit Guarantee Programme of the United Kingdom adopted a new system, the Market Entry Guarantee Scheme, whose low ceiling of application (£100,000) makes it almost exclusively reserved for small and medium projects. The system applied in Canada by the Export Development Corporation has been increasingly applied to projects by small and medium firms: more than 50% of the investments insured are valued at less than one million Canadian dollars. But the most significant measures with regard to smaller companies have been taken in the United States, through a legislative amendment of 1978 on the Act of the Overseas Private Investment Company (OPIC). OPIC had been previously criticized on the grounds that its insurance activity was benefiting primarily large United States transnational corporations. Recognizing the difficulties facing smaller firms interested in overseas investment, OPIC now has to give preference to projects involving smaller firms. In accordance with the above-mentioned Act, this should increase the proportion of such firms to at least 30% of all projects assisted by OPIC. 100/ Other modifications of the OPIC procedures may be of particular interest for smaller firms, such as the widening of the coverage for technology and service contracts.

5. Technical assistance

140. Despite the crucial importance of technical and information services for the international expansion of smaller firms, very few measures can be identified in the programmes of developed countries.

141. Although most developed countries have set up important information and technical assistance mechanisms in the field of foreign trade, such organizations and services usually specialize in exports, and do not deal with technology transfers or direct investments abroad. Besides, with few exceptions, they are concentrated in the promotion of exports of large firms.

142. The development finance corporations (DFC) described in section A.1 above, and certain governmental programmes and bodies granting aid for pre-investment studies, may be considered as examples of measures taken to help resolve some of the problems of small and medium sized firms. Some industrialized countries have set up agencies for promoting the establishment of local firms in certain developing countries; for example, France created in 1972 the Centre of Industrial Promotion in Africa (CEPIA) and the Company for Industrial Promotion and Management (SOPROGI), devoted to the promotion of business ventures in Africa.

100/ Also, insurance for investment in countries with a per capita GNP of over $US 1,000 is restricted to projects of United States small business or co-operatives. Small business is generally defined as companies having less than $US 100 million of consolidated revenue.

143. Apart from the DFCs and the programmes facilitating pre-investment studies, few other mechanisms granting technical assistance to the foreign projects of small and medium firms can be identified.

144. Among the mechanisms related to public aid policies, the Agency for Technical Co-operation (GTZ) of the Federal Republic of Germany seems to be the main example directly affecting the transfer of technology of small and medium enterprises to developing countries. Created under the umbrella of the Ministry of Economic Co-operation, the GTZ work is based mainly on requests for technical co-operation received from developing countries concerning specific projects. In 1977, the GTZ dealt with 828 requests, amounting to DM 566.7 million. 101/ A good share of the material and technical requirements of the projects is covered by suppliers in the Federal Republic of Germany, particularly small and medium firms called in by the GTZ to co-operate, as well as experts and consultants specially hired and sent to the recipient countries. Many requests are directly related to the adaptation of existing technologies to the specific conditions of a developing country, or concern the search for a new solution to a particular problem.

145. In 1979, the GTZ set up a new programme of business industrial co-operation, with the aim of promoting the formation of joint ventures of small and medium enterprises of the Federal Republic of Germany in developing countries. The programme is in general based on missions of consultants sent to the recipient developing countries with the object of assisting the local institutions in defining their technological needs, identifying opportunities for co-operation, searching for appropriate partners and establishing direct contact between firms of the developing country and the Federal Republic of Germany.

146. In other developed countries it is possible to identify isolated actions in the field of transfer of appropriate technology to developing countries, such as the aid granted by the STU of Sweden (National Swedish Board for Technical Development) to local enterprises of all sizes for adapting products and techniques to be transferred to developing countries, or the projects of industrial co-operation with developing countries promoted by the Canadian International Development Agency (CIDA), which reportedly tries to encourage the participation of small and medium enterprises in joint ventures in developing countries.

147. Canada has also set up a Centre for Joint Ventures and Turn-Key Projects, created by the Ministry of Industry, Trade and Commerce for stimulating the interest of smaller Canadian companies in undertaking operations abroad. The Centre helps companies in preparing bids, analysing ways for minimizing risks, identifying opportunities and local partners, and so on.

101/ See GTZ Annual Report 1977, p. 27.

148. With regard to information services, the Federal Republic of Germany and Japan seem to have two of the most comprehensive and systematic systems, covering possibilities, opportunities and channels for investments abroad, with particular emphasis on developing countries, and based on a network of governmental agencies, chambers of commerce and banks at home and abroad. Such programmes are not specifically aimed at small and medium firms, but the vast information services offered reflect the objective of promoting the largest possible number of national enterprises. In this context, one experience which seems to merit further analysis is that of the business chambers of the Federal Republic of Germany established in developing countries. These chambers work with the strong support of and in close relationship with the home government and a network of 70 regional chambers in the Federal Republic. On this basis, the bi-national chambers established abroad provide to smaller firms in the Federal Republic that are interested in setting up subsidiaries or exporting technology, a package of professional services covering, inter alia, the search for local partners, negotiations with the government, identification of projects, and legal counsel.

149. Apart from the governmental initiatives, it is worth noting the activity of several associations of small and medium firms. Examples of this type of organization include the following: (a) Fabrimetal, a Belgian federation of 1200 metalworking, electrical and chemical enterprises, 90% of which have less than 500 employees. The federation has an important Foreign Trade Department dedicated to the analysis and promotion of business opportunities abroad. The federation's activities include organization of group missions (e.g. in 1978, 60 countries were visited); industrial fairs; training activities; (b) the Expolaris Trading Company in Sweden, an umbrella joint-marketing organization of around 170 small and medium-sized companies offering training services, feasibility studies and engineering services in connection with turn-key offers and joint ventures abroad; (c) the Agency for the International Promotion of Small and Medium Enterprises created in France within the National Confederation of Small and Medium Enterprises, which offers information and promotion for overseas projects.

B. Policies and measures in developing countries

150. In general, the policies of developing countries have not yet shown significant signs of a specific interest in attracting the entry of small and medium-sized enterprises to their national economies.

151. Clearly the aspects of the economic policies of developing countries that are potentially related to the transfer of technology by small and medium firms are more complex and difficult to translate into concrete measures than in the case of the home countries. For the latter, there is an obvious advantage in promoting exports and helping the adjustment of smaller firms through incentives for investing and selling technology abroad.

152. For developing countries, the elaboration of a policy for foreign small and medium enterprises involves consideration of a variety of factors - e.g. foreign factors of production, domestic competition, employment and industrial growth - which are not easy to reconcile in a formal homogeneous solution.

153. Furthermore, despite the problems and expectations shared by the third world in general and the common views expressed on certain issues such as the transfer of appropriate technology in the context of North-South relations, there are many differences among developing countries - in their economic structure, degree of industrialization and State intervention, among other aspects - making it almost impossible to detect a general awareness with regard to this specific issue. In fact, it is mainly in the more advanced, semi-industrialized developing countries that some such awareness is descernible. The inertness of least developed countries, where the potential role of non-transnational firms could be more significant, is explained in part by their lack of experience in the field - since most small and medium-sized firms have gone to semi-industrialized countries - and in part by the lower sophistication of their institutional structures.

154. It is thus very difficult to attempt a generalization of the way the developing countries are dealing with foreign small and medium firms. One plausible conclusion would be that they are not doing anything specific in that respect, at least in terms of concrete action. Yet in a number of developing countries there are various areas of economic policies and legislation which, although not specifically related to the problem here considered, could be regarded as providing incidentally a framework for the transfer of technology by small and medium foreign firms. The two main areas concerned are the foreign investment and transfer of technology regimes, and the industrial development policies. These two areas are discussed in the following paragraphs.

1. Foreign investment and transfer of technology regimes

155. The productive co-operation of smaller firms is inevitably affected, in the first place, by the laws and regulations enacted by many developing countries to deal with the impact of foreign capital and technology. Although some of these normative bodies are still oriented to granting incentives and advantages, such as some investment codes in the least developed countries, most of them are addressed to the control - i.e. screening and registration - and to the limitation of the activities of foreign firms. In any case, such regimes were designed having in mind the transnational corporations as the fundamental agents of the transfer of productive resources. Thus the laws and regulations do not make any allowance for the size of the foreign firms. Indeed, all such firms are assumed to be transnationals; in other words, many of the requirements adopted are designed to suit the particular structure and behaviour of large and powerful foreign corporations. The objective of preventing the abuse of international oligopolies and dominant positions is obvious in measures adopted in Latin American, Indian and other legislation dealing with the control of takeovers of domestic companies, the limitation of the use of local credit and the granting of incentives, the prohibition of restrictive clauses in technology agreements and of royalty payments by the subsidiaries to their parent companies. At the same time, the objective of sharing some of the monopoly advantages of transnational corporations is present in the provisions requiring or encouraging the formation of locally-controlled joint ventures and the arrangement of export contracts and other engagements. All such rules are also applicable to small foreign investors, despite the fact that most of the problems tackled and the advantages sought through the measures specified are not, in principle, related to the action of non-transnational companies.

156. It is thus not surprising that in recent times a number of industrialized countries have suggested to governments of certain developing countries that they make such rules more adaptable, arguing that they are discouraging the transfer of technology of small and medium enterprises. 102/ The possibility of granting special treatment to non-transnational forms - for example, relaxation of the local majority requirements and of the formal proceedings for registration and easier access to credit - was in fact discussed in such countries as Mexico and Brazil, where the participation of smaller foreign companies is already significant. But so far the general reaction has been a reluctance to making exemptions to the rules on the basis of size considerations. The extremely variable and changing concept of size among sectors and countries could make its use impossible as a formal criterion in the context of foreign investment and technology legislation. Also, such special treatment could harm the value of legal regimes as general frameworks for foreign firms.

157. However, certain measures indirectly facilitating the participation of smaller international firms have been taken. For example, a recent revision of the Argentine foreign investment law granted flexible approval proceedings for "small" investments, i.e. up to 5 million dollars; and the Indian government recently adopted guidelines recommending priority to projects of small and medium foreign enterprises. The

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102/ There is obviously little public evidence about such appeals. But see, for example, the position of the Federal Republic of Germany in E. Springmann, op.cit., and the United States attitudes in A.D. Little, op.cit.

Brazilian Government, on the other hand, unwilling to relax its general legislation, has nevertheless declared the objective of encouraging foreign investments of smaller firms. 103/ A bilateral industrial co-operation agreement with France in October 1978 made explicit mention of the transfer of technology by small and medium French firms.

158. Moreover, the general trends of foreign investment policies reveal an increasing emphasis on the selection rather than on the restriction of foreign investments, and on the promotion rather than on the protection of local firms. The growing participation of smaller firms of industrialized countries in several Latin American countries has coincided with policies oriented to the diversification of the national origin of foreign investment and to the barring of certain sectors to leading transnational corporations. It is thus the manner in which the law is administered, rather than the provisions of the law as such, which is gradually opening up a wider space for smaller foreign firms.

2. Industrial development policies

159. The industrial development policies of the developing countries are another area of crucial importance for small and medium-sized firms. In most developing countries, the system of industrial promotion has been biased for a long time in favour of large and capital-intensive enterprises. Customs duty exemptions on capital goods and raw materials, import licences granted on the basis of production capacity, promotional credit lines based on financial capacity and export subsidies involving large operations have in general limited or inhibited the role of smaller companies.

160. However, in recent times a number of developing countries have begun to re-orient their industrial policies on the basis of new objectives of higher efficiency, employment, decentralization, specialization, and technical development. Some of the new trends may imply a more favourable environment for smaller enterprises. For example, the aim of promoting the development of national firms has influenced the creation of new laws and institutions specializing in the sector of small and medium enterprises, where the bulk of domestic capital is concentrated. Although the legal definitions of smaller enterprises tend to refer to sizes well below those in industrialized countries, such incentives are in general open to enterprises of any origin and implicitly offer a new field of action for foreign suppliers or partners of comparable dimension contributing to the modernization of local firms.

161. New laws for the protection of competition and the control of monopolies, incentives for the development of smaller markets in decentralized areas, export programmes dedicated to smaller operations, 104/ lower and more even protection policies, the phasing out of concessional credits, and improved tax regimes are being adopted, among other measures, by a number of developing countries with the effect of encouraging the activity of smaller firms.

162. Another significant trend is the process of making bureaucratic requirements and proceedings more flexible, initiated by certain governments with the objective of improving the efficiency of state agencies. For small and medium firms the simplification of red tape could represent a very important incentive.

103/ The Ministry of Finance of Brazil declared that "... the big transnational corporations are already established in Brazil. What we need now is capital investments coupled with good technology for the smaller industries". See Daily Post, 14 June 1979, (Rio de Janeiro), p.1.

104/ For example, the export promotion agency of Brazil (BEFIEX) has introduced new incentives for facilitating the exports of smaller firms.

163. It is in this context that specific measures for facilitating the access of technologies of small and medium-sized foreign firms seem to hold out the most promising prospects.

164. In fact, the Latin American experience includes a few examples of the type of action that could be carried out by host developing countries. Such incipient measures concern two strategic areas of promotional policies - i.e. financing and information - and involve the intervention of local public development institutions. A number of decentralized state agencies are becoming active in the identification of industrial projects and the search for enterprises and technological sources. For example, Nacional Financiera of Mexico, the main state development corporation, is actively fostering specific projects in the capital goods sector by contracting national firms with experience in the local market, and negotiating with potential suppliers of the technology in the international market. The Institute of Industrial Development of the State of Minas Gerais in Brazil is developing a programme of dissemination of information about investment opportunities, with detailed documentation on the market potential, raw material sources, competition and incentives, complemented by a list of local firms available for carrying out each project in a joint venture form. The Secretary of Industrial Promotion of Mexico is also publicizing an updated list of investment projects with detailed information. Although these efforts are not exclusively addressed to smaller firms, it is for them that the active promotion of investment projects may provide more useful results.

165. Local development finance corporations (DFC) have also undertaken co-operative arrangements with similar entities in developed countries. Apart from the participation of several European DFCs in promotion programmes with development banks in a number of Latin American countries, a special mention should be made of the arrangements adopted by the GTZ of the Federal Republic of Germany for the identification of projects and partners for joint ventures, in collaboration with PROEXPO of Colombia and a private consultant group in Mexico supported by the Mexican Government.

166. Another relevant antecedent in Mexico is the organization by Nacional Financiera of a set of co-investment funds with important banks of the Federal Republic of Germany, Italy, the United Kingdom, Spain and Japan. Such funds are devoted to the search for and contacting of enterprises willing to participate in Mexican joint ventures; they can also supply complementary risk capital for such projects. In this way, these funds contribute to encouraging the participation of less experienced foreign investors such as small and medium firms.

167. State banks and financial entities have in a number of cases engaged in the direct promotion of projects of small and medium enterprises, including the participation of foreign investors. For example, the State Development Bank of São Paulo and Rio Grande do Sul, as well as the Superintendency of Development of North-East Brazil (SUDENE) are currently engaged in the promotion of joint ventures of local small and medium-sized firms with foreign minority partners. The promotion has included campaigns in developed countries aimed at attracting foreign investors.

168. In conclusion, the perspectives for encouraging the co-operation of small and medium firms in developing countries seem to be related to (a) the capacity of government bodies to develop and apply new administrative criteria for the treatment of foreign investment, transfers of technology and industrial projects, granting more weight to aspects such as the diversification of sources of technology, the impact of projects on employment and competition, etc.; (b) the role of public development corporations for the financing and promotion of industrial projects and the dissemination of information on investment alternatives, the active search for enterprises and the organization of co-operative programmes with institutions of developed countries.

C. The role of international organizations

169. The increasing agreement among countries at different levels of development in recognizing the potential role of small and medium enterprises as agents of technology transfer, especially in the context of North-South relations, is manifest in the emergence of the issue in recent proposals and projects carried out directly or under the auspices of international organizations. Present antecedents of relevant measures or initiatives include, apart from general declarations, 105/ a number of actions undertaken by the European Economic Community, the United Nations and other international organizations.

170. One of the first programmes dealing directly with international joint ventures among small and medium-sized firms is the Business Co-operation Centre established by the Commission of the European Communities in 1973 with the objective of promoting a higher participation of smaller companies in the integration process. The basic role of the Centre is to find partners for firms interested in co-operating through joint ventures in other countries, and to provide information and advice on legal and administrative matters. 106/

171. A few years later, several non-member countries, including some developing countries, such as the five ASEAN States, applied to the Commission for inclusion in the programme. The request was accepted in 1977 on the condition that there was a "structural link" between these countries and the European Community - for example, a co-operation agreement. An experimental programme was then started by the Centre in 1978. The results of the programme were not satisfactory, according to the Centre, for several reasons, including the following: the intervention of two intermediaries, i.e. the Centre and a similar entity in the third country or region; the different approaches of the Centre and its counterparts in developing countries, the latter being more oriented by development criteria than by business criteria and presenting projects which were normally beyond the scope of small and medium European enterprises; the geographical distance and development gaps; and the shortage of financial and human resources of the Centre.

172. A different type of action by the Community, directly devoted to industrial co-operation with developing countries, is the Centre for Industrial Development (CID) established under the Lomé Convention, which links up 55 States in Africa, the Caribbean and the Pacific. The main areas of activity of the Centre include an information service, the dissemination of business opportunity profiles, identification of partners, feasibility studies, and assistance in negotiations for joint ventures.

105/ The fifth session of UNCTAD resolved to study the possibilities of an increased involvement by small and medium-sized enterprises as sources and receivers of technology transfers, as a way of strengthening the technological capacity of developing countries (see UNCTAD resolution 112 (V), paragraph 26(c)). A major study of UNIDO for the Third General Conference of this Organization contained specific proposals for mobilizing the potential of medium-sized enterprises in the context of bargaining assistance to developing countries (see UNIDO, Industry 2000: New perspectives, op.cit., paragraph 6.5.2). A few years earlier, the Secretary of State of the United States Government stated at the Sixth OAS General Assembly (1976) that the United States will "... explore cooperative ventures in which small- and medium-sized United States firms would provide practical technologies to individual Latin American firms...".

106/ Despite its limited resources, the Centre's activities gradually increased. In 1978, it dealt with 694 requests for information and 114 requests of partners; in the first four years of action, about 200 enterprises of the member countries established co-operation agreements through the Centre. See Sixth Annual Report of the Business Co-operation Centre (1979).

Although the Centre does not invest in equity or finance projects, it helps in obtaining the co-operation of other sources, such as the development finance corporations of European countries. Small and medium enterprises are given priority by CID, which promotes enquiries and offers concerning low-scale projects adopted to smaller markets, and collects information about available labour-intensive and other kinds of appropriate technology for less developed countries.

173. The Commission of the European Communities has also analysed and recommended a Community policy of encouraging European investments in developing countries. The proposed system 107/ would be based on general agreements between the Community and developing countries or groups of countries covering the protection of European investments on the basis of a Community guarantee, and on selective measures to promote investments on a project-by-project basis. But the initiative is not intended to provide special treatment to investments by small and medium enterprises; on the contrary, it seems to have in mind projects in sectors of "vital importance" for the Community, such as the mining industry, and involving a large capital. 108/

174. Finally, the European business community has recently launched new mechanisms of co-operation with developing countries. One example is the European Management Forum, a Swiss foundation organizing international symposia and business councils. In 1978, a Latin American-European Business Council was established, with the sponsorship of the World Bank and the Inter-American Development Bank, and including a co-operation centre for business contracts. Although this Council was presented as giving special emphasis to medium-sized companies, it seems that the participation has been predominantly by large firms.

175. A number of United Nations programmes have recently been dealing with aspects and problems of technology transfer that have a partial or indirect relationship with the role of small and medium enterprises. The United Nations Industrial Development Organization (UNIDO) launched a set of programmes dedicated to practical aspects of the transfer of technology to developing countries. The Investment Co-operative Programme offers services covering the identification and preparation of investment projects in developing countries, promotion services, and business meetings. The main role of the programme is the intermediation between public or private-sector agents of industrial projects in developing countries and sources of finance and technology of developed countries. A network of investment promotion services in developed countries directs itself primarily to small and medium enterprises. 109/ Another UNIDO project is the Industrial Technological Information Bank (INTIB), addressed to the issue of access to technologies, selection and information on alternatives.

107/ See "Need for Community action to encourage European investment in developing countries and guidelines for such action" (Commission communication to the Council), 30 January 1978.

108/ At the Community level there is also a potential significance for the promotion of European investments in the third world in the role of the European Investment Bank and, exceptionally, the European Development Fund. Yet the bulk of the resources of these institutions has been concentrated on large projects or undertakings of large firms within the Community.

109/ During 1979, about 30 projects were arranged, amounting to $US 350 million. See UNIDO Newsletter, January 1980, p.1, and Annual Report of the Executive Director, 1979. (TD/B/240).

176. In the financial field, the main international public lending institutions have not been very active in the promotion of technology transfers with the participation of small and medium firms. The International Finance Corporation (IFC) of the World Bank has been primarily engaged in financing large projects in developing countries in the range of $20 million to $500 million. More recently, however, the World Bank initiated some programmes in the area of appropriate and low-scale technology, and gave support to UNIDO for the Investment Co-operative Programme. The World Bank also provides lines of credit to development finance corporations in developed countries for projects in developing countries. Regional banks for developing countries, such as the African Development Bank, the Asian Development Bank and the Inter-American Development Bank (IDB) are also committed to assist private enterprises in member countries, although they do not have investment corporations as does the IFC of the World Bank. In 1977, the IDB launched a programme of equity capital investment in Latin American countries, with the objective of promoting industrial projects of small and medium enterprises through minority participations and stimulating the collaboration of entities and firms from industrialized countries. 110/ The same Bank has recently launched another initiative concerning the creation of a fund granting guarantees to mining companies operating in Latin America and having in mind the possibility of encouraging investments by smaller or non-transnational companies.

D. Final considerations

177. Depending on the viewpoint and the expectations of the observer, the conclusions about the attention paid by governments and the international community to the technological co-operation of small and medium firms could be very different. If account is taken of the very recent emergence of the phenomenon as a matter of general interest, the detection of a number of antecedents and mechanisms already adopted by countries that are specifically related to the phenomenon would justify a positive impression. If, on the other hand, the existing measures are judged in the light of the problems and prospects of the internationalization of smaller enterprises, the conclusion would be that little has been done.

178. The review of action taken by developed and developing countries as well as by international organizations points to the following conclusions:

(a) Few measures have been taken by few countries, although there seems to be a growing trend, especially by developed countries, to adopt mechanisms.

(b) A comparative analysis reveals no systematic method for dealing with the transfer of technology by smaller firms. Even at the national level, the measures of developed countries are often addressed to different objectives: some belong to aid programmes, either for the smaller firms or for developing countries; others are related to trade expansion policies. It is not always clear to what extent both objectives are co-ordinated or match to the needs and policies of developing countries.

110/ The initial conditions of this programme stipulated a minimum 80% of the equity capital in hands of local investors of the Latin American countries. Such restriction was considered as a negative factor for attracting small and medium enterprises of developed countries in the International Conference on European Cooperation in the Development of Industrial Private Enterprises of Latin America organized by the Interamerican Development Bank and the Institute of Iberoamerican Studies of Hamburg (February 1978).

(c) Of all the efforts undertaken by developed countries, the most promising seem to be the development finance corporations (DFC) created along similar lines by a number of governments. Offering a package of services - financial, technical, advisory and informative - they are well adapted to the needs of smaller enterprises that lack resources, experience and confidence in international operations. Yet the significance and impact of the DFCs varies considerably from one country to another, the Federal Republic of Germany's DEG being the only one with reasonable resources. Moreover, more information should be gathered concerning, inter alia, the criteria used by the DFCs to define and promote the participation of smaller firms, the economic impact of the projects on the economies of both countries involved, and the effective participation of local firms in developing countries.

(d) The general structure of financial and tax incentives for investments abroad is clearly biased in favour of large operations and linked with large-scale export business. One of the few exceptions, the Kreditanstalt programme in the Federal Republic of Germany, indicates the potential impact of special financial treatment in stimulating the foreign expansion of small and medium enterprises.

(e) The system of foreign investment guarantees in most developed countries is still based on the concept of "the larger the investment the higher the risk", and does not take into account the size of operations in relation to the size of the firm. Thus the eligibility criteria implicitly favour transnational corporations and large enterprises, with the possible exception of the systems of Canada, the United Kingdom and, more recently, the United States of America. In view of the strategic importance of these guarantee programmes for encouraging smaller firms to move to the least developed countries, 111/ it would be necessary to adapt their methods along the lines reportedly taken by the United States' OPIC, which reoriented the system in order to encourage a greater participation of small firms and small developing countries.

(f) Given that the main problems of small and medium firms are related to inadequate management resources and lack of experience and information for dealing with overseas business, more action might be expected from the developed countries in the matter of technical assistance. Yet few precedents can be mentioned. One exception is the GTZ of the Federal Republic of Germany, which has established a systematic programme of technical co-operation with the participation of Federal Republic enterprises and organizations in developing countries. Together with the STU programme in Sweden, the GTZ programme seems to be one of the very few actions aimed directly at promoting at the enterprise level the adaptation of technology to be transferred to developing countries. On the other hand, the technical services provided by the DFCs and through other institutions - e.g. foreign trade departments and pre-investment funds - are still incipient or insufficient to cope with the problems of smaller firms. With regard to information networks, few countries seem to have exploited the capacity

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111/ See L. Hoffman, "Industrial co-operation in the field of small and medium-scale private foreign direct investment in low-income developing countries", in UNIDO, Industry 2000 - New Perspectives, Collected background papers, Vol.2, International Industrial Enterprise Co-operation, (UNIDO/IOD.325), December 1979.

of the binational chambers of commerce established in developing countries or the mobilization potential of business associations in the home countries. The successful exceptions of the Federal Republic of Germany's system of chambers, as well as a number of associations of smaller enterprises such as Fabrimetal of Belgium, should be taken into account as possible references for action in this direction.

(g) For their part, developing countries have been excessively passive in the reception of smaller foreign investors. Accustomed to awaiting the arrival of large transnational or to directly promoting their participation in larger projects, the legal and administrative structures of the developing countries are not adopted to deal with the not-so-large enterprises. Moreover, the system of incentives for industrial development is in general biased in favour of the promotion of large industrial units. However, recent trends, such as the search for greater efficiency and specialization revealed by new industrial policies, as well as the emphasis on diversification and selection of foreign investments and technologies, are contributing to form an environment which is better suited to the possibilities of smaller firms. The possibility of granting special or preferential treatment to smaller-scale foreign investors or licensors may be impossible in the context of the present legal regimes. However, there are several other ways of encouraging the entry of non-transnational companies, which have been explored only marginally, such as the preparation and dissemination of information on investment opportunities, the establishment of specialized offices in developed countries, co-operation among firms in the search for foreign partners, and the co-ordination of financial and technical services with entities in developed countries.

(h) Finally, international organizations seem to be progressively refining their methods of technical assistance to developing countries, and becoming more active and more closely associated with the agents of productive resource transfer. The programmes launched very recently by such organizations as the European Economic Community or the United Nations are still at an experimental stage, yet certain trends are already discernible regarding their future role in the mobilization of small and medium enterprises to developing countries. It seems that their role will be primarily catalytic, through programmes and actions to stimulate the interest and to help overcome the problems of the actors and intermediaries at the national level. Rather than assuming direct functions, such as brokerage or contact between firms, which the Community experience seems to call in question, the international organizations would seem, at this stage, to have a more significant role to play in the following areas: (a) the centralization of information and analysis about the experience and problems of small and medium firms in the transfer of technology, about the sectors and activities of developing countries that match to the small and medium firms' capacities and the trends of the industrial structures in developed countries where the co-operation potential is located; (b) the support of programmes in developed and developing countries destined to provide direct technical assistance, advice, information and brokerage services to the firms, with particular emphasis on actions by the private sector, e.g. fairs and exhibitions, engineering and consultancy centres and chambers of commerce; (c) making proposals to governments for new systems to encourage a greater involvement of smaller firms in the technology transfer process, including co-ordination among the DFCs of each country and other existing mechanisms, the creation or adaptation of guarantees responding to the needs of both smaller investments and developing countries, and the agreement on new joint financial programmes specifically addressed to the transfer of technology by small and medium firms. However, before designing and proposing new mechanisms or measures at the national and international levels, much more information about this little-known subject will be needed.

Chapter VI

CONCLUSIONS: THE NEED FOR FURTHER RESEARCH

179. In many respects, the discussion in the preceding chapters indicates in outline the research efforts that are needed in order to obtain final answers and well-defined criteria for effective action with respect to the participation of small and medium-sized enterprises in the transfer of technology to developing countries.

180. The following are a number of areas which seem to emerge as subjects for further study:

(a) A general mapping of the phenomenon. The evidence presented in this study is sufficient to show the widespread scope of the participation of small and medium foreign enterprises in developing countries, in terms of the number of countries, sectors and firms involved. On this basis, more statistical information should be processed to give a complete comparative picture of the relative involvement of developed and developing countries in the technology flows, their sectoral distribution, the modes of technology transfer, and other basic aspects of the phenomenon.

(b) Identification of industries for which an increased involvement of smaller firms of developed countries in developing countries would be a viable and efficient strategy. Such a study should be based on:

(i) an analysis in developed countries of sectors in which the participation of smaller firms is important, and where various factors - i.e. the evolution of the industrial structures, international competition and government intervention - create forces leading to the internationalization of such firms and to new business strategies or motivations with regard to foreign markets;

(ii) an evaluation of the gaps in the industrial structures of developing countries that offer opportunities for co-operation by smaller foreign firms, taking into account industrial plans and priorities as well as the needs of existing local firms.

(c) A case study of the characteristics of small and medium firms of developed countries in sectors with significant potential for the transfer of technology to developing countries. The analysis could be based on selected sectors with different potentials, such as a capital goods branch as an example of dynamic or aggressive strategies, and a traditional industry - i.e. clothing - as an example of passive redeployment factors. A sample of firms in each sector with experience in the transfer of technology would be examined in order to detect their competitive advantages, motivations, decision-making processes, obstacles encountered and the results of their experience. The samples could include firms which have not exported technology, in order to find out the reasons for their different attitudes.

(d) An analysis of the possibilities for co-operation of smaller enterprises in the least developed countries. An effort could be made to evaluate the industrial structures and plans of the least developed countries and to discover to what extent there are complementary capacities in the small and medium firms of certain developed countries and what problems are involved in carrying out co-operative projects. The study could be based on actual cases involving opportunities and prospective partners in both host and home countries, in order to detect the possibilities and problems of effective co-operation.

(e) A study on the competitive advantages of smaller firms and their relations with transnational corporations. Such a study could clarify the possibilities and roles of smaller firms as alternatives or complements to the large enterprises operating in developing countries. The main advantages of smaller firms seem to lie in their higher flexibility and managerial adaptability, and in their capacity to work efficiently in small-scale markets. However, more should be known about the way in which smaller firms are exploiting gaps or market niches neglected by transnationals or, alternatively, how they are associated to the expansion of transnational corporations through subcontracting and other subordinated forms.

(f) A comparison of the experience, strategies and effects of the firms of developing countries as technology suppliers. Although most of the firms of the developing countries that are involved in international activities could not be considered as small or medium in their home markets or in the host economies of other developing countries, they share with the smaller firms of developed countries some basic characteristics, such as the fact that they are not transnationals, that they are newcomers to the international scene, and that they base their competitive advantages on certain features such as flexibility and adapted technology. The analysis should compare their motivations and factors, the different problems encountered and the diversity of their impact in developing countries, and their relative advantages and disadvantages. The possibilities for competition and co-operation among developing country international firms and smaller firms of industrialized countries should be explored.

(g) A study on the organizational forms of the technology transfer by smaller firms, with particular emphasis on joint ventures with local companies. The strategies of smaller enterprises seem to vary according to the type of technology transferred and other factors. The motivations prompting the choice of one among a number of different channels, such as licensing contracts, wholly-owned subsidiaries or joint ventures, could be analysed on the basis of case studies. The various problems encountered in forming joint ventures - for example, identification of partners, negotiation and control - could also be studied. In this way it would be possible to establish which channels are best adapted to the smaller firms' characteristics and what measures are needed to overcome the problems encountered.

(h) A study on the impact of the transfer of technology by small and medium firms in developing countries. The present study has highlighted some of the possible benefits and costs for developing countries occasioned by the international activities of small and medium firms. The analysis should be extended to include the impact on home countries and on the participating firms. The effects on recipient countries should be measured on the basis of case studies in selected sectors, in order to corroborate the role of such firms in the technology transfer, the domestic industrial structures, the mobilization of local firms and the expansion of exports.

(i) Analysis of the public policy implications and the instruments applicable to the promotion of the technological co-operation of small and medium-sized firms. The study should include the implications for the policies and instruments affecting trade, foreign investment and transfer of technology, as well as industrial incentives of home and host countries. It should be based on the experience accumulated by smaller firms through their access to mechanisms and channels in developed countries and the intervention of governments in developing countries. The performances of such institutions and instruments as the development finance corporations, the investment guarantee systems, the technical co-operation programmes, the binational chambers of commerce, the arrangements with local development banks and industrial promotion agencies could be analysed through case studies.

Annex

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RURAL SMALL-SCALE INDUSTRY IN THE PEOPLE'S REPUBLIC OF CHINA

THE AMERICAN RURAL SMALL-SCALE INDUSTRY DELEGATION

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Chapter I

INTRODUCTION

No brief description or short systematic definition can do justice to the great diversity that characterizes rural small-scale industry in the People's Republic of China. Rural small-scale industry is not necessarily even rural (some of it is located in county towns), or all that small (the number of employees sometimes exceeds 500 per factory). And yet there are fundamental differences between large-scale urban plants and those that are termed rural and small-scale. All industries cooperatively owned by rural communes and brigades are classified as "rural small-scale." But state-owned enterprises also are included, provided that they are under the jurisdiction of a county and not some higher level administrative unit (district, city, province, or nation). Being under a county's jurisdiction usually means that the greater portion of the factory's outputs and inputs are sold or obtained within that same county. When an enterprise finds itself supplying a much larger area, it usually is transferred up to a higher level administrative unit.

Our delegation saw China's rural small-scale industry in June and July of 1975. These industries can be described as using greater amounts of "indigenous" as contrasted to "modern" technology, as being smaller in scale (from under 50 to around 600 employees), and as largely devoting their efforts to the service of agricultural production. But if anything came across clearly to our delegation, it is that these enterprises are continually in the process of change, and what is true today may no longer be valid a few years hence. In many enterprises, for example, the scale and the ratio of modern to indigenous technologies are both steadily on the rise. Even the goal of serving agriculture has not always enjoyed the preeminence that it does today and the day may come again when subcontracting for urban factories receives a higher priority in the program.

Some visitors to China attempt to use their brief observations as a basis for a general appraisal of Chinese society. Our group will not even attempt a definitive statement about rural small-scale industry based on our four weeks of study. This report instead represents an attempt to describe what it is we saw and such conclusions as we thought we could reasonably draw from our observations. Our group included seven who could speak and read Chinese, among whom five had devoted their professional life to China-related scholarship. In addition, we had three engineers expert in the fields of cement, chemical fertilizer, and farm machinery. All twelve members of the group had had working as well as travel experience in other developing nations.

Against this relevant experience, however, must be put the vastness of the People's Republic of China. We visited 50 factories and 10 communes, a considerable number we felt at the time, considering the 95° F. heat. But these are only a tiny fraction of the hundreds of thousands of factories and tens of thousands of communes in China. What we saw was in no way any random sample of what China is doing in the area of small-scale industry. Our hosts wanted us to understand what they are trying to do as well as what they have already accomplished, and for that purpose model and advanced areas were deemed more useful than average or backward performers. As a result, all of the regions we visited were advanced in national terms and several were models to be studied not mainly by foreign visitors, but by millions of Chinese who were being encouraged to emulate their more successful brethren.

And even in the areas we did visit, our time was short and the amount of information we could gather varied widely. Much decision making in China has been decentralized to lower levels, and scientific and technical personnel from Peking, even if they were so inclined, cannot usually order factory and county revolutionary committees to divulge information that these revolutionary committees themselves, for whatever reason, are reluctant to give out. Thus in some regions we encountered a willingness on the part of the local people to answer most of the (very large number of) questions that our group could think to ask. In other areas officials were much more reticent.

Because of the limitations inherent in a 28-day visit, any attempt at a definitive statement of what we now know about rural small-scale industry in China, or could know, would have to involve prolonged research in the considerable quantities of material published on the subject. For those interested in pursuing further the issues raised by this trip report, there is no better place to start than with the works of Carl Riskin and Jon Sigurdson. Unless otherwise footnoted, however, all data used in this report were supplied to us by our hosts while we were in China.

What then did we see? Our detailed itinerary appears in Appendix B. We asked to and did visit small-scale enterprises in four kinds of settings: in rural mountainous areas of the north, on the North China Plain, in suburban (but still rural) regions of large cities, and in southern paddy rice regions. The greatest amount of time was spent in the Tai-hang Mountain area of north China and the least on the North China Plain. Except for the flight from Shanghai to Kwangchou, all travel was by car and bus or by train.

The pattern of small-scale industry development varies considerably between regions, but there are common themes. Central to all these themes is "self-reliance," the belief that all units in China (large or small, rural or urban) should not sit around waiting for outside help before setting out to improve their situation. Two of the principal models of self-reliance for all of China are Hsi-yang County in Shansi, which includes the Tachai Brigade, and Lin County in Honan. Both are in the Tai-hang Mountains, and we spent four days in each.

Rural self-reliance begins not with the creation of small-scale industry, but with efforts to raise the output of agriculture by the direct and massive application of labor combined with limited amounts of capital and simple tools (picks, shovels, hammers, carrying baskets, and blasting powder for the most part). In Tachai and now throughout Hsi-yang County, these efforts have been directed at converting small, low-quality fields where crops were washed away by rainy season flooding into what are now known throughout China as "Tachai-type fields." These new type fields are larger, more level, and underneath the fields run large drainage tunnels that divert rainy season floods away from the crops and, where possible, into newly built reservoirs for use in irrigation. Much of the soil for these fields was brought down with carrying poles and baskets from higher up on the mountainside. The tunnels, often several kilometers long, were built by chipping large rocks into the proper shape and then constructing the tunnel (building-block fashion) without benefit of cement and frequently without even the use of much mortar. It is difficult to imagine a more labor-intensive method of construction.

In Lin County the problem was not so much rainy season floods but a severe shortage of water at all times. The solution determined by the county, apparently with some resistance from higher authorities, was to tap the water of the Chang River at a point several ten's of kilometers away and in another province (Shansi). The effort began in 1960 and was completed in 1969. During the slack season the daily work force reached 30,000 (the number was much smaller during peak agricultural labor demand) and over the entire period the work put in totaled 40 million man days at a capital cost of only 47 million yuan, 78 percent of which was supplied by the communes of the county themselves. The end result was a canal network 1500 kilometers in length (including subsidiary channels) and the complete solution to Lin County's water shortage.

These efforts in Hsi-yang and Lin Counties were in a fundamental way preconditions for the small-scale industry program in China. As long as these regions stayed with the old ways, they had ample labor for cultivating, threshing and milling their crops. Nor would it have been easy to use many kinds of farm machinery even if they had such machinery. Power pumps must have water to pump and tractors don't work well on small, uneven, rocky plots.

With the advent of large-scale rural land development and water conservancy schemes, however, there is right from the beginning a demand for cement. And once there are supplies of water for the fields, it is possible to make much greater use of chemical fertilizers. The greater quantities of water and fertilizer lead to increases in crop output, and these increases in turn raise the demand for labor to do the threshing, milling, and moving of the surplus to market. Thus, where before during periods of peak labor demand the supply of workers may have been adequate, now there is likely to be a shortage and hence justification for using certain kinds of labor-saving machinery.

The term "labor shortage" must be used with care. Even in advanced areas such as Hsi-yang and Lin Counties, there is enough labor during slack seasons to continue highly labor-intensive and low-productivity occupations such as tunnel building. But during such peak periods as the harvest, there are no longer adequate numbers of people to perform the required tasks. Rather than cut back farm output, it obviously makes more sense to buy power threshers and milling machines and to transport food to market with a cart pulled by a hand tractor (rather than by a man).

The pattern on the North China Plain and in the rice growing regions we visited differs from the above model in certain key respects. The key difference is that the first stage of the process is more modest in scope and different in nature. Wuhsi County in Kiangsu Province where we spent five days was a comparatively well-off and advanced area even before 1949. There were ample supplies of water, and the drainage problem, although real enough, was not as difficult to deal with as that in Hsi-yang. Thus Wuhsi did not have to lift itself up by its bootstraps *before* it could make effective use of chemical fertilizer and farm machinery. It had a ready use for them as soon as they became available. Crop yields at Ch'i-li-ying Commune on the North China Plain, on the other hand, were quite low in the 1940s and early 1950s, and raising these yields depended not only on the Commune's own efforts, but also on larger-scale water conservancy projects carried out by higher level administrative units. Elsewhere on the North China Plain increased supplies of water have come in recent years from the sinking of tube wells using modern well-digging and construction materials, not indigenous labor-intensive methods. But once the water was available and yields rose, much of the rest of the sequence followed that of the model, particularly with respect to farm machinery.

If cement and chemical fertilizer contributed to an increase in agricultural output and this increase in turn created a demand for farm machinery, it does not follow automatically that the Chinese had to meet this demand through the construction of rural-based small-scale factories. Chemical fertilizer around the world, for example, is usually supplied by large-scale plants, and China itself has a number of large plants and is purchasing more. Cement is produced in smaller units even in the United States, but these "smaller" American plants are still many times larger than the largest of China's rural small-scale cement plants.

The rationale for the use of small-scale factories in rural areas begins with a recognition of the inadequacies of China's rural transport and marketing system. In most developing countries roads are poor, vehicles scarce, and commercial organizations inefficient with the result being that economic contact between rural areas and distant urban centers is limited. Transporting goods from urban to rural locations, or the reverse, is so expensive that the journey can be justified only for items of high initial price, low bulk, and easy transportability. For example, the cost of moving limestone from a rural location to a distant city where it can be processed into cement and then shipped back to the countryside is prohibitive. A similar situation prevails with respect to food processing and to a more limited degree to chemical fertilizers.

China's roads are improving. In the advanced areas we visited all or virtually all communes appeared to be connected to the main highways by good gravel or asphalt roads. But China is still extremely short of vehicles, particularly trucks, for use on those roads. In part this gap is being filled by tractors pulling carts, but human and animal-drawn carts are still very much in use. Even where trucks are available, the cost of moving bulky items is high. In Lin County, for example, the cost of transporting coal a mere 25 miles to the plant site raised its price by 50 percent (from 20 to 30 yuan a ton).

Reinforcing the effects of high transport costs is the nature of China's rural commercial system. Even when communes are prepared to pay the going price for some desired item, it won't necessarily be available. A commune, for the most part, is not free to go into the city and buy a tractor or more fertilizer. Individual commune members can do this with consumer items which are sold off the shelves at a price that usually clears the market.

But producer goods are allocated according to the plan. To purchase a truck, for example, a commune would have to get its request (as part of a proposed county-wide quota) on to the district, and from there to the province or to whatever level held principal responsibility for the distribution of trucks from the large domestic plants and from imports. Needless to say, such a procedure can involve long delays and the real possibility that the request will be rejected. Thus, even if a commune has saved up enough money for a piece of machinery, it may get it faster if it builds one on its own or persuades the local county authorities to build it. As long as local production doesn't draw heavily on higher level sources for scarce parts and materials, higher level planners are not likely to object.

Small-scale industries save time in at least three other ways as well. First, the time of construction (the time before the plant was put into operation) was held to be lower for small-scale plants. Many times in briefings at factories, the initiative of the workers for getting the plant into production in less time than planned was praised. Sitting and waiting for the government to solve local problems was the sort of thing that was overcome by the Great Leap Forward and the Great Proletarian Cultural Revolution. Second, especially in local agricultural machinery plants, but also in a plant producing spare parts for fertilizer plants, the downtime of machinery in repair was frequently mentioned as something being reduced by the plants' operations. Teams from local plants often went into the field at busy seasons, and inventories of spare parts were built up for busy seasons, with the clear intention of reducing downtime. Third, there was a rather confused argument about the time path of production, which had several elements. The basic idea is that you have to start somewhere, so why not start with what you can do now; if you can do something better later, you will be better off in lots of ways for having made investments in what will turn out to have been high cost operations. The most frequent formulation was that the small plant itself went from small to big, indigenous to modern, high cost to low cost, and implicitly that it would not be big, modern, and low cost in the future without the industrial experience, the chance to mobilize the masses in technical renovation, and the capital funds from profits in the meantime, that are the product of its first period.

Closely related to the limitations of transport and marketing is the question of the availability of local resources. If local resources are available at a reasonable cost, and these resources are not otherwise being exploited by large-scale enterprises, then local small enterprises can exploit these resources without cutting into priority projects elsewhere. The widespread availability of small outcroppings of coal and limestone too small for large-scale development, therefore, is a primary justification for the creation of local small-scale industries. And there are many other materials besides coal and limestone that would remain unused or undeveloped if no local demand existed. There is no incentive to develop the production of fruits and many other kinds of perishable foods beyond the needs of the locality, unless there exists a fruit processing plant that prepares the fruit for shipment to more distant points. Slag from a local iron and steel plant can be used to expand cement output if there is a cement plant nearby. This list of goods can be extended indefinitely.

A fifth major justification for rural small-scale industries is that they are closer to their markets than large urban enterprises, and hence can better understand and meet the needs of their customers. For standardized products, knowledge of the peculiarities of a particular market may not be essential, but for items such as farm machinery, this knowledge may make the difference between success and failure. A suburban Shanghai County farm machinery plant, for example, was making rice transplanters specially designed for local use. Transplanters produced elsewhere, it had been found, were designed for a slightly different cropping pattern.

A major shortcoming of state-owned and centrally-planned enterprises in many parts of the world has been their tendency to concentrate on production and to ignore the market for that production. In China too a factory's responsibility for its products often ends when the product passes out of the factory gate. On many occasions we were told that the lineup of new tractors or stacked crates of new machinery so much in evidence in or near the factory grounds was now under the jurisdiction of the county or city commercial bureau, not that of the factory. Placing the factory near to the end users of the product doesn't completely resolve this problem, but it at least removes the barrier of distance that stands in the way of effective market studies by large urban factories with nationwide sales. If a commune is dissatisfied with the product mix of the county farm machinery factory, or feels that output quality is too low, it can complain directly to the factory or to its immediate superiors (the county revolutionary committee) who are also the immediate superiors of the factory. More positively, if a factory wants to adjust production to local needs, all it has to do is form a team to walk a few miles down the road to talk with current and potential customers. Or the relevant county bureaus can do the job for the factory without having to pass their findings through several levels of bureaucratic red tape.

A sixth reason for emphasis on small-scale industry is that the location of enterprises in rural areas tends to narrow the gap between city and countryside. This narrowing has both economic and social advantages. The economic advantages include the elimination of expenditures on urban housing and public utilities. Factory workers continue to live in their old villages and hence have no need for much of the infrastructure that must be built alongside a large urban enterprise.

More important from the Chinese point of view is the elimination of the social gap between countryside and city. In commune and brigade enterprises workers usually continue to do some and often a great deal of work in the fields. Furthermore, in many cases, their wages are paid in the form of work points by their teams or brigades, and hence their incomes differ little if any from their farming neighbors. Workers in county-run enterprises are not integrated into the productive life of the commune, but they frequently live in their old villages and receive wages that are often similar to or only slightly higher than the incomes of those with whom they live. Rural small-scale industry, therefore, contributes to the Chinese goal of eliminating class barriers and preventing new ones from arising.

A closely related goal is the desire to bring modern technology to the countryside immediately rather than to wait until urban development has proceeded to a point where its methods have begun to trickle out into rural areas. By locating factories in the countryside, instead of moving rural people into the cities, the countryside gains a cadre of personnel experienced in modern techniques, and millions not actually working in the new enterprises learn through observation something about the advantages and methods of modern engineering.

Surprisingly, the expansion of rural off-farm employment opportunities does not at present appear to be a major goal of China's small-scale industry program. These new factories do create employment opportunities, of course, but there is considerable effort expended to keep these enterprises from cutting heavily into the supply of labor available to agriculture. Agriculture has priority over rural industry, and rural industry's main priority is in fact to serve agriculture, and the Chinese appear to think of priorities more in absolute than in marginal terms. Activities that deprive agriculture of part of its labor force are, to that extent at least, not serving agriculture. Time and again we were told by factory representatives of the efforts they were making to eliminate manual, highly labor-intensive processes and to substitute mechanized methods. To some degree these modern methods seem to be desired for their own sake, but often the firm appeared to be under pressure to expand output without any major increases in employment. China's rural small-scale industries remain highly labor-intensive when compared to urban enterprises in China, and the contrast is even greater with similar industries in the United States. But most Chinese efforts at the moment appear to be directed not at exploiting the employment potential of labor-intensive techniques, but toward modernizing those techniques in a capital-intensive direction.

The rural small-scale industry program also is not conceived of as a substitute for urban-based large and medium-scale industrialization. The Chinese have attempted to freeze the population of many of China's large cities (neither Shanghai nor Cheng-chou among the cities we visited has grown much if at all during the past decade), but other intermediate cities have continued to increase in size (Hsin-hsiang grew from 320,000 to 420,000 between 1965 and 1975). More important, construction of large enterprises continues at a rapid pace, and by all appearances these enterprises continue to receive the lion's share of state funds. Between 1964 and 1974, for example, 1100 large modern enterprises were built in China. In a similar vein, the gross values of industrial output in Shanghai and Tientsin in 1973 were more than double the levels of 1965, and in Peking there was a tripling.

Finally, it is not at all clear that achieving a greater degree of equality of income between regions of the nation is a major goal of the small-scale industry program. No doubt Chinese leaders hope that greater equality will result, but the whole emphasis of the program is on self-reliance, not on using state funds to help lift up more backward areas. State funds from levels above the county are used, to be sure, and it may be that they are used in a way to promote greater equality, although we did not obtain any information on this subject. The fact that our travels were exclusively in advanced areas meant that we were not in a position to see directly how poorer areas were treated. But to a substantial degree, it would appear, a county or commune is expected to use its own funds and its own labor force. Rural areas with more funds for this purpose, with better leadership, and located near relevant natural resources, therefore, will naturally benefit more from the small-scale industry program than those lacking one or more of these characteristics. And there is no reason to believe that it is the currently more backward areas that are those best endowed for small-scale industrial development.

First and foremost, China is developing rural small-scale industry because this strategy is believed to be doing a better job of supporting agriculture than did the large-scale strategies of the past. There are many rural factories that do subcontracting work for urban enterprises, but these activities are clearly secondary to the main task of supporting agriculture in the rural industrial program as a whole. Furthermore, the rural enterprises that do subcontracting work that is not in support of agriculture appear to be doing only a small fraction of that kind of work. Industrial products designed for purposes other than the support of agriculture, and a substantial majority of all industrial products would appear still to fall into this category, continue to be made, for the most part, in and around urban centers and more often than not in medium- and large-scale factories.

The preceding discussion has attempted to list the objectives and advantages of China's rural small-scale industry program. The words, we believe, are a fair interpretation of many of the things we were told during our visit. Against these advantages must be put the question of the efficiency of these small-scale plants. Put differently, can these plants deliver farm machinery, fertilizer, and other products to agriculture at a cost that is competitive with alternative sources of supply and at a satisfactory quality level?

Our Chinese hosts were willing to discuss individual sources of cost savings, but they were consistently reluctant to add up the costs and benefits and consider the net result in a manner common to project feasibility studies, public as well as private, in much of the rest of the world. Thus our hosts would speak of low investment per plant and the speed with which plants could be constructed. And small-scale enterprises were also praised on occasion for accumulating funds for the state. In addition, as already mentioned, there were important savings in transport and in urban housing and public utilities.

The process of adding up these costs and benefits probably smacked too much of applying capitalistic profitability criteria to enterprises which, in their view, could not be judged properly by such methods. But the issue is really more complex than this. One way or another Chinese planners reach conclusions about the efficiency of small-scale enterprises. During the Great Leap Forward (1958–1960), efficiency criteria may have been ignored. But we saw no enterprises that were clearly irrational from the point of view of conventional cost–benefit analysis, and such a result could not have occurred by accident. To say that enterprises are not "clearly irrational," of course, is not the same thing as saying that such enterprises are efficient. Such conclusions as we were capable of reaching on the question of efficiency are presented in Chapter IV.

The concepts of engineering feasibility and efficiency are related to, but decidedly distinct from, the concepts of economic feasibility and efficiency. In determining whether rural small-scale industry is feasible in an engineering sense, the first question to be answered is whether the area has ample supplies of electric power. In certain of the areas we visited, electric power was obtained by tying the county or commune into one of the major grids. The suburban communes of Shanghai and Peking were obviously well-situated from this point of view, and Hsi-yang County was tied into the T'ai-yuan grid. But Lin County got much of its electric power as an additional benefit from the construction of the Red Flag Canal. And a commune in Kwangtung obtained power by building a dam across one of the tributaries of the Pearl River. Areas that do not yet have electric power presumably have little small-scale industry of a modern type, although we did not visit any such areas.

More difficult engineering questions concern such issues as whether the product being manufactured meets appropriate quality standards, and whether the processes being used make the most efficient use of key materials. These and related issues are discussed at length in Chapters V through VII for three of the types of enterprises visited: cement, chemical fertilizer, and farm machinery.

Before turning to questions of economic and engineering efficiency, however, it is important to understand how the Chinese have organized themselves to carry out their rural, small-scale industry program. How have the Chinese administered these programs, by elaborate rules or by moral example, and what is the role of the very present ideology? In many ways Chinese methods of handling such basic functions as the coordination of supply and demand and the promotion of innovation are similar in their structure to the way these functions are performed elsewhere in the world, but in other ways the Chinese approach is unique. These and related issues are the subject of Chapter II.

At the center of any program is the question of how to motivate the individuals responsible to implement it. Wages and promotions are only a part of the story. There are also non-material rewards for good performance, and the Chinese have made extensive use of praise and public recognition. Incentives, material or otherwise, are the subject of Chapter III.

Other chapters deal with the impact of small-scale industry on agricultural production (Chapter VIII) and on such key features of the Chinese countryside as the level of employment, the role of women, and the nature of rural administration (Chapter IX). Finally, there is the whole question of the role of education and training, both formal and informal. Rural small-scale industry is a source of technological education, but it is also to some degree a beneficiary of nationwide efforts to universalize education at the primary school and junior high school level, to send educated youth down to the countryside, to supply rural areas with practical technical publications, and the like. These and related issues are the subject of Chapter X.

Chapter VI

SMALL-SCALE CHEMICAL FERTILIZER TECHNOLOGY

A fertilizer is a material, naturally occurring or synthetically produced, that provides one or more of the plant nutrients, nitrogen, phosphorous, or potassium to living plants. It also may contain other elements such as sulfur, manganese, boron, copper, zinc, and molybdenum, which are often necessary to achieve optimum plant growth. These elements normally required only in minor amounts are referred to as micronutrients, while nitrogen, phosphorous, and potassium are called primary plant nutrients. The complex mechanisms through which plants make use of the primary nutrients and micronutrients are not thoroughly understood, but numerous researchers have proven experimentally that countries striving to improve crop yields will need fertilizers.

Visits were made to the chemical fertilizer factories in Hsi-yang County, Shansi Province; Lin County, and Hui County, Honan Province. Ammonia, ammonium bicarbonate, and ammonium nitrate products were being produced in Hsi-yang and Hui Counties, while in Lin County only ammonia and ammonium bicarbonate products were being made. Most of the discussion in this section for nitrogen production technology is based on briefings and visits to these factories. Phosphate technology was obtained primarily from Chinese literature, as visits to phosphate factories were not included in the itinerary.

SPECIFIC FERTILIZER TERMINOLOGY

In order to better describe a fertilizer product certain specific terms have been developed over the years that must be understood; some of the terms as used apply only to fertilizer and have been adopted through convention. Some of the more common terms and definitions are:

1. *Chemical analysis*: This denotes the concentration of the nutrients in the material that are needed by plants such as nitrogen, N; phosphorous pentoxide, P_2O_5, and potassium oxide, K_2O. Note that two of the elements, phosphorous and potassium, are expressed in terms of the oxides. Some countries are now adopting a method of expressing the analysis on a weight percent basis as simply nitrogen (N), phosphorous (P), and potassium (K). The analysis is usually expressed in weight percent and denotes the weight of the element divided by the molecular weight times 100. For example, the chemical formula for ammonia is NH_3, which has a molecular weight of 17 (14 for N, plus 3x1 for H), and the N content or analysis is equal to $14 \div 17 \times 100 = 82.4\%$. Therefore, for every 100 pounds of pure ammonia, there would be 82.4 pounds of nitrogen. It is slightly more complicated for the oxide forms since the number of elements may be greater in the oxide form than in the product formula. In this case, phosphoric acid of conventional strength is written as H_3PO_4 (orthophosphoric acid), which requires two moles of the acid to give one mole of P_2O_5. The H_3PO_4 molecular weight must be multiplied by two. The molecular weight of H_3PO_4 is $98 (3H \times 1 + 1P \times 31 + 4 \times 16)$; the molecular weight of phosphorous pentoxide (P_2O_5) is 142. The P_2O_5 content on a pure acid basis is $142 \div 196 \times 100 = 72.4\%$; H_3PO_4 is not shipped in pure form but in aqueous solution, which reduces the P_2O_5 concentration to 54% P_2O_5. It also is usually contaminated by impurities, which tend to lower its analysis. An acid of 54% P_2O_5 concentration is usually referred to as ordinary or ortho wet-process phosphoric acid. This is the acid traded in international markets and is the base for phosphate statistics in supply-demand data; ammonia is the base taken in statistical data on nitrogen in most countries.

2. *Grade of fertilizer*: This denotes the plant nutrient content of a fertilizer expressed in weight percent and is given in the order of N, P_2O_5, and K_2O, except in the case cited above where N, P, and K are given. For example, a 14-14-14 grade indicates 14% N, 14% P_2O_5, and 14% K_2O. This indicates that all three major nutrients are present. A material containing only nitrogen, such as urea, would be expressed as 46-0-0 indicating 46% N, 0% P_2O_5, and 0% K_2O. If micronutrients are present the weight percent and element are given last in the grade. With urea again containing 0.2% zinc, the grade would be 45-0-0, 0.2 Zn, etc. Micronutrients are usually present only in small quantities.

Several other terms used in this chapter are defined when used for the convenience of the reader.

SMALL-SCALE INDUSTRY DEFINITION

One of the many objectives of the delegation assigned for this study was to determine the technology used in fertilizer production in the small-scale industries scattered throughout the country. Representatives of the Ministry of Petrochemical Industries summarized the status and plans for the small-scale nitrogenous fertilizer industry during a briefing in Peking. During the tour the delegation was able to view the factories and discuss details of the operation. Although attempts were made to gain knowledge of the phosphate fertilizer industry, this report deals primarily with the nitrogenous fertilizer industry and more specifically with the small-scale plants. Therefore, the main product is ammonia and associated by-product, which can be converted into other fertilizer materials.

Table VI-1 gives a description of fertilizer materials frequently used in China along with the chemical analysis and method of manufacture. One of the most striking differences in the fertilizer industry in China is the production and use of ammonium bicarbonate as fertilizer, which is one of the prime products of small-scale industry. This appears to be the only country, developed or developing, using this material in substantial quantities as fertilizer. Most other countries use ammonia as ammonia, ammonium sulfate, ammonium nitrate, or urea. According to the Ministry, ammonium bicarbonate can be produced by a simpler process, requires less investment, and plants can be in production quickly. Ammonium bicarbonate is made by the reaction of ammonia with carbon dioxide usually carried out in a simple reactor. The procedure is described in the technology section.

During the period 1958-1965, or eight years before the Cultural Revolution, only about 90 plants for the production of ammonia had been established. From 1966-1974 about 1100 of the small-scale, coal-based ammonia plants were built with an average of 100 new plants per year now being added. The design capacity based on ammonia ranges from 3000 m.t. per year up to 20,000 m.t. per year in the modern small-scale plant, and some of the newer plants produce ammonium nitrate in addition to the solid ammonium bicarbonate. Ammonium nitrate plants represent a greater degree of complexity since nitric acid is an intermediate during the production of ammonium nitrate. These factory complexes are certainly more expensive than those which only make ammonium bicarbonate. At present 29 provinces are reported to have ammonia production capacity. In 1974 the small plants accounted for about 45% or more of the total nitrogen produced in the country; the remaining nitrogen production is from larger scale plants using feedstocks, such as shale oil, natural gas, and refinery off-gas.

Although actual figures for the country cannot be given, a considerable amount of the ammonia produced in small-scale plants is converted into

Table VI-1

FERTILIZERS FREQUENTLY USED IN CHINA

Name	*Grade (Wt.%[a]) N-P_2O_5-K_2O[b]*	*Method of Manufacture*
1. Ammonia	82:0:0	Reaction of nitrogen with hydrogen
2. Liquor ammonia (aqua ammonia)	16-25:0:0	Ammonia dissolved in water
3. Ammonium bicarbonate	17.5:0:0	Reaction of ammonia with carbon dioxide, CO_2
4. Ammonium nitrate	32-35:0:0	Reaction of nitric acid with ammonia
5. Ammonium sulfate	20-21:0:0	Reaction of sulfuric acid with ammonia
6. Urea	46:0:0	Reaction of ammonia with carbon dioxide, CO_2
7. Calcium super phosphate	0:20:0	Reaction of phosphate rock with sulfuric acid
8. Basic slag	0:12-18:0	Byproduct of steel production
9. Calcium magnesium phosphate	0:14-18:0	Burned phosphate ore
10. Ammonium phosphate	11.2:50-60:0	Reaction of ammonia with phosphoric acid
11. Potassium sulfate	0:0:52.8	Reaction of potassium chloride with sulfuric acid

[a]Ranges of nutrient content given which may vary depending on product purity.
[b]First number denotes range of nitrogen content on a percent-by-weight basis; second number denotes range of P_2O_5; third number denotes range of K_2O content.

liquor ammonia (aqua ammonia). Ammonia gas is bubbled into water while cooling to form ammonium hydroxide (NH_4OH) with a concentration of 16-25% nitrogen. The concentration is kept low so that the final solution exhibits no gauge pressure, although it has a vapor pressure, and can be transported in non-pressure containers. The containers must be kept closed, however, to avoid losses of ammonia due to volatilization. This method is simpler and less expensive since pressure equipment for transportation, storage, and handling is not needed. In many countries such as the United States, anhydrous ammonia containing no water is used directly as fertilizer. Since ammonia is a gas at ordinary temperature it must be kept under pressure to maintain liquid form. China does not yet have the pressure equipment on a large scale to handle the volatile anhydrous liquid ammonia. No indication was given in the counties, communes, or brigades visited that they are attempting to produce equipment to allow the direct use of liquid ammonia at the farm level for agriculture. Small applicators for liquor ammonia were observed at several locations. Application methods for solid and liquid fertilizers are discussed in a later section.

China has the technology to construct and operate urea plants of certain capacities. This is an important fertilizer material in the country. However, no plants of the small-scale industry type were observed during the visit and therefore the technology is only briefly described in this report. Likewise, the production of ammonium sulfate was not observed. What little information could be gained on the production methods for phosphate fertilizers in China also are given in a later section.

RAW MATERIALS

The basic building block of all nitrogen fertilizers is ammonia. It is one of the truly fundamental raw materials for modern civilization, and its importance to agricultural production cannot be overemphasized. A very high percentage of that produced in the world (about 85%) is used directly or indirectly as a fertilizer although it also finds uses in the manufacture of such materials as soda ash, nitric acid, nylon, plastics, lacquers, dyes, rubber, and numerous other products.

Ammonia is produced in the synthesis step by combining nitrogen and hydrogen in the proper proportions at specified conditions of temperature and pressure and in the presence of a catalyst. Nitrogen for the process is taken from the air and organic materials, such as coal, natural gas (methane), naphtha, oil, or even water can provide the source of hydrogen. In fact almost any material containing hydrogen is a potential raw material. The production of ammonia by the combination of nitrogen and hydrogen is a relatively simple process; complications occur in obtaining the gases for the synthesis reaction. The gases must be produced, cleaned, mixed, etc., which makes ammonia production a rather complicated process.

China has coal in large amounts and well distributed throughout the country except for the south, and it can be used as a raw material for ammonia production. Coal reserves in China compare favorably with those of the United States and the USSR. It is claimed that coal has been found in every province in China, although the size as well as the type of deposits vary considerably. Coals range from lignite to anthracite, with bituminous types being predominant. In the small plants visited, coal was used both for feedstock and fuel. It is known that China has substantial quantities of natural gas which is an even better feedstock than coal, but plants of this type were not visited. Anthracite or semi-anthracite grade of coal was being used, and lumps were used for feedstock, while the powdered coal was used for fuel. The Ministry of Petrochemical Industries reported that high-sulfur coals and lower grade coals were being used. A method was said to have

Table VI-2

TYPICAL ANALYSIS (ULTIMATE) AND HEATING VALUE OF VARIOUS COALS[a]

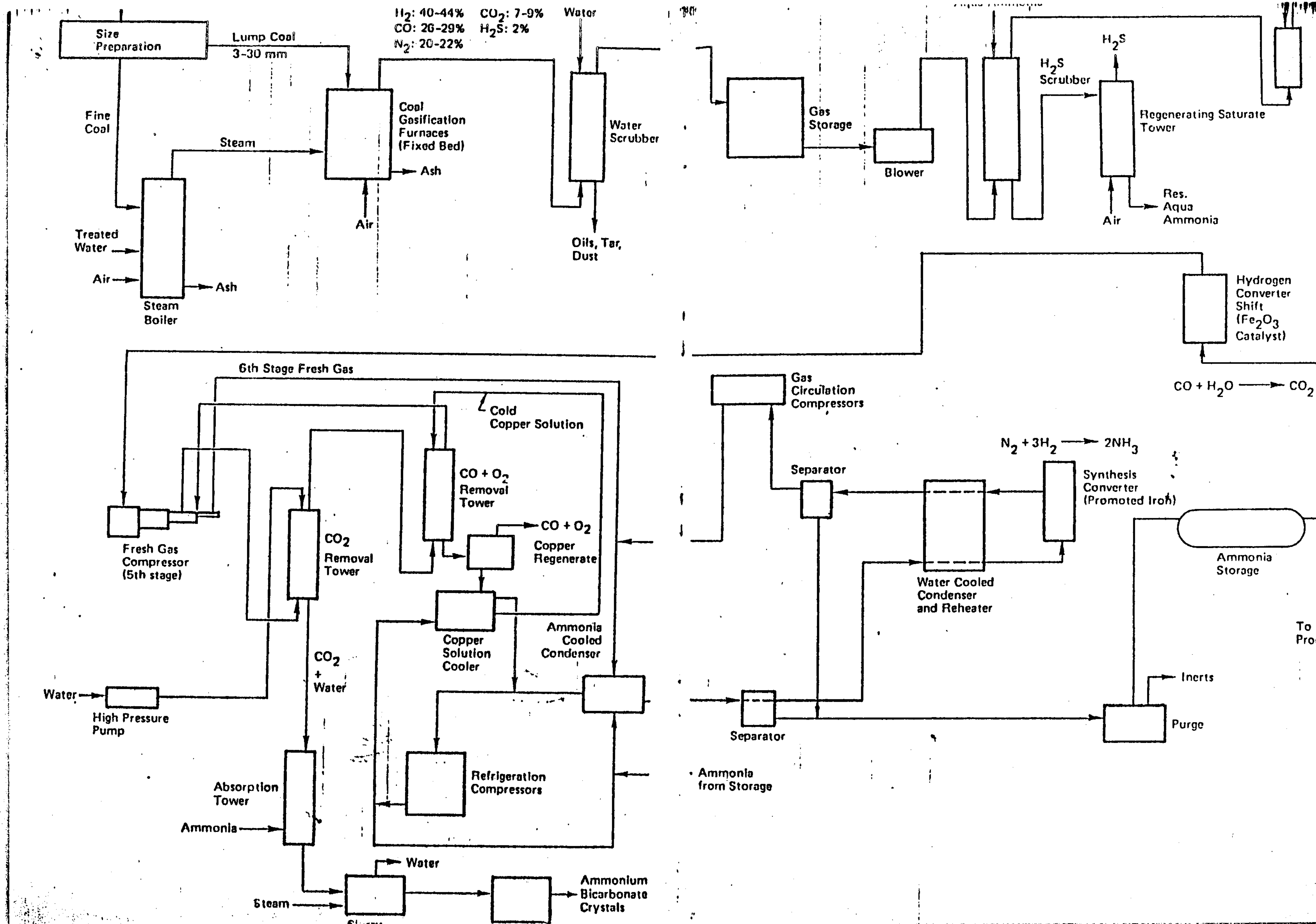
Rank	*Ultimate Analysis, %*					*Heating Value Btu/Pound*
	C	H	N	O	S	
Anthracite-semi	85.4	3.28	1.12	3.59	0.80	14,100
Bituminous	81.73	4.74	1.50	6.54	0.7	14,600
Sub-bituminous	59.8	5.6	1.3	21.0	1.1	10,600
Lignite	36.3	7.0	0.7	45.8	0.49	6,300

[a]Analyses corresponding to American Society for Testing Materials ranking; ranges of values between samples may occur in each rank.

been developed for producing "artificial coal," whereby powdered coals not suitable for feedstock due to small particle size were converted to lumps by briquetting. No details of the briquetting procedure were given. As gases must be reacted with the coal, lumps are needed to assure good contact of gas and coal and to have free passage of product gas through the bed. The use of high-sulfur coal requires more elaborate and more expensive methods to remove the sulfur; sulfur is detrimental to the process and must be removed. The availability of high-grade anthracite coal in many locations is a great advantage for small-scale plants and thus provides an opportunity for locating the factory very near the use area. It is interesting to compare the Chinese approach with that in the United States. In China, basic production units producing final products are located near the use area, whereas in the United States, large complexes provide raw materials and intermediates, which are transported to the use area and further processed by such methods as bulk blending or granulation to create final products. China is moving toward the large complex in nitrogen production, and thus will have to improve the transportation system to serve these factories.

Table VI-2 gives a typical composition and heating value of various coals; it should be recognized that specific values will vary somewhat for the same type of coal. These are shown only to give an indication of the variety of raw materials the Chinese said they had used for the production of ammonia. The analyses were not given to us during our visit.

The quantity of carbon in a coal indicates its relative suitability for use in ammonia production; i.e. the higher the carbon content the better suited is that coal, because less will have to be handled in the reactors. The lower the sulfur content the better, because sulfur is an impurity which interferes with the ammonia synthesis reaction; sulfur or sulfur gases must be removed



Size Preparation
Lump Coal 3-30 mm
H2: 40-44% CO2: 7-9%
CO: 26-29% H2S: 2%
N2: 20-22%
Water
Fine Coal
Steam
Coal Gasification Furnaces (Fixed Bed)
Ash
Air
Water Scrubber
Oils, Tar, Dust
Treated Water
Air
Ash
Steam Boiler
Gas Storage
Blower
H2S Scrubber
H2S
Regenerating Saturate Tower
Res. Aqua Ammonia
Air
Hydrogen Converter Shift (Fe2O3 Catalyst)
CO + H2O → CO2
6th Stage Fresh Gas
Cold Copper Solution
CO + O2 Removal Tower
CO + O2
Copper Regenerate
Fresh Gas Compressor (5th stage)
CO2 Removal Tower
Copper Solution Cooler
Ammonia Cooled Condensor
CO2 + Water
Water
High Pressure Pump
Refrigeration Compressors
Absorption Tower
Ammonia
Water
Steam
Ammonium Bicarbonate Crystals
Gas Circulation Compressors
N2 + 3H2 → 2NH3
Separator
Synthesis Converter (Promoted Iron)
Water Cooled Condenser and Reheater
Ammonia Storage
To Prod
Inerts
Separator
Purge
Ammonia from Storage

before nitrogen and hydrogen are reacted to form ammonia, because sulfur and sulfur compounds will poison the catalyst, thus lowering its reactivity. With these precautions, all of the above materials can be used for ammonia production.

The mining of coal was not actually observed by the delegation, although during travel, numerous small mines were noted near the roadside. Coal, both lump and powdered, was observed being transported for various uses by trucks, also equipped with trailing rubber-tired wagons, trailers pulled by medium-size and hand tractors, and in two-wheel carts pulled by animals or by hand. One fertilizer plant visited was receiving coal by rail. Very little data could be obtained on the transport cost of coal to the factories. Nevertheless, a rough estimate of the cost of coal delivered to the factory is possible and was presented in Chapter IV.

GAS GENERATION USING COAL

The following section is a brief description of the technology being used in the small-scale plants visited in which coal was the feedstock-fuel. The plant described is capable of producing up to 10,000 m.t. per year ammonia. In China, certain parts of plant operations are referred to in terms of workshops. For example, a part of the plant for gas generation most likely will be called a gas generating workshop. Figure VI-1 is a flow sheet showing ammonia production in the small-scale plant.

In this part of the plant the initial reaction toward the ammonia synthesis process begins. This operation is needed to furnish both hydrogen and nitrogen for the final synthesis step. Lump coal is charged to the top of each generator (area of 3m^2, round), and for the size of plant described here, three generators are used. The only gas generators observed are of the fixed-bed type, which must be discharged manually. Reference is made in the Chinese literature to a rotary type, which automatically discharges dust and residue. In some of the discussion, the equipment was referred to as furnaces. Air is blown into each generator, which causes heat to be generated by combustion of some of the coal by the following reaction:

$$C + O_2 \rightarrow CO_2$$

This part of the operation is referred to as the "blow." The carbon reacts with oxygen from air forming carbon dioxide; the carbon dioxide is removed from the gasses and used in other processes to produce ammonium bicarbonate or urea; it is a byproduct of ammonia synthesis. After the bed is heated during the "blow" operation, this is followed by a "run" operation according to the following reaction:

$$C + H_2O\,(\text{steam}) \rightarrow CO + H_2$$

This reaction is endothermic or requires heat, and thus the bed is cooled. In this step, hydrogen gas and carbon monoxide are generated; hydrogen is one of the final gases needed for ammonia synthesis. In the above reaction sequence, nitrogen gas, which is the other gas needed, is supplied by air. Thus the two raw materials for the final ammonia reaction between hydrogen and nitrogen are made and mixed in the proper proportions along with other gases which are removed prior to synthesis. In the plants, the "blow-run" operation was being done automatically, with means provided for manual operation in case of automatic failure. The cycle was on a timed sequence of three minutes with the "blow" operation for one-third of the time and "run" operation for two-thirds of the time. Thus, air was admitted for 1 minute to heat the bed, followed by steam for 2 minutes, which cooled the bed. This cycle was repeated giving a gas mixture consisting of carbon monoxide (CO), carbon dioxide CO_2), hydrogen (H_2), nitrogen (N_2), methane (CH_4), oxygen (O_2), hydrogen sulfide (H_2S), and argon (Ar). The gas was transported by Roots blowers to storage; storage tanks were built of steel, and some were made of stone and concrete. The stone tank was said to give a considerable saving since all materials were locally available. The temperature was not measured in the generator. Steam is produced in steam boilers using the finely-divided coal not of sufficient size for use in the generators. No catalyst is needed for the above reactions.

Following storage, the gas is treated to remove hydrogen sulfide and dust. Water is used for gas washing for dust and dilute ammonium hydroxide is used to remove hydrogen sulfide; the ammonium hydroxide is regenerated.

CARBON MONOXIDE CONVERSION

Gas after cleaning for dust and hydrogen sulfide removal is mixed with an excess of steam and passed over a bed of catalyst consisting of iron oxide (Fe_2O_3). In this reaction, called the shift reaction, carbon monoxide reacts with steam according to the following:

$$CO + H_2O\,(\text{steam}) \rightarrow CO_2 + H_2$$

In this manner additional hydrogen gas is formed and converts most of the carbon monoxide to carbon dioxide; no data were given on the conversion efficiency, but probably this was no higher than 90%. Therefore, some carbon monoxide remains, which must be removed along with the carbon dioxide and other impurities prior to synthesis. The temperature of the conversion reaction is 500°C. After conversion, the gas is cooled before beginning additional gas purification operations. At this point, the gases have the correct mole ratio of hydrogen to nitrogen of 3:1 for synthesis, but still contain carbon dioxide and carbon monoxide, which must be removed.

GAS COMPRESSION AND PURIFICATION

After conversion of most of the carbon monoxide to hydrogen, the gases are subjected to a sequence of compression and purification steps. The gas is compressed in six stages, with intercoolers between stages, until a pressure of 100 kg./cm.^{2} is reached in the fifth stage. Water is pumped into an absorption tower where the carbon dioxide is dissolved. No data were given as to where energy is recovered from the let-down of the water-carbon dioxide solution. It is assumed that no system exists for this. Carbon dioxide recovered in this step is used for production of ammonium bicarbonate.

Removal of the carbon monoxide, oxygen, residual carbon dioxide, and other gases is carried out by further scrubbing after water scrubbing with a cold solution of ammoniacal copper formate. Gas is contacted in a scrubbing tower with the cold solution to absorb carbon monoxide and oxygen. The copper liquor is oxidized in the scrubbing tower during removal of carbon monoxide and is called spent solution. After scrubbing, the spent solution goes to a reflux scrubber where ammonia is absorbed. From the reflux scrubber the liquor goes to a reduction vessel where it is heated under pressure and reduced back to the cuprous form by the dissolved carbon monoxide. Carbon monoxide and carbon dioxide are released from the solution. After regeneration the copper solution is again cooled by ammonia refrigeration to be recycled. At this point the final gases, hydrogen, and nitrogen, are in a condition for the synthesis reaction.

AMMONIA SYNTHESIS

After compression to 320 kg./cm.^{2} the purified synthesis gas is mixed with circulated gas. The combined volume of new and recirculated gas pass through an ammonia-cooled condenser; the gases and condensed ammonia are passed through a separator where liquid ammonia is removed. Liquid ammonia is pumped to storage. Pressure type storage is used in the small-scale plants. After separation of ammonia, the gases are heated by off-gas from the converter in an exchanger and enter the ammonia synthesis converter where they pass through the catalyst bed. The catalyst was not known by plant personnel, but was designated A6. It is assumed to be reduced iron oxide, because a nitrogen blanket is required during periods of shutdown. The converter operates at 500°C. and, as given before, 320 kg./cm.^{2}. The reaction of hydrogen and nitrogen to form ammonia is an equilibrium reaction according to the following:

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

The actual quantity of ammonia formed per pass through the converter depends upon the pressure, temperature, and reactivity of the catalyst. At a given temperature, the conversion is increased by pressure, and at a given pressure, the conversion decreases with an increase in temperature. The catalyst speeds up the reaction rate in order to achieve an economical level of space velocity; this is the number of cubic feet or volume of gas that pass over one cubic foot or volume of catalyst space per hour. At the above conditions only about 15-20% conversion is obtained per pass; thus a considerable quantity of gas must be recirculated. As the reaction of hydrogen and nitrogen to ammonia is highly exothermic, heat must be removed from the converter to maintain the desired temperature. The ammonia converter is 0.5 m. dia. x 6 m. high. Gas and ammonia from the converter pass through a water-cooled condenser and then to a separator where ammonia is removed. This ammonia also goes to storage. Unreacted gases go to the section of the recirculation compressors.

AMMONIA STORAGE

Steel tanks of a horizontal, cylindrical type were used for ammonia storage; the storage volume was 30 m.^{3} for the small-scale plants. Ammonia in vapor or gaseous form is used in other products. No liquid anhydrous ammonia is used for direct application. Ammonia is used for the production of liquor ammonia, ammonium bicarbonate, or ammonium nitrate.

It was striking to note the similarity in the small-scale ammonia plants in China with a plant previously operated by the Tennessee Valley Authority in the United States. In the fall of 1942 the plant began production of ammonia using coke and operated on that feedstock until 1951 when it was converted to natural gas. The TVA plant was much larger, having a design capacity of about 44,000 m.t./yr. of ammonia. Coke is a somewhat cleaner feedstock compared with coal and was selected primarily for that reason by TVA. Technical steps involved including gas preparation, cleaning, compression, removal of impurities, and synthesis were very similar in both plants. The original coke-based plant converted to natural gas at TVA has now been replaced with a more modern technology plant, which also uses natural gas.

TECHNOLOGY OF PRODUCTS MADE FROM AMMONIA

Only three fertilizer products containing straight nitrogen were observed being made and their use made mention of during the visit. These were ammonium bicarbonate, ammonia liquor, and ammonium nitrate. Brief explanations are given for each of these materials.

1. *Ammonium bicarbonate*: This material is sometimes called ammonium hydrogen carbonate or ammonium acid carbonate and contains 17.5% nitrogen, which makes it a relatively low-analysis fertilizer. It is a

PHOTO VI-1. Gas generators where coal is reacted with air and steam to produce a gas mixture of H_2, N_2, CO, and H_2S.

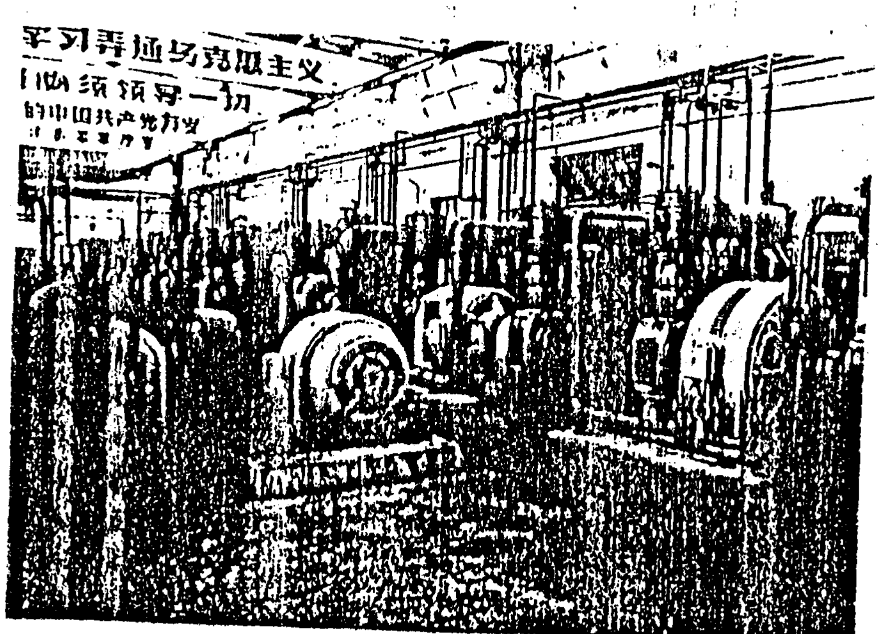


PHOTO VI-2. An overview of compressor room; note the orderly arrangement and well-kept appearance.

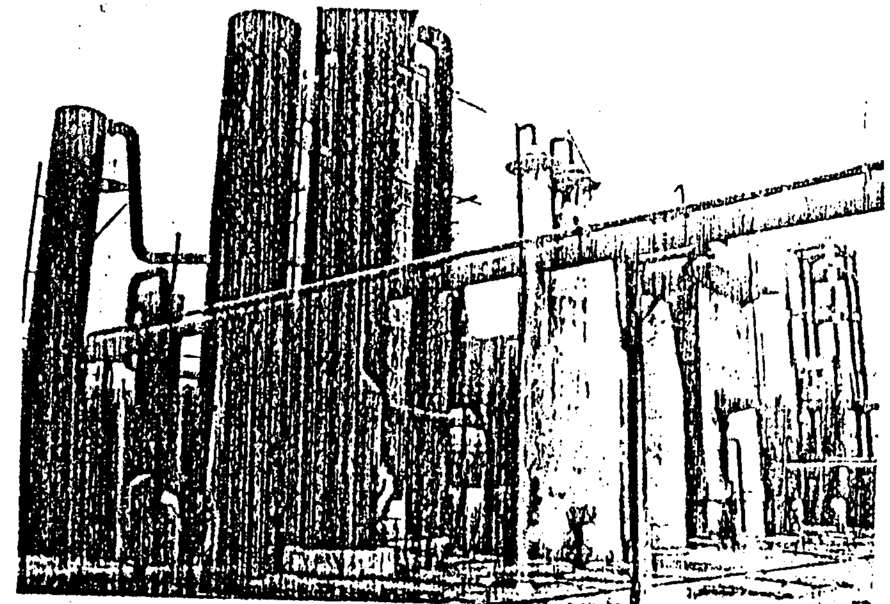


PHOTO VI-3. Ammonia plant absorption towers; note the use of indigenous materials and methods in equipment.

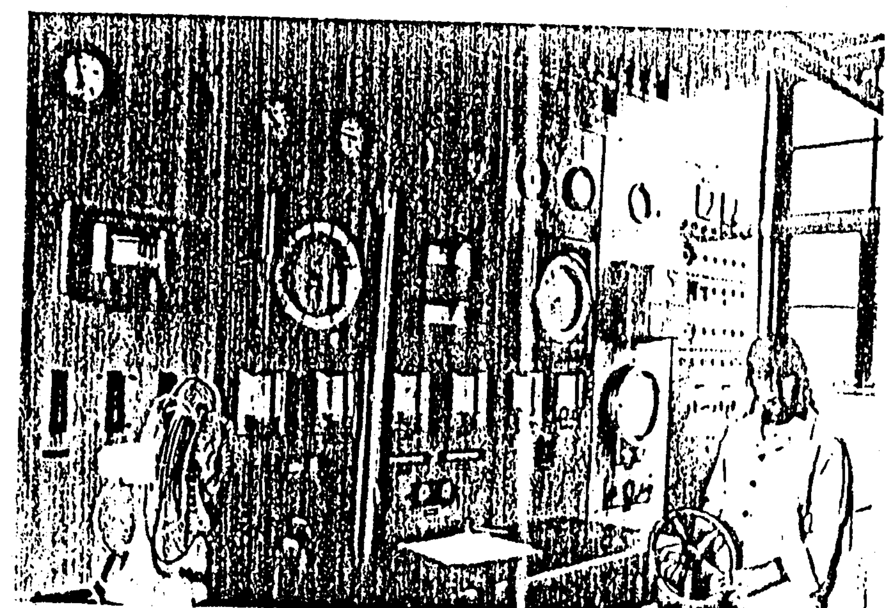


PHOTO VI-4. Control room; much of the process is controlled manually.

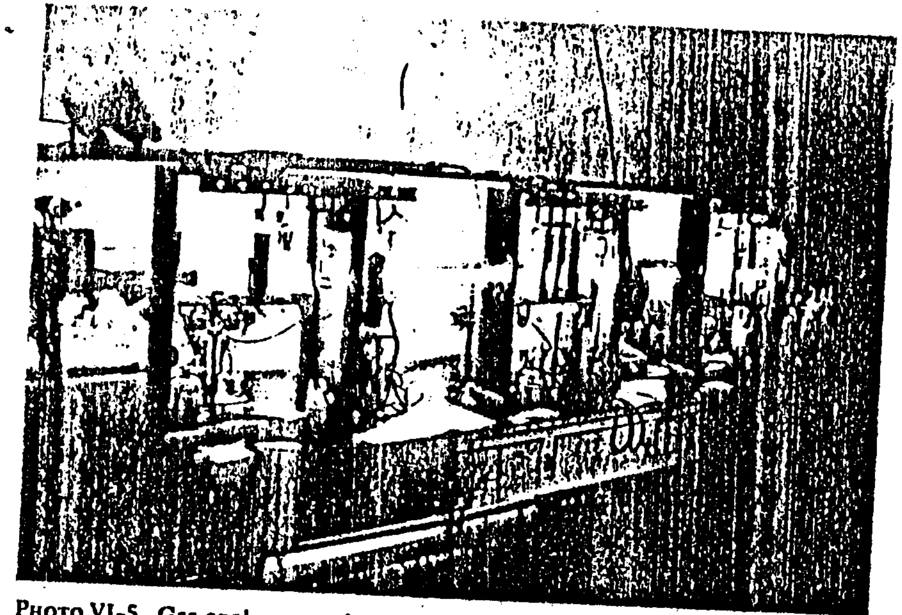


PHOTO VI-5. Gas analyses are done by wet methods; sophisticated instruments are nice but not necessary.

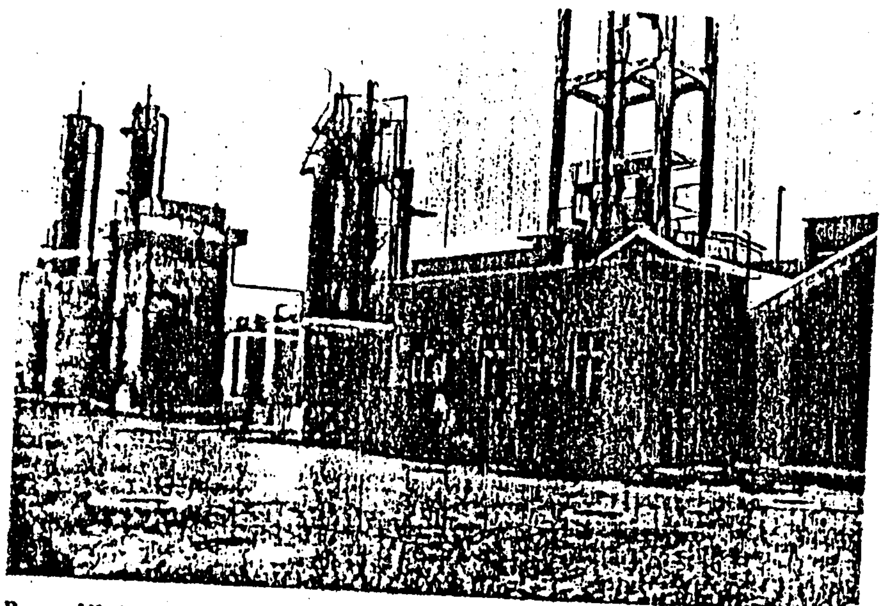


PHOTO VI-6. View of ammonia plant; note converter in center where $N_2 + H_2$ is reacted to form NH_3.

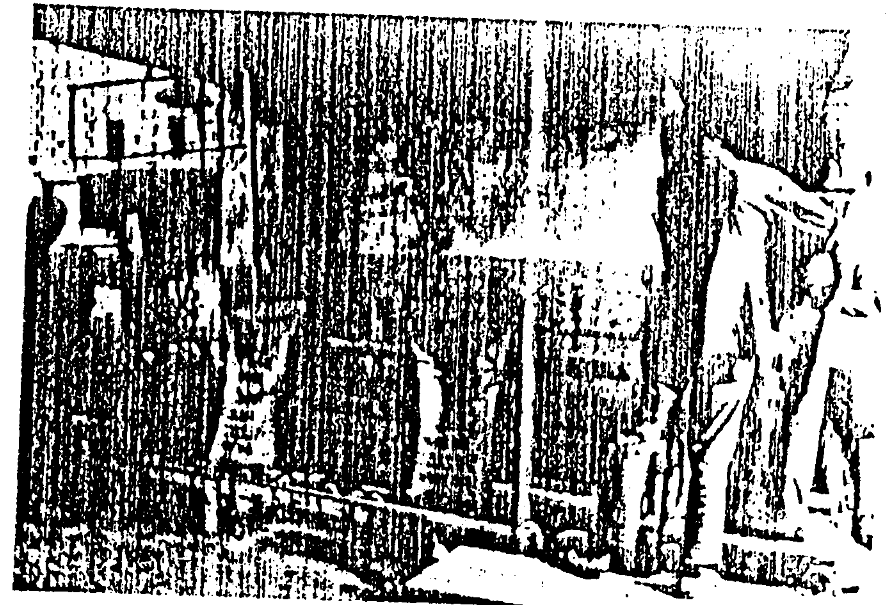


PHOTO VI-7. All solid fertilizer observed in China is delivered to the farm in bagged form.

rather easy compound to prepare and is made according to the following reaction:

$$NH_3 + H_2O + CO_2 \rightarrow NH_4HCO_3$$

An aqueous solution of ammonia (NH_4OH) is contacted with gaseous carbon dioxide, and this is done in an absorption column where the ammonia solution flows downward, and the gas flows upward. As the reaction produces heat, it is necessary to cool the solution. As the solution becomes saturated, crystallization occurs. In the small plants, steam was used to dry up the solution or concentrate the solution to cause crystallization and drying; no separate drying step was carried out. The semi-dry crystals had a wet appearance and smelled strongly of ammonia. The crystals were collected in a holding hopper and bagged by hand into a 25 kg. plastic bag and tied closed. A small quantity of bagged product was stored temporarily outside, alongside the bagging building. The workers around the bagging unit were wearing a cloth covering over the nose and mouth, and a fan was blowing the ammonia fumes away from them. Neither the masks nor fan were doing an adequate job of protecting the workers. During discussions, the people stated that ammonium bicarbonate was difficult to use, as it tended to lose ammonia. Of course, this is a very simple way of converting the ammonia into a solid form which can be transported by the

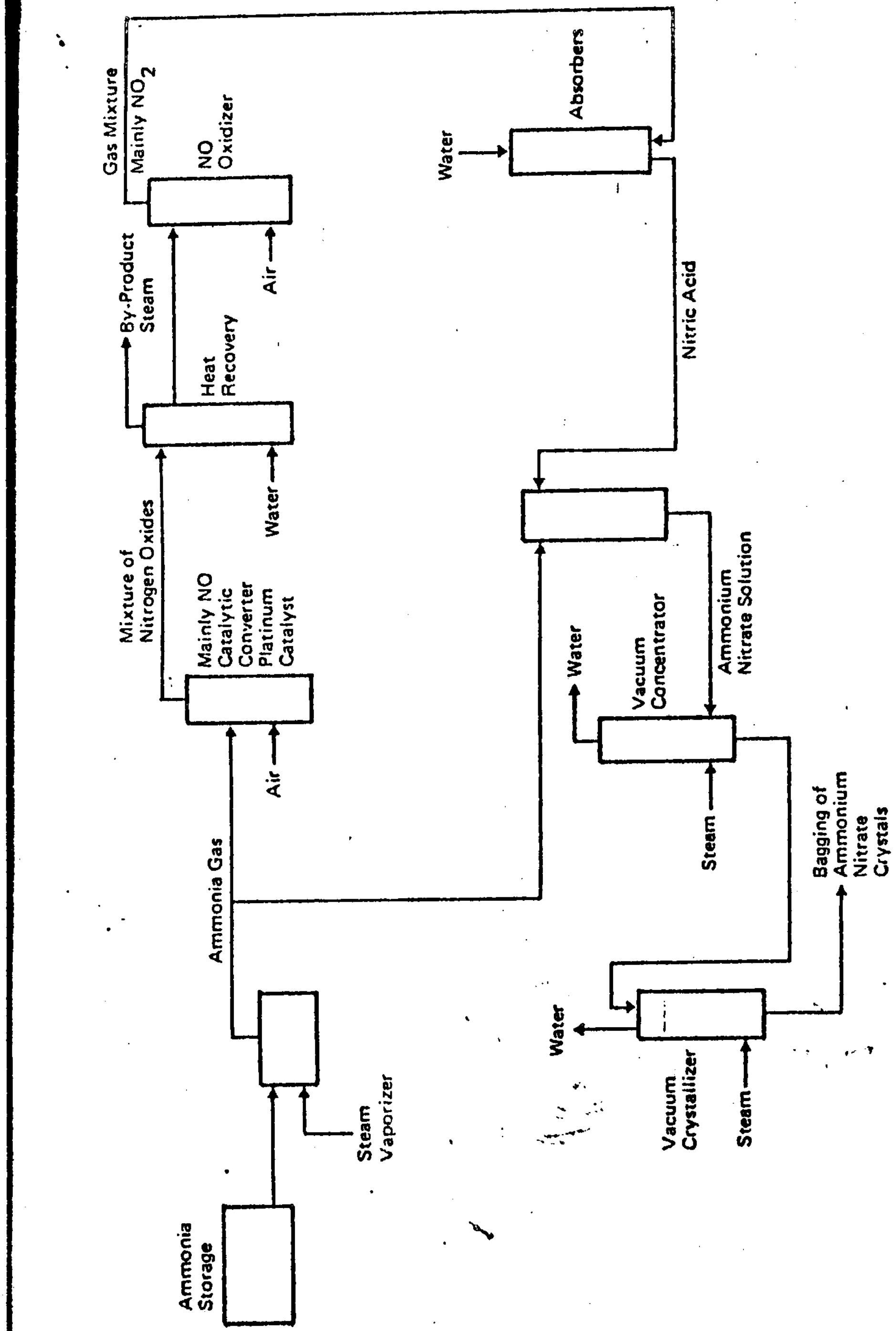


FIGURE VI-2. Small-scale production of nitric acid and ammonium nitrate from ammonia.

available. This portion of the plant could be improved to give a better working atmosphere for the workers. Carbon dioxide for the reaction is a recovered byproduct, and thus contributes no cost to the product. Figure VI-2 shows the production scheme.

2. *Liquor ammonia* (*aqua ammonia*): The production of liquor ammonia is also a very simple process. The gaseous ammonia is contacted with water according to the following reaction:

$$NH_3 + H_2O \rightarrow NH_4OH$$

During the reaction, heat is generated which must be removed. The final solution has no gauge pressure, and thus can be handled in ordinary tanks or even glass containers. It does have a partial pressure of ammonia, which means that ammonia will escape unless the containers are kept closed. Figure VI-2 also shows the production of liquor ammonia.

3. *Ammonium nitrate*: As shown in Figure VI-2, some plants were observed to be making nitric acid from part of the ammonia production and converting the nitric acid to ammonium nitrate according to the following reaction:

$$NH_3 + HNO_3 \rightarrow NH_4NO_3$$

Gaseous ammonia is reacted with air at 800°C. using a platinum catalyst to produce nitrogen oxides; the pressure is 1 kg./cm.[2] The main product is nitric oxide (NO), but at the same time other nitrogen oxides are formed. The nitrogen oxide (NO) is further reacted with cooling air to convert it to nitrogen dioxide (NO_2); no catalyst is required for this. The nitrogen dioxide is absorbed by water in packed towers to form nitric acid. In China the acid concentration was 40%. Even at this concentration, considerable losses of nitrogen oxides were observed at the stack discharge. Modern nitric acid plants operating under pressure produce 56% nitric acid. Equations for the main reactions are as follows:

$$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$$
$$2NO + O_2 \rightarrow 2NO_2$$
$$3NO_2 + H_2O \rightarrow 2HNO_3 + NO$$

Acid was withdrawn from storage and reacted with gaseous ammonia to produce an ammonium nitrate solution of 60% concentration. The solution is concentrated by vacuum evaporation to 80–90% ammonium nitrate using steam. Following this a vacuum crystallization (batch operation) produces solid ammonium nitrate. The product particle size is less than 1 mm. After vacuum crystallization, the vacuum is released, and a door is opened manually. Ammonium nitrate crystals fall down a chute to an open belt conveyor onto a manual bagging hopper. No further drying or conditioning was done. The crystals felt to be about 110–115°F. when being bagged and felt moist to the touch. Bags consisted of 2-ply paper with no plastic liner being used; the bags were weak and tore easily. It was a 25-kg. weight and was labeled 34% nitrogen on the bag. Some bagged product that felt to be quite hard was stored nearby. The plant people stated that before the amonium nitrate was used, it was usually ground with a stone grinder. Some of the product was used for blasting, and the remainder was used for fertilizer. Again, the production scheme for ammonium nitrate could be changed to greatly improve the product quality. They said that a prilling tower is being considered for one of the plants visited. China has experience in the operation of a pan-type granulator or pelletizer used in the preparation of feed particles for the vertical shaft kilns in the cement plants. A similar principle could be used to prepare a high quality granular ammonium nitrate. A melt consisting of 98-99.5% ammonium nitrate (a melt made by heating with steam) could be sprayed over the moving bed in the pan. When the melt is being sprayed, the rotating particles increase to the desired size and are separated and cooled for packaging. The small particles are returned to the pan to serve as nuclei for the production of additional product-size particles. Equipment includes the pan granulator, cooler, screens, oversize crushing mill, elevators, and screens, all of which the Chinese can readily fabricate. Product made in this manner would cost no more than that to be made in a prilling tower and should have superior physical characteristics.

Ammonium bicarbonate cannot be melted without decomposition and cannot be processed as previously mentioned for ammonium nitrate. However, it could be compacted, such as in briquetting machines, to give various particle shapes. Also, ammonium bicarbonate could be pressed between pressure rolls into a sheet and then broken into uniform sizes by screening. For the small production units, even tabletting could be considered.

4. *Urea*: China is known to have some small plants operating that produce urea. This material is made by a pressure reaction of ammonia with carbon dioxide at elevated temperatures. Since no plants were visited which made this product, no data can be given. Some discussion is presented on this material under future trends.

It is known that China is greatly increasing its nitrogen production capacity through installation of modern ammonia-urea plants. Although not dealt with during the visit, it seems appropriate to briefly consider the impact. We could not learn specifically what ratio of nitrogen, phosphate, and potash is used in the country, but it is probably of the order of 1:0.5:0.5 in terms of $N:P_2O_5:K_2O$ weight ratio. Therefore, when nitrogen availability significantly increases, say by 1978, the quantities of phosphate and potassium must likewise be increased to maintain the proper ratio. It would seem that a considerable potential exists to supply the increased demand of these nutrients, and probably a considerable amount must come from imports. If

new nitrogen capacity by 1978 equals 3.5 million tons, then phosphate and potash capacities should be 1.75 million tons each to maintain the above ratio. Once again our delegation was not able to ascertain the consumption ratio on a country basis.

TECHNOLOGY OF PHOSPHATE PRODUCTION

Although in numerous discussions the use of phosphate fertilizers was mentioned, little data could be obtained on the materials and the technology of production, and no plants were visited which produced phosphate-type fertilizers.

Apparently, compared with the small-scale nitrogenous fertilizer industry, a small-scale phosphate fertilizer industry has not evolved in a comparable way or at least to the degree that the nitrogen industry has. There are known scattered deposits of phosphate ore in the country, but in all of our discussions, the material being used was said to be allocated by the state. This also could include imported ores as well as domestically-mined ores. Depending upon impurities in the ore, the P_2O_5 content can vary over a wide range. The ore may or may not be suitable for direct use as a fertilizer, depending on its chemical composition and agricultural conditions. Generally, some chemical reaction must be carried out with the ore to improve its P_2O_5 availability; this is a method of expressing the ability of the growing plant to utilize the phosphate component. The reaction changes the chemical composition of the phosphate ore and puts it in a form that can be used by the plant either through an improvement in water solubility or citrate solubility.

In Chinese literature, the use of powdered or fine-ground phosphate rock for direct application is described. They recommend that sedimentary rock be ground and mixed with manure and lime for direct application to acid soils in the following rates: 50 kg. (100 jin[1]) of manure, 2 kg. (4 jin) of phosphate rock, and 2.5 kg. (5 jin) of lime. It is recommended that the mixture be applied one week before seeding at the rate of 375 to 750 kg./ha. (50 to 100 jin/mu.[2]).

There was occasional reference to plants that produce "burned" phosphates; these products were referred to as calcium magnesium phosphate containing 14-18% P_2O_5. It is assumed that they are made by heating the ore in the presence of a magnesium source to a relatively high temperature whereby magnesium is incorporated in the product. This would be expected to improve the availability. The measurement of availability is an empirical method based on the solubility of a certain amount of

1. 1 jin. = 1/2 kg. = 1.1 lbs.
2. 1 mu. = 1/6 a. = 0.167 a. = .067 ha.

product in an ammonium citrate solution. Generally, the higher the solubility, the higher the availability to growing plants. References are given in Chinese literature to the reaction of magnesium silicate with phosphate rock and with the use of coal. A flow sheet is given as described by them in Figure VI-3. Magnesium silicate, phosphate rock, and coal are screened into lumps and powder. The mixture is melted, followed by quenching it in water, drying, and grinding it to produce calcium magnesium phosphate. Based on other plant visits, the Chinese have the technology and indigenous equipment to carry out the process. They have considerable experience in fabrication and operation of electric furnaces, shaft kilns, rotary driers and coolers, ball mills for grinding, and screening equipment. Much of this equipment was observed in visits to rural,, small-scale cement factories.

During a visit to the Industrial Exhibition in Shanghai, samples of NPK compound granular fertilizer were being shown. However, the hosts were unable to give any details except that it was only being trial produced.

TRANSPORT OF FERTILIZERS

Information on how the fertilizers were transported from the factory to the farm was obtained through personal observation.

Since the plants are located in relatively close proximity to the use area, two rather unsophisticated methods could be used in transport. A 12-h.p. "walking" tractor is used with a two-wheel metal trailer for a large part of the bagged fertilizer. This was said to convey up to 1 m.t. Another method was a two-wheel (heavy-duty, bicycle-type wheel) hand cart with a wooden bed; sideboards were made of wood or wire mesh. These were drawn by donkeys or humans. If a donkey was used, it was attached by a loose rope, and the human guided and also pulled it by two beams on each side. In many cases, two to three men and women were pulling the hand carts using shoulder straps or ropes with one person guiding the cart. In a few cases larger tractors and four-wheel, rubber-tired wagons and trucks also were observed. Cost data on fertilizer transport could not be obtained. At any rate, the production plant was not responsible for delivering the product.

For liquor ammonia some black bags appearing to be made of rubber transported by two-wheel hand carts were used. Some old oil drums also could have been used for liquor ammonia. Concrete tanks also have been seen by others where small boats are available.

SUMMARY

In assessing the role of small-scale fertilizer plants in China and the level of technology, several factors must be kept in mind. One important factor is the availability and wide dispersion of coal in the country. Through

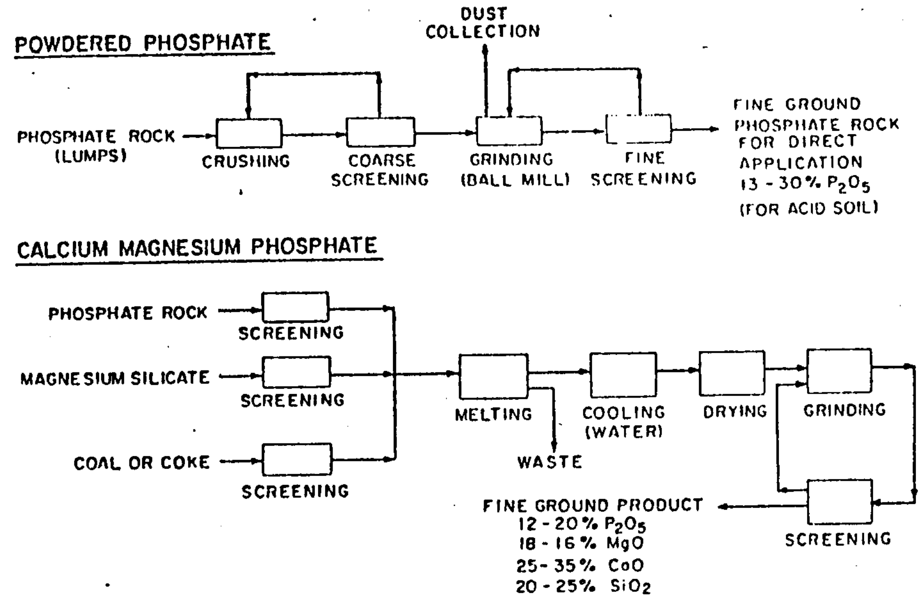


FIGURE VI-3. Small-scale production of powdered phosphate and calcium magnesium phosphate.

some unknown mechanism the technology for using coal for ammonia production became available to the Chinese. They never claimed to have developed the fundamental knowledge during any of the visits. Certain statements were made indicating that they had made improvements and adapted methods better suited to Chinese conditions. Had other feedstocks such as natural gas or oil been as available as coal, they probably would have been used. These plants follow very closely the theme of self-reliance and taking the initiative in their own hands as the feedstock-fuel requires no foreign exchange, plus essentially all of the equipment can be fabricated indigenously, and most of the metal is available in-country. The process does not require special alloys, which probably are not available, except by importation. The reactor vessels are of small size as well as the compressors, which can be fabricated in local and regional shops. Another very significant factor is the location of the plant very near the fertilizer-use area. Transportation is a problem, and the small factory allows the local population to improvise in methods of fertilizer transport. In large complexes, the factory will be required to invest in transportation and distribution facilities, and product will move a much longer distance from production to the point of use. Small locally oriented factories allow the use of relatively low analysis materials to be used economically. As the marketing area becomes larger, there is usually a need to increase the analysis so that the delivered cost per unit of plant nutrient can be kept relatively low.

It was surprising to learn of the number of small-scale nitrogen fertilizer factories utilizing the relatively complex technology required for ammonia production. The technology is similar to that used in other countries before natural gas was available. In fact, the Tennessee Valley Authority of the United States began operation of an ammonia plant in 1942 using coke to produce about 44,000 tons per year. Many of the processing steps in this plant were similar to those observed in China.

In general, the small plants in China were well designed and appeared to be well managed. Unfortunately, time did not permit a detailed inspection of the equipment or process details. The impression gained was that the quality of workmanship in design and layout was good, and this has been standardized to the extent possible, allowing for maximum use of non-metals in some steps based on local options (in scrubbing towers, etc.). Individual workshops were neat and orderly. In most instances safety, such as no smoking signs and the use of safety apparel for the workers, was stressed. Exposed work areas were marked for worker protection. There appeared to be a coordinated scheme for carrying out maintenance, and management appeared to be preventative maintenance-oriented. They often stated that they were working to reduce pollution from the fertilizer factories. These small plants have a high level of manual labor input, and they seemed to be striving for labor-saving methods, but automatic control of most steps was not yet achieved. However, it is likely that these plants will remain oriented to manual labor for the next several years, and attention to automation and labor-saving devices will be directed to the large complexes, whether producing fertilizer or other materials.

One area that would justify further attention would be to improve the quality of the solid products leaving the factory. Although the Chinese literature refers to modern methods of fertilizer finishing such as prilling or granulation, none were observed during the visit. In visits to cement factories or medicinal laboratories, the principle of pan granulation was observed. This technique could be easily applied to solid fertilizers. Formation of ammonium bicarbonate into pellets by such methods as briquetting would improve its handling properties. Prilling of ammonium nitrate with incorporation of additives would improve this product.

It seems that the small-scale fertilizer factory is playing an important role in China and will continue to do so. This type of approach also may be applicable to other countries and situations in the developing world. The small-scale fertilizer industry is certainly establishing a cadre of personnel with training that will be appropriate and helpful in developing a large-scale fertilizer industry in China.

Chapter VII

SMALL-SCALE CEMENT INDUSTRY TECHNOLOGY

Small-scale cement plants began to be built in China in 1958. At this time, in other parts of the world, large rotary kilns with internal heat recouperating devices and external suspension pre-heaters were being installed. The kiln is the heart of any cement-producing facility. Another key feature of cement manufacture is that the product being manufactured is a heavy and relatively low-cost item, and generally speaking must be marketed within a small radius of the factory, because the cost of transport adds significantly to the cost of the product. This is a perishable product and must be protected from contact with moisture.

China has not chosen to take the same steps in increasing its cement-producing capacity as the rest of the world. In China there have been additions of large rotary kilns near large cities where transportation is better developed, but a major capacity increase also has taken place from small "egg-shaped" and shaft kilns. The "egg-shaped" kilns are built below ground level and are lined with brick. They are very small in size. They must be charged, and the material removed manually and are what is known in chemical processing as "batch"-type operations. The shaft kiln is an old technology that has been used to heat many types of minerals and was the type of kiln used in the manufacture of the first portland cement.

Portland cement was first produced by Joseph Aspdin, a bricklayer and mason in Leeds, England, in 1824. It was different from the material used in many parts of the world as a hydraulic binder. Most of the early binders were mixtures of lime and volcanic ash from various eruptions. Mr. Aspdin used limestone and clay in proper proportions and intimately fused these materials by heat treatment to form new compounds. The name "portland" came to the process as a result of the product color, which closely resembled the color of the stone cliffs on the Isle of Portland.

Portland cement is an important product to a developing or a growing nation. It is used almost exclusively in the construction industry. It is the glue when mixed with sand, coarse aggregates, and water that hardens to a stone-like mass, which is used to build water canals, dams, sanitation systems, roads, buildings, and untold other structures. It can be molded and shaped with great ease, so as to decrease the need for hand-cut stone.

Portland cement is made from a myriad of naturally existing minerals, and in some cases, waste materials from other industries. The major chemical compounds formed are tri-calcium silicate (C_3S), di-calcium silicate (C_2S), tri-calcium aluminate (C_3A), and tetra-calcium-aluminoferrites (C_4AF). Thus, it can be seen that a combination of materials which furnish calcium, silica, alumina, and iron are the prime requirements. Such materials as limestone, marls, and oyster shells are commonly used to furnish the calcium minerals. They must be low in magnesia minerals. The other elements come from a varied list; such as, clay, shales, iron ore, and slags. These need to be low in sodium, potassium, and phosphorus minerals.

Exact information concerning cement capacity, production, number of plants, and location were not available to us. We did learn during a briefing on small-scale industries by Institute personnel in Peking that small-scale plants had increased production by a three-fold factor since 1965. In an earlier briefing we learned that China had 2800 small-scale portland cement plants located in 80% of the counties and producing 50% of China's total cement output. Published figures[1] for earlier years show local small-scale production as a share of national total output to be 14% for 1959 and 48% for 1972. The first facilities under this plan were installed in 1958. In those days small mills such as those used in the milling of rice were used to prepare the feed and finished product. Hand crushing was used. One of the early plants was built for an investment of 1000 yuan and employed ten people, who produced 25 kg./da.

One must try to understand the reasons for proceeding in such a manner, because none of the facilities have the economy of scale that would be built in the United States. By 1973, if one estimates that 15.4 million tons were produced by various small-scale processes, the average plant size must have reached 5356 metric tons per year. All of the plants on which we

1. Jon Sigurdson, "Technology and Employment in China," *World Development*, Vol. 2, No. 3, March 1974.

received information, however, were in excess of 25,000 m.t./yr. This means that many of the plants must still be of very small size.

In a briefing concerning cement processes given by Mr. Liu Chien-hsun and Mr. Liu Kung-ch'eng of the Chinese Silicate Society, five points as to why small-scale cement plants were being developed were given. Specifically, they use:

1. Funds from the masses
2. Local raw materials
3. Equipment made locally
4. A low technology base (indigenous methods)

And, they must serve: Agriculture.

There are several ways to finance such projects. Financial help could come from the province or county level. Lower commune levels also could use their accumulation funds to erect such plants, which relieves the central state government from having to allocate funds for a large central plant and still have a difficult transport problem to the job site. Such plants could be built by local authorities as a part of a water conservation project. In fact, many were built in this manner. Seventy (70) % of production goes to agriculture and 30% to local industry. Of course, in a given year these numbers will vary according to need.

Local raw materials should be used. In fact, many areas have small deposits that would not support a larger plant. Clay seems to be abundant throughout China, and small limestone operations were already operating for the stone cutting trades. Local fuel supplies also were important. Many small and low-grade fuels were available and could be used in the shaft-type kiln operation. The low heating value fuels cannot be used in the rotary kiln process.

Much of the equipment was of the type that could be made locally. Plant designs (the earliest of which go back before 1958) were made available by the appropriate industrial ministry. Specific standard designs would have to be altered to meet the existing local conditions. In one example that we saw where expansion had taken place, it was obvious that a compromise had been made with the original lay-out. The basic design types are listed in Table VII-1.

Indigenous methods were required as a result of a low-level of technical capability. The shaft kiln would lend itself to such a situation. Quality of product has been one of the shortcomings of the shaft kiln. We learned that much progress has been made so that now Mark 400 (28-day strengths of 5688 p.s.i.—400 kg./c.m.^{2}) amd Mark 500 (28-day strengths of 7110 p.s.i.—500 kg./c.m.^{2}) can be made. We did not learn if this product is made in all plants at all times. Several Chinese publications obtained indicated that lesser quality has been used in major construction products.

Table VII-1

SMALL-SCALE CEMENT PLANT EQUIPMENT (DESIGN BY INDUSTRIAL INSTITUTE)

KILN				MILL			
Capacity	*Diameter*	*Height*	*Discharge*	*No.*	*Diameter*	*Length*	*Kw*
7,000	1.5	7.0 m.	Manual	2	1.2 m.	4.5 m.	80
20,000 t.	2.0 m.	8.0 m.	Semi-mech.	2	1.5 m.	5.7 m.	135
25,000 t.	2.5 m.	10.0 m.	Semi-mech.	2	2.2	6.5 m.	350
44,000 t.	2.5 m.	10.0 m.	Mechanical	3	1.83	6.1 m.	245

Technicians have been selected from the local people. Assistance has been given by some of the larger factories. Local personnel have traveled to other plants, and other plant personnel have offered on-the-spot assistance.

The shaft kiln lends itself to meeting such criteria as:

1. The use of local manpower
2. Limiting foreign exchange, because whatever was to be done would be done at home
3. Obtaining capital from local accumulations
4. Avoidance of technology not available in rural areas
5. The use of local, small deposits of raw materials which would otherwise not support larger modern plants
6. Relieve an already short supply of transportation
7. Shorter plant erection time

In fact, Jon Sigurdson[2] mentions that India is also using the shaft kiln to advantage under certain circumstances. In a personal conversation with a member of the India Portland Cement Association, this was confirmed. I'm sure that much has been learned since entering this process in 1958. Control of pelletizing moisture is a must for this operation. The pellet formed must retain its shape as it moves through the shaft kiln. Many improvements to control dust were mentioned. Several times it was mentioned that a plant was operating in a "civilized manner." This statement means that working atmospheres have been improved by major dust abatement programs. Packing and shipping is reported as being dusty, but attention is being given to this.

Fuel efficiencies for the small-scale shaft kilns were reported as follows:

Highest — 1300 kcl./kg.
Low — 750-800 kcl./kg.
Average — 950 kcl./kg.

2. Ibid.

Product quality has improved since 1958 from as low as Mark 150. In fact, it was reported that one plant makes 98% Mark 500. They use a dry mortar for making strength tests. A 15-25% water content is used which will tend to make strengths appear higher than we are accustomed to seeing. The chemical and fineness data indicate a lower than normal strength by our standards. They do plan to go to a wet mortar method similar to our ASTM procedures. Slight differences will be made in the testing procedure. This will then allow for a better quality comparison.

During our briefing by the China Silicate Society in Peking, we asked "where are the best small-scale cement plants located?" The Tachai plant in Hsi-yang County and Hui County Plant (formerly Pai-ch'uan) in Huihsien County were rated as being amont their best plants. We were able to spend a short time in each of these plants.

Tavle VII-2 is a summary of the pertinent details for the three plants we visited.

Table VII-2 tabulates many of the details of plant production and equipment. The following paragraphs will furnish further details.

1. *Tachai Cement Factory*. This plant employed conventional wet chemical methods for raw materials, clinker, and cement analysis. They were analyzing for silica, alumina, iron, calcium, and magnesia. The magnesia content was about 1.0-1.5%. Physical testing of cement was not as complete as we would conduct it, but seemed adequate. Tests were made for time of setting, tensil, and compressive strength.

This plant is considered a model plant. Tachai has sent workers to other factories to learn and teach, and some thirty plants have sent personnel to this plant for observation and training.

The limiting factor appears to be raw mix production. To produce 2.5 tph of clinker would require 3.82 tons of raw mix. A flow diagram (Figure VII-1) is included for this plant and is typical of the process being used in the small-scale cement industry in China.

2. *Hui County Cement Factory*. The product from this plant is used in local projects, such as: water conservation, pump stations, canals, reservoirs, roads, and bridges. This is typical of how this industry supports agriculture. There are six other plants located in this county.

The trip through the plant was very hurried, and many items were not developed. It was reported that 70% of the items were built and installed by plant personnel. Some 64 items fall into this category.

Manpower reduction had taken place, and the reported present compliment should have been 800 according to plant management. The new plant expansion comprising two new mills and the automatic shaft kiln was installed in 4.5 months by the plant. During this reconstruction, 100 rooms for workers also were completed.

Table VII-2

SMALL-SCALE CEMENT PLANTS VISITED IN CHINA

Plant:	Tachai	Hui County	Nan-hai
County:	Hsi-yang	Hui County	Nan-hai
Province:	Shansi	Honan	Kwangtung
Origin:	Construction 1967 Production 1968	Construction 1964 Production 1964	Construction 1958[c] Production 1960
Personnel:	144	27 Original 500 Now[a] 15% Women	549[f] 12.7% Women
Capacity:	Designed 7,000 m.t./yr. 1968—3,500 m.t./yr. 1969—7,000 m.t./yr. 1970—10,300 m.t./yr. 1971—12,000 m.t./yr. 1972—14,000 m.t./yr. 1974—20,000 m.t./yr. Plan to double capacity	1964—4 m.t./day 1974—50,000 m.t./yr. 1975—132,000 m.t./yr.[b]	1960—7,500 t.py.[e] 1962—32,000 1965— –[e] 1969—64,000 1974—103,000[e] 1975—6 mos. 58,000 1975—Goal 120,000
Use:	80% used in county capital projects and water conservation 20% in urban projects	90% used locally	All in county
Investment:	350,000 yuan	1,700 yuan Original Total—not available	5,000,000 yuan Total[g] 3,000,000 yuan Province 2,000,000 yuan County
Raw materials:	Limestone—77% Clay —20% Iron ore — 3% Fluorite — – Coal—15% of total raw materials	Limestone—77% Clay —15% Iron ore —8% Fluorite — – Coal—13% of total raw materials	Limestone—82% Clay —10.6% Iron ore — 2% Fluorite —0.6% Coal—5% of Total raw materials
Fuel:	Type: Anthracite Ash: 10% Cost: 3.5 yuan/t. Heating Value: n.a.	Type: Bituminous Ash: 13% Cost: n.a. Heating value: n.a.	Type: Anthracite Ash: 20% Cost: n.a. Heating value: 7000 kcl./kg.
Crushing:	250 mm. x 4 mm.	80 cm. x 60 cm. jaw 12 t./hr.	Jaw 24 in. Hammermill 12.0 mm.
Milling:	Feeders —Table Type mill—Ball Circuit —Open Number —1 Size —1.27 m. x 4.5 m. Production—2.8 t/hr. Motor —80 kw.	Feeders —Vibrating Type mill—ball Circuit —Open Number —2 Size —2.5 m. x 6.5 m. Motor —380 kw.	Feeders —Table Type mill—Ball Circuit —Open Number —2 Size —1.83 m. x 6.1 m. Production—12 t/h. each Motor —245 kw.
Feed preparation:	Type —Pelletizing Type —Rotating disc Water—15%	Type —Pelletizing Type —Disc Water—15%	Type —Pelletizing Type —2.5 m. disc
Kiln:	Type—Shaft Size—1.6 m. x 7.0 m. Temperature—1200–1400°C. Production—2.5 t./hr. Kcl./t.—4000 Refractories—Special mortar, Slag, Alumina brick Discharge—Manual	Type—(6) Egg Shape Type—(3) Shaft—Manual Type—(1) Shaft—Automatic Size—(3) 1.5 m. x 7.0 m. Size—(1) 2.5 m. x 10.0 m. Production—(6) 4 t./d.[c] Production—(3) 3 t./h. Production—(1) 8 t./h. Discharge—See above	Type—Shaft—Two Size—2.5 m. x 9.1 m. Production—6.0 t/h. each Kcl./t.—120 kg./t. Discharge—Automatic
Cement milling:	Type —Ball Circuit —Open Number—Two Size—1.37 m. x 4.5 m. Production—1.6 t./hr. Motor—80 kw.	Type —Ball Circuit —Open Size—(2) 1.5 m. x 5.5 m. Size—(4) 1.2 m. x 4.7 m. Motor—135 kw.	Type —Ball Circuit —Open Number—Three Size—(2) 1.83 m. x 6.1 m. Size—(1) 2.2 m. x 5.5 m. Motor—(2) 245 kw.
Products:	Portland, Mark 400 Slag cements	Portland	Pozzolanic and slag cements
Storage:	Two silos	Eight silos	–
Packing:	Majority—Bag 50 kg.	10% Bag 90% Bulk truck	Bag
Price:	38/t.	n.a.	Wages: Max. 80
Cost:	30/t.	n.a.	Min. 40
Profit:	8/t.	n.a.	Avg. 57

[a]Government standard was for 800 plant personnel.
[b]Production—January through May at 400 t./d. rate; 300 days operation = 132,000 m.t./year.
[e]Productivity—Tons per worker; 1960—20; 1965—120; and 1974—260.
[f][illegible]

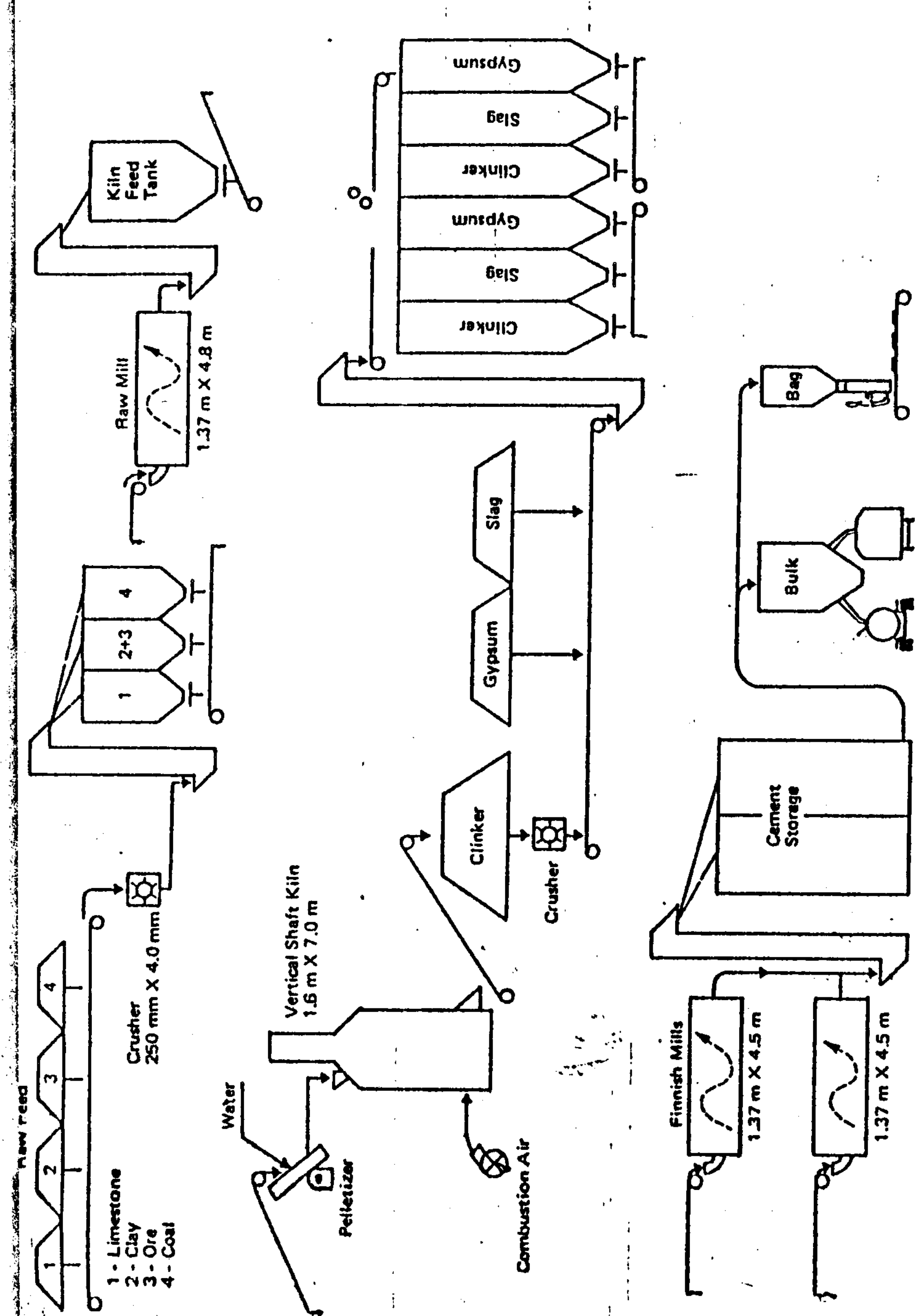


FIGURE VII-1. Flow Diagram, Tachai Plant.

It is our belief that this plant has a much greater potential capacity than is presently shown. Equipment of this type should operate a high percentage of the available time. Using 350 days, or 95.8%, operating time for one's calculations, this would total as follows:

type	*tpd*	*days*	*no.*	*tons*
6 egg-shaped kilns	4	350	6	8,400
3 shaft	72	350	3	75,600
1 shaft (automatic)	192	350	1	67,200
Total				151,200

There appears to be just enough raw grind capacity to sustain the four shaft kilns, so the actual capacity probably should be about 142,000 tons. The "egg-shaped" kilns were not being operated, and we did not see them during our hurried tour. The plant was clean, and appeared to be well maintained.

3. *Nan-hai County Cement Factory.* Construction started in 1958 and went into production in 1960. The plant is a county-run enterprise. The plant was actually built in three stages. The second phase took place from 1964-69. During this phase a call for technical innovation resulted in many changes. Two ball mills were installed; they were 1.83 m. diameter by 6.1 m. long and were powered by 245 kw. motors. Renovation to the shaft kiln resulted in a change from a crude method of pelletizing to 2.5 m. diameter disk-type machines. Feed to the kiln up to now was done manually. An automatic method of charging also was accomplished and improvements in production increased from 2.6 t./h./kiln to 3.4 t./h./kiln. Coal used decreased from 180 kg./t. to 120 kg./t.

The third phase was from 1970 to the present. "Three-in-one" groups were formed, and a further renovation of the shaft kiln was completed. The discharge, which had been manual, was changed to automatic. This was designed, manufactured, and installed by plant personnel. The production was increased from 3.4 t./h./kiln to 6.0 t./h./kiln. Daily production was increased from 110-200 to 220-230 tons. An additional ball mill 2.5 m. diameter and 5.5 m. long was installed in this phase. This allowed achievement of balance in production.

Product was ground into a series of bins and could be extracted by screw type conveyors. All product was packed in bags at a rate of five per minute. These were collected on an automatic stacker and conveyed to a warehouse by hand cart. The bags were a self-sealing type, manufactured at the plant and were 4-ply. Most of the production was shipped in boats having a capacity of 20, 30, and 300 tons. Stock from the warehouse is taken to the dock in two cars powered by a 7.5 kw. motor which can transport 20 tons per trip. Hand loading is practiced at the boat.

The plant is equipped with a good machine shop. Many pieces of equipment have been made here, including the overhead crane for the shop. Duct work for the dust collectors also were being made. A foundry is operated for use at the plant.

Future plans to improve the plant include major attention to the abatement of dust, and several small dust removal units have been designed and installed. The two major areas of concern are the clay dryers and the shaft kilns. Dust from the shaft kiln is high in potassium, so it is planned to be used as a fertilizer. They have erected the superstructure and plan to complete this project very soon. They expect this project to abate 97% of the particulate from the shaft kilns and to collect from 3.3 tons per day of dust to be used as fertilizer. Another project expected to increase production is the replacement of the present Type No. 9 blowers on the shaft kilns with a Type 200 blower. Present blowers have 80 kw. units on each kiln. This should allow for further increases in kiln production.

The Nan-hai County Cement Factory was originally built from plans supplied by the state. Preventive maintenance is practiced because they usually go down with equipment two days per month and an annual major overhaul of 15 to 20 days is routine, in which each piece of equipment is checked. Yearly profit accumulations are partially allocated to maintenance and innovation.

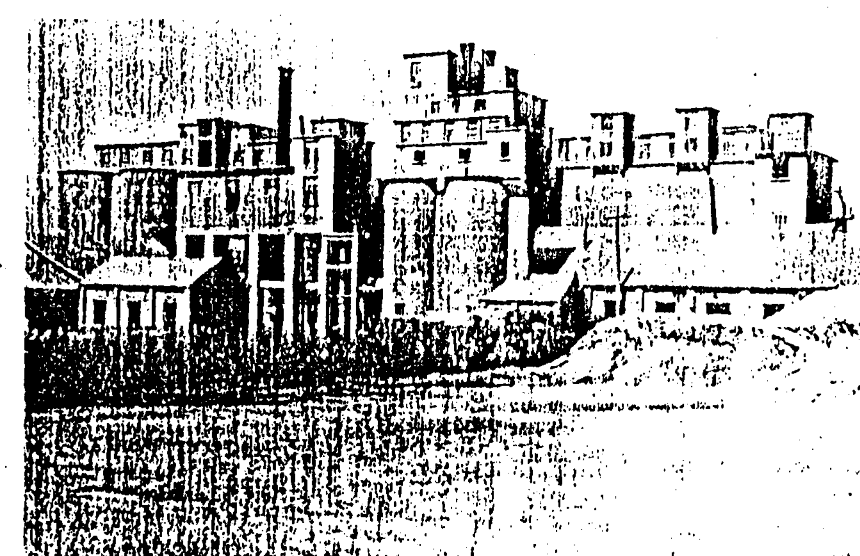
Gross value and price of materials were not available, but we were advised that the cost of raw materials, fuel, and electricity were down, and production was up, so that costs at the plant had to be reduced.

Safety devices were provided, and it was reported that the safety record was good. Three plants, of course, do not make up an adequate sample from which to draw overall conclusions about all 2800 existing small-scale plants. It is clear to me, nevertheless, that the small-scale Portland Cement plant utilizing shaft kilns does meet a need for China under the circumstances and criteria set forth earlier in this report, and this need may still exist for some time into the future. However, as transportation is improved, a more centrally located plant with a much higher productivity and improved quality of product should become more acceptable. For example, the largest plant we saw was producing 103,000 tons of pozzolanic and slag cements. This was being done with 549 workers, not including the quarry personnel. This calculates to 187 tons per worker versus the production of 5200 tons per worker in a very modern cement plant. With some of the new world technology, productivity will improve even further.

Quality of product must become a major concern. The two main reasons why shaft kilns are not used throughout the world are low productivity and unreliable quality. The latter will become more important as more complex structures are required. Very brief observations indicate to me that the making of Mark 400 and 500 products continuously might pose a problem.

It should be repeated that Chinese and American test methods for compressive strength do differ significantly. The Chinese use a dry mortar method which utilizes from 15-25% water. The American wet method uses from 43-45% water. The water content will drastically alter the reported strength. Generally speaking, the lower the water content, the higher the strength. One analysis of Chinese cement indicates that it is ground more coarsely than U.S. products and does indeed develop significantly lower strengths when tested comparatively.

In conclusion, small-scale Portland Cement plants have served a need for China, but in my opinion it is a short-time expedient. Productivity and quality will dictate a different procedure when transportation and materials handling problems can be solved.



Chapter X

EXPANDING KNOWLEDGE AND TRANSFORMING ATTITUDES

ATTITUDES TOWARD TECHNOLOGY

It is a truism that economic development requires many and varied technological skills, but it may not be so obvious that the diffusion of these skills involves much more than simply learning how to do some specific task. Technological diffusion also involves certain attitudes, the recognition of logical-mechanical systems as wholes, and the ability to deduce interrelationships among the various elements of the system.[1] Although China's historical record of technological innovation is rich and diverse, this outlook was traditionally less emphasized than the holistic and analogical patterns of thought which dominated Chinese culture until quite recent times. It was only in the latter part of the nineteenth and the twentieth centuries that the technological outlook began, piecemeal at first, to gain currency in China. Last to be reached were the rural areas, where poor communications and low levels of literacy reinforced the inertia of customary ways and attitudes.

We were frequently told of two kinds of attitudes, which must be transformed in order to promote rural development. The first was an attitude of fatalism, of the impossibility of change. The way things always have been is the way things always will be. Moreover, to tamper with nature or the

1. This ability is movingly described in Richard McKenna's novel, *The Sand Pebbles* (New York: Harper and Row, 1962). See pp. 146-148, 190, and especially 252-256 (page references are to the Fawcett/Crest paperback edition.

traditional ways is to risk dire consequences. References to change in this attitude were often expressed to us as follows: "Formerly we were the subjects of nature (of landlords, of machines, etc.), but now we are the masters of nature."

The second attitude was a kind of superstitious awe of advanced technology, and of those with knowledge of it. Many peasants felt that machines were simply beyond their comprehension or control. To be able to cite a book in which it was written that something must be done in such-and-such a way often conferred a nearly unchallengeable authority on both the process and on the expert who was capable of reading about it.

Much effort has been expended to eliminate or change these attitudes, and it seemed to us that small-scale rural industry has an important role in this process, partly as cause and partly as effect. The existence of local industry is one indication of the changes that have already taken place, while at the same time, it provides a mechanism for further change.

During our visit to China, we heard on several occasions a series of parallel phrases which express at least part of the Chinese attitude toward small-scale industry. The phrases are (1) "*ts'ung hsiao tao ta* (from small to large)," (2) "*ts'ung tien tao mien* (from key points to general application)," and (3) "*ts'ung t'u tao yang* (from indigenous to modern)." The first two phrases are fairly straightforward: small-scale industry is intended to grow in size and scope. The third phrase is both more complex and more revealing.

The term *yang* has a checkered history in China. Literally, it means "ocean, sea." Hence by connotation it has come to mean "coming from overseas: foreign, as opposed to native." That it was used during the nineteenth and early twentieth centuries in the names of modern products, which China was at that time unable to produce herself (e.g., "*yang-huo*—foreign fire—matches," "*yang-yu*—foreign oil—kerosene") seemed to many Chinese a humiliating reproach to Chinese backwardness. In this way, there has taken place a partial merging of the ideas of "modern" and "foreign, alien," a conceptual and psychological conjunction that is reflected in a certain ambivalence toward modernization. To the extent that *t'u* means "native, indigenous," it is identified with the Chinese people and is at least potentially good; to the extent that it also suggests backwardness and primitiveness, it is to be eliminated or transcended. On the other hand, where *yang* means "modern, developed, strong," it is a goal to be achieved; but when it suggests "foreign, alien, westernized," it risks revisionism, the restoration of capitalism, and a continued implication of inferiority by comparison with technologically more developed societies.

To some extent, the "red and expert" issue shares a similar polarity and a similar ambivalence. Expertise is prized, but there is a lingering think the only way something can be done is the way it is done in foreign countries and described in foreign books, which they accept as authoritative. Consequently, they are divorced from the masses, whose ruder methods they look down upon as unsuitable. In this stereotype, the experts want large-scale, urban enterprises, full of the most advanced technology and imported machinery. The perfect "red" is, of course, the antithesis of all this: one with the masses, confident in their ability and their methods, unintimidated by the presumed superiority of the technological mandarins and their foreign mentors. There is thus some degree of consonance between "red" and "native" on the one hand, and "expert" and "foreign" on the other.

Central to the resolution of this contradiction is technological assimilation and accessibility: technologies which are felt to belong naturally in one's immediate environment, not as wonderful and exotic phenomena; and technologies which are capable of being thoroughly understood and mastered by those at all levels who work with them. "Most of the machinery in this plant was made and installed by ourselves." "Our own staff, in teams made up of old workers, cadres, and technicians, have produced 104 innovations in the past six months." Such phrases, which we heard over and over again, bespeak an important role in assimilation and accessibility for local small-scale industry.

The products of such industry have immediate and obvious utility. The production process, from beginning to end, is short enough and straightforward enough to be understood by most workers willing to make the effort. Yet these industries employ machines, machine tools, and processes of substantial complexity. Innovations, even minor improvements, show that the technology and the production process is well understood, and they evince the satisfactions that come with understanding and mastery.

When a young worker has spent several years in a commune or county industry which makes, say, tractor parts, has helped to make the machine tools which make the parts, has been part of a mobile team that goes to the fields during the busy season to make repairs on the spot—when all this has been done, he or she is both competent and confident. If we now imagine that this worker now goes on to a large modern factory, to a university, or to a technical training institute, he or she may well be able to approach a combination of the best features of "red" and "expert," of *t'u* and *yang*.

TRAINING AND THE DIFFUSION OF SKILLS

When one turns from these rather general attitudes toward technology to rural industry itself, one is immediately aware of its importance as a technological training ground. At commune and brigade levels, workers are drawn directly from the peasant population—indeed, they are *both*

peasants *and* workers in that they continue with few exceptions to live in their rural homes, their income is figured in work points rather than in regular wages (as in industry at county and higher levels), and many are dispatched to the fields during periods of peak agricultural activity. This training function is essential, therefore, to the development of a competent labor force.

Although this training function is carried on in all of the "five small industries," it was particularly obvious in the machine shops which existed in every commune and many brigades which we visited. In most cases, some mix of three kinds of work was being done. First, there is the manufacture, usually in batch rather than in continuous flow, of some product or part: water pumps, electric motors, implements, bearings, gears, etc. Second, is the building of machine tools or other capital goods which provide expanded and diversified capacity. We saw lathes, shapers, and pneumatic hammers being built at commune level; in a commune in Hui County (Honan), we saw a ball mill being made for the cement plant the commune was constructing. Third, one sees assembly and repair, with larger jobs being done at commune level and more routine maintenance and repair at brigade level.

All three activities develop or enhance competence in the use of machine tools, semi-precision instruments, and design work. We saw many examples of apprenticeship training being done among younger workers, frequently women, who staff these machine shops. For example, in Liu-chuang Brigade (Ch'li-li-ying Commune, Honan), older workers were obviously instructing young women lathe and shaper operators, who were simply learning how to work the machines and were not making parts. It might be observed in passing that this sort of equipment, and this sort of competence allows considerable flexibility, desirable in the absence of machine standardization, and easily obtained spare parts: to a considerable extent, one can make one's own.

On-the-job training and education is but one aspect of technological diffusion. In writing about the interdependence of enterprises, Jon Sigurdson described a series of linkages which conformed closely to the patterns we observed.[2]

> Links between county-run enterprises within the county: (1) Transfer of skilled manpower; (2) training of manpower; (3) transfer and delivery of equipment; (4) learning the spirit of self-reliance—in order to economize on funds and equipment.
>
> Links with county-run enterprises outside the county: (1) Learning indigenous production technology; (2) learning how to make indigenous equipment; (3) establishing co-operative relations for the future.

2. "Rural Industry—A Traveler's View," *China Quarterly*, 50 (April-June 1972), 326.

Links with higher level enterprises: (1) Learning modern production technology; (2) obtaining ideas for modifying design; (3) establishing donor-recipient relationship, involving further training, on the spot assistance and delivery of equipment.

So often were these contacts mentioned that we began to refer to them as the practice of "sending out and inviting in." A small-scale plant will frequently send its own technicians to larger and more developed plants or to technical institutes to learn about some process which the smaller plant intends to adopt or to improve. Conversely, larger and more developed plants are often asked to supply technological talent to help a smaller plant with its problems. There is thus both a consumer and a supplier function: an enterprise consumes technology from higher levels and supplies it to lower levels. That this flow is sometimes not without problems was suggested by a responsible person in a county-run plant in Honan who said that other factories were often too busy to provide needed assistance. On the other hand, a technician in a Wu-hsi county enterprise remarked that they often sent personnel to Shanghai, fifty miles away, for technical consultation. When asked how this was arranged, he replied, "We just get on the telephone, and tell them we're coming." These may represent two extremes; perhaps, also, "sending out" is easier than "inviting in."

As Sigurdson indicates, the flow can be lateral as well as vertical, between enterprises on the same, or nearly the same, level. Among the places we visited, the clear champion in this regard was the county-run fertilizer plant in Hui County (Honan).[3] The walls of its conference room were literally covered with banners and mirrors expressing thanks for assistance rendered. We spotted only two from commune-level fertilizer plants (one in Honan, one in Shensi near Yenan), but many from county-run plants in Honan, Shansi (2), Shensi, Shantung (2), Anhwei, Peking municipality, Tientsin municipality, Chekiang, and Yunnan. This last one was particularly impressive since the plant went into production only in 1970.

At the county level, the consumption and supply of technology seem about balanced; lower down there is more consumption than supply, while at higher levels the responsibility for supplying technology is greater. In the large plants we visited, technological training appeared to be quite systematized and regularized. In a Cheng-chou textile mill employing 5600 workers, there were at the time of our visit about 3000 middle school youths in the plant for a three-to-four week period of labor.

3. This plant was featured in a recent issue of *Peking Review*: No. 32 (August 8, 1975), 16-19. It is noted, among other things, for having constructed nitric acid absorbing towers out of quarried granite rather than of the conventional stainless steel, at a savings of 80 tons of steel.

Worker institutes, called "7/21 Worker Universities (*Ch'i erh-i kung-jen ta-hsüeh*)" after Chairman Mao's Directive of July 21, 1968, existed at two plants we visited. The first, at the Hsinhsiang Cotton Textile Plant, had been established in 1974, with forty students currently enrolled. Much more well-established was the 7/21 School at the Shanghai Machine Tools Plant, where such an institute was first established in China. The full course lasts for three years of combined study (both political and technical) and work, the proportions of which were not clearly explained. Since 1968, three classes have gone through the school: 52 in the first; 98 in the second (of whom 40 came from other factories); and 109 in the third class, now in session (60 from other factories). There are 26 instructors, four assigned from universities, and the rest drawn from the plant's own staff. After completion of the course, most students return to their parent plant as technicians and planners among other things. Since almost half of the second and third classes will be returning to other, presumably smaller and less advanced plants, the role of the Shanghai Machine Tools Plant in technological diffusion is a significant one.

THE ROLE OF EDUCATED YOUTH

The role of educated youth in rural development generally and in local industry in particular is not easy to determine with confidence. What follows, after a few general comments to put the issue into some perspective, is not in any way an overall assessment of the movement, but only a description of what we saw and heard about educated youth (some of this data is presented in tabular form). Although we tried to ask about this subject wherever we went, we were not always successful in obtaining answers, nor was it usually possible to ask as many questions as we might have wished. Readers should therefore use this material with caution, realizing that the data is fragmentary, may not be typical, and has not been systematically compared with the literature on the subject. At the end of this section, we shall draw a few tentative inferences from what we learned.

"How you gonna keep 'em down on the farm" is a line from an American song that would translate easily into the languages of most developed or developing societies: rural youth wants to move to the cities, and urban youth wants to stay there. Indeed, the urbanization of modern skills is so widespread a phenomenon in developing societies that it seems natural, almost inevitable. Yet there is increasing recognition of the serious imbalances which may result from such a trend. The urban sector cannot absorb so many young skilled and unskilled workers, technicians, and intellectuals, with consequent unemployment (or underemployment), wasted abilities, and the explosive discontents that come from blighted hopes. The cities tend to be overcrowded anyway, especially in countries with large rural populations, and this migration further increases the demands placed on all urban services: food, housing, sanitation, transportation, and police among others.

Meanwhile, the departure of large numbers of rural youth deprives the countryside of their labor and their potential leadership, for it is among the most able and energetic that the migrants are usually found. This widens the gap between rapidly modernizing cities and increasingly stagnant hinterlands. Once it begins, such a pattern tends to be self-sustaining, unless strong counter pressures are brought into play.

Chinese leadership is fully aware of this problem, whose effects were already being seen by the 1930s at the latest. Since 1949, there have been periodic but only partially successful efforts to control rural-to-urban migration and to return surplus population from the largest cities (especially Shanghai) to the rural areas whence it came. Mao Tse-tung, in particular, has always felt greater affinity for rural China than for her cities, which he mistrusts as potential sources of revisionism and bourgeois values. In addition, he is committed to closing the gap, as much as possible, between rural and urban China. Finally—and this is very important—he wants the youth of China, the "revolutionary successors," to train themselves in selflessness, dedication, and service. These traits, he feels, can best be inculcated by the poor and lower-middle peasants.[4]

A campaign aimed at these various goals is the sending to the countryside of educated youth (literally, "*shang-shan hsia-hsiang chih-shih ch'ing-nien*, or educated youth going up to the mountains and down to the villages," also more conventionally called "sent-down youth" or "rusticated youth"). This movement takes as its point of departure the call issued by Mao Tse-tung in December 1968: "It is highly necessary for young people with education to go to the countryside to be re-educated by the poor and lower-middle peasants."

It is said that since late 1968 over 10,000,000 educated youth have volunteered or been assigned to work in the countryside. Much has been written in China and elsewhere about this movement; indeed, from written materials it appears to be one of the most significant ongoing social movements since the Cultural Revolution (many Red Guards having been among the first sent to the rural areas).

Considering the magnitude of the movement and the amount of publicity it has received, there was what seemed to us a rather low level of

4. Chinese sources explain that "poor and lower-middle peasant" is "a term denoting class status and not present economic status." It is selectively descriptive (of those occupying this class stratum in the old society) and normative (referring to those who exhibit the attitudes and values said to be hallmarks of this stratum).

interest in our questions about educated youth. These questions were usually answered without very much elaboration or encouragement to continue along this line. Only once, at the large and self-confident Red Star Commune near Peking, did we speak directly to a person identified as a sent-down youth; on a few other occasions, an educated youth was pointed out to us. It should, perhaps, be noted in passing that virtually all of our information came from areas to which educated youth might be sent, not from the cities whence they might have come.

We quickly discovered that a distinction is often (but not always) made between two types of educated youth. The first are "sent-down youth," coming from the cities or towns for their first prolonged stay in the country. The second are "returned youth (*hui-hsiang chih-shih ch'ing-nien*)," coming back to their native place. The identity of these returned youth is a little unclear. A few may have returned from service in the PLA, but the majority are probably either young persons who had gone into the cities and towns seeking wage labor (what was called in one brigade, "*p'ao ch'eng-shih kao fu-yeh*, going off to the cities to get sideline jobs"), or rural youth who had received some of their middle school education in town.[5] The subject of returned youth seemed to arouse marginally more interest than that of sent-down youth, probably because the former are naturally identified as members of the locality, whereas sent-down youth are outsiders.

We were given no very specific information concerning the nature and amount of education possessed by educated youth, except that most had graduated from middle school (graduates of universities and technical institutes have passed beyond this classification). Graduates of either lower or upper-middle school may be sent (or returned) to the countryside, and this may occur up to as much as several years after graduation if a higher priority work assignment has not been obtained.[6] Hence, educated youth may range in age from about 15 to the early 20s.

Without exception, we were told that educated youth were first assigned to a brigade and team ("*ch'a-tui*, inserted into a team") and required to perform ordinary farm labor.[7] After a substantial period of re-education by the poor and lower-middle peasants, usually said to be two or three years,

5. This might be because some levels or kinds of schools are not operated by the commune, requiring that students be sent elsewhere. In other cases, family ties might be utilized to enable a youngster to continue his education in the city.

6. In Shanghai, we were told, middle school is now a unified four-year course, with no distinction between lower and upper middle schools.

7. Quite frequently and with unconcealed symbolism, this labor involves the handling of nightsoil and manure. Mao is cited: ". . . In the last analysis, the workers and peasants were the cleanest people and, even though their hands were soiled and their feet smeared with cow dung, they were really cleaner than the bourgeois

educated youth are eligible for reassignment. We did not learn very much about how this reassignment takes place, or how many educated youth are affected by it, but the options seem to be these:

1. Reassignment away from the commune or brigade; we saw or were told of (a) return to factory work in the city, (b) entry into the People's Liberation Army, (c) successful application to higher education.

2. Reassignment within the commune or brigade; this was the most commonly mentioned option, with teacher, barefoot doctor, technician, and accountant the most frequently cited jobs. Less frequently mentioned were factory worker, tractor driver, cadre, Party member.

3. Continuing assignment as an ordinary farm worker.

In post-Cultural Revolution China, one can apply for admission to higher education only after a period of work on the production front. Applications must contain recommendation and endorsement by the unit in which the individual has served and by the relevant Party branch. This is unquestionably a major factor in motivating young persons to go to the countryside and to work hard while there.

For many educated youth, therefore, the stay in the countryside is a temporary though prolonged sojourn. Others, however, become permanent members of the local unit: it is said that they "*lo-hu*, settle a household," often by marrying a native or another educated youth. *Lo-hu* is not always done voluntarily, and may sometimes be required for the second option above. Since the commune or brigade makes the assignment and pays whatever additional training costs may be involved, its leaders wish to select those who will remain within the local system. Partly for these reasons, returned youth may be deemed a better risk than sent-down youth.

In the areas we visited—none of them in the remoter areas of China—most of the sent-down youth came from a few nearby urban areas, including county-level towns. This pattern, often noted in the Chinese press, seems to be quite common in the more traditionally settled areas of China. The reasons for adopting it are easily inferred:

1. Youth coming from the same (or nearby) cities have much in common, and can provide companionship and support for one another.

2. Being sent to a nearby area makes for a relatively quick adjustment and avoids the very great difficulty of learning to communicate effectively in a strange dialect. Climate, food, and local customs are also less strange than in a more distant area.

3. Family ties can be more easily maintained, with correspondingly readier acceptance of the assignment by the youth and by his or her family.

Only in Wu-hsi County (Kiangsu, 50 miles west of Shanghai) were we told

of work teams made up primarily of educated youth, although we know from material published in China that this practice is quite common.[8]

The process by which educated youth are assigned to particular communes and brigades was not described to us, but we caught some glimpse of the considerations which might be involved from the point of view of the receiving units. Red Star Commune, we were told, welcomed the assignment of sent-down youth because the labor situation there was "very tight." Precisely the opposite was true of Liang-ts'un Commune in Hui County, Honan. Here, where land reclamation was the major preoccupation of the commune, it was said that land was scarce, and no additional population was wanted; hence there were no sent-down youth in this commune.

It has already been noted that one of the movement's goals is the re-education of educated youth by the poor and lower-middle peasants. In Chinese publications, this is by far the most salient goal. But it is also thought that another goal is to increase the supply of educationally skilled manpower in the countryside, thus facilitating rural development.

In the areas we visited, it is difficult to say what the payoff may be for rural development. It was little dwelt upon by our Chinese hosts, except in general terms. There may be several reasons for this. First, the number of educated youth is very small in the units we visited. Only in Red Star Commune, which may be as atypical in this as in several other respects, did the number exceed 1% of the total population; in most units, it was much less than that. Second, upon arrival, most educated youth have little to offer beyond their intelligence and literacy; for the first two years or so, during which they are performing manual labor, neither their intelligence nor their literacy may be put to use. In most cases, educated youth will not have had enough work experience before rustication to have acquired specialized skills. On the contrary, for farm work they are initially less capable and softer than their local peers. They may require the guidance and supervision of peasants who might otherwise be working. After a learning and toughening period, they probably become as effective as peasant youngsters, but if they then leave the countryside to be replacd by others, the process must begin again. Even for those who *lo-hu* permanently, reassignment will require further training and experience. There is little doubt that in the long run, those educated youth who remain in the country will become potentially important contributors to rural development. But their impact is delayed, and it may be further attenuated by small numbers and dispersion. Finally, as local educational facilities are gradually developed and improved, more and more rural areas will be able to home grow their own educated manpower, at least to the middle-school level.

8. See, for example, *China Reconstructs*, XXIV:7 (July 1975), p. 2-13.

To return to a point made earlier, our delegation visited units in traditionally settled regions of China. Several—above all, Ta-chai and Lin-hsien—were models of rural development, to be emulated elsewhere in China. Others (e.g., Wu-hsi) were clearly prosperous and able to take care of themselves. One might expect that it is precisely in such areas that educated youth would have the least to offer, and it may be for these reasons that relatively few such youth have been assigned to them. In the remoter areas—in Heilungchiang (often chillingly called the "*pei ta-huang*, the great northern wilderness"), in Yunnan, Kansu, Sinkiang, and in the poorer regions of China proper—the experiences and the role of educated youth may well be very different from those in the areas we saw.[9]

THE ROLE OF THE PRINTED WORD

In recent years, the spread of technology has been greatly facilitated by numerous publications of new books by both national and provincial presses. Judging from the number of browsers and purchasers in bookstores, these books are avidly consumed by people trying to keep up with new technical information. There are a few highly specialized books for senior engineers. There are translations of foreign technical books, and journals dedicated entirely to translations of foreign technical articles. But many, if not most, of the new books are meant to popularize technology for workers, peasants, and educated youth.

An example is the 108-page booklet on carbonization processes in small-scale nitrogenous fertilizer plants.[10] Subtitled "Reading material for Workers," this book provides flow charts, formulas of chemical reactions, graphs of differences in chemical reactions under varying pressure and temperature conditions, detailed drawings of the internal construction of valves and chambers, as well as maintenance and repair procedures. Printed in 30,500 copies in December 1971 and selling for only 0.28 yuan, this book is part of a series of six paperbacks meant to be used by workers in after-hours study classes (at the Wu-hsi Electro-chemical Plant, these voluntary classes were said to meet three times per week—once for political study and twice for technical study).

There are similar series for other industries. For small cement plants there is a series of eight booklets covering basic knowledge, raw materials,

9. At Fu-tan University in Shanghai, an extensive correspondence course program has recently begun, with 16,000 students enrolled. Most are sent-down youth from Shanghai. Provinces with large numbers of corresponding students are Heilungchiang, Anhwei, Kiangsi, and Yunnan.

10. Light Industry Bureau, Hopei Province, *T'an-hua* [*Carbonization*]: Small-scale Nitrogenous Fertilizer Plant Production, Reading Material for Workers (Peking: Fuel Chemistry Industry Press, 1971), 108 pp. Union ser. no. 15063.2039.

grinding, firing, equipment, chemical analysis, inspection, and raw cement. The first book in the series, basic knowledge for cement production, was printed in 42,750 copies in 1972; it contains 76 pages and sells for 0.20 yuan.[11] There are other collections of books for agriculture. They cover a wide array of topics: how to raise and prevent diseases among pigs, ducks, chickens, horses, cows, bees, silkworms, and fish. There are books on different grains, their scientific cultivation, test and control plots, and cross-breeding for new strains of plants. There are books on fertilizer application, and books explaining agricultural machinery and its maintenance.

We bought three books on fertilizer application. Though meant for a popular audience, two of these books go into great detail as to the nitrogen, phosphate, and potassium content of various kinds of fertilizer. The advantages, disadvantages, and appropriate application procedures of different fertilizers are discussed. Included are not only the more common chemical fertilizers, but also a very large number of organic fertilizers. One booklet, published in Kwangtung Province, lists the composition of almost 150 potential organic fertilizers, including manure and urine of humans and twelve different animals, various kinds of pressed oil cakes, water plants, vegetables and grasses, silt from rivers and ponds, as well as cured compost.[12] The Kwangtung fertilizer book, with 109 pages and selling for 0.26 yuan, was first published in 50,000 copies in 1974, then republished in another 50,000 copies in 1975. With a total of 100,000 copies, the book could reach every brigade and many work teams in Kwangtung Province.

Many of these books are published for rural administrative personnel, but because in many rural areas the standard of education is now seven years—five years of primary school and two years of lower middle school—many local youth can read these books as well. Equally important, perhaps, these books are aimed at educated youth sent to the countryside after completing seven, nine, or even twelve years of education in the city. This may explain the large stock of such books in city bookstores. By being able to read about and put into practice new technical know how, these urban youth with usually superior education may be given a more meaningful role in the countryside.

In addition to these narrowly technical books, there are a large number of books meant to popularize the leadership, economic, and ideological experiences of advanced production units. These popularizing agricultural

11. Editing group for small cement technology compendium, *Shui-ni sheng-ch'an chih-shih* [*Cement Production Knowledge*], (Peking: Chinese Construction Industry Press, 1972), 8 vol, Union ser. no. 15040.3003.

12. Kwangtung Province, Agricultural Bureau, Technical Materials Editing Group, *Fei-liao chih-shih wen-ta* [*Questions and Answers on Fertilizer Knowledge*], (Canton: Kwangtung People's Press, 1974), 109 pp. Union ser. no. 16111.206.

Table X-1

DATA CONCERNING EDUCATED YOUTH (COLLECTED BY THE SMALL-SCALE RURAL INDUSTRY DELEGATION)

Unit	*SDY**	*RY**	*Origins (SDY)*	*Comment*
Hopei Province, Peking Municipality				
Red Star Commune (also known as the Sino-Korean Friendship Commune; 10 management districts, 129 brigades, 17000 families, 82000 persons	5600		Peking only	SDY currently comprise ca. 7% of the total population. A total of 7200 SDY have served in the commune since 1968, but no information was obtained concerning length of service, rotation, etc. SDY are assigned directly to labor in the brigades; after a period of about two years, they may be reassigned. "Several tens" of SDY were said to be employed in commune industry.
Shansi Province, Hsi-yang County				
Hsi-yang County; population ca. 200,000	ca. 500		"Mostly Peking, Tientsin"	Ta-chai Brigade, the national model in agriculture, has no SDY.
An-p'ing Peoples Commune; 26 brigades, 2700 households, over 10,000 persons	0	1500		Of these, about 120 have been educated beyond upper middle school. About 200 RY have been assigned to units outside the commune.
Shih-p'ing Brigade (Li-chia Chuang Peoples Commune); 8 work teams, 480 households, 1970 persons	0	ca. 100		
Agricultural Machinery Plant (county managed); 310 workers	20+			SDY are nominated by the brigades to which they are assigned; none come directly from the city to the factory. No information on the tasks performed by SDY in this factory
Honan Province, Lin County				
Lin-hsien; 15 communes, 487 brigades, 3932 work teams, about 700,000 persons	ca. 1000			All are first assigned to labor in the brigades and work teams, after which they may be reassigned as teachers, technicians, etc. Assignment decisions are made at the brigade level.
Ta-ts'ai-yuan Brigade (Ch'eng-kuan Peoples Commune); 340 households, 1700 persons	0	About 10 per year		Both barefoot doctors in the brigade are RY.
East is Red Agricultural Machinery Plant (county managed); over 300 workers	A few			Head technician (mid-30s) is a native of Manchuria.
Lin-hsien Cotton Weaving Factory; 186 workers	0	0		
Honan Province, Hui County				
Kao-chuang Peoples Commune; 21 brigades, 218 work teams, 31,500 persons	78			These SDY are assigned to one or the other of only two brigades in the commune. After a period of labor assignment, they may be made barefoot doctors, teachers, etc., in other brigades.
Hsin Liang-ts'un Peoples Commune; 27 brigades, 220 work teams, 42,000 persons	0	Some		Reason given for the absence of SDY was that the land-to-population ratio was low in this commune; additional population was therefore unwanted.
Hui-hsien Chemical Fertilizer Plant; 536 workers	15			
Honan Province, Hsin-hsiang County				
Ch'i-li-ying Peoples Commune; 38 brigades, 298 work teams, 9500 families, 55,000 persons	Over 300		Mostly from Hsin-hsiang City and Cheng-chou	First assigned as labor, then eligible for reassignment as accountants, technicians, etc.

ble X-1 Continued

Unit	SDY*	RY*	Origins (SDY)	Comment
angsu Province, Wu-Hsi County				
u-hsi County; 36 communes, population over)0,000	Some (of 8000)	Most (of 8000)	Some from Chen-chiang, Ch'ang-chou; a few from Nanking	I.e., total of both SDY and RY is about 8000. Educated youth are re-educated by the poor and lower middle peasants; they participate in agricultural production, class struggle, and scientific experiment. More than 500 educated youth have been selected to serve in leading organizations at various levels; over 1500 have become agro-technicians, barefoot doctors, teachers, accountants, etc.
ei-ts'un Peoples Commune; 22 brigades, 104 ork teams, 7475 families,),817 persons	180 combined total			After re-education by the peasants, they become cadres, agro-technicians, tractor drivers, barefoot doctors. Some have been sent to the university.
anghai Municipality, Chia-ting County (Chia-ting County)				
-lu Peoples Commune; brigades, 144 work ams, 7020 families, ,000 persons	About 500		Mostly from cities in Chia-ting County; a few from Shanghai	First tempered in labor, then may be reassigned to other tasks.

*SDY: Sent-down youth
RY: Returned youth
see text for definitions.

models usually run to at least 100,000 copies in the first printing. One 190-page book on the July First Commune outside Shanghai had 100,000 copies in its first printing in June 1974 and was then reprinted in 200,000 additional copies three months later.[13] Through these books, other local leaders learn about the proper mix of water control, field reconstruction, mechanization, leadership techniques, and ideological study, which will hopefully bring success throughout China.

SUMMARY

What we witnessed in China was an extensive, flexible, and varied system for acquiring, adapting, and utilizing standard technologies. By and large, these are not high technologies by international standards, but many such technologies would be inappropriate or of little use in the countryside. Furthermore, higher technologies require (take for granted) a broad foundation of basic technology and a labor force skilled in its use. This the Chinese are in process of creating. When one reflects on how far the Chinese have come since 1949, progress is impressive indeed.

Partially as a result of the emphasis placed on local small-scale industry, a technological infrastructure, previously lacking, is now coming into existence. It is easy for persons from technologically developed nations, where a literate and technically competent labor force has long been taken for granted, to forget how long and painful was the development of this labor force in their own society. This can lead, quite unintentionally, to the application of inappropriate assumptions, comparisons, and judgments.

13. History of Shanghai July First People's Commune, *op. cit.*

Chapter XI

CONCLUSION

In the summer of 1975 China's rural, small-scale industry program had entered into a new expansionary phase centered on farm mechanization. At least that was clearly the case in the areas we visited. Everywhere we went factories were equipping themselves for the production of new (for them) machinery from hand tractors to rice transplanters. At the same time the previous stage in these industries' development, that centered on cement and chemical fertilizer, was in no way being abandoned. Factories in these sectors are being expanded in scale and many of their processes mechanized. The day will probably come when these enterprises can no longer be called "small-scale," but they presumably will continue to be located either in the countryside or in small county towns scattered across the length and breadth of China.

The prime motive force for this extensive development lies within the counties and communes themselves. Provincial and central government planners sometimes provide financial aid and more frequently technical assistance, but it is the interests of the localities that drives the program forward. High transport costs and bureaucratic bottlenecks inherent in central planning both stand in the way of the supply of local needs, and the way around these barriers is to do it oneself.

The ideas for the various parts of the small-scale industry program, of course, did not spring full blown and unprompted from the heads of local

farmers and cadres. In fact, for the past decade and more, the major thrust of the Chinese Communist movement has been based on the view that attitudes must be transformed by education including moral example before people will see and take the correct road. Thus the Tachai Brigade is not primarily an example of land levelling and drainage technology, but of the spirit of what human beings can do for themselves if they are sufficiently determined. And millions of Chinese, particularly the young, are brought to Tachai to study this experience firsthand.

Nor does the technology for the small-scale program originate in rural areas although adjustments in this technology are constantly being made by local people. Research institutes at the province and higher levels, large-scale urban factories, and other similar organizations are the original sources of the basic techniques. The Chinese are not busy reinventing the wheel over and over again in each county. The more advanced counties instead learn from these higher level units; they in turn then pass their experience on to other localities.

Are these enterprises efficient? Much, of course, depends on what one means by the word efficient. In an idealized world where transport and commercial systems are highly developed, many of China's small-scale operations might not make much economic sense. But China is a developing country and like most developing nations, although not always for the same reasons, China's distribution system is anything but efficient.

The issue, therefore, is whether these localities should wait until the state puts up a large chemical fertilizer or farm machinery plant or go ahead on their own relying primarily on local resources. If these local resources could be readily transferred to a major urban center, the efficient decision might well favor the larger urban plant. But these rural plants use local outcroppings of coal, local limestone, and, most of all, local labor many of whom continue to live in their old village homes. The cost of transferring many of these resources would be high and possibly even prohibitive. Basic to the Chinese idea of efficiency, as well, is the concept of dynamic efficiency. Many small-scale plants at the moment may be high-cost producers, but their costs come down as they learn better how to manage operations and expand output.

We, for the most part, saw some of China's best small-scale plants, and therefore we are not in a position to judge what is happening in the country as a whole. Nor were we able to collect enough price and cost data to do a full blown cost-benefit analysis. But in the areas we visited, most small-scale enterprises appeared to be producing items for which there was a ready local market. In fact, there were frequent indications that local demand exceeded the available supply at the going price. It also appeared to be the case that at these prices most enterprises made a profit, often a quite large one. If the opportunity or social cost of many of the inpu these enterprises were used instead of the higher actual wages and raw material costs paid, it is likely in most cases that net social benefits would be higher than reported profits. Whether the net social benefit would have been even higher if these resources had been concentrated in large-scale plants cannot be determined with the data available to us, but it seems unlikely.

For the most part, the technology being used in the small-scale enterprises we visited was not unique to China. There were, to be sure, both major and minor exceptions. No one else in the world produces ammonium bicarbonate for use as a fertilizer. And Chinese farm machinery designs make greater use of cast iron and less of sheet steel than those elsewhere. Generally, however, it is not the techniques themselves that the Chinese are adding to the world's storehouse of knowledge, but the fact that these techniques can be adapted to rural conditions on a widespread scale.

How good are the products coming out of these enterprises? In many cases the quality of output by industrialized nation standards is low, but that comparison is not particularly relevant. More significant is that these products seem to meet a real need at China's current level of development. One does not require high quality cement in the dominant forms of rural capital construction currently underway in China. And if ammonium bicarbonate would involve more bother than it is worth for American farmers who have access to higher quality materials, Chinese farmers don't have comparable access to supplies of urea and the like, and ammonium bicarbonate does significantly increase the amount of nitrogen in the soil.

Rural China's economy at present is not being transformed solely or primarily by rural small-scale industry. County and commune level irrigation works (except for well digging) still involve the mobilization of great amounts of labor combined with relatively little machinery. Even fertilizer still comes more from organic than from industrial sources. And a majority of activities in the field from transplanting to harvesting are still done by hand. But rural small industry is playing an important if supplementary role in raising Chinese farm yields and in feeding the Chinese people. In areas such as those which we visited where these industries have been highly developed, Chinese grain yields are comparable to those in the most advanced agricultural regions in the world, including Japan. It is reasonable to assume that this combination of high yields and well-developed local industry is not a coincidence.

The Chinese, of course, are interested in transforming more than food output, and rural small-scale industries play an important role in the broader effort at social transformation as well. Millions of peasants throughout the country are acquiring through these factories a familiarity with modern technology that will serve them in many ways, not just in those connected with agricultural production. And the peasants involved are not just men.

Large numbers of women are participating in this education in modern technology.

Rural industries also tend to narrow the gap between rural and urban experience in other ways. Factory workers continue to live in rural villages and draw wages not too different from their farming relatives. These workers thus tend less to think of themselves as a class apart and above their rural compatriots as has so often happened in all developing countries including China.

Rural small-scale industries, needless to say, are not the solution to all of China's economic and social problems either now or in the future. Their essential role is really an interim one, to help bridge the gap in both economic and social terms between China's current rural-oriented reality and a future in which China will be both industrialized and urbanized. In fact rural industries will often be the base from which new urban centers will arise. As rural small industries gradually expand in scale and number they will not be moved into existing urban centers. To the contrary, urbanization will be brought to them.

MOD 6 *

10. Relating exports to a weighted index of GDP for major import countries (*PW*) and the relative price of exports (P_x/PXW) gave the following result:

$$\log X = 93.01 + \underset{(0.097)}{0.197} \log(QW) - \underset{(61.1)}{35.385} \log(P_x/PXW),$$

$$R^2 = 0.303.$$

Unless the independent variables can be predicted with some confidence, however, the equation is not of much use for forecasting purposes even if the explanatory power of the function is high.

11. This is a purely arithmetic point that a rate of growth applied to two unequal magnitudes will widen the absolute inequality.

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Brick Manufacturing in Colombia : A Case Study of Alternative Technologies

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Summary. – There is systematic variation in size and capital-intensity across firms in LDC manufacturing industries, variation which is greater than that observed in advanced countries (DCs). This paper examines the hypothesis that the pattern results from diffusion of superior modern technology which is proceeding at a slower rate in LDCs than in DCs. Evidence from the Colombian brick industry is presented which suggests that slow diffusion is not a sufficient explanation.

1. INTRODUCTION

In both advanced and less developed countries alike, there are systematic variations across firms in choice of technique and size of firm, but in LDCs the dispersion of firms is much more pronounced. Large, modern, capital-intensive firms coexist with small, labour-intensive firms using very old techniques.

In the development economics literature, this phenomenon has been stylized as 'dualism': manufacturing is composed of a 'modern' sector and a 'craft' or 'traditional' sector. Explanations have been proposed for the existance of dualism, and its gradual disappearance over time has been seen as a key feature of the development process.[1] Dualism *is* only a stylization since case studies of industries show there is actually a spectrum of techniques. Nevertheless, there is clearly a need for a theory to explain why the dispersion of firms occurs at all, and why the extremes of size and capital-intensity are so much more marked in LDCs.

One explanation is in terms of a process of diffusion. In any country, firms do not instantly adopt newly developed technology for two reasons:

(1) Information about it must spread throughout the industry.
(2) The technology is usually embodied in new capital goods; it is adopted only when the replacement of existing equipment becomes profitable.[2]

In a developing country, one might expect the diffusion process to take place more slowly, which would explain the bigger spread in the technology observed in place. Information, which comes from technologically sophisticated countries, is likely to spread more slowly. Managers in LDCs may be less effective profit-maximizers and therefore slower to recognize the value of new technology. Imperfections in input and output markets occur frequently in LDCs; these may weaken the cost advantage of the superior modern technology. The replacement cycle may thus be slowed and the traditional technology may survive longer in spite of its lower productivity.

In considering the empirical validity of this explanation, one must bear in mind certain key elements in the diffusion model. The newer technology dominates the old and the productivity advantage is greater at higher capital–labour ratios. Scale economies are more important in newer technologies.

Therefore, the industry structure is changing over time in the direction of large capital-intensive firms. Since technology change continues to occur, a stationary state will not necessarily be reached, but the distribution of firms will narrow until it more closely resembles that in DCs, and traditional small labour-intensive firms will be eliminated.

From the policy standpoint, this model

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tends to support the 'modern-is-better' attitude found in many developing countries. It suggests that factor market imperfections allow obsolete technology to survive rather than (as others argue) encourage premature adoption of socially inefficient technology. It portrays the traditional sector as composed of people not smart enough to see that they are obsolete. Speeding up the diffusion process is a good thing. Efforts to provide assistance to small and medium-size firms are suspect on efficiency grounds. Any efforts to provide technology information should focus on spreading information about the superior modern technology, not on spreading information about craft technology, or looking for more productive forms of craft technology.

For many LDCs, the model is plausible, fits with casual observation, and is consistent with aggregate industry statistics. However, casual observation has often proved misleading in the past and industrial statistics can be difficult to interpret. For example, Colombian statistics show that the size composition of industry is changing over time in the direction of larger firms. However, the statistics are not very suitable for examining the composition of industry by size over time, and are likely to contain a built-in bias towards showing that result. The industrial statistics in Colombia (and in nearly all LDCs) include all of the largest and the great majority of medium-size firms but only a small fraction of the small firms. Very little information is available about the number of firms in the smaller size classes of any industry, so it is hard to know just what fraction is included in any given year. Firms generally grow over time. Some firms go out of business, and it is reasonable to think that turnover is greater among smaller firms. For both these reasons, the average size of firm in a sample will automatically grow over time unless adjustments are made for entry and exit. But it is hard to make the correct adjustment. The larger firms entering will tend to be included, but given the lack of information about small firms, it is very unlikely that small firms will be added to the sample in the right proportions to maintain a sample which accurately reflects the real size distribution of firms in the industry.[2]

Thus, it is useful to look at a specific industry at the micro-level. The Colombian clay brick industry is an excellent choice for such a case study. The technology in operation in the industry ranges from a modern, large, capital-intensive factory to tiny artisan establishments using centuries-old techniques. In this paper, the question asked is, to what extent can the structure of this industry be explained by a diffusion process?

We conclude that the empirical evidence suggests that this explanation is not sufficient.

2. A BRIEF HISTORY OF BRICK TECHNOLOGY

The main processes in the production of clay bricks are the excavation and preparation of the clay, the forming and drying of the raw bricks, and the firing of the bricks in kilns. For each process, there is a variety of alternatives available, from purely manual to highly mechanized.

Until the 19th centry, production was characterized by hand-digging, natural weathering, hand-making, outdoor drying, and batch-firing in primitive kilns, either temporary structures ('open clamps') or simple permanent structures.

In the 19th century, moulds were developed which made as many as 15 bricks at once. The process (the 'soft-mud' process) was mechanized, using animal and then steam power. By the end of the century, a new alternative, the extrusion process, had been developed and was well established. In the extrusion process, instead of being moulded, the bricks were extruded as a column of clay which was then cut with a wirecutting machine.

Heated floors were first used to speed up drying. Then chamber dryers were used, in which hot air was circulated around the formed bricks. In 1845, a continuous process dryer (the tunnel dryer), was invented, although it did not become a practical alternative to the hot floor and chamber dryer until the end of the century. In the tunnel dryer, bricks moved on cars through a tunnel as warm air was passed over them.

In kilns, the important innovation was the Hoffmann kiln, invented in 1858. This kiln transformed the firing process into a continuous process. It was composed of a series of individual chambers into which bricks were loaded and unloaded. The fire was moved from chamber to chamber as the bricks in each chamber were fired.

With the 20th century came mechanization of the excavation step, with power shovels, bulldozers etc. There was a shift toward more elaborate preparation of the clay and the development of stone separation, crushing and mixing machinery. De-airing was introduced into the extrusion process. This is the removal of air from the clay as it is being extruded in order to produce a denser, stronger product.

The tunnel kiln had been invented in 1840 but was not adapted for brickmaking until the 20th century. It, like the Hoffamnn kiln, involved a continuous firing process, but in the case of the tunnel kiln, the fire was stationary and the product moved through the kiln on cars.

Finally, mechanical methods of handling the bricks within and between processes were developed.

To summarize, there has been a substantial increase in the minimum scale of plant with the development of new technological alternatives, particularly in the case of kilns. Generally, the newer the technique, the less labour is used relative to capital in each process, and some substitution of skilled for unskilled labour has occurred. Also, for efficient operation, the tunnel kiln and tunnel dryer require skilled management of temperature controls.

3. THE STRUCTURE OF THE COLOMBIAN BRICK INDUSTRY

The characterization of technology is a difficult task. Even if we are satisfied with measuring the primary inputs, the measurement of the capital input raises serious problems. Book value is a poor measure because depreciation relates much more to tax law than to the economic value of the capital. Although measures of electrical energy consumed and rated horsepower have sometimes been found to be correlated with other capital measures, the conceptual basis for expecting such a correlation is weak. Replacement cost is perhaps the best alternative, but most firms have no idea what replacement cost is or even what the original cost of their capital was. Moreover, firms are suspicious of surveys and reluctant to waste their time gathering information. Therefore, we sought a method that would capture the main alternatives but would be feasible.

After preliminary factory visits and discussion with local industry experts, the Colombian industry was divided into eight major categories of technology choice,[3] based on the major alternatives observed in the forming, drying and firing processes. (The choices are arranged here from most to least capital-intensive, within each process.)

Forming: semi-dry press process,
extrusion with de-airing
– imported process,
– Colombian adaptation,
extrusion without de-airing,
manual moulding.

Drying: artificial drying – tunnel drying,
– chamber drying,
natural drying.

Firing: continuous kiln – tunnel kiln,
– Hoffman kiln,
intermittent kiln – vertical flame (updraught),
– inverted flame (downdraught).

Table 1 shows the combinations of choices represented by the categories. A tentative specification of a representative plant was prepared for each category based on information from a small number of co-operative firms. These were used in designing the survey instrument. Brief questions on key points of the production process were included in the survey to determine what category each firm was in. The results of the survey were used to modify the original categories and plant designs. Then a single composite capital–labour ratio was computed for each of categories 2–8 from the modified plant designs. The capital figure was the approximate cost in Colombian pesos of purchasing plant and equipment new in 1975 plus the costs of construction in 1975 for kilns, drying sheds, and simple factory structures.[4] Labour was the number of full-time production workers employed per month.[5]

A capital–labour ratio could not be computed for category 1. This category consists of a single, very large-scale firm using a sophisticated capital-intensive process. Since the firm refused to co-operate it is incorporated in the analysis only to the extent that information about it is available from other sources. Although a capital–labour ratio could not be computed, there is no doubt that this category is the most capital-intensive.

Clearly the industry exhibits a range of techniques rather than a simple dualism. Nevertheless, there is a major jump in the capital–labour ratio between categories 4 and 5; in terms of the 'dualistic' stylization, this would be a reasonable division between the modern and the craft sector.

It is obvious that the capital–labour ratios are very approximate. We know that there is variation within categories but we do not have the quantitative data to say how large the variation is. Little significance can be attached to the numerical values; however, we feel that the ordering is robust. In this paper, capital-intensity is used mainly as an ordinal ranking of the categories.[6]

Table 1, combined with the historical devel-

Table 1. *Categories of technology choice*

Process	Category							
	'Modern' sector				'Craft' sector			
	1	2	3	4	5	6	7	8
Forming	Semi-dry press process	Extrusion with de-airing: imported process	Extrusion with de-airing: imported process	Extrusion with de-airing: imported process	Extrusion with de-airing: imported process	Extrusion with de-airing: Colombian adaptation	Extrusion without de-airing	Manual moulding
Drying	Tunnel drying	Combination* of tunnel and natural drying	Combination* of chamber and natural drying	Natural drying	Natural drying	Natural drying	Natural drying	Natural drying
Firing	Tunnel kiln	Tunnel kiln	Hoffman kiln	Hoffman kiln	Intermittent kiln	Intermittent kiln	Intermit-tent kiln	Intermittent kiln
Composite capital/labour ratio	Unavailable	872.1	512.9	410.3	77.3	45.1	25.8	7.4

* Only the single firm in category 1 dries all of its output artificially.

Table 2.

Category	Kendal rank-order correlation coefficient (Kendall's tau)	Significance level
Vs size measured by employment	−0.5087	0.001
Vs size measured by value of capacity output	−0.5944	0.001

opment of the technology, shows that, as the diffusion model assumes, capital-intensity and 'modernity' of the technology generally give the same ordering of categories. There is one special case. Category 6 uses a Colombian adaptation of imported technology; foreign machinery has been reduced in size and copied for local manufacture. The original technology has been known for a long time; the adaptation began in the very early 1970s. More will be said about the significance of this later.

Size of firm was not used in the determination of the categories. However, in the sample, size of firm proved to be strongly correlated with category and therefore with capital-intensity and modernity, as the diffusion model assumes. Two measures of size were used: total employment and value of capacity output.[7] Quantitative information was available for 47 firms in categories 2–8. The correlation between the ranking by size and the ranking by capital-intensity (as measured by category) is given in Table 2.[8]

4. FACTOR MARKET STRUCTURE

The 'stylized fact' about factor markets in the LDC manufacturing sector is: large, modern firms have higher wage/rental ratios than small traditional firms.

In the case of wages, this is based primarily on aggregate data which shows that the average wage increases with size of firm. This may represent different wages across firms for the same type of labour caused by a market imperfection (tied, for example, to government labour legislation) which applies differently across firms according to their choice of technology, or according to their size. Or it may result from a difference in the composition of the labour force across firms; worker characteristics, such as education and experience may vary systematically with technology or size of firm.

In the case of the rental rate, little data is available but the rental rate may also vary with choice of technology (e.g. because of favourable borrowing terms for the purchase of modern capital) or with size of firm. In another paper[9] we give a detailed discussion of the structure of Colombian factor markets, in general and in the brick industry specifically. We summarize it here.

The survey yielded consistent labour force data for 42 firms. Regressions were run relating the difference between a firm's average production wage and the average for the sample to variables for education, experience, turnover rate, degree of unionization, size of firm and geographical region, in linear and log–linear form. The regressions were also run with dummy variables for the individual categories.

The results indicate that wage rates increase with size of firm as measured by capacity output. Both the regression results and the evidence of local brick experts indicate that the wage differential cannot be explained by differences in education, experience or stability of the labour force across firms. The dummy variables for category were generally not significant, suggesting that the differential is not related to technology choice *per se*.

Unionization was not significant in the regressions; the brick industry is not heavily unionized. However, evidence from the interviews and other qualitative evidence suggest that this is probably a major cause of the relationship between size and average wage. Labour legislation in Colombia specifically discriminates among firms on the basis of size; this reinforces the usual arguments about why the threat of unionization is more important to larger firms.

It was difficult to obtain direct quantitative data on capital costs for individual firms. However, a study of the lending policies of the major sources of industrial credit leads to the conclusion that capital access does differ across firms. An elaborate system of capital market controls gives wide scope for the use of non-economic factors in credit allocation. Capital access may depend to some extent on the nature of a project.[10] But much more important to capital access are characteristics of the borrower such as family background, social position and educational background. The survey showed that the larger, more capital-intensive firms had entrepreneurs with the characteristics associated with better capital access.

In sum, our evidence indicates that there is the predicted association between size, moderity and capital-intensity, and a higher wage/rental ratio. The association is not directly related to the type of technology chosen by the firm, but to other characteristics of the firm and its owners: most importantly, size of firm as measured by output, and family background, social position and educational background of owners.

5. RELATIVE PRODUCTIVITY BY CATEGORY

The diffusion model assumes that modern technology dominates craft technology, i.e. is

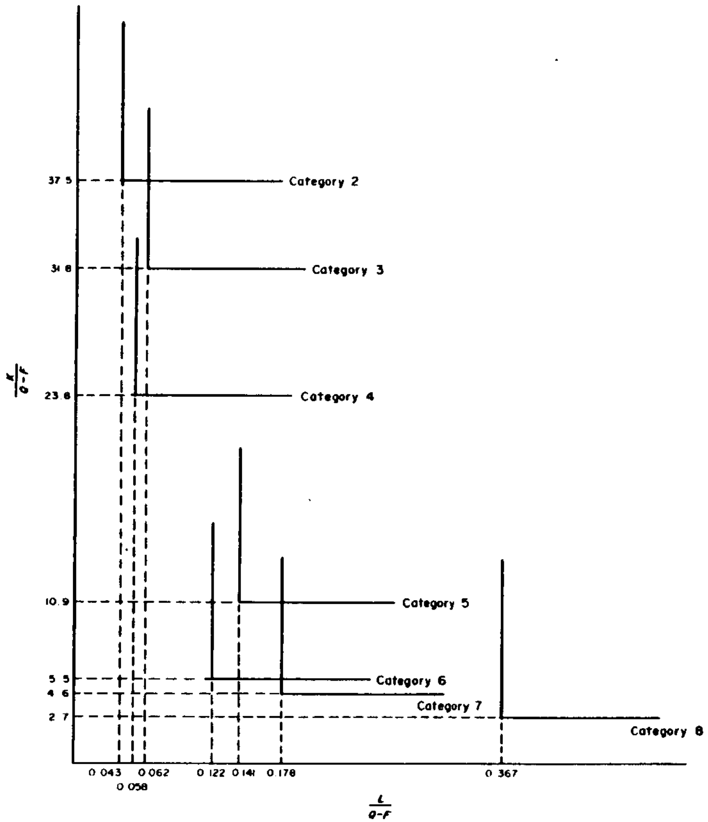

Figure 1. *Fixed capital and labour coefficients (forming, drying and firing).* Footnotes at foot of page 207.

more efficient in the use of both capital and labour. This assumption has been much debated in the development literature. The debate is complicated by the fact that the production function is usually presented in terms of two homogeneous factors of production, labour and capital, while it is recognized that modern technology often requires a different labour skill mix as well as a different kind of entrepreneur. In the brick industry, there are also differences in the kind and amount of fuel per unit of output.

One approach would be to compare the different techniques directly, valuing input and output characteristics at the prices faced by the firms and at appropriate shadow prices. This must be done using not only the technical data on machine capacities, staffing ratios etc. but data on the actual operations of Colombian firms; machines and people may operate differently than expected under everyday conditions in a developing country.[11]

One aspect of this is the quantity and quality of the managerial input, which is hard to measure but very important.[12] The high profit rates which Colombian accountants believe characterize large modern firms may be evidence for the greater productivity of the modern technology – or they may represent rents to scarce entrepreneurial skills and/or rents to the entrepreneurial characteristics which give favourable access to investment funds.

We had originally hoped to get microdata of sufficient quality to enable us to tacke the problem directly, but this goes to the heart of the most sensitive issue to the businessman, his

Notes: Some important reasons why the isoquants shown are very approximate:
1. As noted earlier, the pattern of shift-work did not differ across firms within categories, but there was variation in the number of firings of the kilns per unit of time and the intensity of machinery use within a shift, across firms as well as across categories. Also, utilization rates varied for the same firm at different points in time.
2. There were variations in fuel efficiency, across firms within the same category, and in the same firm at different points in time. Fuel use varies with:
(a) the content of sand and other substances in the clay;
(b) the moisture content of the product at the end of the drying process;
(This means that fuel use varies with the weather, since both artificial and natural drying are less efficient in wet weather; in the wet seasons, the kiln does some of the drying. Also, minor variations in construction of the drying sheds can affect drying efficiency.)
(c) the altitude;
(d) the design of the kiln, within a particular kiln type.
(Minor variations in the structure of the air vents etc., can have major effects on fuel efficiency.)
3. Not all inputs were included. For example, the labour coefficient includes only production labour, not managerial labour. Land is not included, either land for the factory or the land which comprises the clay reserves. It is virtually impossible to value the land in a consistent meaningful way, because typically the brick factories (of various sizes and categories, side-by-side) are located on land on the outskirts of the major cities – land which is unsuitable for agriculture and whose value is expected to increase as the city grows. In many cases, removal of the clay makes the land more suitable for eventual development.

Some specific points on a comparison of categories 3 and 4, and categories 5 and 6:

Category 3 is dominated by category 4, given the coefficients shown. The difference between these two categories is in the use of artificial drying. Category 3 uses more fixed capital (in the form of the cost of the artificial dryer) and more fuel, but it uses less land and less working capital, since the drying time is shortened. The change in the value of work in progress between the two categories is at most about 5% of the difference in fixed capital cost between the two categories, which is a negligible addition to the capital cost. The difference in land per thousands of pesos of $Q - F$ (value of output less value of fuel) is substantial: 5.7 mt^2. However, to balance the Col. $8000 difference in fixed capital investment, the land would have to cost about Col. $1400/$mt^2$, or Col. $14,000,000/ which is a very substantial sum indeed (over US $400,000/acre) especially when it is considered that the land will appreciate in value while the dryer will depreciate. Thus the difference in land and working capital costs is unlikely to be sufficient to justify the increased fixed capital investment.

Category 5 seems to be dominated by category 6. The main difference between these two categories is in the use of a simple domestic machine in preparation and forming in category 6 compared to larger and more expensive imported machinery in category 5. The utilization rate has been assumed to be rather low in category 5 (about 60%) on the grounds that this is representative, while the utilization rate in category F has been assumed to be 100%. To make a rough correction for this, if it is assumed that factors can be adjusted proportionally to give 100% utilization in both categories, then the capital coefficient is very close to that in category 6. (The capital coefficient for preparation and forming is still somewhat higher in category 5 than in category 6, but this is offset by the lower coefficient for firing.) Thus it seems that an important aspect of the Colombian capital is the fact that it enables firms to produce at lower scales of production without having underutilized capacity.

profitability, and we were unsuccessful. We did get enough evidence to convince us that the validity of the assumption of differential productivity is by no means obvious.

Some of this evidence is summarized in Figure 1. The value of output less the value of fuel (at actual domestic prices) was computed by category from the plant designs and used as a rough measure of output. The figure shows production labour and fixed capital per unit of output for categories 2–8; this gives an approximation of a unit isoquant (at the scale of operation assumed for the representative plant in that category, i.e. incorporating any economies of scale that may exist). The plant designs incorporate a host of approximating assumptions, since there were substantial variations in the efficiency of firms within categories in their use of the same basic technique: variations from firm to firm, and for the same firm over time. (The notes to the figure contain further discussion of some of the more important aspects of this.) The figure is far from conclusive but it suggests that neither the craft nor the modern technology clearly dominates. With due allowance for data errors, the alternative techniques appear to lie approximately on an isoquant.

6. EVOLUTION OF THE INDUSTRY OVER TIME

Although we cannot resolve the relative productivity question, we can see if the industry is evolving over time as the diffusion model predicts.

If the new technology dominates the old, new firms should be large, modern and capital-intensive. Old firms should gradually become so as expected profits from the change dominate the costs. Some new small-scale firms may be set up with cheap second-hand capital goods discarded by the modernizing firms, since if there is any market in second-hand capital goods, their prices must adjust until the old capital is competitive with the new. This phenomenon can persist until the old capital

Table 3.

Current category	Kendall correlation coefficient	Significance level
Vs age of firm	−0.2167	0.024
Vs employment at end of first year	−0.3550	0.002

Age of firm	Pearson correlation coefficient*	Significance level
Vs current size measured by employment	0.3082	0.018
Vs current size measured by capacity	0.1791	0.114

Changes in category

Category	No. of firms	No. of firms known to have started in same category	No. of firms for whom initial category unknown	Others	No. of firms set up in 1970s and category
1	1	0	0	One firm started in category 4	0
2	1	1	0	0	0
3†	4	0	2	Two firms started in category 4	2‡
4	7	5	1	One firm started in category 5	3
5	9	6	3	0	5
6	4	3	1	0	3
7	10	6	4	0	3
8	12	12	0	0	8
Total	48	33	11	4	24

* Pearson correlation coefficient can be used because age and size are both interval-level variables.

† Categories 3 and 4 are identical except that category 3 firms have chamber dryers which may be used to dry part of the output. All the firms acquired their dryers after the start of the firm and at about the same time (the early 1970s), so all moved from category 4 to category 3.

‡ Both started in category 4.

wears out or is unprofitable to operate even at a zero price (e.g. because of high running costs).

Although historical information was difficult to obtain, the survey provided data on the age of the firm, the size of the labour force at the end of the first year of operation and the ages of the major items of capital equipment, as well as whether they were bought new or second-hand.

Table 3 shows that the more modern, larger firms tend to be older, not younger, although the correlations are not strong. More direct evidence is provided by looking at changes in category and size of individual firms over time. The data were sufficient to identify an initial category for 37 of the 48 firms (the remaining 11 were the oldest firms; all date from 1957 or earlier). Categories 3 and 4 are identical except that category 3 firms have chamber dryers which may be used to dry part of the output. All of the firms in this category acquired their dryers after the start of the firm and at about the same time (the early 1970s), so all moved from category 4 to category 3 (and two firms may have moved from some other category since their initial category could not be determined). However, with that exception, Table 3 shows that the general picture is not one of firms changing categories to become more modern. Of course, for 11 firms, nearly one-fourth of the sample, we do not know the initial category. But eight of the 11 are still in categories 5–8, the 'craft' sector, even though they are among the oldest firms in the sample.

One-half of the sample consists of firms established during the construction boom in the early 1970s. All of these firms are still in the same category they started in except the two which moved from category 4 to category 3. The distribution of firms by category in this sub-group is not that different from the distribution of firms in the sample as a whole, contrary to the prediction that only modern firms would be set up.

The survey showed that firms generally do grow over time. The change in the labour force is biased downward as an indicator of change in firm size, because of a severe slump in demand at the time of the survey and also because the capital–labour ratio and the output–labour ratio are likely to increase with size. Nevertheless employment had increased for 36 of the firms and decreased for only seven (unknown for five). Capital equipment had generally been added over time. However, Table 3 suggests that growth comes primarily within the same category or with a movement to the next category only.

The age of the firm can be ambiguous. Many firms had changed their form of legal organization and their shareholders over time and it was not always clear what date to take for the founding of *the* company. Thus it is useful to look at the major items of capital equipment to see if there is a pattern of introduction of technology of time. If the age of the equipment is uniformly older, the higher the category number, then one could argue that coexistence of the categories represents the phenomenon of gradual adjustment by investment in the new technology. Modernizing firms are selling off their outmoded equipment to other firms but the category will disappear when this equipment wears out.

Table 4 gives data on the machinery used in the preparation and forming processes in those firms which use machinery. Table 4 shows that the importance of second-hand machinery does increase as the modernity of the category decreases. However, the introduction in category 6 of the Colombian adaptation of the type of machinery used in category 5 suggests that the technology represented by the second-hand machinery is not obsolete. Although the average age of machinery in category 7 is high, the standard deviations are large and there is some relatively new machinery used in the category.

Table 5 shows the average age of the kilns in the sample. The kilns vary widely in age and there does not seem to be any clear pattern between age and modernity of kiln type.

7. CONCLUSIONS

The evidence does not support the hypothesis that the brick industry is tending toward a structure in which most firms are modern, large and capital-intensive, and the traditional labour-intensive categories are eliminated. Although the direct evidence on relative productivity of the categories is inadequate, the indirect evidence indicates that it is worthwhile to set up new firms with craft technology. It is interesting that in the construction boom of the early 1970s, the industry seemed to expand across the board. The largest, most technologically sophisticated brick factory in the country (in category 1) was built. Category 3 was created, with the introduction of artificial chamber dryers for the first time in Colombia. But this was also the period of introduction of an adaptation of imported technology, the Colombian-produced de-airing extruder, which enabled firms to be smaller in scale, and less capital-

Table 4. *Preparation and forming machinery*

Type of machinery	Technology category	No. of firms in category with this type of machine	Total No. of machines	No. of machines bought second-hand	Age of machines: Mean	Standard deviation	Minimum	Maximum
Preparation machinery	1	NA						
	2	1	5	0	21.0	0	21	21
	3	4	23	0	9.4	7.9	4	30
	4	7	20	10	15.5	7.8	4	28
	5	6	17	5	9.5	9.3	2	26
	6	3	4	4	18.0	4.0	12	20
	7	3	6	2	21.3	18.9	4	48
	8	4	4	3	15.0	7.8	4	21
Extruder without de-airing chamber	1	NA						
	2	0						
	3	0						
	4	0						
	5	0						
	6	0						
	7	9	11	10	21.9	20.3	1	51
	8	0						
Extruder with de-airing chamber	1	NA						
	2	1	1	0	21.0	0	21	21
	3	4	7	0	13.9	10.3	4	30
	4	7	7	2	13.7	5.3	5	21
	5	9	10	2	9.3	7.2	4	26
	6	5	5	3	13.4	5.5	6	21
	7	0						
	8	0						
Manual cutters	1	NA						
	2	0						
	3	1	1	1	29.0	0	29	29
	4	0						
	5	1	1	0	6.0	0	6	6
	6	4	4	1	9.5	3.0	6	12
	7	8	10	9	20.6	18.5	3	51
	8	0						
Automatic cutter	1	NA						
	2	1	1	0	21.0	0	21	21
	3	4	7	0	8.1	6.0	4	20
	4	7	7	2	12.4	4.9	5	21
	5	9	9	2	7.9	4.4	4	16
	6	0						
	7	0						
	8	0						

NA = not available.

Table 5. *Kilns*

Type of kiln	Age of kilns*: Total No.	Mean	Standard deviation	Minimum	Maximum	Capacity in common brick volume equivalents†: Total No.	Mean	Standard deviation	Minimum	Maximum
Intermittent (vertical flame)	102	11.8	11.1	0	46	101	40,925	21,339	6 000	86,100
Intermittent (inverted flame)	26	26.7	15.6	1	49	18	47,797	22,506	20,000	84,060
Hoffmann	16	18.7	13.1	5	56	14	286,106	127,881	147,600	508,096
Tunnel‡	1	19	0	19	19	1	1,300,000	0	1,300,000	1,300,000

* Based on data for 148 kilns.
† Based on data for 137 kilns.
‡ Quantitative data available only for kiln in category 2. Tunnel kiln in category 1 is known to be newer and larger.

intensive. In addition, there was a great expansion in the number of tiny artisan firms which use technology even simpler than the simplest craft technology discussed here.

The diffusion model is not a good description of this industry. The structure to this author looks more like the long-term coexistence of a set of representative firms with little tendency for the dispersion to become narrower.

In another paper (Baily, 1979: see note 9) we have argued that the empirical evidence is consistent with a model in which there is only one industry production function, but factor market imperfections create an environment in which profit-maximizing entrepreneurs face different constraints and therefore choose to build firms in the different categories (i.e. choose different points on the production function).

The input market imperfections, which can to a great extent be traced to government policies, have existed for a long time and show little tendency to change (although the whole wage structure is moving upward over time). Thus the industry is likely to continue to develop with a structure of parallel lines of entrepreneurs who never meet. The individual categories may change over time, but the coexsistence of different categories is not tending to be eliminated.

The evidence presented is for only one industry, but the conclusions probably apply more generally. The coexistence of widely different techniques of production is characteristic of other industries. The input market imperfections are not unique to the brick industry, but operate throughout the economy. Therefore it is likely that the results would be duplicated in other industries.

The analysis suggests that modern may not be better. Although it is hard to measure productivity directly, what data there is suggests that the craft technology is not necessarily dominated, and we know that in addition to capital, unskilled labour and fuel (which are incorporated in Figure 1), modern technology does tend to use more of other factors that are in short supply such as managerial labour. Since the market imperfections are such that the wage/rental ratio that produces the large capital-intensive modern-style firm is farther from the social opportunity cost wage/rental ratios that for the smaller firms, perhaps the 'right' industry structure would eliminate the large firms rather than the small firms.

NOTES

1. See, for example, R. Nelson, T. P. Schultz and R. L. Slighton, *Structural Change in a Developing Economy* (Princeton, NJ: Princeton University Press, 1971), Chap. 4.

2. See W. G. Salter, *Productivity and Technical Change*, 2nd ed. (London: Cambridge University Press, 1969), for further discussion.

3. There was an additional category of tiny artisan establishments using temporary kilns (open clamp kilns) which we have not included in the study because it was impossible to get any survey data on them.

4. Since the more capital-intensive categories tend to use more imported machinery and historically the Colombian exchange rate has generally been overvalued, the use of social opportunity cost prices instead of peso prices would not change the order of the categories and would increase the dispersion of the capital-intensities.

5. The pattern of shift-work did not differ across firms within categories. There *was* variation in the number of firings of the kilns per unit of time and the intensity of machinery use within a shift, across firms and across categories The composite capital–labour ratio for the category was adjusted in a rough way to reflect the pattern of utilization that was representative of the category operating at capacity as defined in note 7. In other words, since the capital figure is a stock figure and the labour figure is number of full-time workers per month (hours per month per full-time worker did not vary across firms) the composite ratio implicitly incorporates the choice of capital utilization rates as well as size of capital stock.

Further details of the data and representative plant designs can be obtained in M. A. Baily, 'Technology choice in the brick and men's leather shoe industries in Colombia', final report to Agency for International Development, Contract No. AID/otr C-1326 (1977), or by request to author.

6. Also, we should note that by specifying the industry narrowly, product heterogeneity was greatly lessened but not eliminated. Within the clay brick industry, there are different products whose characteristics are related to variations in choice of technology. However the products are much closer substitutes than in broader industry classifications and no technology category produces a product which has no close substitute produced by some other category.

7. Capacity output was defined as the value of output that the firm would be willing and able to produce, on a long-term basis, with no more than a 5% additional expenditure on plant and equipment, and with as many additional workers as would be needed (assuming that they could be hired at the current

wage rate, and that all output could be sold at current prices). Since the industry was experiencing an unanticipated slump, which was having uneven effects across the industry, it is felt that capacity output is the best measure of size of firm available.

8. Kendall's tau is used as a measure of correlation because it requires only that the two variables be at least ordinal in scale and numeric in type; it does not depend on the normal distribution. The Spearman rank-order correlation coefficient could also have been used since there is no fixed rule about selecting one over the other. See N. H. Nie, C. H. Hull, J. G. Jenkins, K. Steinbrenner and D. H. Bent, *Statistical Package for the Social Sciences*, 2nd ed. (New York: McGraw-Hill, 1970), pp. 288–290, for a discussion of these two statisistical measures.

9. M. A. Baily, 'Factor market structure and technology choice in the Colombian brick industry', *Journal of Development Economics*, Vol. 6 (1979), pp. 573–589.

10. Formal credit lines generally require the security of a machine or building and thus to some extent encourage the use of capital relative to labour. Credit terms tend to be better for imported machinery than for domestic machinery, since the former comes from large international companies with favourable access to capital themselves, and the latter is generally made in small Colombian workshops, which have poor access to capital. Of course any lender will be interested in the ability of the borrower to repay the loan, which gives him an interest in the profitability of the project.

11. For example, we found evidence of significant variation in the productivity of equipment as used in Colombia compared to the original models in foreign countries, particularly in the more sophisticated categories. Minor differences in construction and operation techniques led to lower efficiency in the Hoffmann and tunnel kilns. None of the chamber dryers in the sample worked as well as they had been expected to, and several did not function at all.

12. The quantitative data on labour force composition showed that while production workers hardly differed at all in skill level (being all relatively unskilled), the managerial staff tended to be better educated in the more modern categories. There was qualitative evidence that the more modern the firm in technology, the more sophisticated the entrepreneurs.

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RURAL INDUSTRY AND THE INTERNAL TRANSFER OF TECHNOLOGY IN CHINA

by

Jon Sigurdson

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RURAL INDUSTRY AND THE INTERNAL TRANSFER OF TECHNOLOGY

by Jon Sigurdson

Linkages between agriculture and rural industry, and between rural industry and urban-based modern industry, are clearly important factors in the social and economic development of China. The nature of these linkages may assure both an integrated social and economic development, and a more solid basis for planning from the bottom up, as opposed to central planning. This chapter will discuss the recent development of rural industry, which is at the centre of the linkages, and its impact on industrialization in China. It will analyse the nature of the transfer of industrial technology from the cities and discuss also the role of leadership in the transfer since this is important in an environment where prices and other market mechanisms cannot be used to initiate and control development and is also likely to be important in order to achieve a desired distribution of industrial activities. The question of regional balance is also touched upon in the light of the Chinese leadership's apparent awareness that rural industrialization should be used to lessen economic and social inequalities.

The Chinese approach to linking rural industry with agriculture requires certain inputs - particularly technology, and to a lesser degree skilled manpower - from the modern industrial sector. The creation of demand in rural areas for appropriate technologies, and the development of such technologies, are important aspects of the present stage of development in China. However, the question of the development of appropriate technologies is only briefly discussed here as sufficient data are not yet available. The existence of linkages also appears to be a pre-requisite for the creation of large industrial networks of "subcontractors" and the character of these networks is discussed at some length, since they seem to be an important feature of industrialization in China.

In conclusion, an attempt is made to deal with recent Chinese discussions on the relative importance of steel and electronics to Chinese development strategy. Electronic technology is, no doubt, widely used within the defence sector and also for a number of civilian purposes but the Chinese appear to wish to postpone any large-scale introduction of electronic technology in order not to disturb the present stage of economic and social development.

The frame of reference used for discussing rural industry in this chapter evolved from visits to two rural counties in China in December 1971, and from the study of Chinese press and broadcast materials. All my information - both from personal discussion about policy and from news items - seems to confirm that the Chinese are attempting to develop the rural areas in an integrated way and that, in this development, rural industries play a number of very important roles.

RURAL INDUSTRY

The objectives of rural industry* may differ from one area of the country to another. They depend, among other things, on the closeness of big industrial cities and the relative economic development of the surrounding area which defines their market. However, the primary objective is always to serve agriculture (1). This objective can be broken down into the following three components. First, rural industry has to produce iron, farm machines, machine tools, chemical fertilizer, building material, etc. Second, farm and other machines have to be repaired and many of the necessary spare parts are manufactured by rural enterprises. Third, farm and side-line produce has to be processed. In fulfilling primary objectives in areas close to big industrial cities, rural industries are often required to make use of scrap and waste from big factories. Among the secondary objectives, the manufacture of products needed by modern industry appears to be the most important, and, in a number of places, rural industry also produces export items on the basis of local artisan skills.

* Rural industry is in this context defined as any local industrial unit run by county, commune or brigade. The enterprises may be collectively owned, jointly owned by state and collective units, or wholly owned by the state but under local management. Rural industry includes units attached to middle schools, hospitals and health clinics. Here, rural industry within a county (hsien) is usually discussed because of the importance attached to this level of industry in news reports from China. For certain purposes it may, however, be appropriate to consider the region which, on average, consists of 10 counties. Production technology in rural industry ranges from the very primitive to modern up-to-date process technology depending on product, size and stage of development.

Rural industry exercises a primary influence on agriculture, and provides a basis for future mechanization. It has been stated that China should be able to achieve basic mechanization of her agriculture by 1980 (2). The paradox of mechanization of agriculture, however, is that a relatively abundant and fast growing factor - labour - is replaced by machinery, when the availability of farm workers is not diminishing and may even be increasing. There are, however, important economic reasons for the mechanization of Chinese agriculture. First, the timing of many agricultural tasks requires machinery in order to achieve optimal results and the large-scale introduction of land-increasing innovations such as multiple cropping and close planting require more manpower per unit of land, so that certain tasks must be mechanized. Second, it is often economically rational to replace human and animal power by machine power. Labour-saving innovations such as the use of herbicides for weeding can be profitable as can be seen from the following comment:

> "... Weeding generally takes up about one-third of total farm labour. Since manual and mechanized weeding can no longer meet the requirements of improved farming techniques and mechanization, the use of herbicides has become the most economic and effective method. The Huangshih commune of Milo county, Hunan, found that the weeding effect of herbicides applied by a single labourer in one day equalled that of one day's manual weeding by 30 labourers and the cost of herbicides was less than 1 yuan per mou." (approximately $6 per hectare) (3)

There are also very important non-economic motives for agricultural mechanization: it creates the basis for more advanced forms of social organization in the Chinese countryside. Since it is not possible to continue to demand sacrifices from the rural population while the urban population lives in relative comfort and affluence, agriculture must be mechanized.

The problem is that, once a certain degree of mechanization is allowed, it may be difficult to set limits to further mechanization. However, the mechanization of agriculture and related activities in China is not only dependent on local purchasing power, but is also made dependent on the capability of a given locality to produce almost all the necessary farm machinery and most of the machines needed to make that machinery. This necessitates the local formation of industrial skills and industrial capability, which takes place alongside the mechanization of agriculture and thus creates a basis for future labour absorption when less manpower is needed in agriculture. Consequently, the mechanization of agriculture in China should not be seen in isolation but as part of the overall development strategy.

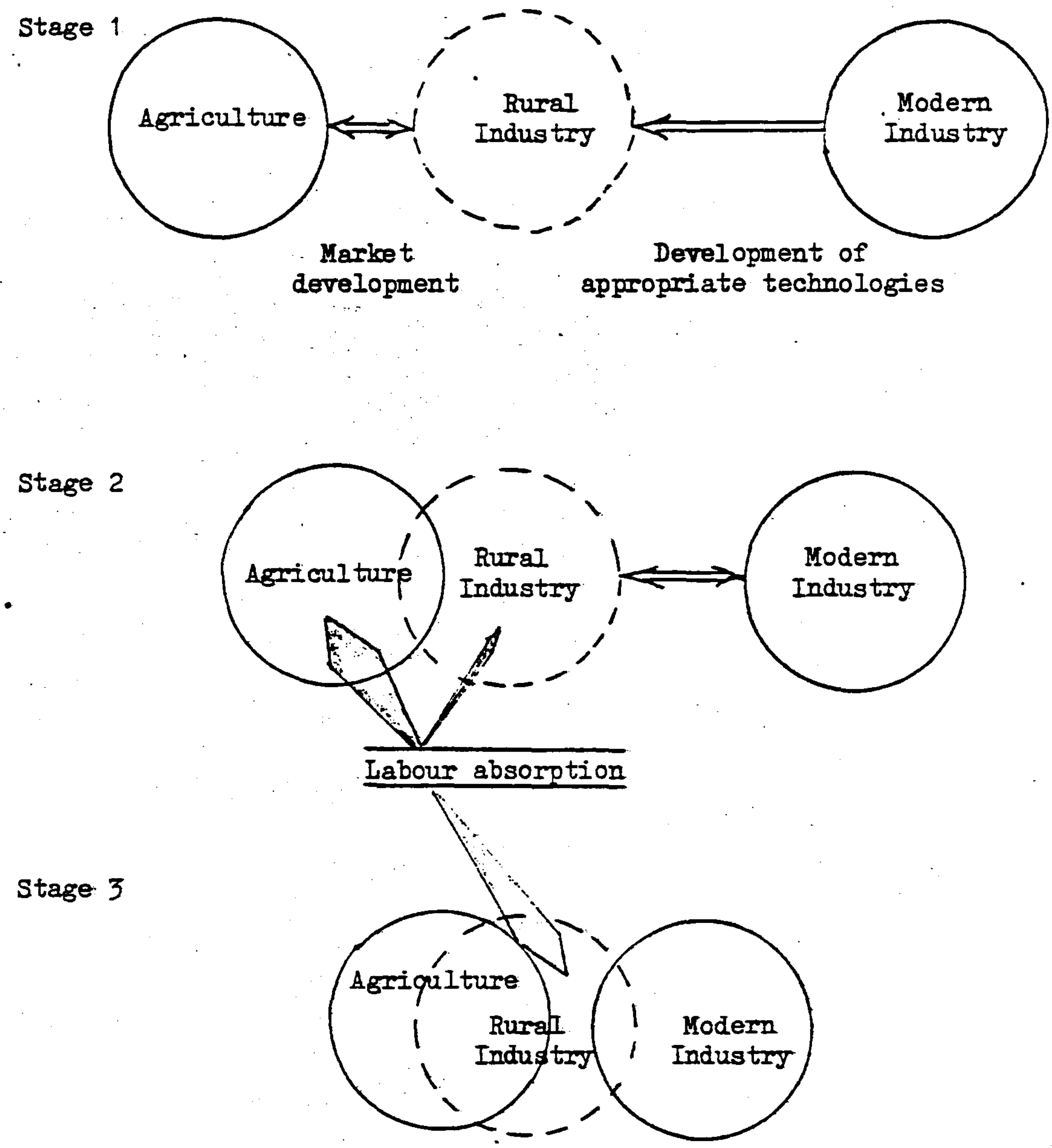
Why does China seek to develop local industries which tend to be on a small-scale and relatively backward, instead of modern large-scale plants in order to mechanize agriculture and modernize the countryside? There are several reasons for this. First, industrial production, if based mainly on large units which require a great deal of capital equipment and transport, could grow only slowly because of the heavy demands their development would make on the engineering industry and on the railways, both of which are needed to develop other branches of the economy. Second, modern large-scale industrial plants do not create much employment and they are usually urban-based. An emphasis on modern plants would therefore severely disturb the present distribution of the population. Third, new technology and new machines have to be adapted to and introduced into areas where people have an essentially conservative mentality. The local character of a small-scale, rural, industry may often shorten the time needed to make the necessary adaptations. This is particularly true for farm machinery accessories which must be adapted to local soil, climatic and other conditions.

LINKAGES BETWEEN AGRICULTURE, RURAL AND MODERN INDUSTRY

As a basis for further discussion, it may be helpful at this point to look briefly at the linkages between agriculture, rural industry and modern industry (4). Modern industry, which in terms of employment is relatively small, is characterized by a relatively high degree of mechanization and further expansion of this sector would not create sufficient employment to absorb the manpower coming of working age. Agriculture, on the other hand, provides much of China's exports which are exchanged for industrial commodities needed by the modern sector. It requires industrial inputs to raise yields, but the low degree of mechanization in agriculture and relatively low productivity initially prevent the substantial accumulation of capital which is required for the mechanization of agriculture.

FIGURE 1

Fig. 1



In the first stage of changing the relations between modern industry and agriculture, rural industry is introduced as a transmission belt for knowledge. Initially, the linkage with modern industry is mainly a one-way relationship, in which rural industry is provided with much of the necessary technology, capital-embodied as well as non-embodied. The linkage between agriculture and rural industry is characterized by a mutual relationship where rural industry is responsible for much of the technical skill formation in the agricultural sector and also supplies increasing amounts of agricultural inputs. Agriculture, in its turn, supplies raw material and capital. Important factors in the further development of linkages are the level of market demand and the availability of appropriate technologies. The price mechanism is of little importance, and the initiatives of local leadership at different levels explain much of the new activity.

In the second stage, rural industry and agriculture become partly integrated, with agriculture supplying industry with increasing amounts of raw material for light industry, and rural industry processing much of the rural farm produce. The increase in purchasing power arising from the increased productivity in agriculture makes it possible to finance more machinery. Labour absorption, at this stage. will still mainly take place within agriculture or related activities, but will also be increasing in the sector of rural industry. Rural industry reaches a certain degree of sophistication and differentiation, and can supply modern industry with some products. Thus, in this second stage, the linkage between the two sectors develops into a mutual relationship.

In the third stage of the sequence, rural industry and modern industry become more or less integrated. Some production is shifted from the modern sector to the rural industry sector. Quality standards and standardization within the rural industrial sector improve considerably, thus permitting a considerable expansion of the subcontracting system. Rural industry and related services become, at this stage, increasingly important for labour absorption, and a fairly substantial transfer of employment from agriculture to rural industry can take place as agriculture is mechanized. As an example of this phase, it is interesting to note that Ts'unhua county in Hopei province, where agriculture is only partially mechanized, has an industrial employment - if all activities are added together - of between 10 and 15 per cent of the labour force of the county (5).

Thus, it can be seen that rural industrialization, based on local resources of skilled manpower and capital, is going to provide the basis for the mechanization of agriculture, which will, in turn, make it possible for peasants to engage in new tasks (e.g. multiple cropping) and raise agricultural yields. With higher yields, more industrial crops can be grown, and this, in turn, will give local light industry more raw materials. In the process, labour is absorbed into rural industry and purchasing power is also increased, thus creating a local market for light and other industrial products.

Basically, rural industry should use locally available raw materials, produce locally, and distribute locally. This implies that arranging plans, allocating raw materials and organizing factory production must be based on local decisions. But as soon as secondary objectives (such as the manufacture of products for modern industry) are emphasized, local planning is increasingly co-ordinated with more centralized plans, which often means those of the next higher administrative level. In meeting the primary objective of serving agriculture, a symbiotic interaction develops between the rural industrial sector and the surrounding agricultural sector. In the third stage of development, when secondary objectives begin to come into the picture, a similar symbiotic interaction is developed between the rural industrial sector and that of modern industry. These interrelations are very important for both the social and economic development of China.

Rural industry in China is being developed gradually and is closely co-ordinated with agricultural development so as to cause no disruption to the local economy. In many localities all over China, a problem-finding and a problem-solving capacity will gradually be built up. This will make it possible to specify local resource availability and demand more accurately. The countryside can thus put forward demands on the basis of increased purchasing power and knowledge. The differences between the countryside and the cities may then diminish: this being an important social goal. Many developing countries are today faced with the problem that they cannot provide enough employment opportunities for people reaching working age. It appears that the rapid development of the rural areas has laid the foundation for solving this problem in China. During the first stage of this development, however, employment is not created primarily in industrial production, but in repair and maintenance, in production of industrial raw materials, in transportation and in other services and in an increasingly diversified agriculture. At the same time, industrial structures are created outside the big cities. With simultaneous expansion of national and local enterprises, the former can increasingly draw on the manufacturing potential of a large number of small enterprises.

It is clear that, by definition, industry must be highly differentiated in order to achieve its primary objective of serving agriculture. The high degree of differentiation desired in practice is also clear from Chinese reports on industrial systems in those counties which have been publicized as models where, in one case, over 900 different items were said to have been produced in well over a hundred enterprises (6).

The objectives of rural industry will of course be more or less comprehensive according to local conditions. The availability of raw material is particularly crucial. Thus, coal, which is used as raw material for the production of chemical fertilizer and for making coke needed in the production of iron, is not locally available all over China. Similarly, iron ore deposits, even if widely scattered, are not available everywhere. Wherever possible however, every county is expected to set up the so-called "five small industries" system, consisting of plants for the production of iron and steel, chemical fertilizer, cement, machinery and energy production units in the form of coal pits or small hydro-electric plants. This system is designed to meet the first component of the primary objective; that of producing industrial inputs for agriculture. Such plants are usually run by the counties themselves, but sometimes communes are assigned the responsibility for running smaller plants.

A three-level repair network with units at county, commune and brigade level is the physical manifestation of the second component of the primary objective, i.e., repair and maintenance of agricultural machinery. This network is almost always combined with the manufacture of farm tools and farm machinery. Between the three levels of the network there is a fairly clear division of labour: brigades are responsible for minor repairs; commune stations carry out medium-scale repairs; and major repairs are, in principle, handled by the county station. At brigade level, the repair and manufacturing station may have only a few employees and a few simple machines, such as a forging hammer and a grinding machine. Commune stations may have from a score to a hundred employees, and often have lathes as well as cutting and shaping machines, while county level stations tend to be relatively well equipped with machines, and engage the manufacture of different equipment and machinery, including simple machine tools, as well as repairs. The repair and manufacturing networks are developed gradually and it must be remembered that they are far from complete even in counties publicized as models.

The third component of rural industry's primary objective is the processing of farm and side-line produce. To do this, shops for oil pressing, flour milling, cotton ginning and sugar refining are established. Further processing, such as fruit canning and textile manufacture, may also be included, but the extent of these activities is, to a considerable extent, dependent on the availability of local raw materials and the purchasing power of the locality.

So far as the production of chemical fertilizer and iron for making farm tools and machinery is concerned, this is, in most counties, usually subsidized through the profits made on light industrial products. Those communes and brigades which are well off can afford to spend more money on consumer goods and these are priced to give considerable profits, so that the well-to-do communes and brigades are indirectly supporting the poorer brigades which benefit equally from the fertilizer and iron produced.

Local industrial development has, in certain industrial sectors, already been of considerable importance. In January 1972, for instance, the Chinese press reported that 60 per cent of chemical fertilizer production comes from small and medium enterprises (7), most of which were run by counties. Total fertilizer production in 1971 was approximately 17 million tons, so that local enterprises must have produced about 10 million tons (8). Similarly, 20 per cent of the total pig iron production of about 20 million tons comes from small iron and steel plants (9), so that approximately 4 million tons of pig iron is produced in some 1,000 small plants all over the country. Small fertilizer and pig iron plants came into existence in the late 1950's and there seems to have been a continuous development of technology ever since directed towards making them appropriate to their particular environment. The limit may indeed have been reached in terms of geographical distribution leaving further development to be in terms of size. As for farm machinery, which is mostly produced in local plants, this has increased approximately 100 per cent from 1965 to 1970 (10) but there is no information available to transform this percentage into concrete figures. It is equally difficult to find out how much development there has been in the rural light industry sector, and how far the repair and manufacture networks have been expanded (11), but there can be no doubt that rural industrialization has reached a considerable level of development, even if there are marked geographical differences.

THE ROLE OF LEADERSHIP

The introduction and acceptance of new and appropriate technologies often seems to require a special type of leadership, even though some mechanisms can be devised to encourage their automatic acceptance. The rapid development of local industry in rural areas is necessary for the further development of agriculture; but is also a consequence of the favourable development of agricultural production in recent years. The improved seeds and their popularization through agricultural scientific networks have, together with increased irrigation and more fertilizers, considerably increased yields per acre in many areas. This has two important consequences. First, the increased grain yields have made it possible to expand the acreage available for industrial crops, thus supplying industry with more raw material. Second, through increased agricultural production, purchasing power and the potential for savings and investments have increased. The peasants can thus buy more agricultural inputs such as machinery and agrochemicals, which in turn will further increase the productivity of agriculture and decrease labour intensity.

The initial development of agricultural production would appear to be an important pre-requisite for starting rural industries. In China, however, such development has not been evenly spread. For example, it has been reported from Hengtung county in Hunan that, since the leadership paid attention to concentrating on progressive units only, and disregarded giving specific assistance to backward communes and brigades, the 13 comparatively backward communes in the county did not undergo a major transformation, although production developed greatly on the remaining 26 communes. The county then sent about 1,250 cadres to stay at 853 production teams in 101 brigades in the relatively backward communes. The people sent included political and administrative as well as technical personnel. As a result, so it was reported, the backward communes and brigades were quickly transformed. The strengthening of leadership in these areas resulted in an increase of total grain production in the county of 29.8 per cent in 1970 as compared with 1969. According to the same report, improvement in the leadership of backward brigades was carried out in a wide geographical basis. Since the beginning of 1971, it was said that leading cadres of counties, districts and communes in the Hengtung region have led about 6,000 office cadres to stay at a total of 1,453 rather backward brigades which constituted one-third of the total brigades in the region. They gave education in ideology and political line for basic-level cadres and commune members and these units were said to have improved remarkably in only a short period, with grain output increasing 15 to 30 per cent above the figure for 1970 (12). Leadership improvement can, in fact, deal with a number of different aspects, such as willingness to try new seeds, the popularization of new seeds, accounting systems and willingness to make investments which will pay off later on, as well as the more strictly political matters generally referred to in press reports.

Conscious decisions to foster technologies appropriate to rural areas take a vast amount of political will on the part of government and Party leaders, partly because of the strong urban bias which has apparently been a serious problem even in China. Furthermore, the type of technological development chosen will play a large part in determining the nature of the society which emerges in China. This point is relevant to Mao's letter to Lin Piao dated 7 May 1966, which says, among other things, (13):

"... While the main task of the peasants in the communes is agriculture, they should at the same time study military affairs, politics and culture. Where conditions permit, they should collectively run small plants... Where conditions permit those working in commerce, in service trades and Party and government organizations should do the same."

This directive has usually been interpreted as an indication of Mao's fascination with the problem of the creation of a "new man" in China. However, it may be appropriate to look at those instructions as a tool, one among many, to create more relevant knowledge and attitudes for a development strategy which, to a considerable extent, must be based on local inter-disciplinary planning.

Attempts to delegate planning authority to local communities have, in many counties, produced unsatisfactory results. This has partly been due to lack of technical skills or resources, or both, but the failure is basically a political one. It appears that an important consequence of the Cultural Revolution in China is that skills and resources are quickly developed in the countryside to enable local overall planning. While broad strategies and policies must be centrally determined, wide authority has been delegated to the localities to plan for themselves. But to make the decentralized approach work the central planners - at all levels - must have a full understanding of the relevance of local developments. Similarly, diversification in the countryside means that more and more people are moving into new activities and consequently peasants need the knowledge and attitudes appropriate to their new tasks. At the same time, urban-based industry is increasingly drawn into interaction with rural industry. If these relations are to develop favourably, the people in all sectors must have a thorough understanding and knowledge about each other's conditions and activities which can only be obtained through a combination of study and experience. Thus, Mao's directive of 7 May 1966 may be seen primarily as a measure designed to foster attitudes and create knowledge which are inter-functional in character and appropriate for the present stage of development in China. The necessity to know all sides of multi-sector planning applies, of course, still more to officials at all levels. This might partly explain the emphasis which in recent years has been given to the May Seventh cadre training schools. The need for a better understanding of the countryside's requirements was of course recognized long before the cultural revolution which is evident from the following Peking Daily editorial in 1960:-

"Acceleration of the pace of agricultural development is the central link in the proportional development of the whole economy at a high speed. The organization of the flow of cadres between cities and the countryside, first of all the organization of a number of urban cadres to go to the countryside by turns to give aid and support to technical transformation of agriculture, is a new kind of development for the revolutionary tradition of the party. .... As a result of the selection of cadres for dispatch to the countryside, the different aid-giving units are able to understand the needs of agriculture better, and are therefore able to give better aid and support to agriculture in all kinds of work. .... The flow of cadres between cities and the countryside is also a political measure for the strengthening of the alliance of workers and peasants further (13b).

REGIONAL BALANCE IN RURAL INDUSTRIALIZATION

The previous discussion has suggested that the question of leadership is of great importance in initiating economic and industrial development. But leadership in isolation is not sufficient to check regional differences. The importance of local initiative is much stressed in economic planning in China at the moment and this may favour the development of areas which are already well-developed, particularly in the initial stages of local development, but there are means at the disposal of the centre (meaning region, province or nation) to guide the distribution of industrial activity and thus the distribution of income. Nevertheless, the question of regional balance and regional variations needs to be discussed.

The rural areas in China have benefited greatly from the creation of networks for different purposes. The machine-building network in Hopei which, it is proposed, be organized as in Figure 2, can be taken as an example (14). The province has two different networks, one for the production of complex products like diesel engines, tractors and trucks for use in rural areas, and one for the repairing and building of farm machinery and other products which are almost exclusively used within counties. The two networks interlock at the county level as can be seen from Figure 2.

Most services are organized in the form of networks with increasing specialization towards the top of the hierarchy. Almost all services in rural areas - public health, education, agricultural extension networks, machinery repair networks - were in the initial stages of development subsidized by

MACHINE-BUILDING NETWORK

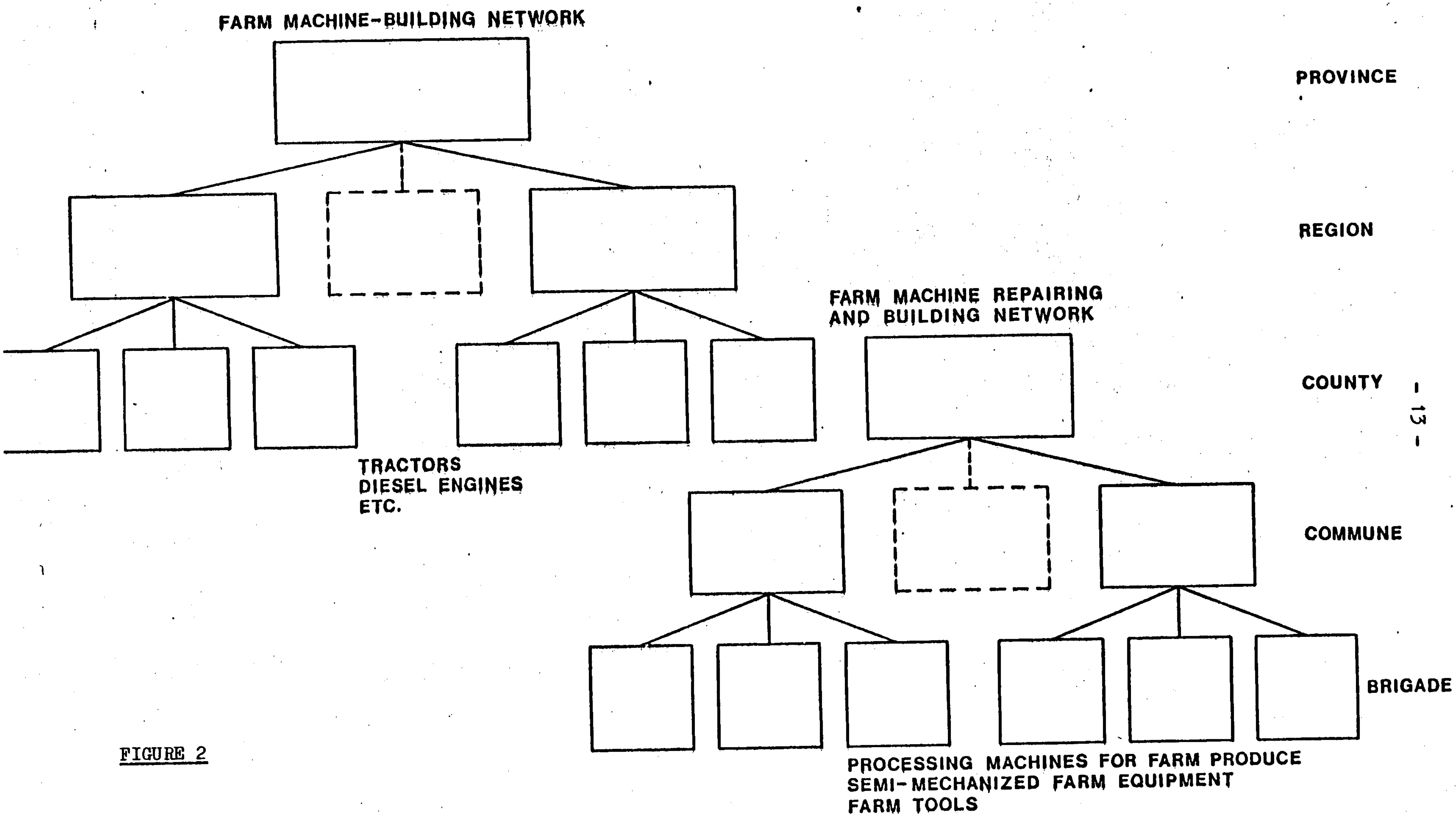


FIGURE 2

higher levels through the allocation of skilled manpower, transfer of equipment, etc. However, it should be noted that the building of these networks is far from complete. All the services mentioned above influence, directly or indirectly, productivity of the units which benefit from them. Through increased productivity, the members of the units will get higher incomes which will enable them to buy more consumer goods which are priced to give surplus at higher levels.

The centre (region, province or nation) will also continue to control admission to institutions of higher learning and is also likely to control the allocation of highly skilled manpower. As more and more sophisticated skills are needed for local industrialization (by counties or communes), the centre will be able, within certain limits, to use the admission of students and the allocation of skilled personnel as a means to guide local development.

The distribution of skilled manpower and equipment may also be a means by which the centre co-ordinates central and local planning. A county industrial system is never likely to manufacture special alloy steels or specialized bearings but such products will be needed in the future. These, and other similar items, are likely to be manufactured only by some of the national enterprises at the top of the industrial hierarchy. As specialized equipment is increasingly demanded by local industry, the localities will become increasingly dependent on the centre for the allocation of certain critical equipment.

The operation of the rural industrial system has to be seen as a whole and some plants may have to be run at a loss. That this possibility is envisaged can be seen from the following statement:-

> "... The development of iron and steel, chemical fertilizer and farm machinery industries needs a lot of investment and produces little profit. For a short time, they may even run at a loss." (15)

The control of investment funds is thus an important means of controlling the geographical distribution of industrial activities. Investment in new local process plants, such as iron plants or chemical fertilizer plants, and the expansion of such plants is usually of a magnitude beyond the capacity of the local level. Similarly, the distribution of electricity and the provision of feeder lines from main networks can become another way of forcing co-ordination between local and central planning. Despite this possibility of subsidization, however, the general policy is that local industry be built on a sound technical and economic basis. This is suggested by the following:-

> "... As for those small industries which failed to follow the correct orientation and whose raw materials, fuel and electric power were not definitely available, they were not allowed to continue their building."(16)

But the effect of widely differing conditions for starting local industry on the level of investment and planning is shown clearly in the following quotation from Hunan:-

> "... Some counties have developed agriculture comparatively rapidly and have surpluses and ample raw materials, so more industry is run there; where that is not the case, not so much industry is run. Some counties have a rather weak industrial foundation and so the region builds more factories there. Some counties have industries run by the centre or the province, so the region runs none at all or not many factories there."(17)

THE CO-ORDINATION NETWORKS

In an article on automated manufacturing techniques in developing economies, Jack Baranson points out that the "ability of the Japanese to substitute human skills for machine capabilities or deficiencies in raw materials was already evident at the turn of the century. Second-hand textile machinery was imported by Japan from England, cheaper short-staple cotton was used in combination with additional workers to mend broken threads, and repairmen were hired to keep older equipment going."(18)

This approach has much in common with Chinese policy towards the development of rural industry. Local industrialization is, apart from the process industries, to a considerable extent based on worn-out machines or obsolete equipment handed down from large urban-based industries(19). In rural industries these machines are repaired, adapted and carefully maintained. While raw materials of top quality are supplied to the big national industries, the local industries usually have to use second or third grades. The iron content of iron ore used in county-run iron and steel plants may be lower than 40 per cent. (as compared with 60 per cent in the big national plants). To make this approach work, China has had to develop high levels of conversion and management skills, for less-automated equipment places a very heavy burden upon supervisory and operator skills. With inferior equipment, industrial workers have to do more in adjusting tolerances, feeding the raw materials and controlling the quality and reliability of finished parts. To achieve this in rural areas, it has been vital to start industrial training from the beginning by producing mainly small and medium farm machinery at the outset.

This approach also involves much adaptation and rethinking. When advanced techniques that embody precision and uniformity are used in labour-intensive units, heavier demands are placed upon machine operators to read blueprints, set up tools and in other ways substitute human skills for machine accuracy. China is today developing a high level of machine labour skills and factory discipline in previously non-industrialised areas and a pool of experienced engineering and technical skills necessary to convert production techniques to local equipment and materials is gradually being developed. The use of old machines is, initially, both the justification for this approach and the necessary training ground. The effects of small industrial units on the modern industrial sector can be illustrated by the development of the production of bearings (20). China still lacks both the capacity to manufacture bearings, as well as capacity to manufacture machines to make bearings. Thus, while the country has the technology to manufacture any bearing needed, this is often only possible in very limited quantities. Similarly the Chinese machine industry can produce most of the machines needed for mass production of different types of bearings, but this capacity is likely to be limited for the most specialized machines.

The commitment to self-reliance means that the Chinese planners will emphasize the further development of production technology as well as production capacity and production equipment for bearings. It appears in this context that the small local machine enterprises can be used for import substitution of machines as well as products. As the national enterprises are not likely to be able to meet the requirements from all those sectors using bearings, the production of bearings within certain quality and size ranges can gradually be transferred to small local plants. Consequently, the national enterprises are enabled to get free capacity in terms of workshops, machinery and manpower, and can allocate more resources to the manufacture of bearings which would otherwise have been imported.

A similar development is affecting the machine tools industry where the manufacture of relatively simple machine tools is gradually transferred to small plants. Consequently, the well-established larger plants have some free capacity and can concentrate resources on the manufacture of more specialized machines which, among other uses, are needed for the manufacture of bearings.

China now has many small bearing plants run by regions, counties and communes (21). These enterprises are usually fairly small, with between fifty and a few hundred workers. The production of bearings in such plants is usually only one of the activities in multi-purpose repair and manufacturing enterprises. Such production has in many places started with the repair of bearings, the necessary replacement parts being supplied from elsewhere or gradually manufactured within the unit. Available information indicates that a number of these enterprises will eventually develop into small specialized bearings factories, producing a rather limited number of varieties.

Most of these enterprises have been established since 1966 and particularly during the past two or three years. They are the outcome of a policy which was initiated in 1958-60 to meet the local demand for relatively simple bearings needed for agricultural machinery and for carts used for long-distance transportation etc. However, very few of the enterprises set up in 1958 stayed in operation. There are two main reasons for this. First, there was no effective demand for low grade bearings until the recent development of local industry. Second, the necessary cumulative skills, equipment and capital for setting up small bearing factories were not available until recently.

When setting up a new plant, technology is usually transferred from other small bearing plants as well as from provincial or national bearings plants. A relatively large number of workers usually go to study in other plants for periods from a few weeks to six months or more. Very little of the equipment in small plants is new and specialized old machines are taken over from provincial or national bearing plants.

Production of bearings in small enterprises is often started within existing farm machinery repair and manufacturing plants. With the policy of the three-level repair and manufacturing network being implemented and the networks being expanded, two trends are emerging which are changing conditions for the local manufacture of bearings. First, more and more bearings are needed for horse-drawn carts, agricultural machinery and simple machine tools which are locally manufactured, within the three-level network.

Second, the fairly experienced, county-run, repair stations have free capacity available when many of their repair responsibilities are transferred downwards to the commune and brigade stations. The county repair and manufacturing stations can then move into the production of industrial commodities, and one of these products has tended to be bearings.

Small bearings factories may be able to take over the production of a considerable proportion of the intermediate size ranges where quality requirements are not so stringent. Some small enterprises are already able to manufacture bearings used for simple machine tools, electric motors and, probably, many of the bearings used for farm machinery. There are already places where small plants have started to manufacture bearings for motor vehicles. If quality can be improved and quantity increased in the small plants, this will mean that large national enterprises can concentrate more of their resources on high quality bearings.

The transfer of used equipment from the large to the small enterprises may also mean that large enterprises will be able to modernize earlier than would otherwise have been the case. The transfer of old machines is facilitated by the fact that wages and social overheads are considerably lower in local industry in the countryside as compared with those in urban-based industry. The average wages in county-run enterprises are likely to be 35 per cent lower than in an urban-based national enterprise. It should also be noted that the transfer of used equipment may be part of a plan to achieve a long-term division of labour between big and small enterprises.

Another area in which rural industries are playing an increasingly important role is when a large number of enterprises are co-ordinated for specific industrial projects. Thus, in industrially developed areas, rural industry is enabled to participate in up-to-date, high-precision levels of industrial production. In areas with a relatively weak industrial foundation this type of co-ordination enables rural industry to raise its technical level. As a consequence, many small enterprises are quickly drawn into close relations with other units of a network and in this process conversion and management skills are developed.

Our earlier discussion of the role of leadership, of regional balance and of the concept of the co-ordination network, implies two kinds of technology transfer. One is the horizontal transfer of technology between enterprises at county level or below and the other is the vertical transfer of technology from provincial enterprises downwards. Both these transfers are illustrated in Figure 3. However, it should be noted that these categories of transfer cannot achieve a regionally balanced development at the provincial level, with the inescapable consequence that provinces with a weak industrial foundation will stay weak.

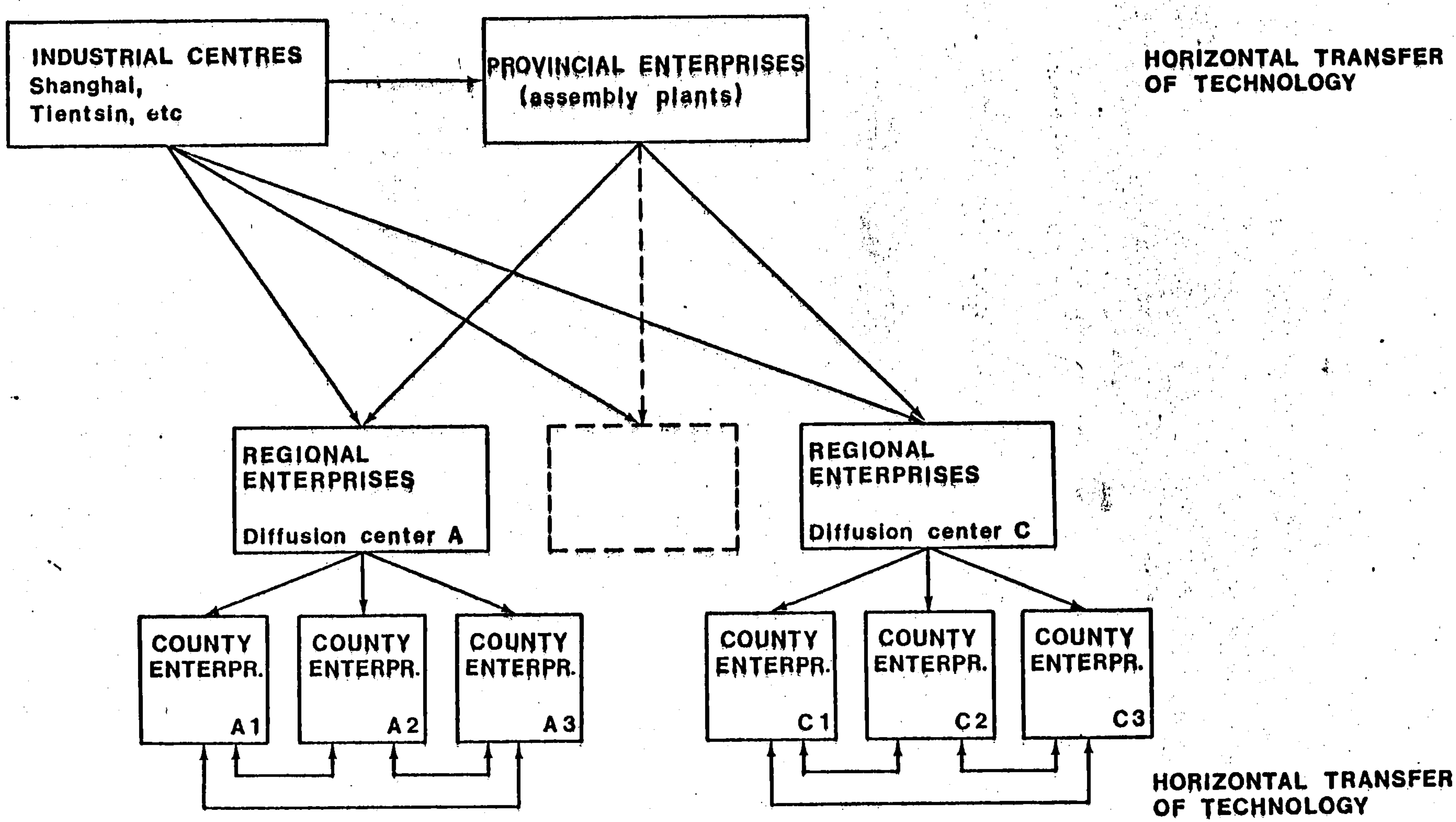
The way in which the creation of provincial co-ordination works for the manufacture of motor vehicles and other heavy and complex products involves a horizontal transfer of relatively complex technology between enterprises high up in the industrial hierarchy is also illustrated in the figure. Industrial centres such as Shanghai, Peking and Tientsin and the cities in the North-East have played an important role in this transfer of technology, Once a co-ordination network for the manufacture of vehicles has been set up the province can draw upon this knowledge pool for a number of purposes.

The co-ordination technique is mainly used for comprehensive production and the motor vehicle industry is a good example of this. Hitherto, most provinces have not been able to manufacture motor vehicles because complete sets of equipment and advanced techniques were required throughout the production process. Today, more than 20 provinces and municipalities can produce cars and trucks. One of the important factors in the rapid development of the motor vehicle industry in China has been the extended use of co-ordination between large numbers of plants. On the basis of the experience in mass co-ordination when the Great Leap Forward began in 1958, automobile repair shops, machine building factories and other small and large plants form a co-ordinating network within a province or within a large municipality (22).

The production of vehicle parts is usually undertaken in multi-purpose subcontracting units. This makes it possible to achieve great flexibility in the use of manpower and equipment. The manufacture of different parts is assigned to the unit which is best qualified and equipped for the task. Thus the use of co-ordination usually makes possible the substitution of labour for capital. There are other important reasons for choosing the co-ordination approach in manufacturing vehicles. If comprehensive vehicle plants were built with modern automatic machines, it is possible that demand might be inadequate in relation to the high initial output of modern technology plants. The co-ordination approach enables a gradual development of vehicle design and a gradual development of productive equipment and of the necessary raw

FIGURE 3

DIFFUSION OF TECHNOLOGY IN CHINA



VERTICAL TRANSFER OF TECHNOLOGY

material supply system. Co-ordination enables a fairly flexible interaction of the production factors. Thus, it becomes easier to strike an appropriate - and changing - balance between the use of capital and labour when making decisions regarding equipment, manpower and raw material.

A further reason for the co-ordination approach is the elimination of the risk that knowledge is monopolized within comprehensive industrial units. It appears that the attack on "economism" during the Cultural Revolution was partly to eliminate workers'exclusive commitment to their own enterprise which was partly based on the operation of extensive bonus systems related to the economic performance of their own enterprise). This relation between wages and short-term economic performance must have made workers and management less willing to accept the co-operation concept and engage in assistance to less developed units.

Although co-ordination networks for the vehicle industry are the most prominent and complex of all such networks, the co-ordination approach is not limited to that industry alone. Similar networks have also been created for small walking tractors with 10 or 12 Hp engines. In this case, it is not provinces and municipalities, but cities and counties, which are the units involved. In recent years, many cities all over China have started production of'walking tractors' based on a co-ordination network of several enterprises. Around the big industrial cities there is also a growing number of such co-ordination networks, mainly based on enterprises within the county, set up for the manufacture of combustion engine or complete 'walking tractors'.

For further industrialization, it is essential that quality standards are set and standardization encouraged, so that local industrial systems can eventually fit into the centrally controlled industrial structure. The local distribution of industrial products within a geographically small area is likely to make feedback mechanisms work efficiently to improve the quality of poor products. Thus, co-ordination networks are important for drawing a number of small enterprises into working relations with quality and standardization-conscious enterprises. It also appears that the centre encourages the development of strict standards through placing orders with county-run and commune-run enterprises for products at prices which enable the local enterprises to make a profit.

APPROPRIATE TECHNOLOGIES

The continued development of rural industry in China appears to depend on two interrelated factors. The development of local demand for industrial products, and of technology appropriate to the local resources.

With regard to the latter, rural industry is involved in two main transfers of technical knowledge. First, rural industry provides the surrounding agricultural area with a variety of knowledge. Agricultural workers from teams and brigades are trained in local industries e.g. to repair pumps. electric motors and other necessary equipment for the irrigation networks. In addition, other people are trained to reapir farm tools and farm machinery and the techniques involved in use of fertilizer. Further, most of the rural industries send repair and instruction teams to assist in relevant tasks within the agricultural units. Thus, the rural industrial system serves as an important training ground for local technicians.

The second transfer is that from cities to the rural industries. This transfer takes place in a number of ways. Some knowledge is capital-embodied: for example, much of the technology in small plants producing chemical fertilizer, iron and steel etc. Other knowledge is distributed through books and other printed material. Due however to unfamiliarity with industrial technology and lack of ability to interpret printed technical descriptions, it has been necessary in China to rely extensively on personal contacts to transmit technical knowledge. In this case technical knowledge may be carried by two categories of persons. Technicians, engineers and managers from advanced plants travel to the sites of small rural plants to assist in all stages from planning to production and distribution. At the same time people from the localities are sent for shorter or longer training periods to advanced industrial units and are given posts of responsibility for technical or managerial matters when they return.

Rural industry is based almost exclusively on local resources of manpower and capital, although equipment from cities is a pre-requisite for initiating much of its development. In this context it should be stressed that the chief feature of rural industries in China is not their smallness of scale but their local character. Local character requires that they be based on technologies which make optimal use of locally available natural resources, manpower and equipment. Rural industries are, of course, in addition often small, particularly in their initial stages of development.

This is a reflection of the limited local supply of capital as well as the limited local market for the products manufactured. As markets develop, so do the industries and the technologies utilized so that a plant may go through successive stages of changing production technologies, as long as the resource base permits this.

The following measures have been important in fostering the development of technologies which are appropriate for the economic development in rural areas in China (23):

1 - The development of "entirely" new technologies in research and design institutes. The design of chemical fertilizer plants seems to exemplify this.

2 - The use of old designs and processes and second-hand machinery which were developed for factor proportions which resemble those in rural areas. Second-hand may not primarily mean old and worn-out machinery, but rather equipment which has become obsolete and is uneconomic in the economic factor climate of the cities. It may still have years of life under economically favourable conditions in the countryside.

3 - The adjustment of factor prices to reflect the relative scarcities in rural areas so that local industries generate innovations appropriate to their factor endowment. The pricing of equipment and machinery "imported" into a county appears to have been calculated in order to achieve a substantial shift to the use of labour instead of capital both in making and using equipment.

The industrial technology which has been developed outside China or in the urban-based industrial sectors in China, is usually not appropriate for use in small-scale industries in the Chinese countryside. Therefore central (region, province, nation) research and design institutes have been assigned the task to make designs which are appropriate for local small-scale production.

Most local fertilizer production comes from relatively small synthetic ammonia plants usually run by counties. A new type of work process was introduced in 1958. The first plants using the new process were set up in the late fifties and had an annual production capacity of 800 tons of synthetic ammonia. The annual production capacity in new plants is now usually 3,000 to

5,000 tons of synthetic ammonia. High quality coke was originally required for the production of synthetic ammonia but the process was gradually changed to use high quality anthracite. Additional changes now make it possible to use relatively poor quality coal. Lignite and poor quality anthracite which could previously not be used are now mined in all the Southern provinces in China. After processing, the materials are used in many places for local production of synthetic ammonia (24).

This development has meant a thorough-going adaptation of the design and production process to suit the market demand of counties which on the average have 300,000 people and a cultivated area of around 60,000 hectares. It has also meant adaptation of the process to raw materials which are locally available. Without this latter development the costs of transporting coal would in many places have made it impossible to set up local small-scale fertilizer plants. But it should be noted that both lines of development have only gradually come about.

The design of a small blast furnace may still be partly indigenous but the production technology is modern to be able to maintain necessary quality standards. Equipment allocated from central sources is based on standard blast furnace sizes of 8, 13. 28, 50, 100 and 120 m^3. The smallest of these gives an annual production of approximately 2,000 tons of pig iron (25). It should be noted that it is only in the blast furnace that a modern up-to-date process is used. The casting of ingots, production of coke and the internal transportation are all done with indigenous labour-intensive methods.

More than half of China's 2,000 counties now have their own small cement plants, these are in very different stages of development in terms both of technology and size. The biggest ones produce around 50,000 tons of cement per year and often use twin vertical kilns. The small ones may not produce more than a few hundred tons per year but are then usually in their initial stage of development. The very small plants use simple concrete pitches for the sintering process. Costs and quality are usually related to the size of the plant and, above a certain capacity range, the vertical kiln is usually introduced. Recently, the further development of the pitch design has been emphasized which would replace the vertical kiln, even for relatively large small-scale plants. The new design comes from Liaoning province in the North-East and is based on a horizontal brick design. It is claimed that it requires less steel and other critical material and can be built more quickly. It appears now to be widely popularized (26).

The present stage of production technology for small plants has been reached through a gradual process. Central research and design institutes are likely to have played an important role in the initial stages but local plants are now an important source for improvements and incremental innovations. The smallest sizes may eventually not be used for new process plants as raw material, equipment and market development can be controlled in order to fit the larger plants already from the beginning.

The development of process plants, like those for chemical fertilizer and iron, is centrally supervised to enable continuous and wide-spread improvement changes. This makes it possible to compare the performance of alternative innovations and adaptations in order to choose still better designs for new plants.

Innovations in productive equipment used in rural enterprises producing or repairing machinery are left almost completely to the localities, to enable them to make best possible use of their combination of capital, man-power and raw material. The manufacture and use of indigenous machines are encouraged wherever the capacity of modern - expensive - machines would not be fully utilized. Machinery and equipment used in agriculture is still a main area of rural innovations and it has often been stressed that mass campaigns to improve farm tools and developing semi-mechanical and improved farm toold, could greatly improve labour efficiency.

The development of appropriate technology for rural industries takes place continuously as the rural industry systems become more and more differentiated. There is an important progressive element in this, in that, as the market develops and the underemployment slack is reduced, the appropriate technologies will adapt to greater scale and capital intensity requirements.

The trial-manufacture of new equipment, small or large, is usually commissioned to several units. A regional or provincial industrial bureau is usually the co-ordinating body for major equipment, but the trial-manufacture for minor equipment may be commissioned by the county industrial bureau to units within the county.

As the size and sohpistication of local industry develops, so does local capacity for finding its own solutions. Thus, when development becomes partially self-sustaining, and the locality becomes increasingly able to analyse its requirements for further economic and social development, the symbiotic relation between urban-based industry and rural industry becomes important. Industrial organization which permits the effective use of small-scale industries in co-operation with modern industrial complexes seem to have been developed in many areas in China. But to function effectively the small rural industries have not only to be able to convert techniques to meet standards of the modern industrial sector, they must also be able to co-ordinate their activities effectively and schedule production within the larger industrial complex. However these conversion and management skills are developed in rural areas as the local industrial systems become more and more differentiated.

THE SIGNIFICANCE OF "ELECTRONICS VERSUS STEEL"

During the past two years there has been much discussion within China about the relative importance of the steel industry as opposed to electronic technology (27). This has sometimes been interpreted as a discussion between the military and civilian sectors, with the military advocating more electronics for advanced weaponry. This is likely to be part of the explanation but should not obscure other considerations which may be more basic to the whole development strategy of China. The electronics versus steel "controversy" can also be seen as an educational theme which is used to educate planners at different levels about the priorities for further development. Important areas for the use of electronic technology are data processing and automation and it could be argued that prematurely introducing advanced electronic technology into these areas would adversely influence China's development strategy.

Electronic technology, for instance, is extensively used for information processing and all large companies and all planning agencies in industrialized countries make extensive use of electronic technology for planning purposes. Electronic data processing is today a necessity for the centralized operations of large companies. But China, on the contrary, is today stressing the dispersal of industrial activities. Small and medium plants are becoming increasingly important and an inter-functional approach in planning is being stressed at all levels. For this purpose there are disadvantages in using electronic data processing since it favours large plants (or plants under centralized control) and requires highly standardized procedures. Such techniques would run directly counter to programmes for mobilizing local resources of raw materials, manpower and savings and would leave little leeway for local initiative.

Rural industrialization requires a large number of machine tools for the manufacture of machinery needed for the mechanization of agriculture. Machine tools can be highly automated and integrated into groups of machines in line-production by the use of electronic technology which, in turn, reduces the need for skilled manpower. Such tools have high capacity but are not generally suitable for simple, small-scale production. Rural areas, with their nascent industries would certainly not yet be ripe, either in terms of scale or level of sophistication, for the application of electronic technology.

Jack Gray has pointed out that Mao specifically seems to have regarded industrialization and the technical transformation of agriculture as simultaneous, and certainly mutually interdependent, tasks (28). Gray further argues that it consequently seems possible that the First Five Year industrialization effort was launched deliberately to achieve a number of specific but short-term results. The aim would thus appear to have been to create, as quickly as possible, a comprehensive industrial base for the purpose principally of national defence but also as a base for technology transfer to non-industrialized regions. In addition to providing for defence needs, such a programme would also serve to stimulate overall industrialization and contribute, indirectly, to the task of modernization. Once such a programme was under way and given the required inputs, which could be fairly precisely planned, it could continue by its own momentum with little interference from or with other sectors. It is within this wider context that the controversy regarding steel versus electronics can be better understood. Emphasis on electronic technology would, at present, among other things, mean technology for specialized, automated, high-capacity plants which would, of course, be urban-based. Machinery produced in long series could then be supplied to the countryside but there would be few possibilities for local adaptations. As a consequence, many rural areas would have been left out either because they lacked the financial means for bying machinery or because the machinery was not suited to their conditions. The other alternative in producing machinery for the countryside has been to make relatively low-grade iron and steel available to almost all counties throughout China and let them all gradually develop their own machinery manufacturing capability based on local skill formation and closely adapted to local land characteristics and the financial resources available in that area. This approach in supplying the countryside with machinery requires less electronic technology but more ingenuity in developing local steel production from the mining of minerals to the manufacture of rolled steel.

If one looks at the characteristics of the local machine building industry where most of the machine tools are being used, it can be seen that the machine tool operator controls the output of his machine. The quality of work is determined jointly by the capabilities of the machinist and of the equipment. Unless a supervisor does the job himself, there is no way to avoid the limit imposed by the expertise of individual machine operators; unless, that is, production is automated. These characteristics contrast sharply with those in the production of iron or chemical fertilizer, where most work is done by teams and the presence of a small number of knowledgeable personnel permits the operation of facilities by a work force consisting largely of unskilled labour.

Further, with demand for most individual products relatively small and subject to change, China is seldom able to support the type of specialized, single-product enterprises which could reduce the need for employee skills by utilizing automatic equipment designed for one product. Thus, machinery production in China requires a large labour force with a degree of training and experience, perhaps superior to that of the average machine-building worker in industrialized countries, where machine-building is becoming increasingly automated. Production of machinery requires not only a high degree of technical skills, but also broad dispersion of these skills among the work force. This explains the graudal approach being used in building up the three-level system for repair and manufacturing, from the repair and manufacture of small simple farm machinery to the manufacture of relatively complicated machine tools, like cutting and shaping machines. The high level of technical skills and their wide dispersion already achieved explains the capability of many counties to manufacture electric motors, ball bearings and diesel engines.

Heavy emphasis on the development of electronic technology would, at present, be likely to damage the development of more balanced socio-economic relations between cities and countryside and minimize the present growing complementarity of the two sectors. Electronic technology introduced now - before extensive skill formation has taken place all over the countryside - would be likely to increase greatly the difference in productivity between modern industry and rural industry, since electronic technology would, at present, be used mainly in urban-based and relatively large plants. In addition to this, emphasis on electronic technology would be likely to reduce the availability of those planning resources needed for the transfer of technology to rural areas and the development of a local steel industry.

The decision to emphasize steel instead of electronics may also have been influenced by a desire to start extensive development of electronic technology at a later stage when the necessary development costs can be spread more thinly on a wide economic base.

However, reports about the Chinese electronics industry show that the planners are well aware of the potential value of electronic technology for future industrial development, although they appear to be arguing that electronics should not be used indiscriminately without due considerations to long-term as well as short-term socio-economic consequences. The Chinese consider that social and technical revolutions are complementary. The social revolution is an integral part of China's development strategy where the social and economic development of the countryside - the creation of employment, economic growth, etc. - play an important role. While these attitudes are mainly directed towards China's internal development, they do also provide support for a foreign policy aimed at the Third World which seeks to show that China is solving problems which are common to many other Third World countries.

CONCLUDING REMARKS

The development of rural industry in China is not related only to the modernization of agriculture but also to China's overall development strategy. The development of rural industry can be evaluated by a number of different criteria such as capital accumulation, the creation of employment, or income distribution, but sufficient data is not available for any full evaluation and I will only try to indicate here some of the consequences of the present policy.

It is too early to draw any definite conclusions about the effects of present policy on capital accumulation. However, it is likely that considerable amounts of capital are mobilized through reduced consumption and through extra labour which, in the initial stages, is almost completely unassisted by modern machines. Local leadership may well amount to introducing the Chinese equivalent of the "Green Revolution" and mobilizing people to make the necessary contributions for a local fertilizer plant, a local repair station or new farm machines. If this is the case, the local character of rural industry may be credited with success in achieving local capital accumulation. Furthermore, the local character of rural industry is likely to reduce the demand for capital in the national transport system and to mean that less expansion will take place in cities, thus reducing the demand for urban housing, schools, transportation, sewage systems and other urban utilities. It is also likely to be of considerable importance that the centre (region, province, or nation) has at its disposal large networks of small, adaptable plants. The development of new products, new processes or new management techniques can then be assigned to small local plants without disturbing the planned targets of the national enterprises. Finally, technologies which are developed in rural industries are likely to be relatively independent in terms of maintenance and complementary support.

So far as income distribution is concerned, available information indicates that uneveness of distribution within a region is considered adversely to effect overall development and consequently, much attention is paid to the relatively backward communes and brigades in order to initiate a self-sustaining development. The resulting diversification of agriculture makes it possible to give meaningful employment throughout the year to commune members with varying physical strength and skills. Diversification also creates conditions for a more optimal use of farm land, since land can be used for a number of purposes and not only for growing grain.

In the long run, a considerable proportion of the manpower in the countryside may be employed in the rural industrial sector, particularly when many local enterprises are fully drawn into interaction with the urban-based industrial sector. In this context, it should be remembered that China eagerly wants to develop her vast rural market since this is a pre-requisite for the full development of her full industrial potential. The national programme for agriculture development over the period 1956-67 clearly states, "... the countryside, with its more than 500 million population provides our industry with the biggest domestic market in the world" (29). As one takes a longer term perspective so the size of this market becomes increasingly important for China since it will enable her to spread the development expenditure for new costly technology on a wide economic base.

The development of rural areas, based on local industries and services is likely to create new relations between cities and countryside. The present difference may virtually disappear; an even income distribution will emphasize the importance of local decisions; and a new pattern of urbanization may be the outcome. Thus, in China, economic and social objectives in planning are closely interrelated. Finally, one must note also the military objectives of the development of rural industrial systems (30). Some Chinese leaders may have seen a choice between a defence strategy based on conventional hardware and a strategy using the strength of a vast inland area to repel an attack. The first alternative would heavily tax Chinese capital and skill resources, and this may well have given support to those among the leadership who wanted to emphasize the development of rural industry.

NOTES

1. See for example "County-run industry on Shanghai outskirts", New China News Agency, (NCNA), 11 May 1972, p.4, Hsinhua Weekly, (London), Issue 171.

2. Information given by a cadre in Shanghai Municipality Farming Bureau in December, 1971.

3. NCNA in Chinese, 10 June 1972, BBC Summary of World Broadcasts (SWB), Part 3 (The Far East) FE/W678.

4. Similar linkages in the Chinese society has been discussed with reference to the public health system in a paper by Susan Rifkin and Raphael Kaplinsky: "Health strategy and development planning: Lesson from the People's Republic of China", Journal of Development Studies, January 1973. An important aspect of the new public health system in China appears to be the emphasis on the effective demand from the rural sector which corresponds to the effective demand for technology in agriculture.

5. See "Rural Industry - A Traveller's view", by Jon Sigurdson, The China Quarterly, No. 51, (April - June 1972) pp. 315-32.

6. Ts'unhua county in Hopei province, NCNA, 17 September 1971, SWB, FE/W641.

7. "New leap in China's National Economy", Peking Review, No. 2, 1972, p.8.

8. In Edgar Snow's last interview with Chou En-lai, he was given the figure of 14 million tons for the total chemical fertilizer production in 1970. Official data released at the beginning of 1972 said that fertilizer production increased by 20% in 1971.

9. "... The iron ore and pig iron turned out by local small and medium-sized iron and steel enterprises throughout the country this year accounted for one-fourth and one-fifth of national output respectively." NCNA in English, 27 July 1971, SWB, FE/W642.

10. "Advance along Chairman Mao's line in agricultural mechanization", People's Daily, 17 September, 1971, SWB, FE/3793.

11. Tangshan region, Hopei, which has a population of 6.5 million, reported that "the rapid development of local industries has brought about an enlarged farm-tool repair and maintenance network serving counties, communes and production brigades in the region - a network which now comprises 24 county-level farm machinery repair and manufacturing plants,

440 commune-level farm machinery repair and manufacturing stations, and 2,000 production brigade-level farm machinery and assembly points", NCNA, 5 June 1972, SWB, FE/W677.

12. Improvement of backward communes and brigades in a Hunan region, Hunan Radio, 27 March 1972, SWB, FE/3953.

13. Far Eastern Economic Review (Hong Kong), 2 October, 1969.

13b. Peking Daily editorial, 6 September 1960, SCMP 2354.

14. Hopei Radio, 27 September 1972, SWB, FE/W695.

15. Development of agriculture and industry in a Hunan region, Hunan Radio, 22 July 1972, SWB, FE/W684.

16. Red Flag (Peking), No. 10, 1972, article by Hsu Chung-yuan on relations between agriculture and industry, SWB, FE/4127.

17. Hunan Radio, 22 July 1972, SWB, FE/W684.

18. "Automated manufacturing techniques in developing countries", Jack Baranson, Finance and Development, Vol. 8 No. 4, December 1971, pp. 10-17.

19. Factories' links with rural communes, NCNA in English, 20 November 1972, SWB, FE/W701.

20. This capability is also evident in other fields like the manufacture of small electric motors, generators and diesel-engines.

21. Kuanghan county, Szechwan, SWB, FE/W641; Hopei region, SWB, FE/W642; Payinkuoleng Mongol Autonomous Chou, Sinkiang, SWB, FE/W669; Information given to the author when visiting bearing plants in December 1971.

22. "Local automobile industry expands rapidly", China Reconstructs, (Peking), October 1970.

23. These categories correspond to those mentioned by Sarah Jackson in Economically appropriate technologies for developing countries: a survey, Overseas Development Council, 1971.

24. China expands small nitrogen fertilizer industry, 9 May 1972, pp. 20-21, Hsinhua Weekly (London), Issue 170.

25. Information given when visiting Ts'unhua county in December 1971.

26. "Small Cement" Technical Material - Circular Kiln, (Chinese Construction Industry Publishing House, Peking, March 1972).

27. See for example "People's Daily on Relative Importance of Electronic Industry", Peking Radio, 12 August 1971, SWB, FE/3766; Kuang-ming jih-pao, 13 December 1971, "Line struggle in industry - A criticism of Liu Shao - ch'i's and other political swindlers' theory of 'electronics as the core'", Survey of China Mainland Press, (U.S. Consulate General, Hong Kong), No. 5045, 3 January 1972.

28. See his chapter "The Two Roads: Alternative Strategies of Social Change and Economic Growth in China" elsewhere in the volume, p.p. 000-00.

29. Leslie T.C. Kuo, The Technical transformation of agriculture in Communist China, New York: 1972, p. 243.

30. It appears from the motives and facts presented in this paper that rural industry has been rapidly developed mainly on economic and social grounds. However, it should not be overlooked that this development in the countryside has important consequences for national defence. It has often been pointed out by the Chinese that the many small synthetic ammonia plants through only minor changes can be converted to producing explosives. Counties with a differentiated industrial system also claim that they can manufacture hand weapons and other equipment needed for defence, such as simple electronic communications equipment.

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Small Establishments as Exporters of Manufactures: Tentative Evidence from Malaysia

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Summary. – Based on the contention that the contribution of small manufacturing enterprises (SSE) to overall development depends – *inter alia* – on their export performance, this paper first presents a theoretical discussion of the export capability of SSE and of the factors which might be responsible for a difference between such a capability and their actual performance. The posited hypotheses are then tested for a microsample of Malaysian manufacturing establishments. The evidence suggests that the export potential of SSE mainly lies in natural-resource-intensive and traditional products, and that for the individual SSE barriers to enter export markets are more important than problems in increasing exports. The evidence further suggests that of particular importance among those barriers inhibiting entry are factors typically affecting overall profitability, like problems of short-term finance, raw-material procurement and capacity underutilization.

1. INTRODUCTION

While the importance of meshing the industrialization process of a developing country with the international division of labour has been well established by empirical economic research,[1] one aspect of such a policy has been unfortunately neglected. This is the role which small-scale establishments (SSE) can play in an export-oriented industrialization. To be specific, insufficient attention has been directed to answering the question, whether SSE activities are mainly confined to local and national markets, or whether these enterprises are also capable of exporting to a significant degree. If the latter is true, there is reason to expect that SSE have a higher potential to contribute to growth, and to the alleviation of underemployment and other urgent problems than would be otherwise the case.[2] The purpose of this paper is to throw some light on this issue.[3]

After a theoretical discussion of the export potential of SSE in Section 2 the actual export performance of such industries will be analysed in Section 3, based on a sample survey of Malaysian manufacturing establishments. Possible determinants of the observed export behaviour will be discussed in Section 4. Section 5 presents some tentative conclusions and suggestions for further research.

2. ON THE EXPORT POTENTIAL OF SMALL-SCALE MANUFACTURERS

In many countries small establishments produce a considerable part of the industrial output and employ an even more important part of the labour force (see Table 1).[4] In the early phase of industrialization their activities are directed mostly towards meeting the needs of the local and the national market. After an initial phase of import-substituting industrialization developing countries generally face the need to increase exports of manufactures, if an efficient allocation of resources is to be secured and overall economic growth is to continue at satisfactory rates. In the light of the relative quantitative importance of the small-scale manufacturing sector, the question arises, to what extent SSE can participate in export expansion.[5] To answer this question, we first have to identify those manufacturing activities where SSE have, or

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Table 1. *Shares of SSE in output, value added and employment of the manufacturing sector* (%)

Country/year	Definition of SEE	Gross output	Value added	Employment
Brazil, 1970	Below 50 employed persons	24.4	22.1	35.1
Israel, 1965–1966	Below 50 employed persons	38.2	38.5	50.8
Kenya, 1967	Five or more, but less than 50 employed persons	17.6	18.9	20.7
Mexico, 1970	Below 51 employed persons	16.2	16.2	31.0
Taiwan, 1971	Below 50 employed persons	19.8	15.9	26.3
West Malaysia, 1973	Below 50 paid full-time employees	22.2	18.7	31.6

Sources: Brazil: Secretaria de Planejamento da Presidencia da República, *Censo Industrial Brasil* 1970, Série Nacional, Vol. 4; Israel: Bureau of Statistics, *Census of Industry and Crafts* 1965 (Jerusalem: 1970); Kenya: Ministry of Finance and Economic Planning, *Census of Industrial Production* 1967 (Nairobi: 1972); Mexico: Secretaría de Industria y Comercio, IX *Censo Industrial* 1971 (Mexico D.F.: 1973); Taiwan: Committee on Industrial and Commercial Censuses of Taiwan and Fukien Area, *Industrial and Commercial Census* 1971 (Teipei: 1973); West Malaysia: Department of Statistics, *Census of Manufacturing Industries* 1973 (Kuala Lumpur: 1978).

can develop, a comparative advantage. Whether they can realize it will depend on a number of factors to be discussed later.

Small establishments are not only competing with foreign suppliers but also with domestic large-scale establishments (LSE). Comparative advantage thus not only has a product component, but also a plant size component. Hence, the range of products which SSE possibly can competitively produce and export is first of all limited to those where the respective developing country has a comparative advantage. Furthermore, it is limited to those, where production is not subject to strongly decreasing average cost.[6] *A priori* reasoning suggests that SSE in developing countries should have a certain potential to competitively export products which belong to one of the following three categories.

The first category relates to products where SSE would seem to have a certain edge over LSE in the processing of spatially dispersed raw materials, if such processing leads to a definite reduction in their weight, bulk or perishability (e.g. wood products, some kinds of manufactured food, some oils and fats). If these products are export goods, the resulting reduction in transportation and handling costs should help them to become more competitive in foreign markets.

The second category includes traditional products which are manufactured by using labour-intensive indigenous technology. SSE which produce goods belonging to this category should have a significant export potential, provided that they will adapt their products to the requirements of foreign markets. On the one hand, their products are typically manufactured by smaller establishments, which suggests that indigenous techniques, beyond the smallest plant size. are characterized by constant or even decreasing returns to scale; on the other hand, competitors from other developing countries can be expected to be relatively few, as the characteristics of traditional products are closely determined by specific local skills and conditions (e.g. batik cloth in south-east Asia).

Finally, turning to the third category, SSE also should be able to export labour-intensive products if the technology is internationally known and if the average cost is not decreasing in the relevant output range. This is likely to be the case for products which cannot be standardized or for specialized products with a small total market.

There are, however, a number of factors, which might account for a difference between potential and performance. To begin with, the general competitiveness of SSE is reduced by a number of factors which either are a consequence of discrimination or are related to the lack of an appropriate institutional and economic environment:

– While the undervaluation of foreign exchange as a consequence of import protection discriminates against all exporters, SSE are put at a disadvantage compared to LSE, if imported capital goods are, as is frequently the case, exempted from tariffs. Compared to a situation with uniform tariffs on all imported goods, the exemption of capital goods causes a larger (percentage) cost reduction for LSE than for SSE, whose capital–labour ratio is much lower.[7] This is even more the case when SSE make more extensive use of indigeneous machinery which often cannot be efficiently substituted for imported machinery.

– Perhaps more importantly, the access of SSE to capital markets usually is limited and lending conditions are often worse for SSE than for LSE. Thus, SSE often have to resort to informal financial markets with their relatively high interest rates. With respect to long-term finance this does not necessarily imply higher average cost for SSE, if, as can be assumed, they face lower wage rates compared to LSE. The more easily labour can be substituted for capital and the higher the labour-bias of non-homotheticity, the better SSE can compensate for higher capital cost.[8] Problems of financing working capital at a reasonable cost are much more likely to seriously affect the competitiveness of SSE. 'In brief, every kind of problem whether of raw material, power, transport or marketing . . . in its ultimate analysis turns to be a problem of finance.'[9] Evidence from a study of small industrial establishments in Delhi suggests, that the shortage of working capital is also the major reason for the existence of unused capacity.[10] The financial requirements of exporting typically are quite large. Problems to finance working capital, therefore, can be expected to be particularly detrimental to export competitiveness.

– Another SSE-specific problem is the procurement of raw materials. SSE often cannot take advantage of discounts as they buy small quantities and lack of working capital prevents larger stocks. This may also reduce capacity utilization.

– Though SSE may be able to avoid taxation and government regulations to a certain extent, they also will be excluded from many types of government assistance or will not be able to take full advantage of them. In some countries SSE are either not eligible for investment incentives or the extent to which incentives are granted is a positive function of size.[11] But even if this is not the case, it is easier from the bureaucrat's point of view to administer and distribute government assistance to a few large units than to many small ones.

Furthermore, SSE face a number of problems in export marketing, which also are pertinent to large-scale producers, but which seem to be much more difficult for SSEs to overcome.[12] They include, *inter alia:*

– lack of information about international trading practices, particularly with regard to import barriers;
– insufficient knowledge of the patterns of demand and supply in foreign markets and their future tendencies;
– deficiencies in the quality of products;
– difficulties in meeting dates of delivery, often due to problems in the procurement of raw materials:
– the need to cope with export formalities and documentation.

Moreover, SSE generally are not aware of export incentives or do not take them into account, when calculating export prices. Many of these problems are more pertinent to SSE than to LSE for the simple reason that selling abroad involves higher fixed cost than selling at home. This is also the focal point of most promotional schemes, which have been proposed in the field of promoting SSE exports. These proposals mostly concentrate on the creation of private or public institutions which provide marketing services to many small exporters and help them in export financing and administrational-problems. The rationale for these institutions is to decrease the average fixed cost of exporting and to provide complementary factors as long as the marginal social cost of their provision is below marginal social revenue.

3. THE EXPORT PERFORMANCE OF SSE IN WEST MALAYSIA

One reason why the role of small-scale industry in export-oriented industrialization has hardly been discussed is due to the fact that there are virtually no data on external trade flows disaggregated by the size of establishments. The following analysis can take advantage of the results of a microsurvey of 399 West Malaysian manufacturing establishments which also supplies information on exports by establishments.[13] This sample has been designed to study the characteristics of the small-scale manufacturing sector in West Malaysia and thus includes industries which actually as well as potentially are important for the development of SSE.[14] It can be seen from Table A2, that in most of the 19 selected industries SSE (here defined as employing less than 50 paid full-time employees) have relatively high shares of value added and employment in the respective industry totals and thus, apparently, can compete successfully with larger establishments.

Compared with the overall export share

(value of exports/value of total production) for the West Malaysian manufacturing sector of 43.6% (Table A3), the export share relating to all sample units of 18.5% seems to be relatively low. The bulk of West Malaysian manufactured exports in 1970, however, consisted of processed primary materials like rubber and basic metals (mostly tin). If we exclude these two industries, which are not part of the sample, from the calculation, the export share of manufacturing decreases to 20.2%. (Table A3); this is only slightly above the export share which has been derived from our sample. As Table A4 shows, the industry structure of export shares, as derived from the sample, is fairly similar to that relating to total branches.[15] The Spearman rank correlation coefficient ($s = 0.62$) is statistically significant at the 1% level. This is also true for the two size groups ($s = 0.56$; significant at the 2.5% level for 0–49 paid full-time employees: $s = 0.63$; significant at the 1% level for 50 paid full-time employees and over).

The analysis of the sample data centres on the following questions:[16]

– To what extent do SSE export, compared with both medium-sized (MSE) and large-scale establishments (LSE)?

– Are the exporting activities of SSE concentrated in certain branches? What are the characteristics of these branches? Are the export activities of LSE concentrated in the same branches?

– Are differences in export shares (value of exports/value of production of all establishments) between SSE and larger establishments a result of differences in export participation (number of exporters/total number of establishments) or of differences in export intensity (value of exports/value of production of exporting establishments)?

From Table 2 it can be seen, that in the total sample of 399 establishments there are 61 exporters of which 33 belong to the category of SSE. Export participation is about one-tenth for SSE, while that of MSE (between 50 and 99 paid full-time employees) is about one-third and that of LSE (100 paid full-time employees and over) is almost one-half. It can also be seen that the export share increases fairly steadily with size. Whereas establishments up to nine paid full-time employees hardly export at all, above that size SSE apparently are able to export to a certain extent. The export share, however, remains in the range between 12 and 14% and only increases to about 27% beyond 100 paid full-time employees. But not only export participation and export share rise with size; this is also the case for export intensity, which is meant to reflect the share of production that is exported by the average exporter (see Table 3).[17] It is, however, interesting to note that, while the differences in export shares between SSE and MSE on the one hand and LSE on the other are quite significant, SSE exporters beyond the size of 10 paid full-time employees are engaged in exporting almost as intensively as large-scale exporters.

This overall picture of course has to be differentiated by a more detailed analysis. As is obvious from Table 2, there are large differences between individual branches. Among the 19 industries which have been included in the sample, only three have above average export shares, six do not export at all. All size groups taken together, sawmills directly export almost one-half of their production, cocunut oil mills more than one-third and batik manufacturers almost one-fifth. These are either industries processing spatially dispersed raw materials or using indigenous technology (batik making). In these industries small establishments also seem to be able to export, at least beyond the size of 10 paid full-time employees.[18] Other branches with above average export shares in the SSE range include manufacturing of medicine, motor vehicle bodies and structural shapes. Manufacturing of medicine, which in the SSE range is mostly production of traditional Chinese medicine, also can be considered as an industry using mainly indigenous technology. Further it is interesting to note that there are several industries with highly export-oriented SSE. Export intensity is above the SSE average for sawmills, industrial machinery and batik making. Industries which do not export at all mostly belong to the type that typically serves local markets, as bakeries, retreading, ice-cream and soft-drink manufacturing.

4. DETERMINANTS OF EXPORT PERFORMANCE

The preceding section has shown that in our sample export performance varies considerably between industries and size groups. But export performance also varies between establishments which belong to the same industry and the same size group. The determinants of export intensity on the microlevel will be analysed in two steps. First, we will look for characteristics which allow us to discriminate between exporters and non-exporters. Subsequently, possible determinants of the export intensity of exporters will be tested in a stepwise multiple regression analysis.

Table 2. *Export participation and export shares by industry and size group, West Malaysia,* 1973 *(survey data)*

	Number of paid full-time employees														Subtotals				Total	
	0–4		5–9		10–19		20–29		30–49		50–99		100 and over		0–49		50 and over			
	EP*	ES*	EP	ES	EP	ES	EP	ES	EP	ES	EP	ES	EP	ES	EP	ES	EP	ES	EP	ES
Bakeries	$\frac{1}{4}$	—	$\frac{0}{8}$	—	$\frac{0}{7}$	—	$\frac{0}{1}$	—	$\frac{0}{3}$	—	$\frac{0}{1}$	—	$\frac{0}{0}$	—	$\frac{0}{23}$	—	$\frac{0}{1}$	—	$\frac{0}{24}$	—
Furniture	$\frac{0}{17}$	—	$\frac{0}{9}$	—	$\frac{0}{5}$	—	$\frac{2}{3}$	25.1	$\frac{0}{2}$	—	$\frac{0}{1}$	—	$\frac{0}{1}$	—	$\frac{2}{36}$	9.8	$\frac{0}{2}$	—	$\frac{2}{38}$	16.2
Leather	$\frac{0}{4}$	—	$\frac{0}{1}$	—	$\frac{0}{2}$	—	$\frac{0}{0}$	—	$\frac{1}{2}$	11.5	$\frac{1}{3}$	1.0	$\frac{0}{0}$	—	$\frac{1}{9}$	8.2	$\frac{1}{3}$	1.0	$\frac{2}{12}$	3.3
Retreading	$\frac{0}{4}$	—	$\frac{0}{4}$	—	$\frac{0}{3}$	—	$\frac{0}{2}$	—	$\frac{0}{1}$	—	$\frac{0}{0}$	—	$\frac{0}{1}$	—	$\frac{0}{14}$	—	$\frac{0}{1}$	—	$\frac{0}{15}$	—
Iron foundries	$\frac{0}{6}$	—	$\frac{0}{5}$	—	$\frac{0}{6}$	—	$\frac{0}{1}$	—	$\frac{0}{2}$	—	$\frac{0}{0}$	—	$\frac{0}{1}$	—	$\frac{0}{20}$	—	$\frac{0}{1}$	—	$\frac{0}{21}$	—
Blacksmithing	$\frac{0}{15}$	—	$\frac{0}{5}$	—	$\frac{0}{4}$	—	$\frac{0}{2}$	—	$\frac{1}{1}$	8.0	$\frac{0}{1}$	—	$\frac{0}{0}$	—	$\frac{1}{27}$	3.8	$\frac{0}{1}$	—	$\frac{1}{28}$	2 9
Industrial machinery	$\frac{0}{9}$	—	$\frac{0}{14}$	—	$\frac{2}{16}$	20.5	$\frac{0}{5}$	—	$\frac{1}{5}$	1.3	$\frac{3}{6}$	4.6	$\frac{1}{3}$	2.2	$\frac{1}{49}$	5.1	$\frac{4}{9}$	3.0	$\frac{7}{58}$	3 9
Motor vehicle bodies	$\frac{0}{6}$	—	$\frac{0}{1}$	—	$\frac{0}{1}$	—	$\frac{0}{1}$	—	$\frac{1}{1}$	20.0	$\frac{0}{1}$	—	$\frac{0}{1}$	—	$\frac{1}{10}$	17.0	$\frac{0}{2}$	—	$\frac{1}{12}$	7.0
Coconut oil mills	$\frac{0}{3}$	—	$\frac{1}{5}$	5.1	$\frac{2}{3}$	20.9	$\frac{0}{2}$	—	$\frac{0}{0}$	—	$\frac{0}{0}$	—	$\frac{1}{1}$	50.0	$\frac{3}{13}$	13.6	$\frac{1}{1}$	50.0	$\frac{4}{14}$	35.0
Ice cream	$\frac{0}{12}$	—	$\frac{1}{4}$	—	$\frac{0}{0}$	—	$\frac{0}{0}$	—	$\frac{0}{1}$	—	$\frac{0}{1}$	—	$\frac{0}{0}$	—	$\frac{1}{17}$	—	$\frac{0}{1}$	—	$\frac{0}{18}$	—
Soft drinks	$\frac{0}{5}$	—	$\frac{0}{4}$	—	$\frac{0}{4}$	—	$\frac{0}{2}$	—	$\frac{0}{1}$	—	$\frac{0}{1}$	—	$\frac{0}{2}$	—	$\frac{0}{16}$	—	$\frac{0}{3}$	—	$\frac{0}{19}$	—
Clothing	$\frac{0}{6}$	—	$\frac{0}{4}$	—	$\frac{0}{3}$	—	$\frac{0}{0}$	—	$\frac{0}{2}$	—	$\frac{0}{3}$	—	$\frac{1}{3}$	4.2	$\frac{0}{18}$	—	$\frac{1}{6}$	1.8	$\frac{1}{21}$	1.5
Sawmills	$\frac{0}{2}$	—	$\frac{0}{1}$	—	$\frac{1}{8}$	2.2	$\frac{5}{10}$	24.6	$\frac{3}{3}$	74.8	$\frac{4}{7}$	45.7	$\frac{9}{9}$	53.6	$\frac{9}{24}$	37.1	$\frac{14}{16}$	51.5	$\frac{23}{40}$	48.9
Medicine	$\frac{1}{6}$	0.7	$\frac{1}{1}$	5.0	$\frac{1}{2}$	7.9	$\frac{1}{1}$	30.0	$\frac{2}{2}$	17.4	$\frac{0}{0}$	—	$\frac{0}{1}$	—	$\frac{6}{12}$	16.7	$\frac{0}{1}$	—	$\frac{6}{13}$	11.0
Structural shapes	$\frac{0}{1}$	—	$\frac{0}{2}$	—	$\frac{0}{2}$	—	$\frac{2}{2}$	25.9	$\frac{0}{0}$	—	$\frac{1}{1}$	5.0	$\frac{1}{2}$	0.7	$\frac{2}{7}$	15.7	$\frac{2}{3}$	1.0	$\frac{4}{10}$	1.6
Wire	$\frac{0}{4}$	—	$\frac{0}{0}$	—	$\frac{0}{0}$	—	$\frac{0}{2}$	—	$\frac{0}{0}$	—	$\frac{1}{2}$	13.8	$\frac{0}{1}$	—	$\frac{0}{6}$	—	$\frac{1}{3}$	8.4	$\frac{1}{9}$	6.1
Tin cans	$\frac{0}{1}$	—	$\frac{0}{0}$	—	$\frac{0}{3}$	—	$\frac{0}{1}$	—	$\frac{0}{2}$	—	$\frac{0}{2}$	—	$\frac{0}{1}$	—	$\frac{0}{7}$	—	$\frac{0}{3}$	—	$\frac{0}{10}$	—
Plastic	$\frac{0}{3}$	—	$\frac{0}{3}$	—	$\frac{0}{4}$	—	$\frac{2}{4}$	5.9	$\frac{1}{7}$	1.9	$\frac{1}{2}$	2.9	$\frac{1}{2}$	6.0	$\frac{3}{21}$	1.9	$\frac{2}{4}$	4.9	$\frac{5}{25}$	3.3
Batik	$\frac{1}{3}$	66.0	$\frac{0}{3}$	—	$\frac{0}{2}$	—	$\frac{1}{1}$	10.0	$\frac{0}{0}$	—	$\frac{1}{2}$	3.6	$\frac{1}{2}$	40.0	$\frac{2}{9}$	18.7	$\frac{2}{3}$	18.7	$\frac{4}{12}$	18.7
Total	$\frac{2}{111}$	1.8	$\frac{2}{74}$	2 2	$\frac{6}{75}$	11.7	$\frac{13}{40}$	13.3	$\frac{10}{35}$	13.5	$\frac{13}{34}$	12.2	$\frac{15}{30}$	26.9	$\frac{33}{335}$	10.6	$\frac{28}{64}$	22.4	$\frac{61}{399}$	18.5

Source: Sample survey.
*EP = export participation; $\frac{2}{16}$, for example, means that two establishments out of 16 actually do export.
ES = export share, i.e. value of exports as a percentage of the value of total production.

Table 3. *Export intensity by industry and size group (%) – West Malaysia*, 1973 *(survey data)*

	Number of paid full-time employees							Subtotals		
Industry	0–4	5–9	10–19	20–29	30–49	50–99	100 and over	0–49	50 and over	Total
Bakeries	–	–	–	–	–	–	–	–	–	–
Furniture	–	–	–	30.5	–	–	–	30.5	–	30.5
Leather	–	–	–	–	30.0	10.0	–	30.0	10.0	21.3
Retreading	–	–	–	–	–	–	–	–	–	–
Iron foundries	–	–	–	–	–	–	–	–	–	–
Blacksmithing	–	–	–	–	8.0	–	–	8.0	–	8.0
Industrial machinery	–	–	62.8	–	20.0	9.4	5.0	51.9	6.6	12.2
Motor vehicle bodies	–	–	–	–	20.0	–	–	20.0	–	20.0
Coconut oil mills	–	10.0	30.5	–	–	–	50.0	25.5	50.0	43.4
Ice cream	–	–	–	–	–	–	–	–	–	–
Soft drinks	–	–	–	–	–	–	–	–	–	–
Clothing	–	–	–	–	–	–	20.0	–	20.0	20.0
Saw mills	–	–	20.0	44.2	74.8	61.8	53.6	59.2	55.3	55.8
Medicine	5.0	5.0	20.0	30.0	17.4	–	–	21.2	–	21.2
Structural shapes	–	–	–	25.9	–	5.0	5.0	25.9	5.0	7.3
Wire	–	–	–	–	–	30.0	–	–	30.0	30.0
Tin cans	–	–	–	–	–	–	–	–	–	–
Plastic	–	–	–	9.6	20.0	8.0	10.0	15.3	9.5	10.8
Batik	90.0	–	–	10.0	–	10.0	40.0	37.6	30.0	32.5
Total	86.2	9.9	32.1	33.7	35.6	39.2	45.1	32.1	44.0	41.2

Source: Sample survey.

Table 4. *Characteristics of exporters vs non-exporters – discriminant analysis results**

	All establishments		SSE (below 50 paid full-time employees)		LSE (50 or more paid full-time employees)	
Group centroids						
Non-exporters	0.319		0.220		0.862	
Exporters	−0.923		−1.059		−0.530	
Variables	Standardized discriminant function coefficients†					
Size variable	−0.156	(11.6)	−0.261	(20.4)	n.i.	
Utilization rate	−0.378	(27.9)	−0.387	(30.3)	−0.330	(20.3)
Competition	n.i.		n.i.		−0.471	(28.9)
Problem areas						
Short-term finance	0.222	(16.4)	0.208	(16.3)	0.117	(7.2)
Equipment	n.i.		n.i.		−0.143	(8.8)
Marketing	0.217	(16.0)	n.i.		0.567	(34.8)
Raw materials	0.381	(28.1)	0.422	(33.0)	n.i.	
		(100.0)		(100.0)		(100.0)
Industry dummies						
Furniture	0.659		0.566		0.653	
Leather	0.330		0.246		0.632	
Industrial machinery	0.641		0.611		0.733	
Coconut oil mills	0.295		0.237		n.i.	
Medicine	n.i.		−0.345		0.297	
Plastic	0.560		0.525		0.700	
Statistics						
Canonical correlation ‡	0.544	(0.296)	0.485	(0.235)	0.684	(0.468)
No. ob observations	222		180		42	

Source: Sample survey.
* n.i. = not included into discriminant function by stepwise procedure (limit: 10 variables).
† Relative contribution (%) in parentheses (industry dummies not considered).
‡ Canonical correlation squared in parentheses.

Discriminant analysis has been used to find that linear combination of variables which best allows us to statistically distinguish between the groups of exporters and non-exporters. These discriminating variables measure characteristics on which the two groups are expected to differ. Making use of a stepwise procedure, the variables with the highest discriminating power can be selected. The objective of discriminant analysis is to linearly combine discriminating variables in such a way that the two (or more) groups are as statistically distinct as possible.[19] The relative discriminatory power of a discriminating variable can be derived from the standardized discriminant function coefficients.[20] Out of the 19 industries in the sample only those which have at least two exporting establishments have been included in the present analysis. This leaves us with nine industries: furniture, leather, industrial machinery, coconut oil mills, sawmills, medicine, structural shapes, plastic and batik. Discriminant analysis has been applied to all establishements in these industries as well as separately to SSE, MSE and LSE (50 paid full-time employees and more). Interindustrial differences were taken into account by dummy variables, because the small size of the sample did not allow an individual analysis for each industry.[21] In addition to these, the following variables have been included: a size variable, the rate of plant utilization, the degree of competition and a selection of dummies relating to problem areas such as short-term finance, long-term finance, equipment, marketing, raw materials, labour and management. A stepwise procedure was used to select those variables with the highest discriminating power. Needless to say, there are many determinants of export behaviour on the microlevel, which are beyond the grasp of a survey. Thus, the subsequent analysis can only be partly successful.

The canonical correlation reveals to what extent the discriminant function is able to discriminate among the groups. The canonical correlation squared can be interpreted as the proportion of variance in the discriminant function explained by the groups.[22] From Table 4 it can be seen that it is considerably higher for LSE than for SSE, thus indicating that there are either additional unknown variables or that random influences are more important in the small-scale range.

The size variable has been defined as value added per establishment.[23] As can be seen from Table 4, the size variable is merely important for discriminating small-scale exporters from small non-exporters. This confirms *a priori* expectations and simply reflects the fact that there is a certain minimum size for exporting.[24]

One of the more successful discriminating variables proved to be the rate of plant utilization (RPU) This is a time-and-intensity measure of plant utilization; it is defined as:[25]

$$\text{RPU} = \frac{\text{actual production}}{\text{maximum production}} \times \frac{\text{actual hours of production}}{\text{maximum hours of production}}.$$

Table 4 shows that, other things being equal, exporters have a higher rate of plant utilization than establishments which do not export. This result was obtained for both SSE and LSE, as well as for all establishments. The direction of causality is, however, not quite evident. Possibly, competition on world markets makes it necessary for the potential or actual exporter to optimally use his capacities in order to reduce cost. In this sense, a relatively high rate of plant utilization would be a condition for exporting. On the other hand, exporting might lead to a higher rate of plant utilization, if domestic demand is inadequate, the producer is competitive on foreign markets, and problems of exporting can be overcome.

The (subjective) notion of the intensity of competition on the domestic market may also discriminate between exporters and non-exporters.[26] The coefficient of this variable, which only has discriminatory power for the group of LSE,[27] reflects that the more intensely competition is felt, the more likely a (large-scale) establishment will be an exporter. This is consistent with the notion held by Linder that most establishments, at least initially, prefer the domestic market over the export market.[28] If the decision to export can be described as an innovation and not just as the result of 'marginal' behaviour, then competitive pressures on the domestic market may be an important impulse to engage in export markets.[29]

In discriminating between exporters and non-exporters, problems of financing the necessary working capital are more important in the range of small establishments than in the range of large ones.[30] Those establishments which have no or only minor problems in this respect, other things being equal, are likely to be exporters. Either exporters have a better credit standing than non-exporters or the availibility of financial resources is a precondition for exporting. Both the availability of credit and the ability to export are likely to depend on the competitiveness of the establishment and on how well it is managed. It is a widely recognized fact that in the small-scale range credit supply is a precarious problem. Our results indicate, as has been hypothesized above, that those establishments which could overcome this problem – for whatever reason – are more likely to export than the others. Thus, an improvement of credit supply – also on the institutional side – seems to be a necessary, though not a sufficient element of an export promotion policy to be successful, especially if it is directed towards SSE.

In the small-scale range, problems with raw materials are an important discriminatory variable. Here more research is needed as it is not quite clear whether it is the high price, the low quality or shortages of raw materials which are the reason that small establishments with problems in this field are likely to be non-exporters. This result indicates that improvements in this field (for example via co-operatives) also can be an important element in a package of measures directed towards improving the competitiveness of SSE and thereby also their ability to export.

Other problem areas which are relevant for the distinction between exporters and non-exporters are problems with equipment and marketing.[31] Large-scale exporters seem to have slightly more problems with their equipment than large-scale non-exporters. Considering the relatively higher quality requirements in export markets and the fairly close connection between equipment and product quality this result is not unexpected. Marketing problems are a relevant discriminating variable only in the large-scale range. The need for marketing, however, to a large extent depends on the kind of product being sold. In the large-scale range more than half of the exporters belong to natural resource intensive industries (coconut oil mills and sawmills) which do not face major problems in marketing as products are highly standardized, while the need of marketing is much greater in the other industries, where also the share of non-exporters is larger.

In a second step only exporting establishments were analysed with respect to the determinants of the share of production that is ex-

Table 5. *Determinants of the export intensity of individual establishments – regression results**

	Standardized regression coefficients (t-ratios in parentheses)					
	All exporting establishments		Small-scale exporters		Large-scale exporters	
Variables						
Short-term financial problems	−0.42	(−2.52)	−0.35	(−2.17)	−0.43	(−2.63)
Utilization rate	−0.32	(−2.18)	n.i.		−0.38	(−2.13)
Competition	n.i.		n.i.		−0.12	(−1.09)
Long-term financial problems	n.i.		−0.23	(−1.41)	−0.15	(−1.40)
Labour problems	−0.20	(−1.52)	n.i.		n.i.	
Marketing problems	0.16	(1.16)	n.i.		n.i.	
Problems with equipment	0.17	(1.26)	n.i.		n.i.	
Problems with raw materials	−0.13	(−1.13)	n.i.		−0.20	(−1.26)
Management problems	n.i.		n.i.		0.16	(1.10)
Size variable	n.i.		n.i.		0.24	(1.48)
Industry dummies						
Industrial machinery	−0.29	(−2.66)	n.i.		−0.64	(−5.08)
Medicine	−0.32	(−2.53)	n.i.		n.i.	
Structural shapes	−0.41	(−3.62)	n.i.		−0.47	(−3.86)
Plastic	−0.14	(−1.02)	−0.31	(−1.87)	−0.09	(−0.51)
Statistics						
$\bar{R}^2$	0.40		0.22		0.72	
F	4.41		3.82		6.98	
No. of observations	57		31		26	

Source: Sample survey.

*n.i. = not included into the regression analysis by the stepwise procedure.

ported. The same independent variables have been used as in the preceding discriminant analysis. The dependent variable, originally a share, had to be monotonously transformed in order to meet the requirements of the regression model.[32] Again, a stepwise procedure has been used in order to select the relevant variables.[33] From Table 5 it can be seen that for the group of small-scale exporters, besides the industry dummy for plastic products, the only significant variable is the dummy for short-term financial problems. This means that small-scale exporters export significantly less, if they face problems in this area. Hence, problems to obtain short-term finance at a reasonable cost not only are relevant for the discrimination between exporters and non-exporters, but also may inhibit establishments which already export from engaging more intensively in export markets. The multiple correlation coefficient, however, is fairly low ($\bar{R}^2 = 0.22$) for the subsample of small-scale exporters. Either there are additional determinants, which have not been considered, or small-scale exports mostly are of an incidental character, as seems to be suggested by the fact that the multiple correlation coefficient for the subsample of large-scale exporters is relatively high ($\bar{R}^2 = 0.72$).

Besides industry dummies, for large-scale exporters the coefficients of two other variables are significantly different from zero at the 5% level (see Table 5). Again, establishments with problems in obtaining short-term finance at a reasonable cost export significantly less, other things being equal. While large-scale exporters tend to use their plant more intensively than large-scale non-exporters, there is an inverse relation between utilization rate and export intensity inside the group of large-scale exporters. A possible explanation lies in the fact that the year of reference, 1973, was a boom year in the domestic Malaysian market. This might have affected to a higher degree the utilization rates of those exporters which are more intensively engaged in the domestic market.

5. CONCLUSIONS

Assuming the sample survey is representative with respect to the questions posed, it can be concluded that in Malaysia, apart from very small establishments, SSE actually are able to export to a certain extent. This positive general result, however, is due mostly to the peformance of some branches, which either are natural resource intensive or make use of indigenous labour-intensive technology. Thus. the evidence supports our hypotheses and suggests that comparative advantages also determine the industry structure of exports in the range of SSE. Another interesting finding of this paper is that, compared to large-scale exporting establishments, exports of SSE make up an almost equally important share of their production, if they already sell abroad. This suggests that it is mainly the barriers to enter foreign markets which are limiting SSE exports. The results of this paper should, however, be taken as preliminary and probably more questions have been raised than answered. This is also true for the analysis of the 'determinants' of export behaviour on the microlevel. Both discriminant analysis and regression analysis have show some regularities. Discriminant results support the hypothesis that in the small-scale range those problems are relevant barriers to enter export markets which also typically affect the overall profitability of SSE, i.e. a low degree of plant utilization, problems to finance working capital and to procure raw materials. In the field of exporting these problems are likely to be even more severe. Further, regression results lay stress on the relevance of short-term finance for increasing the export intensity of those establishments which already sell abroad. This suggests that export promotion policies directed towards SSE should not only concentrate on export marketing, but also on raising the overall competitiveness of SSE.

Though useful information can be gained through discriminant analysis and regression analysis, these analytic toals, of course, neither imply causation nor explanation and thus do not lend themselves to a direct application of their results in policy formulation. Thus, for example, a pay-off can be expected from more detailed research on the relationship between export performance, the rate of capacity utilization, problems in financing working capital and problems in the field of raw material supply.

NOTES

1. See, for example, Donges and Riedel (1977).

2. Recently, international aid agencies, development experts and governments of developing countries have been paying growing attention to the allegedly positive contribution of small manufacturing establishments to economic development and to the alleviation of such problems as underemployment, regional and personal income disparities, lack of entrepreneurial and managerial skills etc. See, for example, IBRD (1978).

3. This has rarely been done before. I could only find two papers dealing with similar issues: Fuji (1971); and Rapp (1976). There exists, however, some literature on the promotion of SSE exports, e.g. Jain (1971); and ECAFE (1970), pp. 1–68.

In an indirect way the question has been approached by Boatler (1975) for Mexico. He identified two groups of craft industries and compared their export performance with that of modern and modernizing industries.

4. This is not only the case for developing countries, but also, though in general to a somewhat minor extent, for industrialized countries, as was shown by Banerji (1978), p. 67.

5. SSE can participate in export expansion either as direct exporters or via subcontracting. This paper, however, will be confined to direct exports (own-account exports and exports via trading firms).

6. On the product component of comparative advantage see, for example, Hirsch (1974. 1977). On the plant size component see for example, Staley and Morse (1965), pp. 97 ff.

7. It is by now a widely recognized fact that the direct capital intensity of SSE is considerably lower than that of LSE. See, for example. IBRD (1978), p. 19; the literature cited in White (1978); Bruch (1979); and Table A1 in the Appendix of this paper. Recent empirical evidence suggests that the difference

in total (direct plus indirect) employment per unit of invested capital is even greater. This means that the intermediate inputs of SSE generally use up less capital per unit of labour in their production than those of LSE. See de Vries (1979); and IBRD (1978), p. 68. Their relatively low capital intensity is to a certain extent the result of factor markets being segmented, which makes SSE face a lower wage – interest ratio than LSE. Irrespective of relative factor prices this further might reflect production functions being non-homothetic. This might be due to the specific organizational conditions prevailing in SSE and the fact that SSE may not be able to make use of certain types of modern capital intensive machinery, if there is a minimum size for doing so efficiently. See Bruch (1979) for empirical estimates for Mexico.

8. See Bruch (1979).

9. See Pareek (1978), p. 46.

10. See Dhar (1958), p. 38.

11. In Malaysia, for example, there is a positive link between the size of an establishment (either capital invested or labour employed) and the length of time during which incentives are granted.

12. For a thorough discussion of SSE-specific problems in exporting and possible remedies see, for example, Jain (1971); and ECAFE (1970), pp. 1–68.

13. This survey has been conducted by Dr. P. L. Chee of the University of Malaya in 1974 (year of reference is 1973). I am especially grateful to Dr. Chee for providing this set of data.

14. The sample has not been designed in order to investigate small-scale exporters and thus there is no evident reason to believe that it is biased in this respect. The sampling scheme being heavily weighted towards small establishments, LSE, consequently, are under-represented in the sample. See Chee (1975), pp. 11 ff. for further details on the design of the sample.

15. In Table A4 industry definitions do not match completely in all cases; rough comparisons, however, should be possible.

16. Further, it would be interesting to analyse the question, whether there are certain regional or locational requirements for SSE to be able to do that for the less developed regions and rural areas with a sufficient degree of representativeness. Under this qualification the figures suggest the proposition, that small-scale exporters must not be confined to certain relatively high developed regions or to urban areas. What would be needed, is a detailed analysis of the relation between locational factors and the determinants of export behaviour for each individual branch. It also would be interesting to investigate the dynamic characteristics of SSE exports. This, however, is not possible on the basis of our sample survey. In an indirect way this has been done by Boatler for Mexico. He concludes that economically viable craft industries have maintained their export position through time, but the more dynamic exporters, at least in Mexico, are found in modern and capital-intensive industries. See Boatler (1975), pp. 503 ff.

17. The abnormally high export intensity of establishments of up to four paid full-time employees (86.2%) is due to only one batik manufacturer, which employs 20 part-time workers, but according to the chosen criterion had to be included in the smallest size class.

18. The batik manufacturer in the smallest size group actually employs 20 part-time workers and thus cannot be considered as an exception.

19. For a description of discriminant analysis see Geer (1971), pp. 243–273; and Klecka (1975).

20. The standardized discriminant function coefficients have an interpretation which is analogous to that of beta-weights in regression analysis.

21. Sawmills have been taken as the basis industry. Thus, no dummy was included for this industry.

22. The interpretation of the canonical correlation squared thus is analogous to $\bar{R}^2$ in regression analysis.

23. Value added per establishment is the adequate measure with respect to the question at hand. In this paper, otherwise, the employment measure has been used in order to remain consistent with census figures.

24. The (positive or negative) sign of the standardized discriminant function coefficient should be interpreted in relation to the discriminant score of the group centroids (the mean of the discriminant scores of the respective groups). The discriminant score of an observation is its discriminant function value. Thus, as the group of exporters has a negative group centroid, a negative standardized discriminant function coefficient means that observations with a relatively high value of the respective variable tend to be exporters, while observations with relatively low values tend to be non-exporters (other things being equal).

25. This measure has a subjective component, as its first element will depend on the respondent's notion of maximum production. For a thorough discussion of the measure see Chee (1975), pp. 169 ff.

26. This variable can take three values: 0 (negligible), 1 (moderate) and 2 (intense).

27. It should be noted that the term 'LSE' is used here only for classification purposes and that most establishments included in this group still are relatively small.

28. Linder (1961), Chapter 3, pp. 82–109.

29. The importance of 'push' factors for the decision to export is one of the major results of a recent study of actual and potential exporters in the Philippines. See Staelin (1976).

30. Problem area variables are defined as dummy variables, which are equal to one if the respective problem is relevant, and are equal to zero otherwise.

31. Other problem area variables which were not selected by the stepwise procedure are problems with labour, long-term capital and management.

32. The dependent variable is defined as $X = \ln[S/(1-S)]$, where S is the share of production that is exported by the individual exporters.

33. The multiple correlation coefficient, adjusted for degrees of freedom, $\bar{R}^2$ has been used as a criterion for selecting the regression equation.

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STATISTICAL APPENDIX

Table A1. *Capital–labour ratios, capital and labour productivity by plant size – total manufacturing, West Malaysia*, 1970

Paid full-time employment size group	Capital–labour ratio	Capital productivity	Labour productivity
0	1.33	1.30	1.72
1–4	2.15	1.35	2.90
5–9	2.79	1.63	4.55
10–19	3.41	1.45	4.94
20–29	4.25	1.37	5.84

Table A1 (*continued*)

30– 49	6.58	1.00	6.57
50– 99	8.00	1.15	9.20
100–199	9.82	0.98	9.66
200–499	12.34	0.81	9.96
500 and over	8.00	1.09	8.70
Total manufacturing	7.95	1.01	7.95

Source: Malaysia, *Census of Manufacturing Industries* 1973, Vol. 1, p. 18.

Table A2. *Shares of small-scale manufacturing establishments in the number of establishments, value added, employment and salaries and wages – West Malaysia* 1973 (%)

	Shares of establishments with less than 50 paid full-time employees (%)			
Industry (MIC code)	No. of establishments	Value added	Total employment	Salaries and wages
Bakeries (31172)	99.3	90.7	88.3	89.7
Furniture (33200, 38120)	97.9	66.0	70.6	59.8
Leather (32310, 32330)	90.6	46.1	54.1	47.1
Retreading	n.a.	n.a.	n.a.	n.a.
Iron foundries (37102)	92.8	28.9	39.6	28.8
Tin- and blacksmithing (38112)*	99.5	87.9	89.2	81.1
Industrial machinery (38210, 38230, 38240, 38250, 38299)	93.7	41.2	58.3	48.9
Motor vehicle bodies (38431)*	92.9	59.1	67.7	56.0
Coconut oil manufacturing (31151)	94.2	50.9	63.7	44.4
Ice-cream manufacturing (31121)	94.8	14.1	56.5	22.7
Soft-drinks (31340)	79.7	12.3	32.8	13.3
Clothing factories (32201)	81.8	21.9	24.0	20.8
Sawmills (33111)	63.5	27.9	32.7	28.9
Manufacturing of drugs and medicines (35220)	91.4	35.2	37.3	23.2
Manufacturing of structural metal products (38130, 38199)	94.4	36.6	50.7	38.5
Manufacturing of wire and wire products (38192)	72.2	13.3	19.7	16.8
Manufacturing of tin cans and metal boxes (38191)	64.3	13.7	16.2	11.4
Manufacturing of plastic products (35600)	88.0	32.4	35.3	30.9
Batik (32114)	n.a.	n.a.	n.a.	n.a.
Total manufacturing	90.4	18.7	31.6	22.0

Source: Malaysia, *Census of Manufacturing Industries* 1973, Vol. 2.
* Shares of establishments with less than 30 paid full-time employees.

Table A3. *Export share of the manufacturing sector of West Malaysia* 1970 (%)

Sector	%
Total manufacturing	43.6
Excluding rubber processing	33.0
Excluding rubber processing and basic metals	20.2
Excluding rubber processing, basic metals, vegetable and animal oils, and fats	15.8
Excluding rubber processing, basic metals, vegetable and animal oils, fats and sawmills	12.0

Source: *Input–Output Tables* 1970, Table 3.

Table A4. *Export shares by industry – West Malaysia*

Sample survey (1973)	Number of paid full-time employees			Total branches		
Industry	0–49	50 and over	Total	Industry	1970*	1973†
Bakeries	–	–	–	Bakeries	0.8	–
Furniture	9.8	–	6.2	Furniture	–	5.3
Leather	8.2	1.0	3.3	Leather	–	3.6
Retreading	–	–	–	Retreading	n.a.‡	–
Iron foundries	–	–	–	Iron foundries	–	1.9
Blacksmithing	3.8	–	2.9	Blacksmithing	n.a.	–
Industrial machinery	5.1	3.0	3.9	Non-electrical machinery	13.9	–
Motor vehicle bodies	17.0	–	7.0	Assembly of motor vehicles	3.5	–
Coconut oil mills	13.6	50.0	35.0	Vegetable and animal oils and fats	59.5	–
Ice cream	–	–	–	Ice cream	n.a.	–
Soft drinks	–	–	–	Non-alcoholic beverages	1.0	–
Clothing	–	1.8	1.5	Wearing apparel	26.0	–
Sawmills	37.1	51.5	48.9	Sawmills	58.6	–
Medicine	16.7	–	11.0	Other chemical products	22.3	–
Structural shapes	15.7	1.0	1.6	Finished structural parts	–	6.5
Wire	–	8.4	6.1	Wire	–	1.7
Tin cans	–	–	–	Metal containers	–	6.3
Plastic products	1.9	4.9	3.3	Plastic products	13.0	–
Batik	18.7	18.7	18.7	Textiles	18.4	–
Total survey units	10.6	22.4	18.5			

Sources Sample survey; *Input–Output Tables* 1970; *Census of Manufacturing Industries* 1973; *External Trade* 1973.
* Calculated from the *Input–Output Tables* 1970.
† Calculated from census and export statistics data.
‡ n.a. = not available.

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WEP 2-22/WP 35

WORLD EMPLOYMENT PROGRAMME RESEARCH

Working Paper

Technology and Employment Programme

TECHNOLOGY DIFFUSION FROM THE FORMAL TO THE INFORMAL SECTOR: THE CASE OF THE AUTO-REPAIR INDUSTRY IN GHANA

by

Ali N. Hakam

Note: Working Papers are preliminary material circulated to stimulate discussion and critical comment.

July 1978

Preface

The standard of living of people who work and live in the "informal sector" could and should be improved in many ways. Under a WEP project entitled "Technological linkages between formal and informal sectors", it is proposed to consider this question in relation to manufacturing industries. For the last few decades, efforts have been made in many developing countries to promote small enterprises, with a view to creating employment and incomes. Progress in this domain, however, has been, more often than not, disappointing.

The promotional schemes for these enterprises have been conceived and implemented independently of policies for larger enterprises, and different aspects such as marketing, training and technical guidance of small enterprises have been dealt with separately. Experience indicates, however, that, to a degree the technological improvement of small enterprises depends on the technology and skill transfer from larger firms, and on the diffusion of transferred technologies and skills within the small sector. Equally there are possibilities of technological improvements from within the informal sector. However, little has been known about the extent and pattern of such intersectoral and interfirm technical co-operation in different countries. The project on technological linkages is an attempt to reduce this information gap.

Under this project, a paper based on a review of literature has already been produced (WP 34 in the list of Working Papers attached at the end of this paper). The present paper is the first in the series of country studies which are intended to examine the current extent of intersectoral technological linkages, to identify factors promoting or impeding the development of such links, and to assess the positive and negative aspects of intersectoral technology transfers within an economy.

A.S. Bhalla

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A.N. HAKAM

TABLE OF CONTENTS

I. INTRODUCTION*

The objective of this paper is to discuss technological relationships between formal and informal sectors of the metal engineering industry, specially auto-repair trade, in Ghana, with a view to throwing some light on questions pertaining to the diffusion of, and adaptations to, "grass-root technologies" in less developed areas.

A sector may be defined to be "informal" where the mode of industrial production is relatively unorganised, where wage-employment is an exception rather than the rule, and where technology is relatively simple. Most notable is the economies in overheads. Their workshops are small and rudimentary, fabricated with the cheapest materials. Often they use part of their residence, vacant lots or sites including those allocated to them by the city authorities at modest costs. For the most part, they have no telephone, and use very little electricity, if any. They have virtually no clerical or accounting staff, and very few of them pay income tax.

In contrast, the formal sector mode of production is largely organised, where wage-employment prevails, and where products are produced in regular factories and machineshops, using more capital-intensive techniques. Thus, we can call

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*The original manuscript of this paper has been considerably edited by Susumu Watanabe to produce this version, which the author has examined and approved.

this sector "developed" and the informal sector "underdeveloped". Here we have a clearcut case of dualism.

On the one hand, we have the highly labour-intensive informal sector. Its capital equipment is largely second-hand, obsolete machines and in some cases nothing but the most rudimentary tools (e.g. hammers, screwdrivers, vices, chisels, mallets, simple drills and oxy-acetylene torches), and materials are scrap iron and steel, and parts from broken cars. Its labour force consists of a master and a number of largely unskilled apprentices and some semi-skilled journeymen. Perhaps the weakest is the managerial, particularly financial aspect. There are entrepreneurs who are innovative, highly skillful and efficient (relative to resources), but these are a minority. The vast majority is inefficient, in comparison to those in the formal sector; they do not have equal command over resources (for example, no import licence is allocated to this sector) and their lack of education handicaps them in obtaining technical information and knowhow.

On the other hand, the formal sector operates with, among other things, the latest designed machinery from the West, foreign technicians and well-trained local technicians and workers. Moreover, they are less affected by shortages of raw materials. They can obtain import licences relatively easily and import much of the raw materials and spare parts which they need. In spite of these disparities in the access to resources and technical competence, the formal sector can be more inefficient in the use of resources. For one thing, it is highly capital intensive in a country which is short of capital and abundant in labour. Secondly, although foreign exchange is very scarce in Ghana, it has not been allocated to the most efficient producers, but to the firms that are well-placed in its connection with the government allocation process. It has often been argued that considerable favouritism and corruption exist in the bureaucratic system of foreign exchange allocations.[1]

How does the technology transfer take place between the two sectors and how is the transferred technology diffused within the informal sector? In Ghana, it is the traditional apprenticeship system that plays a critical role. The processes take typically, the following pattern.

A person acquires a certain skill in the formal sector, and then starts his own business in the informal sector, using apprentices as his main labour input. This type of technology transfer has a long history in Ghana. Among the earliest initiators in modern times were the Dutch Basle Missions in Akwapim. As early as in the 1850s a substantial number of skilled mechanics, blacksmiths, carpenters and other skilled

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[1] See A.N. Hakam, "Impediments to the growth of indigenous industrial entrepreneurship in Ghana, 1946-68", The Economic Bulletin of Ghana, Vol. 2, No. 2, 1972.

workers were trained by them and graduated into self-employment or wage employment in the old Gold Coast.

In the traditional system of the urban informal sector, the master/entrepreneur takes in one or more apprentices. The latter are engaged on a term-contract typically of 3 to 5 years. Usually their sponsor pays the master an initial fee, which was about 150 Cedis[1] in 1975 on an average. Other fees are payable either during or at the end of the contract. These fees help encourage small-scale enterpreneurship, because they provide the master/entrepreneur with part of the capital which is required to commence and continue a business. An important social consequence is that urban unemployment among the youth is substantially reduced.

This will be discussed in the following pages on a basis of fieldwork in Ghana in 1974 and 1975, in which 212 metal-engineering enterprises in the informal sector and 24 establishments in the formal sector were surveyed in five regional capitals, as well as Accra, the national capital.[2]

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[1] Cedis is officially pegged at US$0.85. We must bear in mind that the prevailing minimum daily government and formal sector wage had just been raised from 1 to 2 Cedis at the time of survey, and to 4 cedis in 1977. The rate of inflation was, according to the Commercial Bank of Ghana, 30 per cent per annum in 1971-74: 50 per cent in 1974-76: 75 per cent in 1976-77.

[2] The geographical distribution of the sample was as follows: 115 in Accra, 52 in Kumasi, 20 in Takoradi, 16 in Tamale, and 9 in Koforidua. In each city, the sample firms were selected at random from the list established by means of

(Footnote continued on next page)

After reviewing the current labour market situation in Ghana briefly, we will study (1) the profiles of master/entrepreneurs and apprentices in this country, (2) sources of skills for the informal sector, (3) the inter-sectoral flow of money and capital, and (4) capital equipment in the informal sector.

Although employment statistics are very poor in Ghana, it is believed that the national unemployment rate is 6 to 8 per cent: the 1970 figure on total employment in table I.1 corresponds to 94 per cent of the year's total labour force. Those who are most affected are age groups between 15 and 24: in 1970, the unemployment rate in age group 15-19 was 33.9 per cent in urban areas and 21.2 per cent in rural areas, and that in age group 20-24 was 16.6 per cent and 16 per cent correspondingly.[1] It appears therefore that urban youth has been suffering particularly badly. (One should, however, remember that a considerable portion of the urban youth unemployment is a consequence of the huge rural-urban migration.) The most attractive sector for the unemployed, i.e. the formal sector of manufacturing, has been stagnant, absorbing only marginal amounts of additional labour force every year. The picture since 1974 has not been any brighter. All industries in Ghana face the same problem.

(Footnote continued from previous page)

a total enumeration of firms in the concentrated industrial areas and other parts of the city.

[1] Five-Year Development Plan (Accra, Jan. 1977).

Table I.1: Distribution of employment by industry and sector (1960-74) (1,000 persons)

Industry	1960		1970				1974
	Both sectors		Both sectors		Formal sector	Informal sector	Formal sector
Agriculture	1 581	(61.8)	1 787	(57.2)	49	1 737	89
Mining	48	(1.9)	31	(1.0)	25	6	
Manufacturing	224	(9.1)	380	(12.0)	53	327	60
Construction	89	(3.5)	74	(2.3)	49	25	47
Utilities	14	(0.6)	12	(0.4)	2	-	20
Commerce	371	(14.5)	436	(13.9)	36	400	37
Transport	68	(2.6)	84	(2.7)	33	51	35
Other services	154	(6.0)	329	(10.5)	138	191	181
Total	2 249	(100.0)	3 133	(100.0)	395	2 737	469

Sources: Five-year Development Plan (Accra, 1977), p. 333; The 1970 Census, the 1970 Labour Statistics, and the Economic Survey (Accra, 1977). The figures for the informal sector were derived as residuals by the author.

The greatest cause of the low labour absorption capacity of the formal sector is the slow rate of expansion of its activities, which, in turn, has been due largely to the shortage of foreign exchange and consequent inadequacy in the supply of imported machinery and basic materials.

Whatever the fundamental causes of the economic stagnation may be, the authors of the current development plan have identified the following problem areas with a view to improving the situation:[1]

(1) low labour absorption capacity of the modern sector;

(2) growing unemployment in urban areas;

(3) widening discrepancy between certain categories of products of the educational institutes and job opportunities;

(4) widespread visible and disguised underemployment mainly in the rural areas;

(5) critical shortage of strategic skills at professional, managerial, technical and intermediate levels;

(6) inadequacy of training; paucity of qualified instructors and "physical" facilities for vocational training;

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[1] Five-Year Development Plan, op. cit., p. 337.

(7) low productivity and underutilisation of resources among certain segments of the labour force.

Our study has great bearing on all these points, either directly or indirectly, as educational and training background appears to have an important influence on a person's employment opportunity in Ghana. Of all the registered unemployed in May 1977 (15,742 people), 3.2 per cent had attended secondary school, 26.3 per cent had passed middle school, 43.6 per cent were dropouts of middle school, and the rest (26.9 per cent) were illiterates.[1] Although these figures may not be really meaningful because of the small weight of highly educated people in the total population,[2] the vacancies listed at the Ministry of Labour are for technically trained persons, such as mechanics, machine operators and lathe operators In contrast, unskilled school leavers below and at the middle-school levels will have to wait 1.5 to 2.4 years before obtaining a job,[3] which will be mainly that of a labourer. As our study will show shortly, however, some training, even as apprentices with informal sector masters, improves their chance of finding a

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[1] The Ministry of Labour: Employment Market Report, May, 1977.

[2] In the industrial and transport production activities, for example, only 1.9 per cent of labour force has secondary or higher level education, 29.7 per cent middle school, 10.8 per cent primary school education and 57.7 per cent no education (ibid.).

[3] See Planungsruppe Ritter, "Urbanisation employment and development in Ghana", unpublished report, ILO, 1974, p. 50.

job, including wage employment in the formal sector. Perhaps this, more than anything else, explains the popularity of informal sector apprenticeship.

How much can we expect from this system? Is it possible to improve the performance of the traditional apprenticeship system, and to enhance the standard of the informal sector, which seems to be able to use locally available resources very economically (e.g., by training of youth, recycling of scrap metals, and old second-hand machines), by injecting better technologies? These are the main questions we will try to answer in the remaining pages of this paper. If the answers to these questions turn out to be positive and affirmative, it may mean that the pattern of operation in the informal sector can be brought one step closer to that prevailing in the formal sector, to what one might call an "intermediate sector", and that the informal sector as we know it today will eventually disappear, replaced by a more modern small industrial sector as we find in more advanced regions, e.g., Latin America.

II. THE APPRENTICESHIP SYSTEM IN THE METAL ENGINEERING INDUSTRY OF GHANA

According to the Population Census, 21,280 people were working in the metal engineering industry in 1970, about 60 per cent of whom (or 12,665 people) were in the informal sector. The same Census indicates that there were 31,000 apprentices (including some 300 females) in this industry. As only a small fraction of them (i.e. about 800) was in the formal sector, the number of apprentices in the informal sector was more than twice that of people who were "employed" there. Five thousand four hundred of the apprentices were in Accra and 7,800 in Ashanti, mostly in Kumasi (table II.1). About one half of the latter (i.e. nearly 4,000) were found in the Suame Magazine, a unique centre of the informal metal engineering industry (see Appendix).

Few informal sector masters employ workers with specialised skill, to whom they are obliged to pay wages. Only 48 out of the 212 interviewed masters had paid employees. The total number of such workers was 148, as compared with 1,348 unpaid apprentices. In other words, only about 10 per cent of the total labour force in the informal sector under investigation was paid. The aggregate amount of their wages was 13,375 Cedis a month in 1974-75. Over one-third of this total was paid by three firms which had 18, 14 and 11 paid employees respectively.

Table II.1: Apprentices in the metal engineering industry (1970)

By region	Males	Females
Great Accra	5 303	102
Eastern	5 307	55
Ashanti	7 724	82
Brong Ahafo	1 954	-
Central	3 601	20
Western	2 394	10
Volta	3 682	16
Upper	299	-
Northern	496	2
Total	30 760	287
By age group		
15-19	12 006	68
20-24	12 929	201
25-29	4 259	18
30-34	1 045	-
35-64	521	-

Source: Population Census, 1970.

Typically, a master spends two hours per day demonstrating actual job performance to his apprentices. The latter simply watch until the same demonstration has been repeated often enough for them to do it themselves. When the master has no work to do, he may spend additional time for teaching. Obviously teaching the rudiments of machine operation to apprentices, who for the most part have no theoretical background, is difficult and time-consuming. The average time required to master a new machine is about 10 months, and the average length of time for an apprentice to be trusted with it at actual work is approximately 16 months. The masters are not the only instructors. Experienced apprentices who have had more than 2 or 3 years of training also supplement the master in the teaching role. So do junior masters or journeymen, if there are any.

In Ghana, master/entrepreneurs play a critical role in the technological development in the informal sector, transmitting new technologies from the formal to the informal sector and diffusing such technologies within the latter. By studying the profiles of the master/entrepreneurs and apprentices, we may be able to obtain a fairly clear picture.

1. <u>Master/entrepreneurs</u>

Table II.2 indicates that most of the sample enterprises

Table II.2: Age of the sample enterprise (212 firms)

Years in business	% of total enterprise
Less than 5	54
6 to 10	22
11 to 15	10
16 to 20	6
21 to 25	3
26 and over	5
	100%

are young, 77 per cent of them having been established within the last ten years.[1] This is due to two factors. One is, of course, the high attrition of enterprises within the first few years of formation. Surviving ten years is a great feat among the small-scale informal sector businesses. The other factor is the phenomenal increase in the number of automobiles in Ghana in the last 15 years (table II.3). Indeed, 78 per cent of our sample firms were engaged in trades related to the automobile (table II.4). The rural-urban drift, involving a rapidly increasing number of partially educated youth (middle school leavers) in their futile search for wage employment, also tends to expand the supply of apprentices, which eventually results in a larger number of masters.

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[1] In this regard, the informal sector is not very different from the modern sector where two thirds of the sample were established within the last 15 years.

Table II.3: Imports of vehicles and new registrations (1962-75)

Type	1962	1964	1966	1969	1970	1971	1972	1973	1974	1975
Passenger cars - new	3 109	1 398	1 619	1 234	1 835	3 651	806	798	4 042	3 489
Passenger cars - secondhand	363	568	1 364	3 633	3 136	3 272	1 961	2 481	1 951	2 455
Dual-purpose cars - new	569	553	262	508	375	821	339	417	1 613	895
Dual-purpose cars - secondhand	26	31	68	269	122	310	153	241	245	357
Trucks - new	674	2 600	2 550	1 422	1 879	3 693	1 620	1 892	4 045	2 585
Trucks - secondhand	17	199	87	980	385	2 396	693	670	570	846
New registration of vehicles (new and secondhand)	9 355	n.a.	n.a.	9 789	12 050	16 247	10 950	10 685	15 850	n.a.

Source: External trade statistics: various years, and *Economic Survey*, 1973-74.

Table II.4: Structure of the sample by trade (212 firms)

Type of product	Percentage of total
Vehicle repair (general fitting of engines)	48
Welding, straightening and body building, spraying of vehicles	27
Miscellaneous blacksmithing, including coal pots, cutlasses and hoes	14
Bicycle repairs	2
Batteries and auto electric work	3
Refrigeration work	1
Miscellaneous metal work, such as bolts and nuts	5
	100%

The largest single activity in our sample is engine repairers, who are "fitters". Many of them control other activities like welding, straightening and spraying of vehicles. Where engine repair is their only business, firms are more labour-intensive than the average. Thus, although they consistute 48 per cent of the total number of sample firms, they account for only 23 per cent of total capital employed and 53 per cent of total apprentice labour force.

The second most common activity is that of welding, straightening and spraying. Welding and straightening are typically taken up together, and spraying separately. These activities accounted for 27 per cent of the total number of master/entrepreneurs, but over 62 per cent of total capital and only 28 per cent of the apprentices. Thus, these activities are much more capital-intensive than engine repair.

Blacksmithing, tinkering.and forging use simple machines to produce cutlasses, hoes, metal boxes, keys and locks, coal pots, machetes and miscellaneous small metal articles. These firms accounted for 14 per cent of the total number of masters, but only 9 per cent of the capital and approximately 13 per cent of the apprentice labour force.

Where do they come from? Table II.5 explores both the size and location of their home towns. Only 9 per cent of the sample was from the towns where the firm was presently located.

It is interesting that 53 per cent of our master/entrepreneurs were of rural origin, outnumbering those of urban origin.[1] That there is considerable rural-urban migration in Ghana is also reflected in the fact that 82 per cent of the sample claimed that their father's occupation was farming, fishing or hunting. This does not always mean, however, that it was the father who was responsible for rearing them as children: in the extended family system of Ghana, it is often a maternal uncle or another relative[2] who brings up the child.

What about the ethnic background? It is often argued in the literature on entrepreneurship that certain tribes consistently produce more than entrepreneurs than others. Our findings concur with such a view: the Akans, with 45 per cent of the Ghanaian population, account for 51 per cent of the sample, whereas the Ewes, with less than 15 per cent of the total population, for 27 per cent of the sample (table II.6). The Ewes would have been even more strongly represented, if we excluded the predominantly Akan town of Kumasi. In Accra,

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[1] It is to be understood that in Ghana much of the informal urban sector is neither truly urban nor rural, but rather transitional, closer to being rural as far as human relationships (e.g., extended family system) and cultural outlook are concerned. Their status is that of a migrant. See, for instance, Margaret Piel, <u>The Ghanaian Factory Worker</u>, Cambridge University Press, 1972.

[2] In the case of the Akans, which have a matrilineal society, the maternal uncle is the responsible guardian whereas the Ewes and the Ga's whose community is patrilinealy structured, the father or the paternal uncles assume the responsibility.

Table II.5: Master/entrepreneurs' home town (212 firms)

	%
Rural small town in a different region	32
Rural small town in the same region	16
Urban town or semi-urban town in another region	34
Urban or semi-urban town within the same region	6
Same town	9
Outside Ghana	3
	100%

Table II.6: Ethnic background of the informal sector metal master/entrepreneurs (212 firms)

	Percentage of total
Asante, Akuapim and other Akans	51
Ewe	27
Ga Adangbe	10
Northern	8
Non-Ghanaian Africans	4
	100%

which is traditionally a Ga town, most of its informal sector fitters belong to the Ewe tribe.

Table II.7 describes the educational and training backgrounds of our master/entrepreneurs. A majority of them had just middle-school education (10 years' schooling), and only 8 per cent had gone beyond that level. In this connection, it should be noted that middle-school education in Ghana is hardly sufficient to understand modern technical manuals.

As regards their vocational training, 68 per cent of them had had apprenticeship training from an informal sector master. However, workshops owned by expatriates or the Government are the most preferred by trainees since they do provide the best available knowhow and knowledge about the latest types of machinery. When asked whether they had ever had wage employment related to their fields, only 48 per cent of the respondents answered affirmatively.

Of the sample, 176 master/entrepreneurs replied to our questions concerning financing. They estimated the current replacement value of their capital to be 1,788 Cedis on an average, while they had originally spent, on an average, 768 Cedis. Since book-keeping techniques are virtually unknown to them, they did not make any allowance for depreciation. They had reinvested, on the average, 575 Cedis, purchasing machinery (often second-hand), and had an average working capital of 327 Cedis.

Table II.7: Master/entrepreneurs' educational and training background (212 master/entrepreneurs)

Highest level of education attained	% of total	Mode of vocational training	% of total
None	19	By a master in the informal sector	68
Primary six	9	By a Ghanaian firm in the formal sector	10
Middle school (completed)	64	By an expatriate firm	12
Secondary (uncompleted)	2	By a government-owned firm	3
Secondary (completed)	1	Not responding	7
Technical school (uncompleted)	4		
Technical school (completed)	1		
	100%		100%

Their average amount of sales was 343 Cedis a month, out of which they paid 25 Cedis for rent, 13 Cedis for fuel and another 13 Cedis for electricity. As most of their labour force was unpaid, their average wage bill was only 43 Cedis, and the lunch and other incidentals amounted to 4.9 Cedis.

As noted earlier, only one-quarter of the interviewed informal sector firms (i.e. 48 firms) employed wage earners. Ten of them could attract more skilled workers. Although those master/entrepreneurs' educational backgrounds and managerial techniques were no better than the others, they had more capital and were in an advantageous position vis-à-vis their competitors, offering their customers more sophisticated services (e.g. machining of parts) which required specialised machines. They may be considered to be in an "intermediate sector" between formal and informal sectors.

2. Apprentices

In our sample, we had 45 apprentices, whose ages ranged from 15 to 29. Fifty-seven per cent of them were from urban areas, 33 per cent from rural communities, and the rest from semi-urban areas. This contrasts with the fact that 51 per cent of the masters were of rural origin and might be interpreted to be a sign of increasing urbanisation in Ghana. The greater weight of Ewes in the sample (36 per cent) than among the master/entrepreneurs (27 per cent) might be explained by the rising trend of their emigration from the Volta region.

Their educational background, too, reflects dynamics of Ghanaian society. A larger proportion of the current apprentices have middle-school education (77 per cent) than their masters (64 per cent). Before entering their present apprenticeship, our apprentices had to wait from 6 months to 5 years.

In many cases, a middle-school leaver in Ghana first tries his luck to obtain a regular job in the formal sector. Not having completed a minimum of form 5 secondary school education,[1] his chance of finding such employment is quite thin. Less than 5 per cent of them ever succeed. In the case of our apprentices, 72 per cent wanted to continue their education, but they were too poor. The remaining 28 per cent thought that further education was unnecessary for their career. Twenty-three per cent of our sample apprentices had looked for wage employment in vain, and 46 per cent wanted such employment but had made no search because they felt pessimistic.

Thus, to a great majority of respondents (80 per cent), the apprenticeship in the informal sector was not their first choice. They took it, hoping that their chance of finding a

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[1] Twelve years' schooling.

job would increase consequently. A vast majority, however, believed that the chance of their securing employment at a foreign firm was still scanty (30 per cent of probability), and only slightly better in the case of Ghanaian firms (about 45 per cent of probability). Table II.8 shows their career expectation after the completion of the apprenticeship.

Table II.8: Apprentices' career expectation

Set up own business	31
Continue to work with the present master	27
Combine with another apprentice	9
Seek a wage-paying job	27
Other than the above	6
	100%

It appears that the largest proportion of the apprentices intend to start their own business. A decisive question here is, of course, whether the minimum capital requirement can be met. Fifty-eight per cent of them were optimistic in this regard, while 26 per cent were pessimistic. Those who felt confident of securing capital had no enthusiasm for finding a job in the formal sector. In contrast, apprentices who were unlikely to obtain capital were using the apprenticeship as a springboard for such employment.

How realistic are these apprentices' expectations? Table II.9 summarises our master/entrepreneurs' reports on the placement of their former apprentices.

So far as we can see from this table, their chance of finding employment, either self-employment or wage employment, does seem to be enhanced considerably by the apprenticeship training - always remembering that only 10 per cent of middle school leavers can find employment each year. Indeed, some masters help their ex-apprentices find a job. Out of the 134 master/entrepreneurs who replied to the questions on their apprentices' placement, 55 per cent had had such experience.

How much does their training cost? In the Ghanaian apprenticeship system, the apprentice does not get paid. It is, rather, he who pays a fee to his master. This amount ranges from less than 100 Cedis (40 per cent of the respondents) to over 500 Cedis (6 per cent), varying from occupation to occupation. Part of the amount (20 to 30 Cedis) is usually paid at the beginning of the contract. On that occasion, there is some additional payment in kind. Typically, it consists of a few bottles of beer or gin, or both. Most often the balance of the fee is not paid until the end of the

Table II.9: Placement of ex-apprentices (around 1964/65-1974/75)

	Number	Percentage
Total number of apprentices who completed their training with the 134 replying masters	686	100
Those who started their own business	293	43
Those who were still with the masters	95	14
Those who had found wage-employment	188	27
Those who were still looking for a job at the time of our survey	44	6
Those whose placement was unknown	66	10

Note: The period corresponds to the length of the master's career as master/entrepreneur which, in 78 per cent of the cases, was ten years.

contract, which for the majority runs from three to five years. At the end of the period of training, a party is thrown on behalf of the graduating apprentice in which the rest of the fee for the course is paid to the master. In some cases, the amount owed by the apprentice is paid by means of additional years of work.

Between the completion of the apprenticeship and the ex-apprentice's discovery of a paid job or establishment as a master/entrepreneur, there is usually a considerable lapse of time (sometimes ten years), specially if the master himself had had his training in the informal sector. Moreover, the apprentice's life and working conditions can be very hard, as the following case of Attah illustrates.

The case story of Attah

This case story is intended to show the typical hardship of an apprentice in the informal sector and the various obstacles he encounters both in the everyday life and in the long-term prospect of achieving his goals.

Attah had been an apprentice in Kumasi for the last six years. He was born 24 years ago in a small village in the Volta Region, in Eastern Ghana near Jasikan. Like most apprentices, he could complete only a middle-school education. His parents could not support him for further education, but they chose for him an apprenticeship course with a master fitter in the Suame Magazine. The initial down-payment for the course was a fee of 40 Cedis plus 10 Cedis for drinks, as was customarily demanded. The total fee of the four-year course was to be 90 Cedis.

Meanwhile, Attah's father died. Attah had to work on a farm to save the required initial payment. But then there was the rest of the fee and other payments to be made. To cover them, Attah agreed to work for his master three additional years after the completion of his contract. Now after six years of apprenticeship with the master (two years beyond the contract) he still owed his master 30 Cedis.

Although part-time work outside the apprenticeship is extremely difficult and most masters forbid it Attah work on Sundays. On these days, if he could get some had such work, he might earn as much as 4 Cedis a day. Although he felt now that he was well-qualified to work on his own he would not leave his master before completing the terms of payment. If he dishonoured his obligations, the master would spread the word among all the fitters in the automobile business and it would be extremely difficult for him to get a job anywhere in this business.

He worked from 7.00 a.m. to 6.30 p.m. In order to arrive on time he got up at about 4.30 a.m. In the evenings he did not come home before 7.30 p.m. He actually slept on someone's verandah. For that privilege and for one meal per day he had to do some chores for that man and his family, including the washing of their clothes and the cleaning of their rooms early in the morning. Some evenings the family had no food for him and he had to buy his own meal which consisted largely of "kenke" (corn dough bread). In the morning he ate his only other meal, which consisted of plantains (green bananas, roasted or fried). For clothing he relied on some old hand-out from the man with whom he stayed. His only recreation was a local soccer match once a month at a cost of half a Cedi. He read only a local tabloid newspaper. He had no time to go to a library, nor money for any vice. His only alcoholic beverage was a bottle of beer at Christmas. He had not been to a film show for months.

What about the chance to improve himself with some technical education? He did go to a technical school for week, but he had to stop, since his master was neither willing to give him the time off nor the necessary 5 Cedis a month. Attah could not pay that amount on his own.

Attah, in spite of all this, was still hopeful that some day he would start his own business. The minimum capital for such a business would be 490 Cedis. Once he finished his contract, he would, of course, start buying a set of tools which cost about 40 Cedis. That would enable him to be at least a junior partner with another master or get small car-repairing jobs here and there. Hard work and sweatshop suffering would ultimately enable him to become a master/entrepreneur.

In many ways, Attah's conditions were reminiscent of the sweatshop conditions of the early Industrial Revolution in Europe, and yet he was not atypical in regard to his conditions of work and exploitation by his master and landlord. Nor was he an exceptional case in that, in spite of all the odds against him, he seemed determined to achieve his goal of starting his own enterprise, or finding some regular wage employment.

III. SOURCES OF SKILLS FOR THE INFORMAL SECTOR

As noted earlier, a majority of the masters receive their training from another master in the informal sector. This suggests that the apprenticeship system in Ghana is self-sustaining: one master trains apprentices, who in turn become masters themselves.

At the same time, it should be stressed that, without inflow of a sufficiently large number of masters from the formal sector, one could expect little technological improvement in the informal sector. It is also true that, without attracting easily trainable apprentices, the informal sector could not operate nor maintain its dynamic diffusion process. Whether a master can attract capable apprentices or not depends on the quality of training one can expect from him, and the latter varies considerably according to whether he was trained in the formal sector or in the informal sector.

In this section, therefore, let us examine the sources of supply of highly trained masters for the informal sector.

In Ghana, there are a number of technical training institutes: the state-run polytechnics at the very top, followed by other institutes which were often established originally as a joint-venture of the Ghanaian Government and foreign contributors, such as the Accra Technical Training Centre, the Ghanaian-German Technical Institute, and the

Opportunity Industrialisation Centre. However, only 5 per cent of the masters and 2 per cent of the apprentices in our sample had been to such a technical school. Their main courses are used almost exclusively by formal sector firms and workers, for several reasons: even when the fee is low, as is the case with the state-run institutes (3 Cedis per term), it is still too much for informal sector firms and workers, if board and lodging are taken into account. Second, as we said earlier, masters and apprentices in the informal sector very rarely have education beyond the middle-school level, while those technical institutes usually require secondary school education as a qualification of an applicant. Moreover, the content of training in those institutes is often unsuitable to the informal sector. Lack of official or private sponsorship for potential applicants from this sector is another important obstacle.

Some of those institutes, as well as some others, however, also offer courses which have been utilised by at least some firms and workers in the informal sector.

To these users, short-term courses and on-the-job consultancy services seem to be much more useful than those institutes' ordinary longer-term programmes. The most popular are Accra Technical Centre's Extension Project, the National Vocational Training Institute's special training courses, and the consultancy service of the Technology Consultancy Centre of the University of Kumasi.

The first of the three is a sort of innovation. A trainer/consultant of the Centre, initially a Canadian by the name of Kevin Davis,[1] goes from one establishment to another giving crash on-the-job training and consultancy to the master and apprentices. By 1975 Mr. Davis had visited over 90 workshops, involving nearly 140 masters and 500 apprentices. His is a 24-hour course in auto-repairing, using very simple tools and devices, such as testing meters, electric welders, generators and voltage regulators for demonstration.

The National Vocational Training Institute (NVTI) was set up as a joint Ghanaian-ILO project. Some of its activities are of particular interest to us. For example, it provides crash courses to the wayside fitters (mostly apprentices). By the time of our investigation, the Institute's branch in Kumasi had trained more than 500 people in that area alone. The courses are given in welding, straightening, engine mechanics, electrical works and spraying, mostly for the auto-repair business. The courses last for 6 or 12 weeks under the guidance of 6 instructors who have had good formal education in engineering either at home or abroad, and practical experience with big firms, such as R.T. Briscoe, for an average of four

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[1] He was later transferred to Kumasi where he has recently established a second Canadian technical centre.

years. The courses consist of theory (25 per cent) and practice (75 per cent). Since the maximum intake is approximately 70 students and the minimum requirement only the middle-school certificate, it is not difficult to understand that there is a long waiting list of applicants. Yet, the Institute's courses are not free of problems: although they are designed to get local masters to send their apprentices, masters in the neighbourhood seem reluctant to do so. They fear that their apprentices will become too sophisticated for them, and thus, sooner or later, look for employment elsewhere to get promotion and higher wages. Another problem is that the Institute's equipment is mostly up-to-date and unsuitable for the training of workers in the informal sector. The fact that the trainees have had only middle-school education also makes it difficult to teach them theories that are essential in understanding the latest machinery. One may be able to argue that new machines are essential in the technological improvement of this sector and that, therefore, it would be more logical to have both modern and older machines. In spite of all these shortcomings, these courses may be considered to be a bold step in the right direction.

NVTI also trains masters on a consultancy basis. Unlike the ATTC method discussed above, they do not go out but wait for masters to come with their problems. Therefore, the number of beneficiaries of this programme has not been as large as that of the apprentice training programme.

NVTI also trains workers in other industries, such as non-auto electrical and metal industries. This is mainly in-plant consultancy service at those plants which ask for their service. Due to communication problems, this service is used mostly by larger establishments, and thus it does not reach the informal sector to any great extent.

NVTI also trains instructors for various industries across the nation in training techniques, human relations and allied subjects. The number of such trainees had reached nearly 1,000 by the time of writing this report.

Perhaps of great importance to the future of the informal metal sector is the technical standardisation function which has been given to NVTI. It has set up a trade testing and trade certification department that attempts to enforce national minimum standards of technical qualifications for registration and working conditions. While the trade examination certificate is useful to the apprentices especially in their search for wage employment in the modern sector, the imposition of minimum working conditions and other standards poses a serious threat to the independent-minded informal sector masters and is likely to meet their resistance for some time to come.

The Technology Consultancy Centre of the University of Science and Technology in Kumasi has been set up to help develop small-scale industries by encouraging the use of local raw materials and skills to produce new products and by improving manufacturing techniques through the "means of intermediate or appropriate technology". The Centre, which commenced operation in 1973 is financed mainly by Barclays Bank, the International Development Fund and the Rockefeller Brothers Fund. The Centre's following programmes are of particular interest to our study:

Rural Blacksmith's Workshop: This programme is intended to build up the innovative capacity of local rural blacksmiths, who have been producing hoes, cutlasses and other agricultural implements for some time, by making them familiar with new techniques and equipment. If the programme in Accra succeeds, it will be duplicated elsewhere in Ghana.

Consultancy Service for Small Industries: This is an ordinary consultancy service intended to help small businesses to solve their problems. At the time of our investigation, this service was operating mostly outside metal engineering.

Steel Bolt Production Unit: This is a remarkable innovation whereby the University produces jointly with the Faculty of Engineering of the Technology Consultancy Centre, bolts and nuts not only for the University's own use, but also for market in the Kumasi area. The operation served as a model for private entrepreneurs. One of the establishments interviewed in the Suame Magazine had had its craftsmen trained by the Centre to produce steel bolts and nuts to supply to auto-repair shops in the area.

Similarly, the Centre develops and produces various products, using simple techniques and locally available materials: e.g. welded metal structures and enclosures for industrial plants, popular metal towel racks and toilet-roll holders of the local Teme steel. The hand-operated deep-well pump developed by one of the engineers at the University is expected to be extremely beneficial to the rural sector. The Centre intends to expand these production units in the near future.

Altogether these efforts by the University must be commended highly. Here we have an example of a high-level research institute which is no longer content to remain isolated from the realities of the rural and urban informal sector firms, and to produce only engineers demanded by the small modern sector. Although the amount of diffusion of technology from the Consultancy Centre to the informal sector has been so far very limited, its objectives seem realistic enough to create much greater impact in the next decade.

In addition to the above institutes, there are all kinds of governmental and semi-governmental units and agencies whose pronounced aim is to bridge the gap of the disparities between the formal and informal sectors by providing assistance for the informal sector. Our investigation revealed, however, that the only agencies that had been making a significant contribution to the improvement of technological standards of small businesses is the Management Development and Productivity Institute (MDPI).

MDPI is concerned with the informal sector through one of its technical assistance wings, the Ghanaian Business Bureau (GBB). As its name suggests, MDPI is involved in both the entrepreneurial and technical aspects of businesses. In a way, it is one of the main consultants to the Government on all technical and entrepreneurial matters. One of the broad objectives of MDPI is the co-ordination of all agencies concerned with industrial development of the small and medium sectors through the Bureau. The informal sector firms do not keep books, lack proper accounting and costing, as well as marketing techniques, nor do they have any idea about the modern business organisation (e.g. specialisation and functional division of labour). GBB aims to correct some of these deficiencies through seminars and intensive courses, which usually cost 2 Cedis per day and last one to two weeks. The problem of these courses is that they tend to require education above the level of most masters and apprentices in the informal sector, and therefore they are more suitable to firms in the "intermediate sector". Nevertheless, if better management techniques become embedded in this sector, sooner or later they will have impact on the informal sector, too.

So far we have talked about the public sector agencies and technical institutes. In spite of the diversity of their programmes, they reach the informal sector only marginally, as already noted. The bulk of the technology transfer to the informal sector emanates directly from the formal private sector; namely, through the training of masters as apprentices. Let us examine how it works in reference to the case of R.T. Briscoe.

This company was originally a Danish subsidiary, which has been taken over by the Ghanaian Government. With some 400 workers and the franchise for VW and Mercedes-Benz cars, buses and trucks, it is one of the largest companies in Ghana. It has an extensive training programme, and dozens of masters in the informal auto industry in Ghana have had their training at this company.

Its operation started in 1946. In 1966 Briscoe launched a training programme. Each year 16 apprentices out of 80 candidates are enrolled in a course that lasts up to four years. Although originally Briscoe accepted illiterates, recently the requirements have stiffened to include an aptitude test, and a city and guild certificate.

Consequently, most of the trainees under this regular paid apprenticeship scheme are graduates of the polytechnic schools. Unlike the earlier apprentices, current apprentices can read the manuals and thus are quick learners. However, the main part of the course is practical on-the-job training, and, after four years of apprenticeship, the trainees become well-qualified workers, who normally pass all the relevant internal and external tests with ease.

In addition Briscoe offers five-day intensive courses on specific subjects. As many as 500 workers attend each year. Some repeat several courses as they are offered free.

The completion of a training course with a firm like R.T. Briscoe makes one virtually employable anywhere in the economy. This firm loses, on the average, six of its recently trained mechanics each year. (Over-all, Briscoe loses 36 trained employees per year.) More than 50 per cent of those leaving Briscoe start their own business in the informal sector. Another 12 per cent end up with smaller workshops while the remaining 33 per cent find their way to other large firms.[1]

What is important to us is the fact that those masters who have experience of work in the formal sector are more dynamic and innovative than those who have finished their training in the informal sector. A well-trained fitter from these major firms will probably train dozens of other masters in his lifetime once he sets up on his own.

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[1] Information kindly supplied to the author by R.T. Briscoe. The data are related to period 1970-1975.

Technological innovations in the informal sector are largely of imitative or adaptive nature, while innovations associated with inventions of new machines and new organisation of processes are extremely rare because of the lack of technological research abilities. The most common are adaptive innovations which are intended to economise or substitute expensive or unobtainable inputs; e.g., capital equipment, fuels, raw materials and spare parts. Imitation of another entrepreneur's practice is so extensive and rapid that one cannot know who started a particular practice. This is partly due to the easy entry to this sector and the simplicity of the used technology. It does not follow, however, that innovative skills do not vary from entrepreneur to entrepreneur. Indeed, they do differ considerably according to their training.

From table III.1, it appears that the capacity of innovation is the greatest among the master/entrepreneurs who have experience of work in the formal sector, specially at an expatriate firm in the auto industry. Only a small percentage of the sample had attended a course of a vocational training institute; therefore, it was difficult to establish a definite relationship between such experience and performance. As most of these institutes' technical assistance is of relatively recent origin its effect is likely to increase in the future.

These findings suggest that the intersectoral manpower flow is an important mode of technology transfer, and the

Table III.1: Relationships of the master's previous experience to his performance (151 respondents)

Type of previous job experience	% of total sample	% of accumulated capital	% of total innovations*
A. Wage or non-wage			
1. Wage paying job	49	64	67
2. Non-wage job only	51	36	33
B. Type of employer			
1. Expatriate firm	14	44	17
2. Government firm	3	2	8
3. Private Ghanaian firm	83	54	75
C. Travel overseas			
1. Those who did	4	24	0
2. Those who did not	96	76	100
D. Type of industry where training was obtained			
1. Welding	23	44	28
2. Bolts and nuts	5	8	4
3. Electronics (auto)	8	4	4
4. General auto repair	47	35	52
5. Hoes and cutlasses	6	4	8
6. Other	11	5	4
E. Age of firm (the existing master/employer)			
1. 1-5 years	54	47	52
2. 6-10 years	22	11	16
3. 11-15 years	10	21	24
4. 16-20 years	6	17	0
5. Over 20 years	8	4	8

*Total numbers of reported cases of new parts and product introduction, and modification of existing machines.

apprenticeship system a machine for the diffusion of the transferred technology within the informal sector. Imported foreign technologies are transferred from the formal sector and diffused within the informal sector, by those master/entrepreneurs who are trained in the formal sector and then use apprentices in the informal sector.

However, can these masters impart sufficient new technologies to their apprentices? The answer is "It depends". For one thing, it depends on the industry. In some industries the informal sector has become stagnant and techniques have been handed down from one generation to another with no perceivable improvement. Most of the traditional craft industries belong to this category.[1]

In the metal engineering industry, however, the force of competition is so overwhelming that no master/entrepreneur can afford to neglect new technologies. This is particularly true in some branches of the auto repair industry as we shall examine later. Moreover, as most branches of the metal engineering industry, especially those which are related to the automobile, are relatively new in Ghana, present master/entrepreneurs are quite likely to have been trained by someone who had at least part of his training in the formal

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[1] Recently, however, largely because of tourists who value traditional crafts a great deal, there has been new blood injected to these traditional crafts through some technical and vocational training.

sector. Indeed, after the Second World War many people were trained by foreign firms such as R.T. Briscoe, Leventis, United Africa Co., and Union Trading Co., and later became independent master/entrepreneurs in the informal sector.

However, only 15 per cent of our masters had their training at foreign subsidiaries or state-run factories, and another 10 per cent at small Ghanaian firms which may or may not have been in the formal sector (table II.7). Moreover, the flow is not one-sided. Close to one third of the technical labour force of the formal sector firms had some training in the informal sector.[1]

Our over-all impression is that the inflow of well-trained masters from the formal sector is not sufficient.

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[1] However, if the current stagnation of the Ghanaian economy prolongs the chance of finding formal sector employment even for those who have completed such apprenticeship will continue to decrease.

IV. INTERSECTORAL FLOW OF CAPITAL

Capital is an essential catalyst through which technology is transferred: inflow of capital from the formal sector enables informal sector firms to purchase machines and tools that they need. The most important element here is the capital accumulation by those who have just completed their apprenticeship and who are starting a new enterprise. Such capital may be either saved within the informal sector or imported from the formal sector.

Within the informal sector there are several kinds of payments, beside those related to the transaction of the products. Masters pay apprentices small amounts of money (10 to 40 pesewas[1] per diem) to buy lunch, and pay wages to a small portion of their labour force (below 10 per cent of our sample firms' labour force). Subcontracting of work among firms is observable, but rare outside the Kumasi Magazine, where a huge concentration of petty metal engineering workshops exists. Even in this Magazine, monetary exchange is related mainly to the supply of parts or raw materials only, and its amount is very modest (cf. Appendix). In all, the interviewed masters reported that approximately 4 per cent of their sales was connected with subcontracting. Thus, the most important payment is the apprentices' fees to their masters. As already

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[1] A pesewa is 1/100th of a Cedi and officially worth slightly less than US$0.01 in 1975.

mentioned, this usually constitutes a very significant portion of master/entrepreneurs' initial capital.

A good portion of this cash flow actually originates in the formal sector, as at least part of the money paid to the masters has been earned by their relatives, or by the apprentices-to-be who take up part-time or other temporary employment in the formal sector. How important is this type of financing to the starting masters? By eliminating the ten largest firms from the sample, we obtain an average initial capital of approximately 563 Cedis. Since the average total initial payment of the apprentices to these firms amounted to approximately 137 Cedis, nearly a quarter of the master/entrepreneur's initial capital was financed with the apprentices' fees. As the firm's capitalisation gets larger, the relative importance of this source of funds declines. For most of the informal sector firms, however, the ability to secure a sufficient number of apprentices is a key factor in their initial capital financing.

Another intersectoral monetary flow pertains to the savings made by masters themselves while working in the formal sector. Sixty-six per cent of the respondents claimed that the principal source of their initial capital was their own savings, which amounted to 768 Cedis on an average of our respondents. Twenty-eight per cent obtained their initial capital from relatives; whereas only 6 per cent resorted to external borrowing. We were not able to differentiate the sources of the relatives' contributions and the borrowings as to their sectoral origins. It seems probable, however, that the borrowings were obtained from the unorganised market, as informal sector enterprises are virtually excluded from the organised bank loans. With the rate of interest in the informal sector well above 50 per cent per annum, it is not surprising that the starting entrepreneur would avoid that type of borrowing which could be immensely burdensome to his enterprise.

Since the initiation of their enterprises, our sample master/entrepreneurs had accumulated an average of 575.5 Cedis per firm.[1] Where do such savings come from? These master/entrepreneurs' cost accounts do not show much opportunity for additional capital formation (table IV.1).

The information summarised in the table may be double-checked by rephrasing the question in terms of savings. The masters were more willing to give figures on savings than on profits. On an average, 184 masters saved 29.60 Cedis per month in 1974-75. Although incredibly low, this figure is not altogether unlikely since their consumption ratio is high partly due to their obligations to the extended family and consequent high dependency ratio.

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[1] We could not obtain data on possible negative savings among the master/entrepreneurs.

Table IV.1: Our sample firms balance sheet (176 master/entrepreneurs) (monthly average in 1974-75)

		Cedis
1.	Sales	343.24
2.	Total operational cost	309.93
	Wage payment	42.97
	Cash payments to apprentices	4.91
	Cost of material	209.77
	Cost of fuel	13.25
	Cost of electricity	13.81
	Cost of rent	25.22
1-2.	Gross income	33.31

That their savings are only slightly less than gross income in table IV.1 may be explained by the inaccurate reporting of costs and the confusion of costs of living with business expenses, particularly in regard to rent, electricity, and, in some cases, the cash payments to apprentices. Most of the businesses did not keep books and distinguish the business expenses from living expenditure.

Unfortunately, we could not distinguish transactions within the informal sector from transactions with the formal sector. However, we gained an impression that, on an average, nearly 80 per cent of our master/entrepreneurs' business was with automobile-owners in the formal sector. This is something to be expected, as the use of vehicles is still not so extensive in the informal sector.

Part of their savings may, of course, originate from sources other than the one under investigation, e.g. farming, renter's income, and transport. Only ten master/entrepreneurs admitted that they had such additional sources of income.

Our deduction from the above analysis is that these firms make very little profit and their rate of capital accumulation is extremely low.[1] Consequently, most of the master/entrepreneurs are obliged to be content with outdated obsolete technologies.

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[1] Indeed, only 6 per cent of the masters had borrowed part of their initial capital, but 26 per cent currently owed money to someone else.

However, their financial limitations are even more pronounced in regard to working capital.[1] The average amount of working capital available to our sample firms was only 327 Cedis (of which 182 Cedis was in materials), or one fifth of the value of their fixed capital. One may wonder how the masters in the auto-repair business, which is largely servicing, can operate with so little working capital, especially when one thinks of the high cost of financing within the informal sector and the inaccessibility of informal sector firms to the formal sector financial institutions.

Some credit can be obtained from material dealers in the informal sector, but these master/entrepreneurs' survival and operation are made possible essentially by their customers. Usually, a master in the informal sector can work with very little working capital, because his customers pay cash in advance to help him to buy the raw materials and intermediate goods which are required for the work. Both parties benefit from this arrangement: it solves the master's financial problem and, at the same time, reduces the customer's expenses to a level considerably lower than what is charged by the workshops in the formal sector, as labour cost in the informal sector is about 40 per cent of that in the formal sector.

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[1] In the less-mechanised service sector there may be greater requirement for working capital in relation to fixed capital than in the more mechanised ones (see A.S. Bhalla and J. Gaude, Organisation, consumer time and technology in services, Geneva: ILO Working Paper, No. 18, July 1975, p. 21).

All the same, such dependence on the customer has severe limitations. Masters cannot stock raw materials to hedge against really serious shortages which do occur occasionally. Moreover, to talented and ingenious masters, shortage of working capital is a serious constraint to expansion of their business: indeed, 78 per cent of our sample firms mentioned lack of capital or credit as a constraint to the expansion of their business, while the second largest problem was lack of raw materials, spare parts and machinery. Thus, financial problems are the most serious in the informal sector and they tend to perpetuate the hand-to-mouth existence that has become characteristic of this sector.

The Office of Business Promotion, which is currently called "The Indigenous Development Commission", provides small businesses with loans of from 200 Cedis at the bottom to a maximum of 2,000 Cedis. One of the main difficulties about this programme is the requirement of two guarantors, which is very difficult for an ex-apprentice to meet. Since this Bureau is still at the organisational stage, there is no judging its effectiveness and its record at this time.

V. EQUIPMENT IN THE INFORMAL SECTOR

Technology is often embodied in machines and tools, and the extent of technological diffusion, therefore, partly depends on their spread.

There are no specialised machinery salesmen in the informal sector. When a master wants to acquire the machine which he knows, he either buys it or orders it from the technical departments of such firms as Ghana National Trading Corporation (GNTC) and Union Trading Corporation (UTC). If he were to buy it second hand, he would typically buy it from another establishment in the informal sector or at an auction held by a government workshop. So far as our sample master/entrepreneurs are concerned, they obtain information about machines from catalogues (18 per cent), other mechanics and entrepreneurs (18 per cent), travelling (17 per cent) and other sources (15 per cent). But the most important channel of such information was employment in a formal sector firm (33 per cent).

In previous sections we ~~alluded that, although~~ there are some highly reputable masters who attract clientele from the formal sector and even from outside the country, with their technical efficiency and ingenuity, the average standard of informal sector firms is very low. Similar remarks can be made in regard to the quality of machines, the amount of fixed

Table V.1: Capitalisation by industry

	All industries	Auto spraying	Welding	Bolts and nuts	General repair	Auto elec.	Cutlasses, hoes, etc.
No. of establishments	150	6	10	2	105	8	11
% of sample	47	4	6.7	1.3	70	5.3	7.3
No. of machines:	317	36	96	13	82	19	36
Electric	149	12	51	5	30	19	1
Diesel	19	12	9	1	2	13	0
Mean age of machines (years)	6.2	3.5	6.2	5.2	5.9	0	11.1
% secondhand	25	33.3	13.5	23	25	31	.14
Fixed K per firm	C 685	C 2 600	C 4 263	C 2 304	C 190	C 589	C 191
No. of power-driven machines per firm	1.12	2	6	3	.3	4	0.9
Output per firm (per month)	C 275	C 400	C 1 427	C 1 335	C 160	C 180	C 56
No. of workers per firm (including apprentices)	7.39	4	9	3.6	8.2	6.5	5.1
Capital per unit of output	2.49	6.5	2.98	1.72	1.18	3.27	3.41

capital and the number of power-driven machines vary considerably among trades and also among firms. For instance, while 26 per cent of the sample (39 firms) had invested over 1,000 Cedis in tools and machinery, some 40 per cent (60 firms) had invested less than 300 Cedis. While firms in general auto repairs and simple metal forging (cutlasses, hoes, etc.) used mainly hand tools, others in auto-spraying, welding and in bolts and nuts used electric cutting, welding lathes, drilling and grinding machines. Within the informal sector, adoption and diffusion of new equipment is the most active among the auto-related firms, especially those in the welding/body building, auto-spraying and bolts and nuts manufacturing.

It appears that there is a functional relationship between the rate of technology adaption and diffusion on the one hand and the rate of growth of demand for the products and services on the other. In addition, competition within the informal sector and between the formal and informal sectors seems to have an important influence here: competition induces the informal sector firms to improve their capacity (in terms of machines, knowhow and manpower) so as to offer better products and services.

Market conditions have been favourable to the informal auto-repair industry. Since the end of the 1960s, a considerable number of second-hand cars have been imported, and this has given rise to a sizeable market for the industry, as, by and large, the formal sector specialises in new cars, and the informal sector in second-hand cars. Moreover, the shortage of imported parts and the high cost of services in the formal sector induce many a car owner in this sector to turn to informal sector repairers, who are often more ingenious in procuring spare parts, e.g. by cannibalising old cars, using at times allegedly stolen parts, hoarding and even manufacturing their own parts.

Such ability combined with the low costs of labour and overheads often give informal sector masters a good competitive edge. The relatively low barrier of entry, however, invites more competitors. Many of the entrants are but novices of questionable performance and quality, with low standards of training and inadequate euqipment. It takes them quite a while to establish a good reputation, and obviously many never attain it.

Conditions vary, however, among different trades within the metal engineering industry, as will be shown below.

Auto spraying industry. Competition with the formal sector is intensive, largely in terms of cost. The preparation of a vehicle for painting is highly labour-intensive work. It may take a day or two to straighten all dents, remove all stains, and immaculately polish the surface with pre-paint fluids. In these operations a skillful master in the informal sector has a clear cost advantage over formal sector workshops which have to pay minimum wages set by the Government, as many informal sector masters use equipment similar to that which prevails in the formal sector, e.g. hand-held, diesel-driven polishing and spraying machines. What differentiates the two sectors most is the drying techniques. The formal sector uses highly capital and energy intensive electric ovens, while the best informal sector masters would dry by the sun and then place the vehicle in a tightly closed chamber for a day or two to keep it from dirt. The author has personally used a reputable master on three occasions and the quality of his finish was almost as good as that of the formal sector, although the cost (30 Cedis for a Datsun 1200 in 1973) was less than a quarter of that charged in the formal sector. Competition within the informal sector is limited by the large amount of initial cost and the high standards of skills that are required for entry into this trade.

Welding and truck body building. Again, this is one of the most dynamic of the informal sector metal trades. Aside from wider use of hammers, hand (instead of electric) drills, and second-hand machines, there is no great difference between the technologies in the informal sector and those in the formal sector (exceptions are auto assemblies), both using power-driven machines like oxy-acetylene cutters and welders, drilling, grinding and sanding machines. As in the case of auto-spraying, the decisive factor for a master's success is the adaptive abilities. When materials are short in supply, a skilled welder can recondition scrap metal and broken-down auto bodies into car parts, metal furniture and other products. Although this industry is capital intensive by the informal sector standard, it is also very labour intensive and skill intensive. Therefore, a skilled master can compete very well not only within the informal sector, but with the formal sector.

Recently, active demand has made the informal sector of this industry highly dynamic. Huge demand for bodies of lorries and buses originates from among informal sector transporters who import only chassis. More importantly, when the formal sector cannot obtain parts for damaged cars, this sector fixes them with parts made out of scrap metal. Some subcontracting from the formal sector occurs from time to time. Lately this trade has been diversifying its operation into metal furniture (again in response to unfulfilled demand stemming from prohibitive cost of imports).

Bolts and nuts. This is another technologically dynamic trade responding to active demand. Encouraged by the feasibility demonstration by the University of Kumasi's technical consulting unit, masters have started forging out or reconditioning bolts and nuts and other metal parts either unobtainable or too expensive in the formal sector, using grinders, lathes and drilling machines. The huge demand comes from largely, but not exclusively, informal sector auto repairers, e.g. in Suame Magazine in Kumasi. Lately, formal sector firms have begun to come for parts unavailable elsewhere.

VI. CONCLUSION

We have seen that the informal sector of the metal engineering industry in Ghana has been responding to market conditions, and displaying a certain degree of innovative and adaptive abilities. It trains a fair number of youths as apprentices, who would otherwise add to social problems, being deprived of opportunities for further education and employment. According to our findings, some of the informal sector's trained apprentices (about one quarter) do eventually end up as wage earners either in the formal or in the informal sector, and about 40 per cent as masters/entrepreneurs in the informal sector. These informal sector firms work with very little capital, using a labour force that consists largely of apprentices and materials that are mainly scrap metal and parts of broken-down cars.

Obviously the sector makes important contributions to the economy:

(1) utilisation of otherwise idle human resources (apprentices) and materials (scrap);

(2) diffusion of technologies and skills at very low costs through the masters;

(3) satisfaction of demand for low-cost products and services that might not be available otherwise.

Against these positive elements, the sector has some negative aspects, too. Except for a few trades like spraying and body-making, the sector is largely using second-best techniques and obsolete technologies. For the most part, its standards are extremely low, especially with regard to marketing organisation, accounting and financing. Furthermore, as the case of Attah illustrates, apprentices' conditions of work are sometimes reminiscent of the worst days of the Industrial Revolution in Europe. Also, in many cases, the sector's operation borders on unlawful activities (e.g. theft of parts, tax evasion, etc.). The question is how to aid this sector at a low cost to the economy.

We discussed in section III technical assitance provided by various institutes, e.g. the National Productivity Institute. Unfortunately, most of their programmes appear to be intended for the small-scale formal (or what might be called intermediate) sector. They do not reach the informal sector because of language and other communication barriers, requirements of higher level education, and fees that ordinary informal sector masters cannot pay. Moreover, there is a mutual suspicion between these masters and government agencies, resulting from evasion of taxes, and non-conformity to labour standards and laws. Master/entrepreneurs obviously fear that, if enforced effectively, such standards and laws would wipe out the informal industrial sector almost completely. The Government does recognise the positive role of the informal sector particularly with respect to the youth unemployment problem and therefore has been cautious in implementing existing laws. We, too, are inclined to advocate continued caution in this regard: such laws should be introduced gradually and preferably at later stages, as far as the informal sector is concerned.

What the public sector institutes could do, in the meantime, is to raise the productivity of the informal sector, e.g. by increasing its input and output linkages with the formal sector. We discussed earlier the demand-induced technological changes in the informal sector. Encouragement should be made to induce the formal sector to subcontract,[1] on a much more substantial scale, labour-intensive work such as straightening, welding and body building, to this sector. Such efforts for expansion of demand will have to be accompanied by improvements on the supply side: e.g. increase in the supply of raw materials and parts (the import of which should not be monopolised by formal sector firms), and leasing appropriate machines and tools at reasonable costs. In section IV we discussed financial problems especially with respect to working capital. There is an obvious need for small loan schemes.

These tasks might be best handled by producers' co-operative associations, similar to the Suame Magazine Co-

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[1] See, for instance, S. Watanabe, "Reflections on current policies for promoting small enterprises and subcontracting", International Labour Review, Vol. 110, No. 5, Nov. 1974.

operative Association. This would be, however, a challenging task, as the small enterprises' co-operative movement in Ghana, be it in urban or rural areas, has been regarded mistrustfully and frequently associated with "embezzlement" and "diversion" of funds. It is also obvious that such a co-operative would have to receive initially various technical assistance.

What is most important is, however, training. Quality-wise, training at formal sector firms like R.T. Briscoe, Union Trading, etc., is obviously the best. Costs, however, are high. The average cost per student for R.T. Briscoe amounted to 2.50 Cedis per day, and 750 Cedis on an annual basis. One solution to this problem would be to initially subsidise the cost of training by such firms through tax rebates. Costwise, therefore, the informal sector apprenticeship combined with Kevin Davis type of on-the-job training (cf. section V) seems to be the most expedient approach. This, together with continued expansion of the vocational training institutes, could perhaps improve the informal sector's technological standards at minimum costs.

What we are proposing is a general modification of the traditional system. The aim is to improve it from the inside, without destroying it. For instance, recent requirement that no vehicles older than three years could be imported into the country may be detrimental to the auto-repairing industry of the informal sector, in that the bulk of their repair work is done on older cars. Another governmental interference that could decrease the operational effectiveness of this sector is the introduction of legislation which requires all the masters e.g. to pay certain minimum allowances to their apprentices.[1] Such institutional changes should not be imposed prematurely, as these would only tend to aggravate the unemployment problem existing in the country. It is best to aim to modify the system from within by improving its performance and thus its profitability. If that is achieved, then, the sector would be more ready for its share in taxes and wages in proportion to its earning power.

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[1] King is also concerned about this problem in the Kenyan context (cf. K. King, "Skill acquisition in the informal sector of an African economy: The Kenya case", Journal of Development Studies, 1969, pp. 112-114).

Appendix

SUAME MAGAZINE

The area is about one mile long and 300 yards wide. Although it was originally intended to have 500 plots, a survey by the University of Kumasi in 1971[1] discovered 1,085 establishments, where 1,615 masters and junior masters worked with 3,870 apprentices.

Apart from a few single-level shops, temporary sheds and makeshift structures, the bulk of activities are carried out in open air with very few facilities to support them. For instance, there is virtually no permanent drainage system, only eight standing pipes, eight public latrines and very little electricity to serve the entire area. Access roads are, moreover, scarce.

Out of 108 sample establishments, one-third had less than 125 square feet of covered workspace, and only 17 per cent over 500 square feet. Only 29 per cent of the establishments were using electricity and only 6 per cent obtained water directly from a tap. The others had to have someone carry their water.

Fifteen per cent of the firms had partners. Seventy-seven per cent of the masters were self-employed and the rest

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[1] University of Kumasi: "Social and economic survey of Suame Magazine" (Kumasi, 1971) unpublished mimeo. document.

had at least another master working at their shop. Sixty-five per cent of the establishments worked six days a week (ten or more hours a day) while 35 per cent worked similar hours seven days a week. It must be noted, however, that frequently there was not much work to do, and so workers were sometimes kept idle or simply sent for parts or on errands. Many of the conditions regarding masters and apprentices cited elsewhere in our paper prevailed at Suame.

People come to establish their business here for a number of reasons. The low cost of the plots and various facilities provided by city authorities are among the most important reasons. So are social and economic externalities: there is considerable horizontal and vertical input-output linkages, as well as co-operative association and flow of trained persons, among the establishments. For instance, a majority of the masters/proprietors (98 per cent) in the survey belonged to the Suame Mechanical Association, which takes care of, e.g. disputes among the members and members' funerals, and takes common grievances to the City Council (Kumasi's governing body). Grievances are numerous: overcrowding of the Magazine, lack of facilities, spare parts, raw materials, tools and machines, as well as their high costs.

Some inter-relationships and complementaries of the establishments can be seen from the following table showing the "mix" of the firms. George Aryee's study, which was mainly concerned with the informal sector of Kumasi and notably its magazine section, found considerable backward and forward linkages among his firms. In regard to 20 metal working firms, 49 per cent of the intermediate inputs were purchased from other firms, but only 9 per cent from the formal sector.[1]

Suame is a microcosm of the informal sectors' plight, but the rising machine shops, the innovators such as Mohammed and the ability of Suame's shops to repair cars that are not repairable elsewhere in Ghana, to manufacture some of its own spare parts, to train many very skilled apprentices at low cost are encouraging developments, but these are not the average firms. The majority of firms require intensive assistance in technical, managerial, marketing skills and, in the case of manufacturers of parts, the capacity to expand output with reliable delivery and at a standardised quality of output. Only then can the formal sector turn to Suame for expanded business.

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[1] George Aryee, "Small-scale manufacturing activities: A study of the inter-relationships between the formal and the informal sectors in Kumasi, Ghana", Working Paper (ILO, Geneva, 1977), pp. 52 and 56.

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WORLD EMPLOYMENT PROGRAMME RESEARCH

Working Paper

Technology and Employment Programme

TECHNOLOGICAL LINKAGES BETWEEN FORMAL AND INFORMAL SECTORS OF MANUFACTURING INDUSTRIES

by

Susumu Watanabe

Note: Working Papers are preliminary material circulated to stimulate discussion and critical comment.

March 1978

Preface

The standard of living of people who work and live in the "informal sector" could and should be improved in many ways. Under a WEP project entitled "Technological linkages between formal and informal sectors", it is proposed to consider this question in relation to manufacturing industries. For the last few decades, efforts have been made in many developing countries to promote small enterprises, with a view to creating employment and incomes. Progress in this domain, however, has been, more often than not, disappointing.

The promotional schemes for these enterprises have been conceived and implemented independently of policies for larger enterprises, and different aspects such as marketing, training and technical guidance, of small enterprises have been dealt with separately. Experience indicates, however, that, to a degree, the technological improvement of small enterprises depends on the technology and skill transfer from larger firms, and on the diffusion of transferred technologies and skills within the small sector. Equally there are possibilities of technological improvements from within the informal sector.

Although co-operation between the two sectors in marketing has been attracting increasing attention among development planners, the technological linkages - technology transfer through the movement of skilled workers, the supply of better tools and machinery, the provision of technical guidance under a subcontracting arrangement, etc. - have been almost totally neglected until recently. The project on technological linkages is an attempt to reduce this information gap.

Under this project, it is intended to undertake a series of country studies to examine the current extent of inter-sectoral technological linkages, to identify factors promoting or impeding the development of such links, and to assess the positive and negative aspects of inter-sectoral technology transfers within an economy.

A number of case studies are already underway: on agricultural machinery and other industries in the People's Republic of China; metal engineering in Kanpur District in India; auto-parts manufacturing in the Philippines; textiles in Egypt; auto-repair in Accra (Ghana). Additional studies are envisaged in Latin America. Although each study will be conducted following a common framework, special attention will be paid to certain aspects specific to individual countries and regions. For example, the Egyptian study will examine whether there are distinguishing features among the public and the private sectors of the same industry.

The present paper is the first in the series of studies under the project. While exploring the current state of knowledge on related subjects by means of a review of literature, it aims at providing an orientation for the subsequent country studies. It also provides a historical perspective to the development of inter-sectoral linkage with special reference to the Japanese experience.

A.S. Bhalla

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Susumu WATANABE

WORLD EMPLOYMENT PROGRAMME RESEARCH

TECHNOLOGY AND EMPLOYMENT PROGRAMME

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A common feature of the labour-surplus developing economies is dualism. A relatively small sector enjoys access to the organised product and input (capital, trained labour, raw material, etc.) markets and consequently higher productivity of labour, while the rest of the economy is deprived of such opportunities and continues to work with a low productivity. Lewis[1] analysed this subject using his famous two-sector model. According to his scenario, surplus labour in the "subsistence sector" was to be absorbed into the "capitalist sector" gradually, as capital formation proceeded in the latter. Moreover, it was expected that "once a capitalist sector has emerged, it is only a matter of time before it becomes sizeable".[2] Such an expectation would seem reasonable in the light of the experience in the West during the Industrial Revolution[3] and the more recent history of industrialisation in the Far East. In reality, however, growth of population and labour force has been too fast in most of the current developing countries. People migrate from rural to urban areas, either as a result of saturation of the

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[1] W. Arthur Lewis, "Economic development with unlimited supplies of labour", in Manchester School, May 1954, pp. 139-191. His theory was further developed by Fei and Ranis (John C. H. Fei and Gustav Ranis: Development of the labour surplus economy (Homewood, Ill., Richard D. Irwin, 1964).

[2] Lewis, op. cit., p. 160.

[3] See, for example, Maurice Dobb: Studies in the development of capitalism (revised edition) (New York, International Publishers, 1963), Ch. 7, and particularly p. 268.

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I. INTRODUCTION

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expected. The "capitalist" sector has been brought in by the government or foreign investors before adequate preparation was made in economic and social infrastructure. Labour and social legislations and systems have been imported prematurely with a consequence of increasing the price of labour, although the unlimited supply of labour at a subsistence wage rate was the basic condition of the Lewisian model as well as that of the Industrial Revolution in today's developed countries. Another form of governmental intervention - restriction on industrial competition and growth - may have been another important explanation, as we will discuss later.

As regards the second question, all kinds of policies have been recommended by various authors and many of them have been put into practice, with more or less success. In the manufacturing sector, considerable efforts have been made in many developing countries in order to promote small enterprises. However, their results have been disappointing. Most of these schemes for small enterprises are conceived and implemented independently of policies for larger firms, while the two sectors are closely inter-related in the choice of their techniques, growth of their market, etc. Also, various aspects of small enterprises (marketing, training, technical guidance, etc.) are dealt with separately, thus causing, for example, under-utilisation of newly created production facilities and trained people.

Experience shows that the technological standard of the small sector improves, to a great extent, as a result of transfer of technology and skills from the large sector and diffusion of transferred technologies. It also indicates that economies can be made in marketing, investment and training by co-ordinating efforts in these domains, e.g. under a subcontracting arrangement. Such was indeed the philosophy of the ILO/UNDP Comprehensive Employment Mission to Kenya, when it emphasised the need of "strengthening the linkages of the informal sector (with the other sector) and fostering a dynamic growth of its final demand".[1]

Although a number of authors[2] have explored into related subjects, especially in reference to Japanese experience, we know still too little about relationships between the two sectors. This is particularly true in regard to the technological aspect, i.e. inter-sectoral technology transfer and diffusion of transferred skills within a sector.[3] Neglect of this subject is surprising, as international technology transfer has been

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[1] ILO: Employment, incomes and equality, op. cit., pp. 507 and also 6 and 22. For a similar argument, see Robert S. McNamara's speech at the World Bank-IMF annual meeting (1975): "Reducing urban poverty", published in Economic Impact, No. 14, 1976, p. 21 and ILO: Employment growth and basic needs, a one-world problem (Geneva, 1976), pp. 63-64.

[2] For example, Henry G. Aubrey: "Small industry in economic development", in Social Research (New York), Sep. 1951, pp. 269-312; Gustav Ranis: "Factor proportions in Japanese economic development", in American Economic Review (Menasha [Wisconsin]), Sep. 1957; Ram K. Vepa: Productivity in small industries, some lessons from Japan (Tokyo, Asian Productivity Organisation, 1969); and Susumu Watanabe, "Subcontracting, industrialisation and employment creation", "International subcontracting, employment and skill promotion", and "Reflections on current policies for promoting small enterprises and subcontracting", in International Labour Review, July-Aug. 1971, May 1972, and Nov. 1974, respectively.

[3] Lately, the Asian Productivity Organisation has made a couple of thrusts in this virgin territory (see the Asian Productivity Organisation: Intra-national transfer of technology (Tokyo, 1976), and International subcontracting: a tool of technology transfer (Tokyo, 1978)).

among the most favourite subjects of development economists and international conferences for the last few decades. It is also unfortunate, because the amount of contribution made by imported technology undoubtedly depends on the extent of its diffusion within the country: modernisation of Japanese industries, for example, was accelerated not by free or cheap access to foreign technologies (which seems to be a major target for policy-makers in today's developing countries), but by adaptation and swift diffusion of technologies[1] that were imported selectively but at high prices.[2] In a way, therefore, discussing international transfer of technology without knowing much about its internal diffusion is like putting the cart before the horse.

Confining ourselves to manufacturing industries and by means of a review of literature, we will try in this paper to lessen this information gap, and consider how and to what extent technological standards of informal sector firms can be raised by encouraging development of their linkages with formal sector firms. Among other issues, we would like to investigate the following questions:

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[1] One of the best examples is related to the LD converter that was imported from Austria and contributed to the rapid rise of the Japanese steel industry in the 1960s. For some experience in the cotton industry in earlier years of industrialisation, see Gary Saxonhouse, "A tale of Japanese technological diffusion in the Meiji Period", in Journal of Economic History (New York), Mar. 1974, pp. 149-165.

[2] Cf. Terutomo Ozawa: Japan's technological challenge to the West, 1950-1974: motivation and accomplishment (Cambridge, Mass. and London, the MIT Press, 1974), pp. 28-29.

(a) To what extent is the formal sector a source of skills and technologies used in the informal sector?

(b) What are the channels of technology and skill transfer from the formal to the informal sector?

(c) How and to what extent are the transferred technologies and skills diffused within the informal sector?

(d) What are the factors that limit the spread of linkages between the two sectors?

(e) What are the most promising ways to reduce such cons straints?

Answers to these questions may vary according to the industry, the pattern of the economy, and the stage of industrialisation. It is therefore necessary to examine them not only across borders of industries and countries, but also over different stages of development of a given economy.

After clarifying a number of key concepts and relationships in the rest of this section, we will review in Section II the development of linkages between the informal (small and petty) and formal (large and medium) sectors in the Japanese industries since earlier days of the country's industrialisation. This will provide us with a sort of model in reference to which we can discuss the situation in developing countries later in this paper. At the same time, it is intended to illustrate the important bearing of socio-political and institutional elements on the motivation of technological development.[1] Section III deals with the extent of transfer of technologies from the formal sector and their diffusion within the informal sector in developing countries. Section IV contains a brief summary of our findings and a discussion on their implications for policy-makers and researchers.

1. Definitions

(a) Informal sector

Different authors have given "informal sector" similar but not exactly the same definitions,[2] and many people have been using the term without defining it clearly. We need to define it in reasonably simple and workable terms.

Relative importance of different features attributed to this sector varies according to what economic activities the author or discussant has mainly in mind. For example, illegality or illegitimacy, which is stressed by Keith Hart,

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[1] Ilchman and Uphoff rightly point out that, when certain development strategies are proposed, an abstract from the historical record of their model regime should also be presented, so that the concomitant political and administrative strategies, along with their costs and benefits and their long-run achievements, would be clear (Warren F. Ilchman and Norman T. Uphoff, "Beyond the economics of labour-intensive development: politics and administration", in Ekistics 237, Aug. 1975, p. 92).

[2] Keith Hart, "Informal income opportunities and urban employment in Ghana", in Journal of Modern African Studies (London), Mar. 1973, pp. 61-89; ILO: Employment, incomes and equality in Kenya, op. cit., pp. 5-7; John Weeks, "Policies for expanding employment in the informal urban sector of developing economies", in International Labour Review, Jan. 1975, pp. 1-13; S.V. Sethuraman, "The urban informal sector: concept, measurement and policy", idem, July-Aug. 1976, pp. 69-81; and P.R. Souza and V.E. Tokman, op. cit., pp. 355-365.

coiner of the term, is probably much more important in services than anywhere else. So long as manufacturing industries are concerned, the essential characteristics of the so-called informal sector are: (1) the small size of enterprises and (2) their segregation from the organised product and input (capital, trained labour, raw material) markets to which the larger enterprises have access. As a consequence of (2), enterprises in the informal sector rely mainly on private hoardings and borrowings from friends, relatives and "curb market" instead of ordinary bank loans, family labour instead of wage employees, part of residence instead of proper factories, simple and often obsolete labour-intensive production techniques instead of modern capital-intensive ones, and they supply their products to a petty local market. The most important consequence of such segregation is low productivity of labour (their productivity of capital can be high, as they often work with capital equipment of a negligible market value).

Lack of protection from the government, industrial associations and trade unions, and unrestricted competition (including free entry) among enterprises are usually considered to be major features of this sector. However, this may or may not be true in the case of manufacturing industries. Not a few governments prohibit larger firms to manufacture certain products that are, or can be, supplied by small enterprises. These enterprises are also very often protected by means of import restrictions.

Small and petty enterprises naturally tend to be more commonly unenumerated and more easily evade laws (e.g. labour legislations) and public sanctions than larger ones, but enumeration and legality are largely a matter of efficiency of the administrative machinery.

We therefore define "informal sector" simply as that part of small and petty enterprises which are segregated from the organised product and input markets in the above-described sense, and whose productivity of labour is extremely low. We may take, broadly, enterprises with fewer than ten workers (those with fewer than five in Japan) as "small enterprises".

Productivity of the informal sector enterprises can be increased either by raising the rate of operation of the existing production facilities, and/or by bettering the quality of equipment and labour (both operational and managerial). Looked at from a different angle, their productivity can be enhanced either by leaving them "informal" and expanding the market for their products, or by absorbing them into the formal sector (i.e. by providing them with better access to the organised markets). In the latter case, it must be remembered that elimination of barriers to the organised markets (particularly input market) does not necessarily contribute to the improvement of their productivity: provision of capital, training and raw materials must be accompanied by an additional market for the product.

(b) Technology and skills

"Technology and skills" in this paper cover those related not only to production processes, designing and quality control, but also management. This wider definition is adopted because a managerial innovation is often a precondition of successful innovations in production techniques, as will be discussed later.

"Technological progress" manifests itself in (1) increased productivity, (2) improved quality and/or (3) higher reliability in delivery of the product. In each case, we will have to remember the possibility of causes of improvement other than progress made in technology and skills. For example, (1) can be a result of mere expansion of demand for the product, (2) may be due to improved quality of raw materials, and (3) can come from development of infrastructure.

(c) Subcontracting

"Subcontracting" is a business practice whereby the party offering the subcontract (parent firm, enterprise or company[1]) requests another enterprise (subcontractor, or "ancillary industry" in India) to manufacture or process parts or whole of the product it sells as its own. Subcontracting differs from the mere purchase of ready-made parts and components "off the shelf" in that there is an actual contract between the two parties setting out the specifications of the order. The

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[1] This concept is distinguished from "principal firm" which will be used as the antithesis to "subsidiary".

parent firm can be a wholesaler or a retailer who does not undertake any manufacturing or processing of the product himself, or it can be a manufacturer who uses the purchased product as parts or components of its own product. The first case may be called "commercial subcontracting", and the second "industrial subcontracting". Sometimes manufacturers can become parent firms in commercial subcontracting, a typical example being garment manufacturers who subcontract part of their work to others, e.g. because of the shortage of production capacity.[1]

2. Inter-relationship between input and market linkages, and technological linkages

Three types of linkages may exist between the formal and informal sectors.

Input linkages are relationships between the two sectors in regard to the supply of raw materials and machinery. They take place, for example, between petty garment producers on the one hand and suppliers of textile fabric or sewing machines on the other. The two parties work for two different end-product markets, and the production and investment plans of one party are not directly connected with the other party's.

In contrast, market linkages are found between the parent firm and its subcontractors, who work in close collaboration on

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[1] For a fuller discussion on subcontracting, see Watanabe, "Subcontracting, industrialisation and employment creation", op. cit.

a basis of specialisation and division of labour, in order to supply the same end-product to the same customers.[1] In industrial subcontracting, the two parties' production and investment plans (including choice of techniques) will be closely inter-related.

Technological linkages, i.e. transfer of technology and skills between the two sectors, may take place independently as a consequence of movement of skilled workers (either on their own accord, or according to a plan of individual enterprises or the government). Or, they may take place in connection with input or market linkages, technology and skills being provided by the supplier of materials and machinery, or by the parent firm.

This is clearly indicated in the findings of a rare survey that the Small Business Finance Corporation of Japan (Chū-shō Kigyō Kinyū Kōko) conducted towards the end of 1975.[2] Its major findings relevant to our study are summarised in table I. As can be readily seen, parent firms in subcontracting arrangements, suppliers of raw materials and machinery, and clients are the major sources of technical guidance, co-operation in

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[1] Hirschman's "backward linkages" and "forward linkages" fall partly under "input linkages" and partly under "market linkages" (cf. Albert O. Hirschman: The strategy of economic development (New Haven and London, Yale University Press, 1958), Ch. 6).

[2] Hideji Ogawa: "Chū-shō Kigyō no Gijutsu Kaihatsu-ryoku, sono Genjō to Zōkyō no Tedate (Technology development capacity of medium and small enterprises: present state and measures for its improvement", in Chū-shō Kigyō Kinyū Kōko Geppō (Tokyo), June 1976, pp. 27-43, and idem, "Chū-shō Kigyō to Tekunoroji Toransufā" (Medium and small enterprises and technology transfer), in Chū-shō Kigyō Kihō (Osaka), No. 2, 1976, pp. 1-9.

Table I

Technology transfer to medium and small enterprises in Japanese manufacturing (end 1975)

(Note: numbering indicates the order of importance in terms of frequency of replies.)

Sources of technology or frequency	Mode of technology transfer: (1) Technical guidance	(2) Introduction of innovative machinery	(3) Recruitment of technical and research staff	(4) Joint research	(5) Overseas study trip	(6) Commissioned research	(7) Introduction of patents and know-how
(A) In the past:	(1) Parent firm (2) Supplier of raw materials (3) Client other than (1) (4) Supplier of machinery (5) Public laboratory or research institute	(1) Japanese firm which developed own technology (2) Japanese firm which adapted foreign technology (3) Foreign firm	(1) New graduate (a) university and college; (b) high school; (c) postgraduate school; (2) Ex-employee of M or S firm (3) Ex-employee of L firm (4) Ex-employee of parent firm	(1) Parent firm (2) Client (3) Supplier of raw materials (4) Public laboratory or research institute (5) Supplier of machinery (6) M or S firm in the same trade	Seldom (68.8%) Occasionally (27.5%) Fairly frequently (3.7%)	(1) Public laboratory or research institute (2) Parent firm (3) R and D firm or institute in the private sector (4) University or college	(1) Parent firm (L) (2) Foreign firm or R and D institute (3) Client (L) (4) Client (M or S) (5) Firm in the same trade (M or S) (6) Parent firm (M or S) (7) Supplier of machinery (M or S)
(B) In the future:	(1) Parent firm (2) Supplier of raw material (3) Client other than (1) (4) Public laboratory or research institute (5) Supplier of machinery	No change	No change	(1) Parent firm (2) Public laboratory or research institute (3) Client (4) Supplier of raw materials (5) Supplier of machinery (6) M or S firm in the same trade	Seldom (52.8%) Occasionally (41.7%) Fairly frequently (5.5%)	No change	(1) Parent firm (L) (2) Client (L) (3) Public laboratory or research institute (4) Foreign firm or R and D institute (5) Supplier of raw materials (L) (6) R and D firm or institute in the private sector

Source: Ogawa in Chû-shû Kigyô Kinyû Kôko Geppô, op. cit., p. 33.

Note 1. The size composition of the sample firms (2,328 manufacturers) were as follows: enterprises with 50 or fewer workers: 43.8%; 51-100: 28.8%; 101-300: 24.1%; over 300: 3.3%.

" 2. L stands for "large" enterprises with 300 or more employees; M and S stands for "medium and small" enterprises with 299 or fewer employees; R and D stands for "research and development".

" 3. Technological guidance most commonly takes a form of advice or consultancy provided by technical staff who come on an ad hoc basis or sometimes at regular intervals. This is followed by seminars, lectures, etc.

" 4. In Japan, there are many high schools specialised in industrial and technological subjects. Some of them are run by the Government.

joint research, and supply of know-how, for medium and small enterprises in Japanese manufacturing.

Such close relationships between technological linkages, on the one hand, and input and market linkages, on the other, seem to suggest that the extent of inter-sectoral technological linkages and the rate of its expansion are, other things remaining equal, positively related to the aggregate scale of industrial production and its growth rate, although the relationship is not one-sided, i.e. although development of inter-sectoral linkages will help accelerate industrialisation.

3. Direction of technological linkages

In reference to the Chinese "modern" and "rural" industries, Sigurdson argues that, at the earliest stage of development, linkages are mainly one-sided, the modern industry providing the rural industry with the necessary technology. When rural industry has reached a certain level of development, linkages become mutual. In the third and final stage, the two sectors become more or less integrated, the improvement in the quality standards in the rural sector permitting a considerable expansion of the subcontracting system.[1]

Exceptions do exist. Sigurdson himself reports from China that when very small plants in a locality are closed down

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[1] Jon Sigurdson: "Rural industry and the internal transfer of technology", in Stuart R. Schram (ed.): Authority participation and cultural change in China (Cambridge University Press, 1973), pp. 203-205; and idem: Rural industrialisation in China (Cambridge, Mass. and London, Harvard University Press, 1977), pp. 18-21.

due to commencement of operation at a larger plant, the "core" workers are transferred to the new plant.[1] In Africa, enterprises in the formal sector sometimes hire ex-apprentices trained in the informal sector.[2] Also, small entrepreneurs in developing countries exhibit, at times, considerable imitative and adaptive abilities.[3]

It is difficult, however, to believe that transfer of ideas and technologies from the informal to the formal sector can be more than exceptions in these countries, although it becomes more important in a developed economy.[4] The lower the stage of industrialisation, the greater the technological gap between the large and small sectors tend to be,[5] partly due to

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[1] Idem: "Technology and employment in China", in World Development, Mar. 1974, p. 77.

[2] A.N. Hakam, "Technology diffusion from the formal to the informal sector: automotive repair trade in Ghana", a forthcoming WEP working paper, (WEP 2-22/WP 35) (Geneva, 1978).

[3] For some concrete examples, see Frank C. Child and Hiromitsu Kaneda, "Links to the Green Revolution: a study of small-scale, agriculturally related industry in the Pakistan Punjab", in Economic Development and Cultural Change, Jan. 1975, pp. 261-262, and Nicolas Jéquier (ed.): Appropriate technology, problems and promises (Paris, OECD Development Centre, 1976), p. 40 and various country papers included in this publication.

[4] See Charles Kennedy and A.P. Thirlwall, "Technical progreee, a survey of literature", in Economic Journal, Mar. 1972, pp. 55 and 62, especially; and James D. Hlavacek, Brian H. Dovey and John J. Biondo, "Tie small business technology to marketing power", in Harvard Business Review, Jan.-Feb. 1977, pp. 106-116.

[5] As a result, the difference in productivity between Colombia and the United States is 300 per cent in size groups with over 200 workers, but 1,000 per cent in size groups with fewer than 20 workers. In the case of Mexico, the difference is 200 per cent in size groups with over 50 workers, and 500 per cent in size groups below this (Victor E. Tokman, "Tecnologia para el sector informal urbano", a PREALC occasional paper 4 (Santiago, Jan. 1978), p. 8).

a higher rate of illiteracy.[1] Findings in Kenya, Mexico and the Philippines to the effect that foreign firms are more likely to make appropriate alterations to imported machinery than local enterprises[2] seem to be explained largely by greater technical expertise possessed by foreign firms.[3]

We may therefore safely assume that the pattern described by Sigurdson can be taken as a generally valid one, and confine our investigation in this paper to the transfer of technologies and skills from the formal to the informal sector and their diffusion within the latter sector. To what extent this assumption holds good will be one of the subjects to be examined in the country studies.

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[1] Ishikawa draws our "particular attention" to reforms of the education system and to the tremendous rise in the school enrolment ratio, at the primary school level in particular - from 56 per cent in 1962 to about 90 per cent in 1972 - as a factor contributing to China's remarkable technological development (Shigeru Ishikawa, "The Chinese method of technological development - the case of the agricultural machinery and implement industry", in The Developing Economies (Tokyo), Dec. 1975, p. 452).

[2] A.S. Bhalla, "Technology and employment: some conclusions", in International Labour Review, Mar.-Apr. 1976, pp. 195-196.

[3] Howard Pack, "The substitution of labour for capital in Kenyan manufacturing", in Economic Journal, Mar. 1976, pp. 45-58, and especially pp. 56-57.

II. DEVELOPMENT OF INTER-SECTORAL LINKAGES IN JAPAN: A HISTORICAL PERSPECTIVE

Advocates of a development strategy emphasising inter-sectoral linkages seek, more often than not, supporting evidence for their argument in the experience of the Japanese economy. With a view to providing a base for our later discussion and obtaining some useful insight, therefore, let us examine the evolution of inter-sectoral linkages in this economy.

The subject may be discussed in reference to three different periods, although the demarcation dates cannot be very precise. The first is from about 1854, when Japan was opened towards the Western powers with a series of "unequal treaties"[1] to about 1900, when the inevitable Russo-Japanese War became a major national concern. Industrialisation advanced with light industries, particularly textiles, as its driving force, under the famous motto of "_Fukoku Kyôhei_ (Enrich the Nation and Strenthen the Army)" which was intended to help replace the unequal treaties with more equal ones. The second is from about 1900 to 1945, i.e. the end of the Second World War. Textile industries continued to be the greatest earners of foreign exchange, but the main feature of this period is the

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[1] Under the threat of Western battleships, and in the light of China's bitter experience of the Opium War (1839-42), Japan accepted treaties which denied her tariff autonomy and provided for extra-territorial rights for Europeans (including Russians) and Americans. Revision of those "unequal treaties" completed only in 1911, when tariff autonomy was obtained. Although Japanese import duty was initially 20 per cent as a rule, Japan was forced to reduce it to 5 per cent and keep it at that low level between 1867 and 1911.

development of heavy industries under the leadership of the army and particularly the navy. The third period starts with the end of the Second World War. The cease-fire and the loss of all the overseas territories gave rise to a serious problem of economic dualism. Within about 15 years, however, the problem was largely solved as a result of rapid growth of heavy industries, which was accelerated to a great extent by an efficient system of industrial subcontracting.

Period I (1854-1900)

In order to understand the nature and pattern of development of small industries in Japan during this period, it is useful to have some idea of the industrial activities in earlier times.

Guild and apprenticeship systems similar to those in medieval Europe had existed since the Middle Age of Japan (end of the 12th - 16th century). Various industries (e.g. silk, cotton, lacquer ware, paper, iron products) developed during the 15th and 16th centuries.[1] As the money economy spread rapidly after the beginning of the 17th century, those industries were further encouraged by the feudal clans who invited famous craftsmen from other provinces or sent their own men to them for training. At the same time, the advance of the money economy impoverished, first, smaller farmers and, then, Samurai (warrior class). They sought sources of secondary

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[1] Yoshiji Nakamura (ed.): Nihon Keizai-shi (Economic history of Japan) (Tokyo, Yamakawa Shuppan-sha, 1968), pp. 47-52.

incomes in these industries. Around the mid-18th century, i.e. about a century before the massive arrival of Western technologies[1] and the opening of the country to the Western powers, the "putting-out system" under wholesale traders ("Tonya" or "Toiya") and sometimes rich farmers started spreading in various parts of the country.[2] "Tonya" distributed materials and sometimes equipment (e.g. hand-looms) as well as work among those homeworkers, and marketed their products widely, often on a national scale.

Towards the end of the Edo period, or during the first half of the nineteenth century, silk and cotton yarns and fabrics, paper, paper lanterns, umbrellas (of paper and bamboo) and similar goods were produced under this system in various parts of the country, while in a number of provinces like Kumamoto, Kiryu, and Ashikaga, factories using wage employees ("manufactures" or "manufactories") had started in silk reeling, weaving, brewery, etc.[3] Even where the products were

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[1] Even before the opening of the country, Western sciences (especially medical) and technologies (especially metallurgy) had kept coming in through the Dutch, who were allowed to come to Hirado (Nagasaki) together with the Chinese, and Japanese scholars who mastered the Dutch language.

[2] It is interesting to note that a similar system started in the early seventeenth century, or one century and a half before the beginning of the Industrial Revolution, in Britain (cf. Dobb, op. cit., Ch. 4).

[3] Nakamura, op. cit., pp. 122-140, particularly pp. 139-140. For English literature on this subject, see, for example, Daniel Lloyd Spencer, "Japan's pre-Perry preparation for economic growth", in American Journal of Economics and Sociology, Jan. 1958, pp. 195-216, particularly pp. 206-211; and Mataji Miyamoto, Totaro Sakudo, and Yasukichi Yasuba, "Economic development in pre-industrial Japan, 1859-1894", in Journal of Economic History, Dec. 1965, pp. 541-564, particularly pp. 544-545.

not marketed commercially, skills in reeling, spinning, and weaving were common among the rural population, handed down from mother to daughter, as theirs was an autarchic economy.[1]

In brief, Japan emerged from her two-and-a-half century-long isolation with a virtually unlimited supply of labour equipped with those skills, together with highly developed infrastructure in regard to the administration and taxation system, road and waterway systems, commercial practices and, last but not least, the general level of education.

Opening of the country to the Western powers meant resumption of foreign trade and importation of new technologies, which had been interrupted since 1635. The Meiji Restoration (1868) abolished restrictions on freedom of movement, choice of occupation, and trade. Consequently, modernisation of Japan started and advanced with an energy which Lockwood compares to the bursting of a dam under the pressure caused by the release of long pent-up forces.[2]

Modern heavy industries (shipbuilding, machinery manufacturing, and metal - particularly iron and steel - manufacturing) were initiated.[3] Even towards the end of the

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[1] Kamekichi Takahashi: Nihon Kindai Keizai Hattatsushi (History of development of the modern Japanese economy) (Tokyo, Tōyō Keizai Shimpō-sha, 1973), Vol. II, pp. 141, 183 and 235.

[2] William W. Lockwood: The economic development of Japan (Expanded edition) (Princeton, N.J., Princeton University Press, 1968), p. 5.

[3] Their origin may be sought in the 1830s, when Mito, Saga, and Satsuma Clans started manufacturing guns and canons under the increasing threat of Western warships off Japan (cf. Hirotake Koyama: Nihon Gunji Kōgyō no Shi-teki Bunseki (A

(Footnote continued on next page)

period, however, they consisted mainly of the arsenals of the army and navy, and a number of state-supported (directly or indirectly) enterprises. Although these industries developed rapidly around the Sino-Japanese War (1894-95), no significant "informal sector" enterprises existed in these industries yet.

Meanwhile, various light industries spread widely, partly due to the Government's encouragement, which was intended to provide work for impoverished ex-samurai families and other people.[1] Traditional industries, as well as new industries like match manufacturing, operated essentially on small and petty scales including masses of household enterprises and homeworkers, who worked, more often than not on a part-time or seasonal basis.

Those cottage industries accounted for nearly 70 per cent of total industrial production in 1890 and over 50 per cent before the Russo-Japanese War (1904-05) (table II), employing 80 per cent of total industrial labour force in 1882, 85 per cent in 1888, and over 70 per cent around the war with Russia.[2] The percentage fluctuated with the trade cycle in the Japanese economy, rising with depression and falling with prosperity.

(Footnote continued from previous page)

historical analysis of the Japanese war industry) (Tokyo, Ochanomizu Shobô, 1972), pp. 20-25).

[1] Hiromi Arisawa et al. (ed.): Nihon Sangyô Hyaku-nen-shi (A century's history of the Japanese industry), Vol. I (Tokyo, Nihon Keizai Shimbun-sha, 1967), pp. 52-53.

[2] Koji Taira: Economic development and the labour market in Japan (New York and London, Columbia University Press, 1970), p. 64.

Table II: Structural change in Japanese manufacturing (1890-1965)

(Output in and before 1940: million Yen at 1934-36 prices)
(Output in and after 1953: billion Yen at 1960 prices)
(Employment: thousand workers)

	Total industrial output	Non-factory* output		Total industrial employment	Non-factory* employment		Factory employment					
							Total		Textiles**		Machinery manufact.	
		Amount	%		No. of workers	%	No. of workers	%	No. of workers	%	No. of workers	%
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1890	1 311	898	68.5	-	-	-	-	-	-	-	-	-
1895	1 812	1 066	58.8	-	-	-	-	-	-	-	-	-
1900	2 086	1 114	53.4	-	-	-	-	-	-	-	-	-
1905	2 163	1 142	52.8	-	-	-	-	-	-	-	-	-
1909	2 742	1 474	53.9	3 024	2 203	72.8	821	100.0	520	63.3	50	6.1
1914	3 533	1 674	47.4	3 069	2 059	67.1	1 010	100.0	602	59.6	82	8.1
1919	6 100	2 403	39.4	4 171	2 363	56.6	1 808	100.0	994	55.0	227	12.6
1925	7 043	2 449	34.8	4 903	2 907	59.3	1 996	100.0	1 049	52.6	250	12.5
1931***	9 466	2 540	26.8	5 394	3 552	65.9	1 842	100.0	1 006	54.6	189	10.3
1937	17 320	4 466	25.8	6 429	3 176	49.4	3 253	100.0	1 204	37.0	688	21.1
1940	20 210	3 426	16.9	7 160	2 674	37.3	4 486	100.0	1 119	24.9	1 541	34.4
1942	-	-	-	-	-	-	-	-	862	-	2 084	-
1953	6 078	476	7.8	7 190	2 532	35.2	4 658	100.0	952	20.4	979	21.0
1958	10 431	480	4.6	8 990	2 879	32.0	6 111	100.0	1 032	16.9	1 440	23.6
1961****	19 853	1 100	5.5	10 160	1 972	19.4	8 188	100.0	1 168	14.3	2 299	28.1
1965	30 321	950	3.1	11 580	1 930	16.7	9 650	100.0				

Sources: Columns (1), (4) and (7): Kazushi Ohkawa and Henry Rosovsky: Japanese economic growth, trend acceleration in the twentieth century (Stanford, Calif., Stanford University Press, and London, Oxford University Press, 1972), pp. 81 and 83. Marginal changes were made according to the figures in column (7) for 1958 and 1961 according to the figures from the Census of Manufactures published in the Bureau of Statistics: Japan Statistical Yearbook 1964 (Tokyo), p. 160.

Columns (9) and (11): for the period 1909-42, Shôwa Dôjin-kai (ed.): Waga-kuni Kanzen Koyō no Igi to Taisaku (Unemployment in Japan: its structure and solutions) (Tokyo, 1957), pp. 613 and 623, and for the later years Japan Statistical Yearbook 1964, pp. 160-161.

The rest of the columns were calculated using those data.

* Enterprises with four or fewer operatives before 1942 inclusive, and enterprises with three or fewer workers after 1953 inclusive.

** Spinning and weaving only.

*** 1930-31 was the peak of the Great Depression in Japan.

**** The Japanese economy is believed to have passed its "turning point" from a surplus labour to a full employment phase around 1960.

However, the pattern of development varied even among light industries.

With the opening of the country, machine-made cotton textiles from the West hit the local industry immediately. Weavers soon learned to cope with the problem by using imported yarns, but spinners could do nothing, particularly as Japan was deprived of tariff autonomy. After a short transitory epoch of the "Gara" spinning machine, which used the water wheel and spread after the Domestic Industrial Fair[1] of 1877, the Japanese spinning industry restarted as a new imported industry.[2]

Traditional cottage-type enterprises were wiped out quickly by large factories using imported steam-powered ring frames and Indian cotton. The success of Osaka Bôseki Kaisha (Osaka Spinning Co.), which started operation in 1883, had demonstrated that the imported technology was more profitable than conventional techniques at a scale over 10,000 spindles. It was about 80 times more productive than hand-spinning. The burden of high capital cost was reduced by introducing a night

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[1] The Fair's objective being the encouragement of local industries, exhibition of imports by a non-governmental body was prohibited. On the other hand, people were encouraged to bring in locally produced imitations of such products, and newly devised or invented equipment. The Fair attracted nearly half a million people during its period (102 days) and is believed to have had an important impact on the development of local industries. Such a national industrial fair was held five times by 1903. Stimulated by their success, on an average, three local major fairs a year have been taking place since (Kenji Suzuki, "An account of a century-old industrial fair", in Nihon Keizai Shimbun (Tokyo), 20 Aug. 1977 (morning), p. 20).

[2] Arisawa et al. (ed.), op. cit., pp. 20-21 and 36-43.

shift, to make the industry competitive with Lancashire. As compared with the mule which dominated the British industry, the ring frame was more suitable for continuous operation and therefore more productive. As it produced coarser yarn, it was also in conformity with the Japanese consumers' taste.[1]

The picture was completely different in reeling and weaving. As is widely known, exports of silk expanded rapidly with the reopening of foreign trade, to some extent as a consequence of the silkworm epidemic in Europe. Partly due to the difference in the quality of silk used by the Japanese industry (e.g. Nishijin of Kyoto), and partly due to the lack of mass production techniques, however, a problem arose: in 1870 a large quantity of Japanese raw silk was abandoned in London, because it was "not suitable for machine-weaving".[2] Attempts were made to modernise the industry by establishing large-scale factories using imported machines. The most famous example is the "model factory" of Tomioka, which started operation in 1972. In this factory, girls from various parts of the country worked at steam-powered French machines under French instructors. However, the new method required a large amount of capital and yet the productivity of labour was only 4.3 times higher than the traditional method. Its adaptability to fluctuations in the demand for silk and in the supply of labour

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[1] Takahashi, op. cit., Vol. III, pp. 493-503.

[2] Toshio Furushima: Sangyō-shi (History of Japanese industries) (Tokyo, Yamakawa shuppan-sha, 1966), Vol. III, p. 183.

(rural female labour) and cocoons[1] was much more limited than the traditional hand-reeling. Consequently, even in 1907, the unit cost of production was nearly 30 per cent higher in machine-reeling than in hand-reeling.[2] It was therefore natural for the latter to remain dominant. Adaptations were, however, made to the traditional reeling, and girls trained at the "model factories" helped spread twilling and twisting techniques, which were added to the traditional skills to meet Western customers' needs.[3] The basic skill remained essentially the same, and girls continued to learn it "literally at their mothers' knees".[4] It was only after the Sino-Japanese War (1894-95) that mechanisation of reeling started as a combined result of rising wage rates, local inventions of relatively cheap cocoon-drying and reeling machines, and the development of railway system which made collection of large amounts of cocoons, coal, and labour easier.[5]

Development of the weaving industry followed a similar pattern. In spite of various attempts to transplant large-scale power-weaving techniques, mechanisation did not gain momentum until towards the end of the nineteenth century.

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[1] In those days, cocoon-raising was still limited to springtime only, in most places, and cocoon-drying techniques were primitive. Thus, the supply of cocoons was subject to considerable seasonal fluctuation.

[2] Takahashi, op. cit., Vol. III, p. 538, and also p. 535.

[3] ibid., p. 537.

[4] Arlon Tussing, "The labour force in Meiji economic growth: a quantitative study of Yamanashi Prefecture", in Journal of Economic History, Mar. 1966, p. 71.

[5] Takahashi, op. cit., Vol. III, pp. 538-539.

Dominant were hand-looms produced by carpenters, who incorporated some European ideas to traditional hand-looms. New skills related to these hand-looms were spread by girls who were trained at Shokuden, an institute which the Kyoto Metropolitan Government established specially for this purpose.[1] The explanation for the failure of imported power looms was simple: they cost 100-300 times more than locally-made Battan looms if necessary auxiliary equipment, land and buildings were included, while a girl could operate only five or six machines instead of one. Moreover, the Japanese consumers traditionally used materials with intricate designs, which made mass production difficult.[2] Thus, the industry continued to operate largely as a cottage industry.

Technology diffusion took place similarly in newly imported cottage industries like match manufacturing.[3]

This industry started in 1876, when Makoto Shimizu established a company, Shinsui-sha. Many other companies

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[1] Furushima, op. cit., p. 245. Imported dyeing techniques were diffused through a similar institute in Kyoto in those days (Ichiro Oshikawa _et al_. (ed.): _Chū-shō Kigyō no Hattatsu (3)_ (Development of medium and small enterprises, No. 3) (Tokyo, Tōyō Keizai Shimpō-sha, 1965), p. 34).

[2] Takahashi, op. cit., Vol. III, pp. 549-550. The importance of persistent traditional taste of Japanese consumers has been emphasised by a number of authors, as an important explanation for the continued survival and contribution of small industries and labour-intensive small-scale technologies in Japan. See, for example, Tokutaro Yamanaka, "Japanese small industries during the industrial revolution, a study of national structure of industry", in _The Annals of the Hitotsubashi Academy_ (Tokyo), Oct. 1951, and David Felix, "Technological dualism in late industrialisers: on theory, history and policy", in _Journal of Economic History_, Mar. 1974, especially p. 233.

[3] Oshikawa et al. (ed.); op. cit., pp. 111-120.

followed using techniques acquired there. At the same time, training was provided in a number of prisons, according to Shimizu's proposal.[1] The attempt was particularly successful in Kobe. It is believed that those ex-prisoners played an important role in technology diffusion in those years. The Government encouraged the industry for the purpose of providing the ex-Samurai class with new jobs. Consequently, the match became the eighth most imporant item of exports of Japan in 1891, the top seven being all products of traditional industries.

As in the Edo period preceding the Meiji Restoration, most of those petty producers worked in the putting-out system under "Tonyas", in both traditional and imported industries such as hosiery and match manufacturing.[2] As Tonyas kept contact with large trade centres like Tokyo, Osaka and Yokohama, they were well informed of new developments in production techniques. Thus, they could provide technological advice, as well as support in marketing and financing.

From our discussion above, we can identify the following three major agents of inter-sectoral technology and diffusion in this period: (1) workers who acquired new skills at large factories and other institutes in the public and private sectors, (2) carpenters who got ideas of Western machines

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[1] Shimizu seems to have thought of using prisoners partly because it was still difficult to find industrial workers with good discipline. The repulsive odour of yellow phosphor may have been another reason (ibid., pp. 112-113).

[2] Takuji Komiyama: Nihon Chû-shô Kôgyô Kenkyû (A study of medium and small industries in Japan) (Tokyo, Chû-ô Kôron-sha, 1941), p. 12.

demonstrated at factories or industrial fairs and produced cheap "intermediate" versions by adapting them to the traditional local equipment, and (3) wholesale traders ("Tonya") in the "putting-out" system who provided information about new production techniques and sometimes even equipment for petty producers and homeworkers. Fulfilment of their task in this regard was, however, made considerably easier by the fact that the basic skills, either in using the equipment or in producing adapted versions of equipment (e.g. reeling, spinning, weaving and carpentry), were already there as common knowledge among villagers. Rapid improvement in the general level of education also helped expand their absorption capacity and increase their ingenuity.[1]

Period II (1900-45)

Modernisation of the Japanese industries accelerated after the two wars with China (1894-95) and Russia (1904-05). Not only the vast market was secured in China and Korea, but foreign trade and shipping which had been controlled by foreigners were taken over by the Japanese. More important was the recovery of the tariff autonomy (1911), which enabled the Government to abolish export tax and import duties on raw materials and introduce import tariffs to encourage infant heavy industries. At the same time, the railway system spread and electricity became widely available. The international boom after the First World War also accelerated the process.

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[1] Takahashi, op. cit., Vol. II, p. 235.

Huge numbers of petty enterprises were operating in many lines of business: even in 1932, 92.7 per cent of factories in cotton weaving (57,161 factories), 94.5 per cent in silk and mixed weaving (68,437 factories), and 99.9 per cent in straw mat manufacturing (78,352 factories) had fewer than five operatives.[1]

Not only domestic demand still provided a sizeable market for such traditional, basically handicraft-type, industries (e.g. weaving), but new small industries appeared (electric bulbs, Western-style umbrellas, celluloid and rubber products, etc.). Petty producers of both categories adapted to the age of mechanisation quite well by using electricity, instead of steam power which wiped out smaller enterprises during the industrial revolution in Europe.

Electric motors became increasingly popular after 1905. By 1909, over 60 per cent of prime movers of factories employing 1,000 or more workers were electric motors, and the percentage reached almost 90 per cent by 1914. Among factories with five to nine workers, the similar percentage was still as low as 17 per cent in 1909, but it surpassed 50 per cent by 1914 and 90 per cent by 1930.[2]

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[1] ibid., p. 472.

[2] Ryoshin Minami, "The introduction of electric power and its impact on the manufacturing industries: with special reference to smaller-scale plants", in Hugh Patrick (ed.): <u>Japanese industrialisation and its social consequences</u> (Berkeley, Los Angeles, and London, University of California Press, 1976), pp. 301-306.

By merely extending an electric wire to an ordinary house and installing one small electric motor within the house, petty producers could mechanise their operation. While industrial wages rose, labour productivity could be increased considerably by this innovation which required only small amounts of capital. Electric motors permitted at the same time a maximum degree of flexibility in factory layout and work organisation. Thus, there is a consensus among the Japanese scholars that the early spread of electricity and electric motors has been one of the key contributors to the continued existence of a large number of small enterprises and maintenance of their efficiency.

With the advance of industrialisation, however, the relative importance of the "non-factory" sector declined although the trend reversed temporarily during the great depression at the beginning of the 1930s (table II). This trend accelerated considerably after the outbreak of the second war with China (July 1937), and particularly the Second World War in the Pacific region (December 1941), when light industry lost its weight in the Japanese economy rapidly. The share of spinning and weaving industries in total factory employment fell from 63 per cent in 1909 and 55 per cent in 1931 to 25 per cent by 1940 and below 20 per cent in later years. In contrast, the share of machinery manufacturing rose from a mere 6 per cent in 1909 and below 15 per cent in the early 1930s to 34 per cent in 1940 and soon surpassed 40 per cent. In 1942, 2.1 million workers were employed in the "factory" sector of this industry, as compared with fewer than 0.9 million in spinning and weaving (table II).

Within light industries, there was a marked tendency towards concentration. A typical example is cotton weaving, where mechanisation and large-scale operations spread quickly as a result of the entry of cotton spinning companies into this industry. Various factors on both demand and supply sides stimulated it. On the demand side, a huge market was secured in China and Korea where people normally used plain cloth. Japanese consumers' taste was changing, and demand for plain cloth was increasing at home too. On the supply side, cheap and efficient wooden power looms became available thanks to a series of inventions by Sakichi Toyota, wages were rising, and electricity became available everywhere.[1]

In silk reeling concentration took place, as major firms established chain factories equipped with the advanced Minorikawa reeling machine. Semi-automatised with simple devices like a stopper, thread-binder, and electric motor, this machine had up to about 20 reels, which were handled in a low heat and at a low speed by operatives in a standing posture, instead of 4 to 6 reels treated in a high heat and at a high speed in a squatting position as had been the case with conventional techniques. Difference in the cost of production

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[1] Takahashi, op. cit., pp. 503-505 and 551-552; Nakamura, op. cit., pp. 247-248. While those mechanised large factories drove out imports and expanded its share of export market, producing wide plain cloth, a large number of petty weavers using adapted traditional techniques co-existed, supplying narrow material with intricate designs to traditional local markets.

between the new and old methods was small, but Minorikawa's machine produced silk of much higher quality. Minorikawa won a silver cup at the Tokyo Industrial Fair of 1907, but the machine did not attract much attention until around 1920, when Japanese silk began to be driven out of the US market by local rayon. In order to compete successfully, the Japanese industry had to increase lustre and regularity in thickness of threads and yarns. Minorikawa's machine was ideal for this purpose.

Thus, after a number of improvements, its patent was bought by Katakura Silk Co., which introduced the machine at its factories from January 1928 on. Imitations and adaptations of the machine mushroomed in various parts of the country. By the end of May 1936, 254 factories in 38 prefectures were using the new technology. The three largest companies (Katakura, Gunze and Kanebō) controlled 105 factories, of which over 80 per cent used it. Smaller producers followed, introducing similar machines manufactured by smaller firms, some of whom distributed their machines through silk producers' associations.[1]

Meanwhile, a new type of informal sector was emerging in heavy industries.

The army and navy arsenals, and major factories in the private sector which received protection and encouragement from the arsenals and the Government, became the major supply

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[1] Yukihiko Kiyokawa, "Seishi Gijutsu no Fukyū Dempa ni tsuité: Tajō-Sōshiki no Ba-ai (On the diffusion of reeling techniques: the case of the Minorikawa reeling machine)", in Keizai Kenkyū (Tokyo), Oct. 1977, pp. 337-354.

sources of engineers and skilled workers for the entire economy. Nearly 25,000 workers left the arsenals between 1907 and 1910 with their newly acquired skills.[1] At the same time, industrial equipment and machinery manufacturing spun off from the shipbuilding (the navy arsenals), and started supplying lathes, drilling machines, cutters, etc. However, demand for such machinery was still small and progress slow, after a jump that took place during and immediately after the First World War. Although the army and navy arsenals are believed to have reached the internationally competitive technological standard by around 1910, moreover, the level of machinery manufacturing in the private sector remained, generally speaking, very low. The gap between large and small firms was even larger. So, major factories under the Government's protection were equipped with integrated production facilities, in spite of inevitable waste, and this limited opportunities for division of labour between large and small enterprises until the mid-1930s.[2]

Surplus labour kept flowing into the small sector of this industry in a form of learner-workers and left their employer-trainers after a few years to start their own enterprises. Equipped with obsolete lathes and drilling machines, they undertook all kinds of metal engineering work. On the eve of the second war with China (July 1937), some of them were getting work from larger manufacturers of machinery. In nearly

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[1] Kozo Yamamura, "Success illgotten? The role of Meiji militarism in Japan's technological progress", in Journal of Economic History, Mar. 1977, p. 125.

[2] Komiyama, op. cit., pp. 39-40.

half of the cases, they got such work through merchant-brokers ("Tonya"), who charged high rates of commission.[1] Large enterprises treated those petty subcontractors as "reserve army" who helped them in meeting peak demand, e.g. by doing rough finishing of parts.[2] The relationship between the two parties was unstable ("floating"). Tonyas could not provide technological guidance related to the modern industry, so petty producers gained little technologically.

With the start of the war with China, such small and petty enterprises mushroomed, encouarged by the expansion of demand for military equipment. But their production facilities were of extremely poor quality and 40 per cent of their labour force were learner-workers. Even when equipment was of reasonably good quality, petty producers did not have sufficient training to operate it properly and had no sense of quality control, so much so that, in order to use shafts produced by them, holes had to be readjusted.[3] Consequently, rejection rate was high, and the mounting shortage of materials and labour force made it necessary to weed out inferior producers after 1939. Necessary materials were rationed selectively among factories above certain standards, unit

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[1] ibid., pp. 54-56 and 70.

[2] ibid., p. 35.

[3] ibid., pp. 72-85, and Keizo Fujita: <u>Nihon Sangyô-Kôzô to Chû-shô Kigyô: Shitauké-sei Kôgyô o Chûsin ni shité</u> (The structure of Japanese industry and medium and small enterprises, with special reference to subcontracting enterprises) (Tokyo, Iwanami Shoten, 1965), pp. 58-63 and 164-169.

prices paid by the military authorities were cut, and those who could not reduce their costs were eliminated.[1]

At the same time, efforts were made to level up the standard of subcontractors. Grouping of subcontractors was encouraged in order to rationalise the system. First, a horizontal grouping, i.e. associations of subcontractors only, started in the second half of 1935 (Kôgyô Kumiai),[2] but this rarely succeeded because of the conflict of interest among the members. As it became increasingly difficult to maintain the quality of subcontracted products, another form of grouping developed - this time a vertical one (Kyôryoku-kai). Selecting the most efficient subcontractors, parent firms kept them under their direct control, gave them orders regularly, and played an active part in raising their technological and managerial standards (e.g. by training subcontractors' employees and sending instructors from among their own staff). Subcontractors were provided with the equipment necessary for maintaining quality, e.g. jigs and gauges, and specialisation in a narrow range of activities was encouraged. Such vertical grouping began to receive the Government's support around 1940 and had spread far and wide by the end of the Second World War. The parent firm at the top of the pyramid assembled the parts manufactured by its "child" firms (often called Kyôryoku-Kôjô), which further subcontracted parts of their work to "grandchild" firms, and so on. The selective allocation of resources through the parent

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[1] ibid., pp. 169-174.

[2] Tsunehiko Yui: Chû-shô Kigyô Seisaku no Shi-teki Kenkyû (A study on the history of policies for medium and small enterprices) (Tokyo, Tôyô Keizai Shimpô-sha, 1964), pp. 311-312.

firms thus fostered a stable paternalistic subcontracting relationship, replacing the earlier "floating" one.[1]

As regards the upgrading of the standard of small and petty producers in the countryside, the programme of the Kuré Navy Arsenal is most famous. It was initiated in 1934, when the Prefectural Government of Kōchi requested the Arsenal to provide work for the local metal engineering industry, which had not recovered from the Great Depression. Encouraged by the success of this case, medium and small enterprises in various localities were organised into industrial associations in order to participate in the programme. After 1936, it was supported by the Ministry of Commerce and Industry and spread all over the country. By February 1938, the number of associations benefiting from it had reached 325.[2]

In order to help those petty producers meet the Arsenal's requirements regarding the quality and delivery, prefectural governments supervised production processes, provided technical guidance, and extended financial assistance, e.g. by arranging special loans from local banks.

It was soon discovered that the lack of specialisation and division of labour among petty producers was the major obstacle to their progress: everyone of them had been trying to do everything at his own workshop. Participation in the programme <u>forced</u> them to accept specialisation in a narrow

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[1] Komiyama, op. cit., pp. 98-111; Fujita, op. cit., pp. 157-164 and 175-189.

[2] Komiyama, op. cit., p. 112; Yuri, op. cit., pp. 314-318.

range of activities and division of labour with other members of the association: "it was impossible to overcome the problem of lack of adequate training and equipment and improve those petty producers' standard by a 'democratic' approach".[1]

These attempts were essentially intended to maximise the industrial production under the constraint of very limited resources. Undoubtedly, industrialists and policy-makers in post-war Japan had learned a crucial lesson from such experience. At the same time, the following two developments during this period seem to have set the stage for the post-war industries.

The first is the accumulation of an enormous amount of industrial manpower, which resulted from the already mentioned abnormal expansion of employment in the machinery manufacturing industry. The second is the elimination of the Tonya's influence from this industry. The implication of the first point will be obvious, but the latter point may need some elaboration.

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[1] Komiyama, op. cit., pp. 111-126.

During the period of recurrent recessions and the Great Depression in the 1920s and early 1930s, the demerits of the "putting-out" system became clear. Namely, the "cut-throat competition" among Tonyas led to relentless cuts in producers' prices and ultimately resulted in the image of Japanese exports as "cheap and low-qualified products". The situation was worsened by the fact that individual petty producers did not distribute their products under their own brands and felt no responsibility. For the same reason, they were not enthusiastic about improving their technological standard. The problem became much more serious where a Tonya acted as an intermediary between large machinery manufacturers and their subcontractors. Vertical grouping of manufacturers eliminated the room for their intervention in machinery manufacturing. At the same time, the role of the merchant in financing and marketing diminished considerably as manufacturing activities came to depend increasingly upon the governmental funds and rationing.[1]

The role of Tonya was also reduced as a consequence of development of business associations and appearance of large manufacturers who were capable of taking care of smaller enterprises.[2]

Trade and industrial associations were established in regard to various product groups after the late nineteenth

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[1] Fujita, op. cit., pp. 192-193.

[2] Cf. Miyohei Shinohara, "A survey of the Japanese literature on small industry", in Bert F. Hoselitz (ed.): <u>The role of small industry in the process of economic growth</u> (The Hague and Paris, Mouton, 1968), p. 70.

century, with a view to exchanging business information, controlling quality of exports and regulating excessive competition. The Government promulgated "the Law for the Trade Association of Important Export Goods" in 1897, and "the Law for the Trade Association of Important Goods" in 1900. Under the latter law, not only producers but also dealers or merchants were made members of the association.[1] One of the most successful was Dai Nihon Bôseki Rengôkai or briefly Bôren (the All Japan Cotton Spinners' Association). Its membership covering over 97 per cent of the industry's spindleage, it played a crucial role in technological diffusion in the industry between 1889 and 1937, e.g. through its journal and members' mutual exchange of opinions and information.[2]

As the membership of such associations naturally was biased towards the larger enterprises, however, their impact on the smallest enterprises seems to have been indirect (e.g. control and destruction of Tonyas, and demonstration effects of technological progress made among their members), and their direct influence marginal.[3]

In brief, three groups of industries can be distinguished in regard to this period. Most of the traditional industries and some imported industries like match manufacturing modernised by electrification while remaining cottage

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[1] On this subject, see Yamanaka, op. cit., pp. 22-24.

[2] See Saxonhouse, op. cit., pp. 149-165, and idem, "Country girls and communication among competitors in the Japanese cotton-spinning industry", in Hugh Patric (ed.), op. cit., pp. 97-125.

[3] Shinohara, op. cit., pp. 70-71.

industries essentially. The second group consists of those traditional industries, above all textiles, which evolved into large-scale mechanised export industries adopting new techniques. The third is new heavy industries which developed as a result of armament efforts where the lack of demand would have forbidden their development under normal circumstances. Here a new type of petty enterprises emerged, and a novel pattern of inter-sectoral linkages was experimented - industrial subcontracting.

Period III (1945-)

Ceasefire released some 4 million workers from military goods manufacturing, and added over 6 million people to the labour force as a result of dissolution of the army and the navy, and return of overseas inhabitants. About 5.7 million were absorbed into the primary sector and raised its share in total labour force to the 1920 level (53 per cent). Every sector sheltered a large number of underemployed. The average real wage in 1947 was equivalent to 28 per cent of the 1933-36 level. About 1.5 million people came into the manufacturing sector, and the percentage of employment in enterprises with four or fewer workers rose to over 40 per cent in 1947.[1] Such surplus labour was to be absorbed, however, within two decades as a result of industrialisation which was accelerated considerably by an efficient industrial subcontracting system.

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[1] Shōwa Dōjin-kai, op. cit., pp. 626-630.

Immediately after the war, petty manufacturers could take advantage of the general shortage of consumer goods. Towards the end of 1947, however, larger enterprises started operation to compete with them, and the deflationary policy of 1949 ("Dodge Line") hit petty enterprises very hard. Under this policy which was intended to curb the post-war inflation and rebuild a healthy economy based on a competitive market mechanism, various subsidies were cut and a single exchange rate of the Yen was established. Meanwhile, the post-war boom was ending abroad. Inter-firm competition intensified. Raw materials were rationed selectively to more efficient firms. In order to reduce costs of production, larger firms cut redundant labour force and ceased operation of relatively inefficient plants.[1]

Petty producers, who started their post-war activities, often in a field related to their experience during the war, could not obtain ration materials and had to turn to the black market for their supply. Demand was depressed, and their financial position was desperate. They discovered a solution to the problem in becoming subcontractors for larger firms. As wage differentials between large and small firms became sufficiently large - a consequence of the concentration of

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[1] Keizai Kikaku-cho (the Economic Planning Agency): <u>Shiryō Keizai-Hakusho 25-Nen</u> (Information material; 25 years of the Economic White Papers) (Tokyo, Nihon Keizai Shimbun-sha, 1972), pp. 49-50. However, open unemployment increased only marginally from 660,000 in 1947 to 730,000 by June 1950, largely due to the expansion of underemployment: the agricultural sector alone absorbed half a million male workers and 1.1 million female workers (Shōwa Dōjin-kai. op. cit., p. 631).

capital and advanced technology in the large sector[1] - such an arrangement was also beneficial to larger firms. Moreover, the Government encouraged it by providing financial assistance to smaller producers through their parent firms (the Law of Co-operative Associations of Medium and Small Enterprises, August 1949). Thus, this is considered to have been a decisive period for the development of the industrial subcontracting system in post-war Japan.[2]

After the Korean War (June 1950-July 1953), Japanese industries started rationalisation and modernisation. In this process, the decline of the textile (spinning and weaving) industries became decisive. Their share in total industrial employment had fallen to only 24 per cent by 1951 as compared with [illegible] per cent in 1934-36, while that of metal, machinery and chemical industries rose from 38 per cent to 45 per cent.[3] Such a shift towards heavy industries was encouraged by the Government's import-licensing, tax, and financing systems. This was considered to be appropriate, because industrialisation in other Asian countries and the rising wages at home would soon deprive the Japanese textile industries of their international competitiveness, while heavy industries, particularly machinery

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[1] Miyohei Shinohara: Structural changes in Japanese economic development (Tokyo, Kinokuniya Bookstore, 1970), pp. 312-329.

[2] Fujita, op. cit., pp. 204-206. It is interesting to note that the recovery of Tonya's influence as marketing and financial agents for petty producers remained only marginal. This seems to have been due to such producers' enthusiasm for "vertical association" with larger parent firms - obviously a reflection of the lesson learnt during the war - and to the above-mentioned attitude of the Government (ibid., p. 206).

[3] Keizai Kikaku-chō, op. cit., p. 55. Also see table II.

manufacturing, were associated not only with higher value-added and higher foreign exchange earning ratios than light industries, but also to greater employment and industrial linkage effects.[1] This structural change of Japanese manufacturing increased opportunities for industrial subcontracting.

At the same time, several other factors made Japanese machinery manufacturing depend on subcontracting more heavily than their counterparts abroad. One of them is the very low level of capital accumulation in Japanese industries.[2] It was not rare for them to depend on external sources (e.g. bank loans) for 80 per cent of their investment funds. And yet their investment rates were kept at a high level: relying on imports for the supply of virtually every raw material, they had to earn foreign exchange (the Government often licensed import of such materials according to the export performance of individual enterprises), and in order to export they had to fill the enormous technological gap between their rivals in industrialised countries as soon as possible. Moreover, technological innovations tended to expand the optimal scale of operation, and this intensified inter-firm competition over the

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[1] ibid., pp. 207-215 and 228.

[2] Until the early 1960s, when the Japanese economy reached its "turning point" and shifted from a labour-surplus to a full employment situation (cf. Ryoshin Minami: The turning point in economic development: Japan's experience) (Tokyo, Kinokuniya Bookstore, 1973), this approach had two additional merits: (1) by relying on smaller enterprises for labour-intensive work, the parent firms could save labour costs considerably, and (2) by transferring their old equipment to subcontractors, they could save capital and at the same time improve the quality of subcontractors' equipment.

market-share of the home market. Such competititon was all the more fierce, because the dissolution of Zaibatsu and the Government's anti-monopoly policy during the post-war period encouraged entry of new firms. Thus, technological innovations, inter-firm competition and industrial growth stimulated each other and intensified the process of industrial progress. However, this made it necessary for major firms to concentrate their investment in the core production processes (processes where up-to-date technologies were the key to survive and win competition) and to rely on subcontractors for the rest.[1] In this way, active demand for subcontractors arose.

On the supply side, there was a large number of petty producers, who had certain industrial skills and experience from the wartime. By becoming a subcontractor for a large firm, they could secure supply of raw materials as well as orders when they were difficult to obtain. Parent firms provided financial assistance, and advised them about how to rationalise and modernise their production methods, as we will discuss later. However, there seems to have been a more fundamental reason why smaller producers felt enthusiastic about becoming a subcontractor. The Japanese economy during the post-war period has been characterised not only by a high growth rate but also by recurrent violent business

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[1] On the Japanese parent firms' motivation, see Watanabe, "Subcontracting, industrialisation and employment creation", op. cit., pp. 58-59.

fluctuations,[1] and the smaller the size of the enterprise the larger the impact of such fluctuation tended to be[2] - largely because of the "cut-throat competition" among such producers. Thus, smaller enterprises were (and still are) eager to secure survival and increase stability by becoming a subcontractor. Hence an active supply of subcontractors.

As a result of the inter-action of such considerations on both sides, the peculiarly Japanese industrial structure was created, where over 50 per cent of medium and small enterprises in every size group (table IV, p. 83) are subcontractors, to a greater or smaller extent. That the practice of subcontracting goes much further than in the other industrialised countries is illustrated by the fact that the six major car assemblers in Japan subcontract, on an average, over 70 per cent of their total material cost, as compared with 30 to 40 per cent in the case of American and European assemblers (e.g. Fiat, Ford, Renault and Volkswagen). Only Volvo subcontracts as much as the Japanese,[3] in this case to other European countries.

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[1] To take a decade starting 1953, the standard deviation of industrial production indices was 5.9 per cent in Japan, 4.9 per cent in the United States, and 3.2 per cent in West Germany, after adjustment pertaining to the growth trends (Keizai Kikaku-cho, op. cit., pp. 187-188).

[2] Tadao Kiyonari: Tôsan, sono Kêsu to Yôin-Bunseki (Business failures, some case studies on their causes) (Tokyo, Kinyû Zaisei Jijô Kenkyû-kai, 1968), p. 33.

[3] Kikai Shinkô Kyôkai (Japan Society for the Promotion of Machine Industry), Economic Research Institute, Nichi-Bei Kikai Kôgyô ni okeru Nai- Gai-sei Mondai ni kansuru Chôsa Kenkyû (A study on own production and external procurement in Japanese and American machinery manufacturing) (Tokyo, 1975), pp. 128-130.

Apart from the difference in the extent of its spread, the subcontracting system in the post-war Japanese industries is different from that in the previous period in the following aspects: first, with the exceptions of a few industries, notably garment and food processing, manufacturers are dominant among parent firms (table III); second, in the smallest size group with three or fewer workers, as many as one-third of the total number of enterprises are "tied" to one parent firm (table III), indicating an increased stability in their relationship with the parent firm.

Now, let us examine how small and petty enterprises' technological standard has been improved, as a result of their linkages with larger firms in this period.

Modernisation of Japanese machinery manufacturing in the post-war period started, among major enterprises, with a series of innovations in managerial practices that were based on modern management techniques imported from the United States. Soon after the war, scientific quality control techniques (QC) were brought in.[1] Industrial engineering techniques (IE) were introduced in 1955, and system engineering, value analysis (VA), etc. by around 1960.[2] Adoption of IE techniques like

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[1] The Allies' procurement during the Korean War required strict observance of specifications on the one hand, and accompanied, on the other, technical guidance pertaining to modern scientific production, inventory and quality control techniques. This helped reduce the technological gap between Japanese industries and their counterparts in industrialised countries greatly (cf. Koyama, op. cit., p. 348).

[2] M. Takeuchi (ed.): Keizai Seichō-ka ni Hembō-suru Chū-shō Kigyō (Economic growth and changes in medium and small enterprises) (Tokyo, Japan Productivity Centre, 1964), pp. 277-
(Footnote continued on next page)

Table III

Importance and types of subcontracting by industry in Japanese manufacturing
(as of 31 December 1966)

(Enterprises employing fewer than 300 workers)

Industry	Subcontractors[1] as % of all enterprises: Total	Subcontractors[1] as % of all enterprises: Enterprises with three or fewer workers	"Tied" subcontractors[2] as % of all enterprises: Total	"Tied" subcontractors[2] as % of all enterprises: Enterprises with three or fewer workers	Parent firm of "tied" subcontractors[2] (% of total): Manufacturer	Parent firm of "tied" subcontractors[2] (% of total): Wholesaler	Parent firm of "tied" subcontractors[2] (% of total): Retailer (including department store)	Parent firm of "tied" subcontractors[2] (% of total): Other
All manufacturing	53.6	52.3	24.2	32.8	58.5	26.3	2.9	12.3
Textiles	79.5	86.2	50.6	64.4	65.8	26.0	0.3	7.9
Electrical machinery, equipment and supplies	77.6	89.2	28.9	39.4	85.7	4.8	0.2	9.3
Machinery (excluding electric)	71.6	73.7	26.1	41.9	78.5	8.7	1.1	11.8
Fabricated metal products	71.2	64.3	20.1	31.1	70.7	13.9	1.7	13.7
Apparel and related products	69.6	71.6	42.0	54.4	42.5	41.8	4.7	11.1
Transport equipment	69.3	51.6	27.7	24.1	86.1	2.6	-	11.3
Rubber products	68.3	69.2	38.2	42.7	63.9	26.5	1.6	8.0
Iron and steel	65.9	60.5	15.7	34.0	76.2	12.2	0.3	11.3
Precision instruments	62.9	75.3	25.0	44.7	73.4	15.0	0.5	11.2
Leather and leather products	60.2	71.7	32.6	48.2	50.2	33.5	3.2	13.5
Paper and allied products	59.3	52.9	23.7	29.1	52.2	29.5	4.7	13.7
Miscellaneous manufacturing[3]	52.7	49.0	27.7	29.7	46.6	33.6	1.4	18.3
Non-ferrous metals and products	51.0	68.7	13.0	32.1	73.6	18.1	0.2	7.8
Furniture and fixtures	44.9	37.8	11.7	15.8	42.4	35.4	7.1	15.1
Publishing, printing and allied industries	41.6	49.5	9.6	14.9	37.7	11.1	5.9	45.3
Lumber and wood products	39.8	36.7	18.4	23.4	43.1	31.5	8.4	16.7
Ceramic, stone and clay products	32.7	33.4	13.5	20.1	42.7	39.5	2.7	15.1
Chemical and allied products	32.7	45.2	15.1	22.4	56.6	18.2	3.6	21.6
Food and kindred products	17.4	15.5	9.4	9.7	21.9	42.7	17.3	18.0
Petroleum and coal products	11.0	26.9	5.0	11.5	37.0	45.7	-	17.4

Source: Chû-shô Kigyô-chô (the Medium and Small-Scale Enterprise Agency): Dai-Sankai Chû-shô Kigyô Sôgô Kohon Chôsa Hôkoku sho (The third basic survey on medium and small-scale enterprises). Quick report, table 6, and Vol. I, table 21. Owing to rounding, the percentages shown in the last four columns do not always total 100.0.

[1] Includes subcontractors for a single parent firm and for more than one parent firm, and enterprises which are engaged both in subcontracting and in non-subcontracting business. For a breakdown on these lines see table VI in S. Watanabe, "Entrepreneurship in small enterprises in Japanese manufacturing", in International Labour Review, Dec. 1970. p. 552.

[2] Subcontractors for a single parent firm only.

[3] Includes products like toys, fountain pens, jewellry, lacquer wares, brooms and brushes, matches and umbrellas.

time, movement and flow studies helped reduce cost of production considerably by inducing a shift of the layout of existing machines from a "batch work system" to a "process flow system" and standardisation of work. Until towards the end of the 1950s, technological progress was mostly based on such managerial changes, semi-autonomisation of existing machines by attaching simple devices (e.g. stoppers) and introduction of transport machines like chutes and belt conveyors. Thus, this period is often referred to as a "low-cost rationalisation" period.

By the end of the 1950s, the domestic market for durable consumer goods had started expanding to an important extent due to the rising rural income level - the annual output of the automobile industry, for example, grew from 69,000 units in 1955 to 482,000 units in 1960. At the same time, the Government decided (March 1959) to liberalise trade in the near future[1] and urged industries to modernise and increase their scale of production to an internationally competitive level. On the basis of preparation during the "low-cost rationalisation" period and with all kinds of encouragement (particularly under the Provisional Law for the Promotion of Machinery Manufacturing Industries), therefore, major technological innovations started to replace "human wave production methods" with automatised mass-production techniques at larger firms.

(Footnote continued from previous page)

278; Chû-shô Kenkyû Sentâ, "Waga-Kuni ni okeru Gaichû, Shitauké Kanri no Tenkai (Development of subcontract management techniques in Japan)" (Tokyo, Sep. 1976), pp. 13-14 and 22-23.

[1] This decision was motivated largely by the Government's intention to join the IMF and OECD.

subcontractors varied from over 100 workers to below 10 workers but they had their own subcontractors, mostly of the household type.[1] The assemblers' efforts for modernisation became their groups' efforts. Competition among the assemblers was competition among the groups.

Technical guidance and assistance from parent firms grew, as the degree of technological sophistication in Japanese industries increased. At the time of the Korean War, when the main concern was maximisation of production by "human wave" production methods, the most important kinds of assistance from parent firms were related to the supply of raw materials, provision of capital equipment and tools (usually used equipment and tools which were idle or replaced by new ones at the parent firms), and financial support. Technical guidance was relatively unimportant and managerial guidance was seldom mentioned.[2] Studies around 1960, however, found technical guidance to be the most common kind of assistance from the parent firms, followed by financial and managerial assistance.[3] The trends of rising importance of technical and particularly

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[1] ibid., pp. 8-9, 30 and 45-46.

[2] See, for example, Osaka Furitsu Shô-kô Keizai Kenkyû-sho and Osaka-fu Shô-kô Keizai Kenkû-kai: Kikai Kôgyô ni okeru Gaichû, Shitauké no Jittaai (Actual conditions of subcontracting in machinery manufacturing) (Osaka, Mar. 1954), pp. 57-62.

[3] Economic Bureau, Tokyo Metropolitan Government: Tonai ni okeru Kikai Kôgyô no Shitauké Keiretsu Kankei (Vertical grouping of subcontractors in machinery manufacturing in Tokyo Metropolitan Area), Feb. 1963, pp. 22-25.

As their scale of production grew, large firms shifted hitherto own-produced parts and components to subcontractors and the subcontracting system deepened.[1] In this process, technological gaps between firms of different size groups became a serious problem. To take the case of Toyota as an example, the margin of error in cutting and milling work was about 3/1,000 mm at Toyota and 1/200 mm at its ten affiliates, while it was 1/100 mm at medium-scale subcontractors and 1/50 to 1/20 mm at small and petty subcontractors and sub-subcontractors.[2] A study in 1959 found only seven out of 31 sub-subcontractors of Toyota had below 20 per cent of rejection ratios.[3] As Toyota is known to be one of the leaders in the field of subcontracting control, general conditions in Japanese manufacturing as a whole must have been much worse. For a successful introduction of mass-production techniques at the top of the subcontracting hierarchy, increase in the reliability of parts makers was imperative. Just as the assemblers' success in their innovations depended on the rationalisation and modernisation of their primary sub-contractors, moreover, the extent of progress made by the latter was largely determined by the degree of improvement in their own subcontractors' performance. The size of those sub-

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[1] See pp. 52-53 below.

[2] Ichiro Oshikawa et al. (ed.): Kôdo Seichô Katei ni okeru Chû-shô Kigyô no Kôzô Henka (Structural Change of medium and small enterprises in a process of rapid economic growth) (Tokyo, Tôyô Keizai Shimpô-sha, 1962), p. 163.

[3] Aichi Prefectural Economic Research Institute: Tôkai Chiku ni okeru Jidôsha Buhin Kôgyô no Kôzô Henka to Sai-hensei (Structural change and reorganisation of auto-parts manufacturing in Tokai District) (Nagoya, 1967), p. 54.

managerial guidance and declining importance of material assistance have continued ever since.[1]

A parent firm's direct technical and managerial guidance to its subcontractors took (and takes) place mainly in connection with determination of the unit price of their product(s).[2] The unit price of the subcontractor's product is given by an hourly rate multiplied by the standard time required for the work, where the hourly rate is equal to the labour cost per unit of time plus miscellaneous overhead costs and the standard time is the time required for the work when it is done most efficiently (e.g. at the parent firm). Alternatively, it may be fixed on the basis of a target sales price of the end-product. In many cases, offered prices are considered to be too low by their subcontractors. When such complaints are made, parent firms send their experts to the firm. The experts point out all the sources of waste and inefficiency and show the subcontractor how to cut costs in concrete terms.[3] Changes in the layout of the plant are recommended, acquisition of particular equipment is advised and, if necessary, financial support is offered for such investments.

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[1] See, for example, the Medium and Small-Scale Enterprise Agency: Chû-shô Kigyô Hakusho (White Paper on Medium and Small Enterprises), 1976, p. 144.

[2] S. Sei, H. Ohmori and H. Nakajima: "Jidôsha Buhin Kôgyô ni okeru Seisan Kôzô no Kenkyû (Jô) (A study on the production structure in the auto-parts manufacturing industry, Part 1)", in Kikai Keizai Kenkyû (Tokyo), Aug. 1975, p. 87; and Economic Research Institute, Chû-ô University: Chû-shô Kigyô no Kaisô Kôzô (Hierarchical structure of medium and small enterprises) (Tokyo, 1976), pp. 50-52.

[3] For a case study on Nissan Motors in this connection see Junzô Wada: "A case history of guidance and upgrading of subcontracting firms", in the APO: Intra-national transfer of technology, op. cit., pp. 87-119.

Large parent firms also provide assistance and guidance collectively through their subcontractors' co-operative association. Some parent firms have maintained such a system of vertical grouping since the wartime (notably Toyota's Kyôhô-kai), and others restored it during or after the Korean War.[1] Parent firms organise lectures, seminars and in-plant training courses through those associations. They played a crucial role in transfer of ideas and parent firms' experience pertaining to scientific management during the "conscious revolution" of management around 1960.[2]

Now, the demand of price cuts as well as technological guidance and assistance to attain such targets are relayed from the large parent firm at the top of the subcontracting hierarchy down to homeworkers at the bottom in a way similar to the bucket-relay fire extinction method. Industrial growth in Japan has been realised partly by the growth of existing members of individual subcontracting groups and partly by the increase in the number of enterprises in the group. The latter takes place at various existing levels of the hierarchy and also at additional levels. In other words, industrial growth has widened the spread of the subcontracting system

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[1] Keizo Fujita: "Shitauké no Gôrika, Soshikika to Seisansei Kôjô Mondai (Rationalisation and organisation of subcontractors and the problem of increasing their productivity), in Tokutaro Yamanaka (ed.): Chû-shô Kigyô no Gôrika Soshikika (Rationalisation and organisation of medium and small enterprises) (Tokyo, Yûhikaku, 1958), pp. 184-185.

[2] Takeuchi, op. cit.; and Wada, op. cit.

horizontally and deepened it by adding new strata.[1] It sometimes results in a reduction of the number of subcontractors at higher levels of the hierarchy by shifting existing primary, secondary, ... subcontractors under the care of secondary, tertiary, ... subcontractors, in order to simplify the management of subcontractors. In the case of Toyota, for example, there were few sub-sub-subcontractors around 1959, most of them being cottage-type enterprises with one or two workers.[2] But a recent study revealed six steps in a subcontracting relationship: automobile assemblers, Hitachi (electrical car parts section), Hitachi's own subcontractors, Hitachi's sub-subcontractors, Hitachi's sub-sub-subcontractors (= household enterprises), Hitachi's sub-sub-sub-subcontractors (= homeworkers).[3] Thus, the Japanese subcontracting system stretches from some of the largest enterprises in the world to homeworkers. In 1966, 6 per cent of the enterprises with four or fewer workers had subcontractors (three, on an average), and the similar percentage rose gradually to 78.9 per cent in the size group with 1,000 workers and over, but the number of subcontractors per parent firm remained to be only 84.2.[4]

As the scale of production of a group expands and as the subcontracting system under a parent firm deepens, assistance

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[1] Economic Research Institute, Chû-ô University, op. cit., p. 153.

[2] Aichi Prefectural Economic Research Institute, op. cit., pp. 45-46.

[3] Economic Research Institute, Chû-ô University, op. cit.

[4] Watanabe, "Subcontracting, industrialisation and employment creation", op. cit., p. 60.

for petty producers at and near the bottom of the system becomes more modest, as their parent firms themselves are small and may not have sufficient capacity to help them. In such cases, various schemes of the Government provide guidance and means to implement given advice. The Government's efforts to encourage the rationalisation and modernisation of small enterprises (over 50 per cent of which are subcontractors, as was noted earlier) in the post-war period have consisted of three major elements: (1) organisation of small enterprises into co-operatives and financial support for such co-operatives; (2) technical guidance, free of charge, through its diagnosis programmes for small businesses or their groups, whereby a group of experts on management and production techniques visit individual enterprises and groups of enterprises to point out all the sources of inefficiency and show in concrete terms how to improve their performance; and (3) financial support with its special funds for modernisation and rationalisation of production facilities. It is said that the diagnosis programmes and the Government's funds for rationalisation and modernisation, including loans from the People's Finance Corporation, have been particularly beneficial to petty subcontractors.[1] For example, they sometimes learned about techniques of scientific management and accounting from business diagnosticians of the prefectural governments, improved the layout of their plants, and modernised their

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[1] On this point, I have benefited from a meeting at the Institute of Small Business Research, Osaka Keizai Daigaku, which Professor Keizo Fujita kindly organised for me in December 1976.

capital equipment, according to their advice, with the help of loans from the Government's special modernisation funds.[1]

The above-discussed guidance and assistance by parent firms and by the Government seems to have been made considerably easy and efficient by the improvement in book-keeping practice, which had started earlier by the introduction of the "blue return form system" for an income tax report in 1949-50. In those days, few small enterprises had a proper book-keeping system and this was a serious obstacle to their rationalisation. To solve this problem, American advisers (the Shoup Mission) recommended that, when a tax-payer kept a certain mode of book correctly and used it as a base for his income tax report, he was to be granted a preferential treatment with regard to income tax. The idea was spread through seminars and lectures organised under the auspices of the Medium- and Small-Scale Enterprise Agency. At the same time, the business diagnosis emphasised the importance of the financial control aspect of management. Such modernisation of accounting practices in medium and small enterprises stimulated efforts for cost reduction and facilitated parent firms' guidance in concrete terms.[2]

Such assistance and guidance would not have been so effective if petty producers themselves had not been eager to improve their performance. Their enthusiasm came from the hard

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[1] Sei, Ohmori and Nakajima, op. cit., p. 82.

[2] The Medium and Small-Scale Enterprise Agency: <u>Chû-shô Kigyô-chô 25-Nen-shi</u> (25 years of the Medium and Small-Scale Enterprise Agency) (Tokyo, 1973), pp. 18-19.

competition among petty enterprises, which would grade them down to a lower level of subcontracting hierarchy or eliminate them from the group relentlessly, once they failed to meet their parent firms' needs.[1] Subcontractors often co-operated to solve their common problems. To quote an example, a special training night school was set up by a metalworkers' association in Nagoya to overcome the shortage of semi-skilled and skilled workers, particularly at the sub-subcontractors' level.[2] Such co-operative associations' schemes were (and still are) often supported by the parent firms and the Government.

As a result of such concerted efforts, efficiency of engineering industry was enhanced rapidly: 19 studied small auto-parts makers almost doubled their productivity between 1956 and 1960, in spite of the cut in prices of their products by at least 20 per cent during the same period.[3] At the national level, prices of auto parts went down by 30 per cent, on an average, and by over 90 per cent in regard to certain parts, between 1955 and 1960.[4] At the same time, spread of the "process flow layout system" at various levels of the subcontracting system enabled early discovery of defects in

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[1] Sei, Ohmori and Nakajima, op. cit., p. 43; Oshikawa et al., p. 196.

[2] Aichi Prefectural Economic Research Institute, op. cit., pp. 48 and 70.

[3] Oshikawa et al., Kôdo Seichô Katei ni okeru ..., p. 203.

[4] Sei, Ohmori and Nakajima, op. cit., p. 87.

products, and the rejection rate of parts fell very commonly by about 50 per cent, sometimes within a year.[1]

Such was a combined result of progress made in managerial practices and improvement in equipment. The latter is reflected in the fact that 90.3 per cent of lathes acquired by the automobile industry in 1957 were used ones, while the similar percentage fell to 39.1 per cent by 1962. The most striking was, however, the case of sewing machine manufacturing, where all the newly acquired milling machines were used ones in 1957, but most new ones (85.4 per cent) in 1962.[2]

Under the Provisional Law for Promoting Machine Manufacturing Industries (Kikai Kōgyō Shinkō Rinji Sochi-hō), which was first enforced in 1956 and renewed several times later on, the Government (1) designated certain (electrical, transport and other) machinery and parts whose quality and production costs were to be improved, (2) fixed concrete targets to be attained within a given period of time in regard to their quality and production cost (in the case of the automobile industry, for example, the production costs was to be reduced by 30 per cent between 1961 and 1964), (3) provided special loans and granted taxational privileges to encourage investment in order to help attain such targets, and (4) exempted from certain regulations of the Anti-Monopoly Law those firms which

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[1] Oshikawa et al.: Kōdo Seichō Katei ni okeru ..., op. cit., p. 36; the Aichi Prefectural Economic Research Institute, op. cit., pp. 21-22.

[2] Shinohara, Structural changes in Japanese economic development, op. cit., pp. 26-27.

wished to level up their scale of production to an internationally competitive level by merger. Thanks to such encouragement by the Government, and also to the development of basic industries (e.g. iron and steel manufacturing) and an efficient subcontracting system, machinery manufacturing made a tremendous progress towards the end of the 1950s, and the supply of industrial machinery and equipment became cheap and abundant. The process was intensified by fierce competition among suppliers, which made terms of instalment payment much more generous and prices much lower than otherwise. At the same time, with a view to modernising equipment of small and petty firms, the Government provided special loans and granted accelerated depreciation allowances for them, and established a special insurance scheme for the suppliers against unrecovered credits. Thus, the development of local machinery manufacturing helped improve efficiency of even petty producers.

Table I indicates that, in Japan, suppliers (including trading companies) of raw materials and machinery are one of the most important sources of technical guidance and co-operation for small and petty enterprises. This has been specially true in the garment industry:[1] "The speed of technical progress in the garment industry is governed by the

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[1] Oshikawa et al.: "<u>Kôdo Seichô Katei ni okeru ...</u>, op. cit., pp. 22-25.

speed of similar progress made in industrial sewing machine manufacturing."[1]

An important aspect of the development of industrial machinery manufacturing is the fact that the features and standard of its product are greatly influenced by the feedback of information and advice from the cliental industries. Such feedback seems to have been specially important between sewing and knitting machine manufacturers, textile fabric manufacturers and garment producers. When a new kind of fabric was introduced, garment producers sometimes had difficulty with conventional machines and, subsequently, the machines were modified to meet the users' needs. As competition among industrial equipment manufacturers and dealers has been quite hard, even petty producers' special needs tended to receive a serious consideration on the part of machinery and material dealers.

Before we close this section, we will touch on the supply source of skills of petty firms. We mentioned a huge stock of industrial manpower that the Japanese industries emerged with from the war. In later years, most of the new small and petty entrepreneurs obtained their skills as employees in the trade related to the one in which they launched their enterprise. In a survey conducted in November 1975, as many as 73 per cent of them had such experiences, 65 per cent of them used to work in

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[1] "Chû-shô Kôgyô ni okeru Gijutsu Shimpo no Jittai (6) (Facts about technical progress in medium and small enterprises)", in Chû-shô Kigyô Kinyû Kôko Geppô (Monthly Bulletin of Small Business Financing Corporation), Nov. 1960, pp. 21-26.

small enteprises and the rest in medium and large enterprises.[1] Some of the former group must have had experience in a large enterprise, too. According to a survey in the Tokyo-Yokohama area (i.e. the largest industrial centre of Japan) in 1954, those entrepreneurs and skilled workers who had moved from large to small factories, and those who had moved from small to large factories and then moved back to small ones, accounted for 26 and 32 per cent in machinery manufacturing, respectively, and 30.9 per cent and 21.4 per cent in the manufacturing industries as a whole.[2] Starting as a learner-worker after ordinary or industrial school, a majority of them have 7 to 15 years' experience before becoming independent. This permits them not only to acquire the necessary knowledge and skills but also to develop useful business connections in regard to marketing of their products and supply of raw materials, and to accumulate at least part of their initial capital.[3]

In an industry like garment manufacturing, various forms of short-term training courses organised by equipment (e.g.

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[1] The Medium and Small-Scale Enterprise Agency: Chū-shō Kigyō Hakusho (White Paper on Medium and Small-Scale Enterprises), 1976, p. 238. "Small", "medium" and "large" enterprises are defined to be enterprises with fewer than 20 workers, 20 to 299 workers and 300 and more workers, respectively, in this survey. For a similar picture in 1966, see Watanabe, "Entrepreneurship ...", op. cit., pp. 536-539.

[2] Kanagawa Prefecture: Keihin Kōgyō Chitai Chōsa Hōkokusho (Report of a survey of Tokyo-Yokohama industrial district), Mar. 1954, quoted in Shinohara, Structural changes in Japanese economic development, op. cit., p. 315.

[3] Watanabe, "Entrepreneurship ...", op. cit., p. 539; and Kokumin Kinyū Kōko (People's Finance Corporation): Nihon no Shō-Reisai Kigyō (Small and petty enterprises in Japan) (Tokyo, Tōyō Keizai Shimpō-sha, 1967), pp. 106-107.

sewing and knitting machine manufacturers, dressmaking schools, and even courses at school) can be a source of necessary skills.

In brief, Period III is a period when, on the basis of preparation made during the preceding periods, a large amount of surplus labour that existed at the beginning of the period was absorbed and dualism in the Japanese economy disappeared rapidly as a result of development of all the three kinds of linkages (industrial subcontracting, equipment supply and movement of skilled workers) between the two sectors. The key factors that accelerated this process have been the rapid rates of technological innovation and growth in the formal sector and intense inter-firm competition in both sectors, which interacted and reinforced each other.

Over the three different periods we have studied - and even within each of them - the basic economic and political conditions changed considerably, and the major contributors to the industrialisation varied. Nevertheless, one thing seems to have been true in regard to all the three periods: the pattern and the timing of technological progress in both the formal and informal sectors of Japanese industries have been governed largely by factors in the demand side: long survival of traditional tastes of consumers: expansion of export markets which resulted either from changes in international political and economic conditions, or from active salesmanship of Japanese exporters; changes in the pattern of demand abroad; or expansion of home market due to the Government's armament programme (in the pre-war period) and modernisation programme for trade liberalisation, and the rising income level in the rural sector (in the post-war period). Producers, both in the large and in the small sector, introduced new technologies or adapted existing ones to meet such new market conditions.

It is also notable that the Government almost never tried to protect industries that could not keep up with such changes. Its "relief measures" were intended either to help increase their competitiveness, e.g. with modernisation funds, or to encourage them to shift to other lines of business, where the Government judged the first approach impossible or too costly. For the sake of industrial reorganisation and rationalisation that were considered to be essential in order to maintain and promote the long-term strength (e.g. international competitiveness) of the national economy, sometimes a considerable amount of sacrifice was made in terms of business failures and unemployment. Probably such an approach was possible because Japanese agriculture maintained a considerable capacity to "hold" surplus labour and provided a source of additional income for the informal sector industrial workers' households.[1]

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[1] In many cases, especially in earlier years in industrialisation, wages from industrial activities were a second income for such workers.

III. INTER-SECTORAL TECHNOLOGICAL LINKAGES IN DEVELOPING COUNTRIES

The extent of technological linkages between formal and informal sectors depends on the amount of technology and skills imported from the former into the latter, and the extent of their diffusion within the informal sector. In this section we will discuss them in turn.

1. Modes of technology transfer

(a) Supply of equipment

We saw earlier that inventions of cheap locally made equipment and development of efficient machinery manufacturing industry had stimulated technological progress in small and petty enterprises in Japan on many occasions, while table I indicates that, today, suppliers (including trading companies) of raw materials and machinery are the second and fourth most important sources of technical guidance and co-operation in joint research, for the medium and small enterprises. Similar examples are observed in various parts of the world.

A study in Dakar[1] notes that, in order to attain productivity and income higher than mere urban subsistence, more sophisticated and versatile equipment than that available within the informal sector is required. Such equipment is

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[1] Chris Gerry, "Petty producers and the urban economy: a case study of Dakar", ILO World Employment Programme Research Working Paper (WEP 2-19-101-1,WP8), Sep. 1974, pp. 43-45.

supplied by large dealers of electric sewing machines, a local subsidiary of a French gas and welding equipment manufacturer and an importer of carpentry and woodworking machinery. Credit and rental systems play an important role in making access to such machinery easier for informal sector firms. This seems particularly the case in tailoring.

In a study on Mexico and Puerto Rico, Strassmann argues that the crucial transfer of information occurs often through the machinery manufacturers' follow-up service and points out that salesmen and manufacturers' agents may well be the most extensive carriers of technical information.[1] Indeed, where competition is hard among such suppliers, they make considerable efforts in this regard. Just as Japanese equipment manufacturers establish distribution centres equipped with training facilities for customers as part of their sales campaign, foreign machinery manufacturers in Hong Kong very often recruit and train local engineers in the operation of equipment before promoting business, so that customers can receive sufficient technical guidance, including on-the-spot training of operators.[2]

The lower the stage of industrialisation at which an economy is, the greater the importance of such embodied technology transfer and the role of sales agents may be,

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[1] W. Paul Strassmann: Technological change and economic development: the manufacturing experience of Mexico and Puerto Rico (Ithaca, N.Y., Cornell University Press, 1968), particularly pp. 33-34.

[2] Pai-Tai Wong, "Intra-national transfer of technology", a country paper of Hong Kong prepared for the APO Symposium on Intra-National Transfer of Technology, 24-28 Feb. 1975, p. 3.

because other kinds of linkages become rarer. Indeed, this is the only media of technological linkages between the two sectors in most parts of Africa.[1] However, the absolute extent of such linkages seems to be limited for a number of reasons.

Probably the greatest limiting factor is the absolute shortage of supply of equipment, which is due, in turn, to the restriction on import of such equipment or materials required for its production, investment restriction, inefficiency of the distribution system within the country, etc. In some countries, technological progress of informal sector firms is directly discouraged by deliberately established disincentives. In Bombay area, for example, many such firms are not using electricity because otherwise they would have to pay various taxes:[2] this makes a striking contrast to their Japanese counterparts' situation where the introduction of electric motors contributed to their modernisation after the First World War.

Even where these problems do not exist, the quality of equipment from the formal sector may not be compatible to the level of education and training in the informal sector, and the price may be too high. In reference to Indian industries, Koga maintains that, for these reasons, evolution of traditional

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[1] On this point, I benefited from talks with Mr. Jens Müller of the Centre for Development Research, Copenhagen, and Dr. R. Kaplinsky of the Institute of Development Studies (Sussex/Nairobi).

[2] I owe this information to Mr. Tom Tinberg of the World Bank.

industries into modern small-scale industries is "certainly difficult, and achievement of it is rare indeed".[1]

As we noted earlier, machinery manufacturers and dealers in Japan work in close collaboration with their clients to develop appropriate kinds of machinery and equipment to meet the latter's requirements. In China, considerable improvement seems to have been made after the introduction of a "three-in-one" combination in the designing, trial manufactures, and experimentation stages around the mid-1960s. Under this system, the staff of the designing organisations in the country is to make an initial design on the basis of detailed analysis of, e.g. imported machinery and related data, but it is also to participate in field experiment' and trial manufacture and listen to the opinions of the user farmers or the factory workers and managers before the final design is established.[2] Without development of a feed-back system, relying either on a Chinese-style administrative machinery or on individual manufacturers' or dealers' marketing efforts as in the case in Japan, the so-called "appropriate technology strategy" seems to have only a limited scope of success.

Apart from the supply of new machinery, transfer of used machines from larger enterprises can be an important means of enhancing the technological standards of petty enterprises. Where capital is short, this may have double effects: it helps

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[1] Masao Koga, "Traditional and modern industries in India", in The Developing Economies (Tokyo), Sep. 1968, pp. 318-319.

[2] Ishikawa, "The Chinese method of technological development", op. cit., pp. 443-445.

reduce the cost of technological progress among small enterprises, as well as the cost of innovation in large firms. The relatively short history of industries and the slow rate of their development, however, limit the potentials of this approach in most of the developing countries, keeping the rate of turnover of machinery low. In China, the transfer of used equipment from large and modern to small and more primitive enterprises has become quite substantial only in recent years.[1]

(b) Movement of skilled workers

In early stages of industrialisation, inflow of experienced skilled employees from the formal sector is a very important mode of technology and skills transfer to the informal sector, public enterprises and foreign firms playing a role of supply base of such personnel.

In Ghana, a recent study of 24 large metalworking firms revealed that these firms had lost 51 per cent of their trainees within five years after completion of their training. One company lost 36 trained employees per year. More than half of them started their own business in the informal sector; another 12 per cent ended up in smaller workshops and the remaining 33 per cent or so found new jobs in other large firms.[2]

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[1] Sigurdson: Rural industrialisation in China, op. cit., p. 122.

[2] Hakam, op. cit., p. 22.

In Argentina, technicians trained by the automotive industry leave to set up their own garages to produce components or parts for industry.[1]

In India, where the Government made it compulsory for large firms to subcontract part of their work to smaller enterprises in 1967, foreign parent firms sometimes encourage their technologically reliable employees to start their own business as subcontractors for them. At the same time, the technological standards of subcontractors sometimes change considerably as a consequence of departure or arrival of skilled workers.[2] Important impacts which dispersal of ex-employees of foreign subsidiaries makes on the technical standard of the local industries has also been observed in Pakistan.[3]

A more concrete example is related to the electronics industry of Hong Kong. This industry was started by American subsidiaries which brought in machinery, components, materials and other senior staff including engineers, from the home country. While working in these companies, local engineers learned techniques of assembly-line arrangements, production

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[1] Jack Baranson: Automotive industries in developing countries (World Bank Staff Occasional Paper No. 8 (Washington D.C.), International Bank for Reconstruction and Development, 1969), p. 48. There is a strong inclination among Argentinians to have thier own business, regardless of the opportunity cost (ibid.). It is, however, not clear how many of them produce parts and components for assembly or for the replacement market.

[2] K. Subramanian: "Country Report, India", in the APO: International subcontracting: a tool for technology transfer, op. cit.

[3] K.M. Riazuddin: "Country Report, Pakistan", idem.

processes, quality control systems and supervisory methods, sometimes as a result of training in the United States that was provided by the employers. Subsequently, some of them became independent and started their own small enterprises, which now supply parts and components to their former employers and to other large assemblers.[1]

In many developing countries, however, the inflow of workers from the formal sector is extremely rare, as already noted in the previous section. The Dakar survey, for example, found only 4 out of 285 petty manufacturers had experience of employment in a large foreign enterprise.[2] In Kumasi, Ghana, only 25 out of 298 informal sector entrepreneurs had training at a training institute or as an apprentice to a wage earner.[3]

The very meagre inflow of trained workers into the informal sector can be explained easily. First, in many countries, especially in Africa, operation of modern industries itself is rather new and limited in number and scale. Consequently, opportunities of industrial training are very limited. Second, general shortage of skilled workers in the formal sector gives rise to a considerable inter-sectoral earnings gap. Third, the Government's wage policy which guarantees high wages to the public sector employees and

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[1] Fai-Tai Wong, op. cit., pp. 2-3.

[2] Gerry, op. cit., p. 40.

[3] Georges A. Aryee, "Effects of formal education and training on the intensity of employment in the informal sector: a case study of Kumasi, Ghana", World Employment Programme Research Working Paper, WEP 2-18/WP 14 and WEP 2-19/WP 17 (Geneva, 1976), p. 11.

Unless some special efforts are made to encourage dispersal of people trained in large enterprises, therefore, opportunities for introduction of new skills into the informal sector will remain extremely limited and it will be difficult to upgrade the standard of enterprises in the informal sector.

Important examples of such efforts are not lacking. We have already discussed the important role played by Japan by the "model factories" in silk reeling, the Shokunden in weaving, prisoners' training in match-manufacturing, and the army and navy arsenals in machinery manufacturing.

Similar but more institutionalised - i.e. less dependent on individual workers' or firms' own decisions and on the market conditions - methods seem to have been used in contemporary China. People, including new graduates, are sometimes transferred more or less permanently to work in rural areas. Inter-enterprise contacts between different administrative levels and therefore different size groups have also been a major means of transfer and diffusion of technology and skills. Such personal contacts have been necessary and, at the same time, turned out to be the most effective way to transmit technical knowledge, because of unfamiliarity with industrial technology and lack of ability to interpret printed technical descriptions.[1]

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[1] Sigurdson: Rural industrialisation in China, op. cit., pp. 91-92. The limited use of disembodied technology transfer media like printed materials is also noted by Strassmann (Strassmann, op. cit.).

Agricultural machinery and implements manufacturing may be taken as an example. As Ishikawa reports, there was a large technology gap between the handicraft factories and co-operatives - which were the major base of production in this industry even in the mid-1960s - on the one hand, and the small sector of modern enterprises, on the other. This gap started narrowing down and the technical diffusion channel was gradually built up after the second half of the 1960s, when a "three-level network" transfer system was introduced. The system consists of _hsien_ (county)-level government enterprises, people's commune factories, and production brigade shops which are enaged in repairing and manufacturing these machinery and implements.[1] Technicians, engineers and managers from more advanced, larger enterprises go to small rural plants to assist in all stages, from planning to production and distribution, while people in the localities are sent for training to the larger enterprises and are given posts of responsibility when they return.[2] Here, larger enterprises at higher administrative levels[3] appear to play much the same role vis-à-vis smaller enterprises at lower administrative levels as state-run enterprises did vis-à-vis private sector enterprises in Meiji Japan.

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[1] Ishikawa, op. cit., pp. 440-442.

[2] Jon Sigurdson: _Rural industrialisation in China_, op. cit., p. 94.

[3] Seven administrative levels exist in China: nation, province, region, county, commune, brigade and team, in the order of hierarchy.

A more unique approach adopted by the Chinese is related to the rural industry system which provides training opportunities for local people in various ways:

(1) formal factory training: short-term courses are arranged in commune-level enterprises during slack farming seasons, covering principles, structure, operation and maintenance of machines;

(2) informal factory training: production teams send, on their own initiative, members to factories for "learning-by-doing";

(3) delivery training: commune-level enterprises send technicians to buy units at the time of delivery;

(4) mobile repair and maintenance teams training: people are trained on the spot at the time when repair or maintenance is required;

(5) factory repair training: team members accompany machinery to the repair unit.

Rural industry is thus part of a communication network where an important task is to spread innovations as quickly as possible within a local technology system.[1]

Formal vocational training schemes in most of the developing countries seem, more often than not, to have little impact on the informal sector. This is due to various factors: too large costs to be payed by trainees, too high

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[1] ibid., p. 95.

qualifications required of the applicants, gaps between the content of the training provided and the needs of the informal sector enterprises, etc. Recently, efforts have been made to correct these shortcomings in the conventional training programmes. The general trend appears to be in favour of tying such training schemes closely to workplaces. Some interesting examples are described in Hakman's study in Ghana.[1] In Singapore, the Government has contracts with a few major foreign subsidiaries whereby the latter train more workers than they need for the purpose of supplying necessary technical personnel for supporting industries.[2] Co-operation in this regard between enterprises in the two sectors is common where an industrial subcontracting system has developed, as we mentioned in various parts of the previous section. In Nepal, prisons play an important role as vocational training centres, where skills for cottage industries (e.g. spinning, weaving, hosiery and printing of cloths) are acquired.[3]

(c) Subcontracting-based technological linkages

In order to create employment and save foreign exchange, an increasing number of developing countries have been trying to develop "supporting industries" for e.g. automobile,

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[1] Hakman, op. cit., Ch. 5.

[2] Annex II to Watanabe, "Main report" in the APO: International subcontracting and transfer of technology and skills, op. cit.

[3] Keshab P. Sharma, "Country paper" of Nepal presented at the APO Symposium on Technology Transfer, 6-10 February 1978, New Delhi, p. 23

electronic and other machinery assembly manufacturing industries. Their common weapons in such efforts are import restrictions (or prohibitions) and regulations of minimum local content requirements, on the one hand, and preferential financial and taxational treatments on the other.[1] Where the history of industrialisation is relatively long, some significant progress has been made in terms of the number of local suppliers and the amount of purchase from them. Argentina, Brazil, India, Mexico and, more recently, the Philippines are good examples. The situation is best publicised in regard to the automobile industry.

In Argentina and Brazil the automobile industry had several thousand components and parts manufacturers already in the mid-1960s. Many of them were small garage shops and served as subcontractors to larger parts manufacturers.[2] Localisation of auto-parts supply had reached nearly 100 per cent by the early 1970s.[3] Most of the important parts and component manufacturers are of medium and large size, linked to foreign firms in one way or another.

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[1] Cf. Ian Little, Tibor Scitovsky and Maurice Scott: Industry and trade in some developing countries, a comparative study (London, New York and Toronto, Oxford University Press, 1970), various parts.

[2] Baranson, op. cit., pp. 46 and 48-49, and Joel Bergsman: Brazil, industrialisation and trade policies (London, New York and Toronto, Oxford University Press, 1970), pp. 120-130.

[3] Miguel S. Wionczek, Gerardo M. Bueno and Jorge Eduardo Navarrete: La transferencia internacional de tecnología - el caso de México (Mexico D.F., Fondo de Cultura Económica, 1974), p. 83.

In the process of rapid growth of the Brazilian economy that started in 1968, the growth rate of transport equipment industry was the highest among the manufacturing industries[1] (21.5 per cent per annum between 1970-74), and the annual production of automobiles more than doubled from 0.4 million units to over 1 million units between 1970 and 1977. To some extent, development of consumers' credit system contributed to the expansion of demand.[2] To what extent this benefited petty enterprises is unknown.

In India, import prohibitions and domestic content requirements became the chief instruments to encourage the local production of the auto-parts in 1953. At first, most of the local parts were produced by the assemblers themselves but, after 1960, the development of domestic parts makers was attempted by means of (a) the investment licence; (b) the capital-goods import licence; and (c) the foreign collaboration licence. In 1965 the Government issued a "reserve list" to demarcate items which could be produced only by the parts makers. Assemblers who already had such items in their manufacturing programme were allowed to continue to produce them but could not expand their production capacity. Cost differentials between parts producers and assemblers were considerable, especially in the case of propeller shafts,

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[1] See Werner Baer, "The recent development of the Brazilian economy: an interpretation", in Brazilian Economic Studies (Rio de Janeiro), No. 1 (1975), pp. 12-31.

[2] Information collected at various offices of the Government of Brazil during my visit in December 1977.

crankshafts and shock absorbers. In 1967 all of these items were, nevertheless, reserved for local parts makers.[1] Consequently, by 1969, all the five assemblers except Standard Motor Products had raised domestic content of their cars to over 94 per cent.[2] The proportion of bought-out components ranged from 39.4 per cent (Ambassador) to 62.2 per cent (Jeep) in 1967.[3]

Parent firms offer technical guidance and assistance as the need arises. A good example is the case of Ashok Leyland, a subsidiary of British Leyland. When the principal firm stopped producing its van "Comet", Ashok Leyland had to find local suppliers of bodies, among others. It contacted Press Metal Corporation, which was doing cold-rolling in Bombay, and passed British Leyland's cold-rolling technology to this Indian firm. It also invited experts in raw material treatment from Japan, the source of supply, and sent some of the Indian subcontractor's staff to Britain for in-plant training. Some of Ashok Leyland's subcontractors have their own subcontractors

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[1] Anne O. Krueger: <u>The benefits and costs of import substitution in India: a micro-economic study</u> (Minneapolis, University of Minnesota Press, 1975), p. 56.

[2] ibid., p. 48. In Indian terminology, "domestic content" or "indigenous content" refers to the direct sources of parts and components but not to the origins of materials used at earlier stages of production. It therefore has little meaning in regard to the foreign exchange savings.

[3] ibid., p. 55.

and provide them with technical guidance and assistance similar to those received from their parent firm.[1]

However, transfer of such "core production technology" from parent firms and relay of received knowledge down to other subcontractors appear to be rather exceptional, largely because lack of inter-firm competition makes such efforts unnecessary.

The "reserve list" reduces the bargaining power of the assemblers because they cannot threaten to make a component themselves.[2] Competition among parts makers themselves is also restricted by the Government's licensing system, both entry of new competitors and expansion of existing ones being subject to control. Moreover, the use of import quotas rules out the possibility of competition from abroad.[3] All these effects of governmental interventions add up to the creation of a seller's market[4] and little incentive seems to exist to stimulate

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[1] Subramanian, op. cit.

[2] Krueger, op. cit., p. 56.

[3] Jagdish N. Bhagwati and Padma Desai: <u>India, planning for industrialisation - industrialisation and trade policies since 1951</u> (London, New York and Bombay, Oxford University Press, 1970), p. 273.

[4] "The pending orders for scooters in mid-1971 were in the region of 370,000; increased production during the year barely touched the fringes of the outstanding demand ... Bajaj Auto have applied for permission to raise its capacity from 24,000 to 100,000 and the APO from 24,000 to 60,000. However the Monopolies Commission pruned the capacity target in both cases to 48,000 scooters each" (Association of Indian Automobile Manufacturers: 12th annual report, 1971 (Bombay), p. 4). In passenger car manufacturing, it is said that customers have to wait a couple of years between the placement of their orders and delivery.

efforts to reduce the costs of production and improve the quality of products.[1]

The linkages between the formal and informal sector enterprises seem to be marginal. Although there are innumerable small "one-man" and family enterprises which produce small parts and components, they work for the replacement market and only occasionally supply to the assemblers.[2]

In Mexico, a programme for localisation of automobile industry started with the decrees of 1962 and 1963. With the usual obligations and privileges placed on the nine approved assemblers, the local content rose from about 20 per cent of the direct production cost in 1960 to 45 per cent in 1965 and 63 per cent in 1972. In order to stimulate the industry's localisation further, the decree was amended in 1969. Each assembler who had attained the local content ratio of 60 per cent was given a certain production quota. This quota was to be reduced by 10 per cent per annum after 1970, resulting in zero in 1980. In order to continue his operation in Mexico, each assembler had to earn a production quota by increasing the local content or a CKD import quota by increasing exports.[3] In

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[1] Baranson, op. cit., p. 22.

[2] Krueger, op. cit., p. 65.

[3] Wionczek, Bueno and Navarrete, op. cit., Ch. III.

1977 a new decree revised the target rate of localisation to 75 per cent in 1981 in the case of passenger cars.[1]

By 1977 some 450 parts manufacturers had developed. About 250 of them were original parts makers, the rest being engaged in replacement parts production. Some 160 had been receiving technical assistance from abroad. Among the original parts makers, however, firms with fewer than 50 workers were rare.[2]

Like their Indian counterparts, Mexican parts makers enjoy a quasi-monopoly position. Import of parts and components, expansion of existing firms, and entry of new ones are subject to governmental control. Competition among the assemblers is limited by production quotas, which are used to reserve a large part of the market for companies with a majority of Mexican ownership.[3] Thus, the f.o.b. prices of passenger cars were from 32 to 85 per cent higher than those in the country of origin (most of the assemblers in Mexico are multinationals) in 1971, and, in the case of certain parts,

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[1] Secretaría de Hacienda y Crédito Público: Decreto por el que se establece las cuotas de los derechos por servicios que presta la Secretaría de Hacienda y Crédito Público en materia de Registro Federal de Automóviles, June 1977.

[2] Information obtained in Mexico during my visit in December 1977. A report quotes 557 as the number of parts makers in 1975, 280 of them being specialised in this line of business (Nihon Bōeki Shinkō-kai (JETRO): Mekishiko Kōgyō Ritchi Misshon Hōkokusho, Jidōsha Buhin Sangyō o Chūshin ni shite (A report of a mission to study the industrial location in Mexico (the auto-parts manufacturing) (Tokyo, 1976), p. 8.

[3] Timothy King: Mexico, industrialisation and trade policies since 1940 (London, New York and Toronto, Oxford University Press, 1970), pp. 78-79 and 107.

price differentials were as much as 200 to 300 per cent,[1] the industry enjoying the highest effective protection rate in the Mexican economy.[2] The 1977 decree abolished both production quota and price control in regard to the assemblers. The effects of these changes are still to be seen.

In the Philippines, where the Government introduced its "Progressive Car Manufacturing Programme (PCMP)" in January 1973, the number of local components suppliers rose from 80 to 220 by 1975. This was largely a result of diversification and enlargement of operation by firms that had existed in the same or related trades, mostly textile and rubber product manufacturing. More skill- or technology-intensive items are either imported or produced by the assemblers themselves: the local standard of equipment and skills is too poor to meet the assemblers' requirements pertaining to price and quality. This is particularly so in regard to smaller firms. On the other hand, many small local firms prefer to work for the repair market, where prices and tolerance regarding quality are much higher. Even so, the increase in subcontracting was accompanied with a considerable rise in car prices, which was largely due to the increased import duties: higher costs of local production caused by the increased local content were translated into higher prices of cars, under the shelter of

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[1] Wionczek, Bueno and Navarrete, op. cit., p. 99.

[2] Gerardo Bueno, "La estructura de la protección efectiva en México", in Economía y Demografía, Dec. 1972.

increased import duties,[1] as has been the case in most of the developing countries.

All these scattered pieces of evidence leave us with an impression that apart from some exceptional cases, transfer of technology and skills from the parent firms to petty enterprises does not go very far: the subcontracting system still remains "shallow". Even where work is given to informal sector firms, lack of competition keeps efforts for cost reduction and quality improvement not a matter of life or death to the enterprises.

The shallowness of the subcontracting system in developing countries is illustrated in table IV, where the percentages of subcontractors in various size groups in Korean manufacturing are compared with similar percentages in Japanese manufacturing. Although linkages between the large and the smallest firms seem to be more widespread in Korea than in other developing countries, the proportion of subcontractors in the smallest size group is almost one-fourth of that in Japan, and it rises steadily with the size of establishment while in Japan it remains almost constant. The Korean figures are related to establishments and the Japanese to enterprises, but this does not seem to make a great difference, particularly in the smallest size groups where multi-establishment firms are rare.

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[1] Watanabe, "International subcontracting: a tool of technology transfer", op. cit., Annex I. For a fuller study on the PCMP, see his forthcoming WEP working paper on the subject.

Table IV: Importance of subcontractors in South Korean manufacturing (1967) and Japanese manufacturing (1966)

Size of enterprise (no. of workers)	South Korea		Japan	
	Total no. of establishments	% of sub-contractors	Total no. of enterprises	% of sub-contractors
All manufacturing[1]	23 344	18.6	565 581	53.6
1-3	.	.	214 879	52.3
4-9	.	.	194 112	53.7
5-9	13 927	14.9	.	.
10-19	6 758	22.8	80 219	54.8
20-29			27 415	54.5
30-49	1 261	24.7	21 839	55.6
50-99	924	28.4	15 449	50.9
100-199	474	31.0	6 643	56.6
200-299	.	.	1 852	55.5

Sources: Information provided by the Medium Industry Bank, Seoul; and Medium and Small-Scale Enterprise Agency: Dai Sankai Chū-shō Kigyō Sōgō Kihon Chōsa Hōkoky-sho, op. cit., quick report. The table was reproduced from Watanabe, "International subcontracting ...", op. cit., p. 429.

[1] Establishments with 5-199 workers only as regards Korea. The Japanese total includes enterprises with 300 workers or more.

Note: The Korean figures concerned with "establishments" and the Japanese with "enterprises".

Table V: Subcontractors' productivity increase by factor - Korea (1976)

Cause of productivity increase	% of total respondents who reported productivity increase
Capacity effect:	
(a) increased sales	29.2
(b) regular flow of orders	22.2
(c) more favourable supply of raw materials	1.4
Technology effect:	
(d) innovations in production processes	11.1
(e) improvements in quality of products	10.4
(f) better training of workers	4.9
(g) decrease in production cost	3.5
(h) replacement of obsolete facilities	2.8
Production effect:	
(i) introduction of new products	14.5
Total	100.0

Source: Korea Productivity Centre, "Country report, Korea", in the APO: International subcontracting: a tool of technology transfer, op. cit., It is important, however, to note that, where subcontracting does take place, it can improve the productivity of small enterprises even without substantial technology transfer. In a survey on international subcontracting conducted by the Asian Productivity Organisation, all the Korean subcontractors who replied to the questionnaire reported that their productivity had increased after becoming a subcontractor. Increased work and a more regular flow of orders were the most common explanations for the improvement (table V).

On the "Chinese approach"

Before we move to the next subject, we may discuss the situation in China briefly.

Our earlier discussion suggests that, in China, efforts have been made to maintain and increase technological linkages among different size groups of factories at different administrative levels, with a view to helping small rural factories to start their operation and improve their performance. Their approach to this end (e.g. intersectoral transfer of skilled personnel and used machinery, exchange of advisors, development of suitable equipment for those factories, etc.) resembles the Japanese especially in earlier years. As regards the subcontracting arrangement, however, the Chinese picture is quite different from the Japanese, large and small enterprises in China catering to mutually independent segregated markets of their own. This difference seems to be explained partly by the difference in the stage of economic development and partly by "historical accidents".

The rationale of the well-publicised "Chinese approach" - the development strategy based on labour-intensive rural small industries - is related to the underdevelopment of transport facilities, the shortage of raw materials, and the seasonality of labour supply: the approach is a device to overcome these obstacles.

Small and petty rural factories (i.e. "handicraft industries" in the Chinese terminology[1]) mushroomed in order to equip farmers with simple agricultural instrument that was desperately short in supply after the end of the War (October 1949). During the Great Leap Forward Movement (late 1957-mid-1960), the construction of irrigation systems and activities induced by it (e.g. afforestation) gave rise to a huge demand for agricultural and construction tools and equipment, fertilizers and insecticides, all over the country. This, in turn, boosted the demand for machinery, transport, iron and steel, electricity, etc., by backward linkages. Due to the underdevelopment of transport facilities and shortage of raw materials, however, each locality had to meet such demand by establishing small factories which used simple (traditional) techniques and local materials.[2] Need of repair work and processing of local agricultural products added to this. By

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[1] "Handicraft industries" in China are those factories which employ fewer than 30 workers and no power, or fewer than 15 with power (Rei-itsu Kojima: Chûgoku no Keizai to Gijutsu (Technology in the Chinese economy) (Tokyo, Keisô Shobô, 1975), p. 236).

[2] Carl Riskin, "Local industry and choice of techniques in planning of industrial development in Mainland China", in United Nations: Planning for advanced skills and technologies, Industrial Planning and Programming Series No. 3 (New York, 1969), pp. 171-180; Sigurdson, "Rural industry and the internal transfer of technology", op. cit., p. 206; Kojima, op. cit., pp. 85-96 and 105-144.

the end of May 1958, over half a million rural small factories had been built.[1] Although the Great Leap Forward Movement was destined to fail partly as a result of diverting too much labour away from agriculture,[2] the basic philosophy seems to have survived.[3] And, these rural factories have been receiving all kinds of assistance from larger factories in urban areas, as we already discussed.

Examples of industrial subcontracting are not lacking. Sigurdson mentions about such arrangements in automobile industry,[4] but the extent of such practice seems very limited. In contrast to the Japanese picture where exports of light industries have been produced by tens of thousands of petty subcontractors, exports like thermos flasks, fountain pens, bicycles, radios, clocks, etc. are manufactured by large integrated enterprises in China: in the case of bicycles, there are factories with an annual capacity of half a million units in Kuang-chou, Shang-hai and T'ien-ching.[5] What seems to be very common in China is a "co-operative or co-ordination network" whereby many medium and small factories work together

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[1] ibid., p. 130.

[2] ibid., p. 165.

[3] A large number of those small rural industrial units were closed down in 1961, and a new proliferation started in 1969-71. The number of such units seems to have recovered the 1958 level. Increasingly, however, use of more machinery has been suggested in order to increase productivity of labour (Sigurdson: Rural industrialisation in China, op. cit., pp. 3 and 12-13).

[4] Sigurdson, "Rural industry and internal transfer of technology", op. cit., pp. 219-222.

[5] Kojima, op. cit., p. 181.

to produce a product (e.g. truck, tractor, diesel engine or high-capacity generating unit).[1] This system resembles the "countryside industry" programme of the Kuré Navy Arsenal in pre-war Japan (pp. 36-37 above), not only in its organisation but also in its objectives.[2]

Constraints on development of subcontracting-based linkages

(a) Structural factor

A large number of developing countries are still at a stage of industrialisation which is equivalent to that of the Japanese economy during the Meiji or even earlier period. Assembly industries still do not exist, or they are just starting. In other words, small and petty enterprises are engaged almost exclusively in foods, garment, footwear and furniture manufacturing[3] where opportunities for industrial subcontracting do not exist. As they cater mostly to a tiny local market, moreover, chance seems very scanty for them to work under a merchant-parent firm, too.

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[1] Sigurdson: Rural industrialisation in China, op. cit., pp. 123-127.

[2] For example, one of the objectives of the "co-ordination network" seems to be "to achieve a geographical dispersal of industrial activity to make the country less vulnerable in case the main urban centres were to be attacked by an enemy" (ibid., p. 127).

[3] Souza and Tokman, "The informal urban sector in Latin America", op. cit., p. 360; and Weeks, op. cit., p. 9.

Where the economy has reached a more advanced stage of development (e.g. Argentina, Brazil, India, Mexico, the Philippines, ...), intersectoral linkages are limited, because small and petty enterprises work for a market different from larger firms: e.g. repair and replacement market instead of original-parts market, for the following reasons.

(b) Lack of industrial skills and experience

Baranson regards the following as "important reasons why India has not been able to develop a subcontracting sector in any way comparable to Japan's":[1]

- shortage of the experienced engineering and technical skills necessary to adapt techniques to local equipment and materials;

- shortage of much lower machine skills and factory discipline, including machine operators' abilities to read blueprints, set up tools and, in other ways, substitute human skill for machine accuracy;

- lack of an industrial organisation that permits the effective use of small-scale shops as adjuncts to modern industrial complexes, or lack of the experienced and industrially disciplined small-scale industrial sector

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[1] Jack Baranson: Manufacturing problems in India: the Cummins Diesel experience (New York, Syracuse University Press, 1967), pp. 68-69.

which can adjust and co-ordinate its activities to those of the large industrial complexes.

These are all related to the shortage of skilled and experienced industrial manpower in both larger and particularly small enterprises. Underlying this problem is the inadequate level of education. Poor quality and consequent low productivity of labour keep the labour cost of production in the informal sector high, in spite of the low wage rates,[1] and lack of basic education impedes transfer of technology and skills from the formal sector by limiting the absorption capacity.[2]

(c) Small market and low growth rate

Baranson also mentions:

- the limited size of domestic markets[3] and the lower growth rates.

As we already noted, however, the relationship is not one-sided. Otherwise, one could not explain, for example, how the Japanese automobile industry has managed to develop so fast, depending so heavily on the subcontracting system: in the

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[1] See, for example, Bergsman, op. cit., p. 161.

[2] In the APO survey, this was the problem that was most frequently mentioned by parent firms who had been trying to improve their local subcontractors in developing countries (see Watanabe, "International subcontracting: a tool of technology transfer, main report", op. cit., p. 49).

[3] See also Eugene Staley and Richard Morse: Modern small industry for developing countries (New York, London, Sydney and Toronto, McGraw-Hill Book Company, 1965), p. 262.

early 1950s, this industry was producing only 0.03 million units a year, against 8.1 million units in the United States and 0.1 million units in Italy, the smallest of the major automobile manufacturing countries in those days.[1]

The major constraint to the development of intersectoral linkages, then, is not so much the small size of the existing market as the slow rate of growth, which is often a result of governmental interventions (e.g. restrictions on production and investment). The negative impact of such interventions seems particularly serious, where enterprises have a legacy of integrated plants.[2]

(d) Lack of competition

Rapid growth of Japanese industries in the post-war period has been accomplished partly by reduction in the prices of their products, as we illustrated in reference to the automobile industry. Need of such price-cutting induces larger firms to take advantage of cheap labour in the informal sector and, at the same time, to make it employable by technical guidance and assistance. In most of the current developing countries, prolonged application of protective trade policy and restrictions on production and investment have resulted in an

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[1] Toyota Automobile Manufacturing Company: Toyota Jidôsha 30-nen-shi (30-year history of Toyota Automobile Manufacturing Co.) (Toyota, 1967), p. 315.

[2] Cf. Watanabe "Reflections ...", op. cit., pp. 414-418. We discussed earlier how linkages between the Kuré Navy Arsenal and small producers in countryside were developed in Japan by forcing the latter to abandon their habit of doing everything at a place. Similar problems appear to be common in developing countries (cf. Staley and Morse, op. cit., pp. 263-264).

unthreatened sellers' market, where a cost-plus pricing method prevails. Hence, there is little reason why larger firms should bother about technology transfer to smaller enterprises.

(e) Some ideological factors

The point raised in the previous paragraph makes it necessary to touch on the frequently expressed view that subcontracting is a means of exploitation of smaller producers and their employees by larger firms.

The appropriateness of this view is open to question. Nobody would object that subcontracting based on the wage differentials is something undesirable, but, well-regulated, it can be the quickest way to reduce economic dualism. The Japanese experience testifies this. In 1954, 20 to 24-year old employees of manufacturing enterprises with 10 to 29 workers were receiving only 70.1 per cent of the wages the same age group received in enterprises with 1,000 workers or more, excluding biannual bonuses and other fringe benefits that enlarged the differential further. In the size group below this level the situation was even worse. By 1964, however, surplus labour had disappeared and the first group of workers was earning 1.5 per cent more regular wages than the latter,[1] although the balance was reversed if bonuses and fringe benefits were included. Meantime, petty enterprises were transformed from a reservoir of surplus labour into a source of

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[1] Ministry of Labour: Rōdō Tōkei Yōran (Summary of Labour Statistics), 1966, p. 120.

high income which is preferred to employment in larger enterprises by would-be entrepreneurs,[1] and the percentage of parts makers who used subcontractors and sub-subcontractors for the purpose of taking advantage of wage differentials fell, according to one study, from 25.0 per cent in 1961 to 9.5 per cent in 1967.[2]

Another ideological question is concerned with the "tied" subcontracting relationship. Being labelled as "captive" or "feudal", such relationship with the parent firm is widely believed to make a subcontractor's position more unstable in recessions and more vulnerable to abuses by the parent firm then untied subcontractors. According to the Comprehensive Survey quoted in table III, however, 48.9 per cent of the untied subcontractors wanted to be "tied", while only 22.6 per cent of the "tied" subcontractors wanted to become "untied". This seems to indicate that the above-mentioned view is a myth. It is true that many petty subcontractors lose work during the recessions because this is the easiest way for their parent firms to adapt to the market situation. It is also true, as we saw in section II, that those subcontractors have to cope with their parent firms' demand for price cuts. However, are those "tied" subcontractors worse off than other petty producers? The Japanese petty entrepreneurs' propensity towards a "tied" position seems to indicate that, according to their experience,

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[1] Watanabe, "Entrepreneurship ...", op. cit., pp. 548-550.

[2] Chû-shô Kigyô Kenkyû Centre: Jidôsha Buhin Kôgyô no Genjô to Mondai-ten (The present situation and problems in auto-parts manufacturing), The Centre's Research Report Series No. 6 (Tokyo, 1968), p. 12.

the "tied" subcontractor's position is, by and large, preferable, particularly as subcontractors are protected from abuse by the parent firm legally (e.g. the Anti-Monopoly Law of 1947 and the Payment of Subcontractors (Prevention of Delay) Law of 1956).

The Japanese small enterprise's inclination towards a "tied" position seems to have much to do with the increasing care they can expect from their parent firms as their dependency rises (table VI). The relationship runs, of course, in two ways. Parent firms take better care of relatively competent and necessary subcontractors and rely on them for supply of parts. The subcontractors, in return, make efforts to satisfy their parent firms with their service in order to secure such care and protection.[1] Obviously, the traditional Japanese ethics of paternalism and "Giri" (or sense of personal obligation)[2] plays an essential role here.[3]

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[1] In this connection it is important to remember that the relationship between the parent firms and their subcontractors in Japan is usually continuous, although it is not established as such by law or by contract and can be interrupted during a depression. In contrast, a contract is usually concluded by tender in European and American subcontracting and this seems to be the case also in developing countries, e.g. in India (except the "ancillary units" in a special industrial estate attached to the parent firm).

[2] Cf. Ruth Benedict: The chrysanthemum and the sword (Boston, Houghton, Mifflin Company, 1946), Ch. 7.

[3] The great relevance of socio-cultural elements to the efficiency of a subcontracting system will become clear if one compares this picture from Japan with the following report from India. Enfield (India) selected occupants of its ancillary industrial estate from among friends and provided all technical help. There was a 100 per cent tie-up between the two parties but the wage differentials between the two were also considerable. Knowing their monopoly position, the ancillary workers resorted to strikes and Enfield had to look for

(Footnote continued on next page)

Table VI

Guidance and assistance from parent firms received by Japanese subcontractors by type of assistance and degree of dependency[1]
(1975)

Type of assistance provided	Degree of dependency				
	Below 30%	30 to 50%	50 to 75%	Over 75%	All sub-contractors
Technical guidance	33.5	50.5	58.4	68.2	53.9
Managerial guidance	9.6	18.5	26.8	32.6	22.9
Provision of machinery	15.8	23.7	27.1	43.4	29.1
Financial assistance	7.1	12.3	16.0	22.8	15.0

[1] Degree of dependency is expressed in terms of the parent firm's share in the subcontractor's total sales.

Source: The Medium and Small-scale Enterprise Agency: Chû-shô Kigyô Hakusho (White Paper on Medium and Small-scale Enterprises), 1976, p. 144, based on the Agency's survey in Nov. 1975.

Note: 1,700 subcontractors replied to the questionnaire.

Although such difference in the socio-cultural background is undoubtedly an important factor which policymakers cannot neglect, the scepticism about the "tied" relationship in developing countries seems to result largely from the slow rate of industrial growth which makes individual parent firms reluctant to commit themselves vis-à-vis their subcontractors for provision of a sufficient and constant flow of orders, and partly from the lack of competition among subcontractors which makes them appreciate support from the parent firm much less than otherwise. No matter what the direct explanation for their behaviour may be, fear of subcontractors' shift to another parent firm is one of the largest disincentives for the parent firm's technical assistance.[1]

2. Diffusion mechanism within the informal sector

(a) Training at home

As traditional textile industries in Japan depended on the girls trained "at their mothers' knees" in early years of industrialisation, informal training at home may be considered to be a major mode of technology diffusion in many developing countries today. But it involves an important problem: "the

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(Footnote continued from previous page)

alternative suppliers (S.K. Subramanian: "Field survey on ancillary development in India", in the APO: Intra-national transfer of technology, op. cit., pp. 72-73).

[1] Watanabe, "Reflections ...," op. cit., pp. 417-418, and "International subcontracting, a tool of technology transfer", op. cit.

native technology, being passed on from father to son, lacks a theoretical "body of knowledge" and it is therefore of a static nature.[1] The scope of progress is thus very narrowly limited.

(b) <u>Apprenticeship</u>

As already mentioned, apprenticeship is the main machinery of diffusion of technology and skills in the informal sector in Africa.[2] We already discussed this subject in regard to Ghana. In Nigeria, apprentices and "learners" comprise well over half the labour force of the indigenous enterprise sector and the apprentice system imparts modest artisan skills "on a vast scale".[3]

In Dakar, some 70 per cent of the surveyed petty producers had acquired their skills as apprentices to artisans, small producers, or small self-employed subcontractors.[4] In Kenya,[5] as well as in Ghana,[6] fee-paying apprenticeship plays an important role, not only for training but also for raising capital for the masters' enterprises.

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[1] Keshab P. Sharma, "Country paper" of Nepal presented at the APO Symposium on Technology Transfer, 6-10 February 1978, New Delhi, p. 1.

[2] For a comparative discussion on the apprenticeship system in different parts of Africa, see Kenneth King: <u>The African artisan: education and the informal sector in Kenya</u> (Heinemann (London, Nairobi, Ibadan, Lusaka) and Teachers College Press (New York), 1977), Ch. 2.

[3] Peter Kilby: <u>Industrialisation in an open economy: Nigeria 1945-66</u> (Cambridge University Press, 1969), p. 246.

[4] Gerry, op. cit., pp. 40-41.

[5] Kenneth J. King: "Skill acquisition in the informal sector of the economy", in David Court and Dharam Ghai (ed.): <u>Education, society and development: new perspectives from Kenya</u> (Nairobi, Oxford University Press, 1974), pp. 297-300.

[6] Hakam, op. cit., pp. III and 29.

Apprenticeship seems to be a major training system in the informal sector in other parts of the world, too. In Jamaica, for example, in small enterprises and particularly those in the informal sector, workers learn the "skills, patterns and habits of work" by observation, while helping and imitating skilled operators.[1]

A universal problem is too little inflow of masters from the formal sector. Their level of education being extremely low, ex-apprentice masters can hardly learn anything new from reading or other informal instruction. Thus, apprentices never learn from their masters more than practical manual operations, which are carried out with inappropriate obsolete tools. They are consequently conditioned to stick to the old ways and lack adaptability,[2] so much so that ex-apprentices at auto-repair shops cannot repair new models of cars.[3]

It is thus argued that: "These informal training arrangements have the disadvantage of perpetuating defective and obsolete methods of work. The prospects of transition to formal status are inhibited by lack of standard performance conferred by variable, and sometimes obsolete methods of work; the present system of skill transfer is clearly in need of reform. Like his operatives, the small owner/proprietor may also lack systematic training in technical skills, persons with

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[1] NPA/PREALC, "The informal sector in metropolitan Kingston: a policy framework" (an ILO internal document), 1976, p. 57.

[2] Kilby, op. cit., p. 246.

[3] Hakam, op. cit., p. VIII.

a sound technical education preferring employee status in the formal sector. Owner/proprietors with an artisan background may lack the education necessary for 'self-study' and other informal instruction."[1]

The current apprenticeship system in developing countries seems to require two sorts of reforms: the increase in the inflow of properly trained masters on the one hand, and the remuneration for apprentices.

As regards the last point, it was found in Ghana that most of apprentices receive an allowance of 0.20 cedis per week,[2] while the statutory minimum wage is 0.75 cedis per day and the minimum wage guaranteed to the public sector employees and recommended to the private sector by the Government is 2.0 cedis per day. As they pay substantial amounts of fees to the master, they cannot be considered as "employed" although they must contribute to their masters' business operation. In a way, then, their labour is free goods for their masters. Under such conditions, it is natural for the latter not to be concerned with their training seriously. This may also be an explanation for the fact that employers tend to have more apprentices per skilled worker (i.e. journeyman) than the law requires in certain countries.[3]

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[1] NPA/PREALC, op. cit., p. 57.

[2] Aryee, op. cit., p. 28.

[3] Joshi, Lubell and Mouly, op. cit., p. 59.

(c) Co-operative associations

In the Far East, various kinds of informal and/or institutionalised machinery exist for diffusion of technology and skills among petty enterprises and homeworkers. First, interested people get together informally at private houses to learn bits of skills from experienced people and exchange information. If the group becomes larger, trade associations are organised in individual villages and towns. Local chambers of commerce and industry will organise similar gatherings, if necessary, inviting lecturers and demonstrators from elsewhere. This has been the way in which many localities started various industrial activities, particularly those related to textiles and clothing, as illustrated by the case of the knitwear industry of Onta City in Japan, and the Shibori (silk material for Kimono) in Korea.

The knitwear industry in Ohta[1] was started just after the Second World War by 20 people who had lost their jobs at the Nakajima Aircraft Manufacturing Company, together with people who had had some experience in the textile industry before the war. Woollen materials were procured from former associates of Nakajima, and the local Chamber of Commerce and Industry and the city's authorities organised a crash training course. All the family members worked. As textile fabrics were in short supply, Ohta became at one time the largest producer of hand-twisted wool. When this material became out of fashion, the

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[1] "Ohta Chihô no Meriyasu Kôgyô" (Knitting industry in Ohta District), in Geppô (Monthly Bulletin) of Kokumin Kinyû Kôko (People's Finance Corporation) (Tokyo), Jan. 1958, pp. 18-19.

technique of sweater knitwear was acquired similarly. Products were distributed by pedlary all over the country. Some of the pedlars who accumulated capital soon bought knitting machines, investing some 4,000 yen ($11) per machine. In August 1949, 14 people established an Ohta Association of Knitting Industry, which could get the Government's support. By 1951 the number of members rose to 94 and there were over 100 knitting machines.

Around 1953, some people took a fancy to ladies' knitwear. The major difficulty was related to designing. They organised study meetings with support from the Association, the local Chamber of Commerce and Industry, etc. In August 1953, they succeeded in holding their first fair in Tokyo, which opened their connection with trading companies in Tokyo. After this they could operate on a longer-term plan, with mass production methods, relying on the trading companies for marketing. By the end of 1956 membership of the Association had increased to 110. There were 330 establishments with 3,368 machines which enjoyed a total sales of over 1,600 million yen and employed about 5,000 or about 10 per cent of the total population of the city. The trading companies provided the producers with designing services, advice and guidance concerning fashion changes, information about the sources of supply of raw materials, etc.[1]

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[1] For a similar tale of co-operation of merchants, scholars, trade associations and research and development institutes for technological development and evolution of a local industry, see Keinosuké Ono, "Field survey on inter-firm technology transfer: flatware industry in Tsubamé City, Japan", in the APO: Intra-national transfer of technology, op. cit.

A similar method has been used to train and upgrade the standards of people in the informal sector in Korea. A typical example is shibori processing. Orders for processing this silk material for kimono are received from Japan by some two dozen Korean "window companies": usually only the most labour-intensive part of the work - tying dots on the silk fabric (100,000 dots on the material for one kimono of the best quality), and recently also some dyeing. The industry was originally transplanted from Japan in the first half of the 1920s as a source of secondary income by a number of Koreans who had acquired the skill in Kyoto. Later it received various kinds of encouragement (e.g. subsidies) from the Japanese Administration.[1] After the war, the "bonded processing" of shibori for Kyoto and other centres in Japan was resumed in 1962. Those who had had experience in earlier years helped spread the necessary skill by showing their neighbours, how to do the work, in a living room, or at a short crash training course which agents of the "window companies" organised in local assembly halls or elsewhere in individual villages. In 1970, shibori exports amounted to $34 million. The equivalent of about 37,000 full-time workers are estimated to have been required to produce this amount. In fact, however, the work was undertaken by approximately 150,000 people, mostly farmers'

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[1] Kyôto Shibori Kôgyô Kyôdô Kumiai (Kyoto Shibori Manufacturers Co-operative Association): Kyôto no Kanoko: Bi to Dentô (Kyoto Shibori, its charm and history) (Kyoto, 1975), pp. 225-227.

wives and daughters who worked at home on a seasonal and part-time basis.[1]

This is similar to the way in which the silk industry of the nineteenth century Japan developed. Industrialisation in the contemporary China seems to have been advancing in much the same way, too. The common element underlying all these countries' approach is the spirit of mutual help and willingness to share acquired knowledge and skills, although the direct motivation may be different between Korea and Japan on the one hand and China on the other.

Such attitudes of people in the Far East, however, seem to puzzle Western researchers. For example, in reference to the extremely fast diffusion of new technologies in the Japanese cotton industry during the Meiji Era (1868-1912), Saxonhouse argues that "what with the quantitatively oriented secretariat of Bōren, the sales engineers of Platt Brothers, and the spirit of technological co-operation that seemed to exist among competitive firms, the cost of acquiring technological information for any given Japanese spinning firms was extremely low by international standards" and wonders, in his conclusion, "why was there so much technical co-operation among firms in this industry?".[2] In other parts of the world, we are quite often told during our field surveys that one of the difficulties in transferring technology and skills to

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[1] Watanabe, "International subcontracting, employment and skill promotion", op. cit., pp. 433-434.

[2] Saxonhouse, "A tale of Japanese technological diffusion in the Meiji Period", op. cit., pp. 163 and 165.

current developing countries is that the individuals who have been trained would not transmit their experience and knowledge to fellow workers.

Where does this difference come from? As is often argued, racial and cultural homogeneity of the Far Eastern nations, as well as their Confucian tradition, will definitely result in a greater sense of fraternity and co-operation, particularly when they are competing with foreign rivals. Under the feudal system, Japanese peasants were organised into a group of five households to fulfil their taxational duty collectively. The guild system in Japan appears to have been much weaker than their European counterparts, partly as a result of intervention by the feudal authorities on a number of occasions, and it was abolished completely with the Meiji Restoration. The socio-cultural and historical backgrounds are completely different in other parts of the developing world. Moreover, the tradition of apprenticeship, particularly fee-paying one, may naturally tend to make monopoly of skills a valuable asset. The system of workers' craft union may have a similar effect.

Co-operative associations supported by the Government are fairly common in developing countries. How much they have been contributing to technological upgrading of informal sector enterprises is not clear, but there seems some ground for doubt.[1]

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[1] See Douglas Fisher, "A survey of the literature on small-sized industrial undertakings in India", in Bert F. Hoselitz (ed.), op. cit., pp. 139-140.

First, such associations seem to be utilised more easily by the relatively large of the small enterprises. In the case of the common-facility co-operatives (Jigyō Kyōdō Kumiai) in Japanese manufacturing,[1] for example, the membership has been the highest (over 50-60 per cent) in size groups with 20-99 workers, and the lowest in size group with one to three workers (slightly over 30 per cent), throughout 1957-66.[2] Such a tendency will naturally intensify as the literacy rate falls and the means of communication become poorer, as in most developing countries.

Second, it seems that those associations are used much less for technological progress by the smallest firms and under depressed or underdeveloped economic conditions than by the larger firms and in a more prosperous situation. In 1966 the most important purposes of such co-operative membership in Japan were financing, collective production and purchasing. In 1957 when the Japanese economy was still in the surplus labour phase and in a down swing of the trade cycle, the most important purposes of the membership was price and production control, marketing, purchase and financing. Only 8 per cent of the members (or 5,000 out of nearly 0.8 million enterprises) with one to three workers used co-operatives for the technological purpose (research and experiments).

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[1] There are several forms of co-operatives receiving financial and other aid from the Government in Japan. The common facility co-operatives are the most widespread. See Watanabe, "Entrepreneurship ...", op. cit., pp. 568-569.

[2] The Medium and Small-Scale Enterprise Agency: Chūshō Kigyō Sōgō Kihon Chōsa Hōkokusho, op. cit., for 1957, 1962 and 1966.

It appears therefore that the direct contribution of co-operatives to the technical progress among the smallest enterprises is only marginal, although their actual contribution must be somewhat greater as about twice as many smallest enterprises use co-operatives for the purpose of acquiring common production and quality control facilities as for research and testing.[1]

Comprehensive and systematic information to permit similar assessments is lacking in developing countries.

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[1] Shinohara notes that "despite the number of participants, the majority of these organisations are sometimes viewed as 'sleeping' associations", the major benefits enjoyed by the members being financial and taxational privileges (Shinohara, "A survey of Japanese literature on small industry", op. cit., p. 71).

IV. SUMMARY AND CONCLUSION

1. Summary

Experience in Japan and China suggests that transfer of skills and technologies from the formal (or large and medium) sector and their wide diffusion within the informal (or small and petty) sector are crucial to economic progress. In these countries, modern technology co-exists with traditional and intermediate technology, each supporting the other ("two legs") and the former helping improve the latter's standards. In most of today's developing countries, however, our findings tend to support Singer's view[1] that the existence of the modern formal sector firms does not do much to pull up the informal sector firms, or may even positively serve to pull it down.

Importance of the factor of time

Technological linkages between the two sectors arise in relation to the supply of tools and equipment, the movement of skilled workers, and subcontracting. There appears to be a certain inter-temporal sequence in the development of these three modes of linkages. Suppliers of tools, equipment and raw materials are almost the only media of technology transfer to the informal sector at the earliest stage of industrialisation, as is the case in many African countries. At this stage, merchant-parent firms in commercial subcontracting (e.g. the

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[1] H.W. Singer: The strategy of international development essays in the economics of backwardness (London, Macmillan, 1975), p. 68.

putting-out system) can play an important role as transmitters of new technologies and ideas, as well as marketing agents for informal sector producers.

As the stock of skilled workers in the formal sector increases at the second stage, their migration to the informal sector will start and their skills and experience will be spread through their learner-employees. Thus, the movement of skilled workers becomes an important mode of technology transfer to the informal sector. At the third and last stage of industrialisation, when assembly industries develop and when a fair amount of industrial skills and experience has been accumulated even in the informal sector, technological linkages between the two sectors are further increased for and through industrial subcontracting.

The Japanese experience discussed in section II illustrates the importance of the factor of time. Lewis said that "once a capitalist sector has emerged, it is only a matter of time before it becomes sizable", but it was a matter of almost a century even in Japan, where importation of Western technologies started after a much more advanced preparation than in most of today's developing countries, and where the rate of industrialisation was <u>forced</u> to rise to an abnormally high level for the purpose of armament.

<u>Pattern and extent of demand, a crucial factor</u>

The factor of time is important, largely because it has much to do with changes in the pattern and extent of demand.

Increasing attention has been paid recently to the relevance of the pattern of demand, or consumers' taste, to the choice of techniques.[1] Appropriateness of such attitude is amply testified in various parts of our discussion on the Japanese experience. Experience in Japan, and China, also suggests that a rapid expansion of demand for goods and services is a basic condition of technological progress and inter-sectoral linkage development. This is, of course, specially true in regard to subcontracting and related technological linkages: "The division of labour is limited by the extent of the market".

Supply of appropriate technology, as well as improvement in the infrastructure (e.g. communication system and electrification), is important. Developing countries, however, can and do rely on external sources for the supply of basic technology. This is not the case with the market for their products: until attractive goods can be offered, other countries can help very little. A market must be created and expanded with own efforts. Once a market is there, search for appropriate techniques will gain enthusiasm and technological adaptations will follow one after another, as a matter of necessity, to overcome factor supply constraints and to survive competition. Adaptations to traditional and imported techniques in Japan, and also in China as it appears, have been made in this way, a typical example being the introduction of twilling and twisting techniques in reeling, while the delay in

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[1] See Felix, op. cit.: Paul Streeten: The frontiers of development studies (London, Macmillan, 1972), especially Ch. 22 ("Technology gaps between rich and poor countries"); Frances Stewart, "Technology and employment in LDCs", in World Development, Mar. 1974, pp. 21 ff.

adoption of Minorikawa's machine testifies that improved technology can have no real impact until a suitable market develops.

Although the required rate of economic growth may differ according to the pattern of economy and the stage of development, there seems to lie much truth in a view that economic dualism could be solved in a process of rapid economic growth, and that therefore the immediate policy objective of a programme aiming at full employment should be the maintenance of a high growth rate over a sufficiently long period,[1] although this may sometimes cause violent business fluctuations and temporary hardship to petty producers.

Expansion of demand can originate either in the formal sector or in the informal sector. Where the economy is more or less unified on a national scale thanks to a well developed transport and communication system, increased demand for formal sector products can more easily be shared by informal sector firms while, otherwise, expansion of demand will have to originate within the informal sector to a greater extent. The "Japanese model" characterised by co-operation among different sizes of firms based on a functional division of labour and specialisation is an example of the first case, and the

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[1] Saburō Okita: "Choice of techniques", in United Nations: Industrialisation and Productivity (New York), Bulletin No. 4, Apr. 1961, p. 26.

"Chinese model" based on the geographical division of labour is that of the second.[1]

In either case, expansion of agricultural activities and income has been an important stimulant of demand for industrial products. That this is true in China is clear directly from our discussion (pp. 85-86 above). The expansion of demand for durable consumers' goods in post-war Japan (p. 49 above) was due, to an important degree, to the rising income level in the agricultural sector, which resulted from one of the most thoroughgoing land reforms in the world,[2] the Government's agricultural (specially rice) price policy and the cheap and abundant supply of fertilizers.[3] In this connection, we may note that Korea's success in industrialisation has also been accompanied by efforts for agricultural development: her national average output of paddy rice rose from 4.11 tons per hectare in 1961-65 to 5.97 tons in 1976, which was the world's highest.[4]

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[1] In this connection, the development of small agricultural instrument manufacturing enterprises induced by the Green Revolution in the Pakistan Punjab is interesting. See Frank C. Child and Hiromitsu Kaneda, op. cit.

[2] Cf. H.E. Voelkner, P.B. Morrow, K.H. Sherper and A.Y.C. Koo: Land Reform in Japan, South Korea, Taiwan (Washington D.C., USAID, 1970).

[3] On this subject see Shigeru Ishikawa: Economic development in Asian perspective (Tokyo, Kinokuniya Bookstore, 1967).

[4] FAO: Production Yearbook 1976 (Rome).

Importance of institutional factors

Our findings also indicate the importance of institutional factors in the spread of inter-sectoral and inter-firm co-operation. Some of them are too deep-rooted in the society (e.g. the Confucian philosophy) to be transplanted to other parts of the world. Some others can be easily transplanted if a strong leadership exists, but may not always be desirable or acceptable (e.g. the spread of sense of national crisis vis-à-vis foreign rivals). Still, there seem to be many elements that are relevant to other countries.

Development planners' attitude towards dualism itself is a case in point. In the Far East, dualism has been taken as an unescapable reality, and "cheap labour" has been used, as a second-best strategy, for filling the gap between the two sectors as quickly as possible. Policy makers in other parts of the world, however, would not admit, at least explicitly, that this might be the only way to reduce dualism quickly, and they are preoccupied with a high standard of immediate welfare of those who are employed, even when they formulate their policy proposals in the light of experience in the Far East. Is it really possible to imitate the Far Eastern approach while denying the underlying socio-ideological elements? To say the least, under the current conditions of most of the developing countries, it might be a bit too optimistic if one expected larger firms to be enthusiastic about using and looking after petty subcontractors, while demanding them to treat such subcontractors as "equally" or "democratically" as in highly industrialised countries.

Causes of limited extent of linkages in developing countries

The linkage through the supply of equipment is limited in developing countries, either because of underdevelopment of local industry which can supply relatively simple equipment at low prices (e.g. in most of the countries in Africa), or because the lack of competition among machinery manufacturers takes the heat out of their sales efforts (in semi-industrialised countries). Governmental restrictions on import of such equipment and on investment and production in local industries have much to do with the situation in the second group of countries.

The limited amount of spontaneous movement of skilled workers from formal to informal sectors can be explained by the absolute shortage of skilled workers in the formal sector itself, and the consequent large earnings gap between the two sectors.

Underdevelopment and slow growth of assembly industries naturally limit the extent of technological linkages based on industrial subcontracting. Even in those countries where larger enterprises and particularly foreign firms have been forced to subcontract part of their work by governmental regulations, the subcontracting system has remained "shallow" and linkages have rarely extended into the informal sector.

Individual firm's choice between integrated operation and subcontracting. The latter will be influenced by (i) the planned growth rate of production compared with the available amount of capital, (ii) the availability of alternative sources of supply, (iii) the relative costs of production at the own plant and at the alternative sources of supply.

The extent of technology transfer from the parent firm depends on the gap between the subcontractors' technological standard and the required standard (in terms of cost of production, quality and delivery of the product). Given the product, the latter is largely determined by the intensity of inter-firm competition.

Foreign subsidiaries and large local firms both in the public and in the private sector seem to have more than enough capital to meet the stagnant or very slowly growing demand with their own equipment. Where they are forced to subcontract by the government, they have little need to increase the number of subcontractors beyond a certain limit. Due to lack of competition, cost reduction and quality improvement are not a matter of life or death to assemblers. Thus, they cannot be enthusiastic either about utilising petty enterprises' cheap labour, or about helping upgrade their technical standard. At the same time, social preoccupation about "equal" or "democratic" treatment of subcontractors sets an institutional barrier to the co-operation between the two sectors.

2. Policy implications

We have stressed earlier the importance of the factor of time. This implies that development planners need to have a sound sense of proportion in regard to the long-term and short-term objectives of their policies. At times, it will be necessary to sacrifice short-term welfare for long-term one (e.g. stability vs. long-term development). This will be possible, however, only where political stability is secured.

Development of different modes of linkages would deserve different amounts of emphasis in different countries. In those countries which are still at the earliest stages of industrialisation, accumulation of industrial skills and development of simple equipment manufacturing capacity would require the highest priority. State-run enterprises and multinationals could play a crucial role for these purposes. In this connection the current attitude against the multinationals in some countries might deserve a re-examination.

In semi-industrialised countries where assembly industries have developed to some extent practice of industrial subcontracting could be encouraged to increase inter-sectoral linkages. In many countries, protective trade policy and restrictive industrial policy seem to require a serious review. It would be good, for example, to set certain time limits to protective measures and combine them with obligations to attain certain targets pertaining to efficiency.

In all these efforts, at every stage of development, expansion of demand is a key to technological development and spread of intersectoral linkages. Industrial competition is another. Waste of competition in the short run (e.g. failures of inefficient firms) could be more than compensated by long-term industrial health and development.

For countries at the earlier stages of industrialisation, many aspects of the "Chinese approach", which has much resemblance to the approach of the Japanese in earlier years of industrialisation, could provide important lessons, both to create demand and to develop inter-sectoral linkages. It would require, however, a strong leadership not only at the top of political hierarchy but also in each locality. Commitment to economic progress and hard work among the people in the informal sector is among other preconditions for its success. Physically, it might be better suited to a large country with a dense population, where segregated local markets of certain sizes exist.

In many countries, the prevailing attitude pertaining to the economic dualism may need some reconsideration. The size of this problem appears to be too large to solve it with just curative measures. The fastest and easist way to reduce it may be to take advantage of it for the time being as a means of capital accumulation.

Managerial innovations (e.g. introduction of scientific book-keeping and cost accounting techniques) can facilitate technological innovations and development of technological linkages, particularly in assembly industries. Experience also indicates that taxational incentives could stimulate petty entrepreneurs' enthusiasm for acquiring such techniques - where the taxation system of the country effectively covers their enterprises.

3. Some questions for future research

Factual information on the subject of our study is extremely limited in developing countries. On almost every issue we discussed in this paper we need to know much more. Efforts are required to collect information which permit generalisation at least within an industry of a country or significantly large district. For example, a fair amount has been written about individual firms' subcontracting and their technical assistance in certain countries, but there is no clue to answer how representative the studied companies are in the economy or industry concerned. Another type of information which is desperately needed is the one which provides us with a sense of proportion, order of importance or priority. For example, many authors discuss inadequate supply of raw materials and equipment in developing countries but very rarely make it clear what are the most important problems: is it the absolute amount of production or imports, prices, quality, distribution system, or any other factors, that are mainly responsible for the inadequacy in supply? For policy formation, it is imperative to know the order of importance of individual items.

With this as a general remark, the following are some of the points we could not discuss because of the lack of information, or those we would like especially to know more about.

(a) We have repeatedly emphasised that without industrial growth development of inter-sectoral linkages would be next to impossible. Development of cheap equipment supplying industries and accumulation of industrial manpower must be geared to that goal. Hence, identification of industries with the greatest growth potentials should be an important task for future researchers in individual countries. This may sound too obvious, but, alas, how commonly this obvious fact has been neglected everywhere!

(b) Although the important role played by merchants and equipment dealers as media of technology transfer to the informal sector has been mentioned sometimes, no systematic information exists to tell exactly how important their role is and what are the alternative medias. These questions, as well as the merits and demerits of each of the available media need some empirical studies. It would be also interesting to know about the impact of the oppression of expatriate (e.g. Chinese and Indian) merchants in certain countries in this connection.

(c) In Meiji Japan, and probably in contemporary China, carpenters have been important suppliers of "intermediate" equipment. To what extent do such local potentials exist and what prevent their active contribution, in today's developing countries?

(d) In both pre-war Japan and contemporary China, the state-run large factories and arsenals were (and are in China) important suppliers of skilled manpower, and developers of essential machinery and equipment for the private sector, including the informal sector. In today's developing countries, how much and how successfully do the public sector factories play a similar role?

(e) We have suggested earlier that cheap labour resulting from economic dualism should be put to active use for industrialisation rather than cover it up with a fig leaf. The case will become stronger if most of the workers in the informal sector are earning something additional to other own or household incomes. Keith Hart draws our attention to the fact that informal sector workers have quite commonly more than one job.[1] This may or may not be the case in different countries, and merits a special investigation.

(f) How close collaboration exists between equipment manufacturers/dealers and petty users in developing countries?

(g) As we emphasised earlier, institutional factors are very important, specially in motivating inter-sectoral and inter-firm co-operation and efforts of individual entrepreneurs and workers for technical progress. Different types of institutional elements will, however, have different influence according to the country or

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[1] Hart, op. cit.

region. Much research efforts seem to be needed on this subject.

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MOD
6

19 *Lomé's Informal Industrial Sector*

ERIK DEMOL, G. NIHAN & C. JONDOH

I Industrialization and Employment in Togo

Togo is one of the smaller West African countries, with a population of roughly 2·5 million inhabitants on 56,000 km². The capital city, Lomé (approximately 280,000 inhabitants), is at the same time the main port, with a hinterland reaching Upper Volta and Niger, and a busy trading centre on the coast road, which provides the main links with Ghana, Ivory Coast, Benin and Nigeria. The per capita GDP is in the 200–300 range.[1] Gross domestic product, at constant prices, rose between 1960 and 1966 at an average annual rate of 10%.[2] During the First Five-Year Plan (1966–70) this rate was approximately 7% against only 4·5% for the Second Five-Year Plan (1971–5), despite the 7·7% target. The balance of trade has been moderately negative for a considerable number of years, and has suffered from price difficulties for phosphates, and major production shortcomings for Togo's two main export products: coffee and cocoa. Imports have risen constantly, with major growth rates for both investment and intermediate goods.

The sectoral contribution to GDP shows relatively important movements between 1970 and 1975; these, however, are largely due to primary sector problems, where agriculture has suffered from both drought and structural recession. On the whole, 30% of GDP is attributable to the primary sector, 20% to the secondary and approximately 50% to the tertiary sector. Between 1965 and 1975 an annual growth rate of 36% has taken place in manufacturing, which accounts now for approximately one-third of the secondary sector's present contribution; however, two breweries and soft drinks producers, the cement factory and one cotton mill alone represent roughly 70% of manufacturing GDP. The relative and increasing importance of the tertiary sector is due mainly to the considerable development of the commercial sector as a result of the trading tradition along the West African coast and the preferential agreements which exist with the other members of the franc zone.

The Third Five-Year Plan (1976–80) relies less on infrastructural projects than the two former plans, and its main objective seems to be the strengthening of the present economic structure in preparation for an 'economic take-off in 1985'.[3] This would roughly coincide with the widened perspectives which ECOWAS – the West African common market – will bring, in terms of both a broader market and communal industrial projects. Accordingly, a major emphasis in industrial development lies in the integration of different existing import substitution oriented production units and new agro-industrial projects into an interrelated economy.

Notwithstanding the broadening of the market which ECOWAS will ultimately provide for the Togolese economy, the present industrialization strategy stresses the importance of small- and medium-scale enterprises. Bearing in mind the narrowness of the present domestic market, both in terms of numbers and of purchasing power, and the fact that – except in the case of phosphate, which accounts for three-quarters of Togolese exports – mineral resource exploitation is considered unprofitable (given present world prices), the Third Development Plan clearly states that 'the future of Togolese industry lies in the development of small and medium-scale industry, harmoniously spread over the whole national territory and utilizing as far as possible local resources'.[4] In addition, 'the first objective of existing [production] units is the improvement of the product, in accordance with the local consumers' taste; the main emphasis will be on the production of essential commodities'.[5] Government policy aims at promoting an industrial structure where 'modern enterprises with advanced technology constitute the framework supplemented by smaller units with more labour-intensive technologies'.[6] These labour-intensive units are much needed in view of the country's factor endowments (in terms of labour and capital), and more specifically the problems that arise from the excess supply of labour – including those with school qualifications. The plan forecasts for the 1976–80 period a total of 175,000 school leavers without professional qualifications; of these only 16,000 will find employment in the modern formal sector.[7] Despite the present efforts to channel larger proportions of them into the agricultural sector, the excess supply of unskilled labour, especially in urban centres, remains a problem, which the 1985 universal primary education programme is unlikely to alleviate.

It is within this context that the Togolese Ministry of Planning and Industrial Development requested the ILO to carry out a study of the modern informal sector in Lomé as part of its Research Programme on Skill Acquisition and Self-Employment in the Urban Informal Sector of Francophone Africa.[8] The aims of the programme – which also covered the capital cities of Cameroon, Mali, Mauritania and Rwanda – were first, to obtain a clear picture of how the sector functions; and second, to provide government with concrete recommendations regarding the development of production, employment and training potential in the informal sector.

II The Survey of the Informal Industrial Sector[9]

Following the procedure adopted in the earlier surveys, our study on Lomé began with an exhaustive census of the informal sector conducted in October and November 1977. In order to obtain a comprehensive picture of this sector all categories of activity were covered, including commerce. The sample survey of the categories thought to be the most dynamic was carried out in April and May 1978. The activities selected in this case were woodworking, metalworking, building and mechanical and electrical repairs (further data are given in the appendix to this chapter). These activities make up what we call the 'modern' informal sector,[10] because it produces goods and services similar to those of the modern formal sector for which consumer demand may be expected to expand if appropriate steps are taken to improve the undertakings' productivity and quality standards.

The census[11] enumerated a total of 23,824 informal economic units in Lomé. If wage-earners and apprentices are also taken into account,[12] it can be estimated that at least one-fifth of the economically active population is engaged in informal sector activities.

An initial analysis of the results of the survey[13] enabled us to identify in some detail the part played by the modern informal sector in Lomé with regard to both employment and apprentice training as well as the incomes derived from this type of activity. We found that the sector is expanding with respect to both employment and capital investment. However, the rate of expansion is slow, partly no doubt because of limited room to manoeuvre but also because the technical and financial management of the undertakings is still at a rudimentary stage – even in those that have invested heavily in equipment – with the result that growing capital intensity leads to serious productivity problems. These problems could become even worse if the apparent satisfaction of the more capital-intensive entrepreneurs with their present – often considerable – profits were to destroy their will to introduce more advanced production methods. Such attitudes could in the long run jeopardize the survival of a sector which is in danger of missing its chance to develop into a 'national' small- or medium-scale sector capable of competing with the large-scale firms in the rapidly expanding modern sector.

In the short term, however, the diagnosis that emerges is far from negative: this sector, without obstructing the modern formal sector, performs an important training and income-generating function for the vast majority of those engaged in it. It also represents an intermediate stage which, if skillfully handled, could become an important component of development policy, as acknowledged by the Third Plan.

The survey revealed that there were 3,586 apprentices in the modern informal sector.[14] It should be noted, however, that they make up 88% of the employed workforce in these undertakings, which raises the possibility of their being used as a source of cheap labour. The conclusion to which our analysis leads, while not underestimating that danger, is that there is also much to be said in favour of this type of apprenticeship. For example, it was found that as many as 84% of the apprentices covered by our investigation were trained under conditions that may be described as satisfactory. This positive assessment is confirmed by the fact that entrepreneurs who served an apprenticeship in this sector – i.e. 96% of them – run their businesses just as productively as entrepreneurs who were trained in a vocational centre or in the formal sector.[15] We have here, then, a traditional and inexpensive training process which performs an important function as a preparation for self-employment and at the same time acts as a springboard to employment in the modern formal sector since one-third of former informal sector apprentices were able to find jobs in the formal sector at some stage of their working lives.[16]

The informal 'industrial' sector provides employment at the present time for 1,863 craftsmen and entrepreneurs and 87 partners actually working in the undertakings. The average life of the undertakings is 5·9 years and 57·5% of them have been in operation for at least four years. In addition to the 1,950 jobs thus created there are also 483 wage-earning employees, 450 of whom are skilled workers, which brings the total 'permanent' labour force (i.e. excluding apprentices) up to 2,433. If we compare this figure with the 12,000 or so jobs in manufacturing, services and building in Togo, it can be seen that the modern informal sector in Lomé provides employment for the equivalent of 20% of the workforce in the formal sector throughout the country, without the benefit of the capital resources invested in large-scale industry. If the number of apprentices is added, the proportion rises to the equivalent of 50% of employment in the formal sector.[17] Assuming a stable market, the number of jobs in the modern informal sector will continue to rise, if slowly, at a rate of about 2·5% a year, with skilled employment tending to increase more rapidly since its weighted average rate of growth is greater than that of the apprentices (9·5 and 3·4 per cent respectively). Nevertheless, this 9·5 per cent rate only applies to a numerically small group, so the informal sector cannot be expected to resolve the whole problem of youth unemployment. Nor can the observed growth in this sector as measured by the establishment of new undertakings be expected to produce any radical change in the situation: its annual rate of growth was estimated at approximately 5% on the basis of the census and survey findings.[18] Assuming that these trends continue, one can expect an annual increase in the modern informal sector of approximately 270 apprenticeships and 160 productive jobs in the short run.[19] These figures are merely indicative, but they show clearly enough that the sector's contribution to the solution of the employment problem is important without, however, being sufficient in itself.

Participation in the modern informal sector is far from being a form of disguised unemployment: taking into account their levels of skill, 72·9% of the entrepreneurs probably make a better living than they would if they worked in the modern formal sector, which makes it easier to understand why 64% of those who previously had a job in the formal sector moved from modern sector wage-earning employment to artisanal activity: 82·5% earn incomes equal to or greater than the guaranteed inter-occupational minimum wage (SMIG) and the same applies to 68·6% of the wage-earners. The wages of apprentices – on average 17·8% of the SMIG – should not be analyzed in the same context since their status is quite different.[20]

The social contribution made by the modern informal sector is important for the city. Its undertakings cater mainly to the needs of the low-income groups, artisans and petty traders, with whom the volume of business amounts to 56·1% of their turnover, while sales to public employees and workers in the modern sector make up another 40%. Its contribution to the economic activity of the country as a whole is no less striking. Confining ourselves to activities for which data are available in the formal sector, the value added in woodworking in the informal sector of Lomé, for example, is 28·5% of that produced by modern sector woodworking throughout the country, the corresponding figure for repair services provided for households being 10·6%; taking Lomé on its own, the ratio rises to more than 350% for woodworking and is still 28% for the building trades. And yet these results are achieved on the whole with a relatively low level of capital investment: half the undertakings possess capital assets with a current value estimated at less than 62,000 francs CFA,[21] with the overall average approaching 200,000 francs CFA only because one group of undertakings (those comprising the top decile of the survey distribution) own equipment valued at over 500,000 francs CFA. This investment, which originates within the sector itself (normally personal savings for starting capital and self-financing for subsequent development), has produced a weighted average rate of increase in fixed assets of 5·7% a year and 8·4% in the case of the top decile. The self-financing capacity is considerable, since after outlays for housekeeping and assistance to the extended family are deducted,[22] 80% of the entrepreneurs still have a balance of at least 50,000 francs CFA a year for further investment and 50% are left with 157,000 francs CFA or more, which goes to show that there is a disparity between many entrepreneurs' capacity to invest and their willingness to do so.[23]

These figures confirm the special place occuped by the modern informal sector in the Togolese economy, where it has carved out a market of its own and enjoys a relative independence of commercial and industrial capital. Most of its undertakings seem to be operating in a fairly satisfactory manner; the fact, however, that there does not seem to be any clear indication of its prospects in the medium and long term suggests that it has not adopted the forward-looking approach to development found in large modern undertakings.

Generally speaking, the findings show clearly that the main problem facing the informal sector arises out of its very rough and ready methods of enterprise management and price fixing.[24] The standards of technical management and bookkeeping are poor whatever the level of capital investment. Out of the 280 entrepreneurs covered by the survey, only 15 (5·4%) state that they devote any time to bookkeeping (an average of 3·3 hours a week). Moreover, only 20·7% keep a record of receipts and expenditure and 2·5% maintain more sophisticated accounts; and although 52·5% state that they calculate their production costs, only 1·1% can break them down correctly – mainly because only 2% of all entrepreneurs take depreciation into account.

An improvement in economic behaviour can be observed to take place as the undertaking's level of capital investment rises. The effects are particularly noticeable in the best-equipped group: 60% of entrepreneurs in the top decile keep a record of receipts and expenditure and 18% keep more elaborate accounts. There is thus a certain awareness of the need to organize the undertaking along more sophisticated lines as its capital assets increase. This conclusion, however, is placed in better perspective when one adds that only

20% of this group state that they devote time to bookkeeping (2·6 hours a week on average), while none of them has an employee to assist with this work. It is scarcely to be wondered at, then, that even in this group only 8% are able to identify with precision the components of their production costs and only 13% allow for depreciation. Nor, it should be noted, are these entrepreneurs any different from their less capital-intensive colleagues in the field of work organization.

Technical management seems to require just as much improvement: labour productivity in the modern informal sector is low in all the various sizes of undertakings compared with the modern formal sector. Depending on the category of activity, it ranges between 14% and 55% of that of the corresponding large undertakings in Lomé. Moreover, greater investment in machinery and equipment seems to be accompanied by a disproportionate *decline* in the productivity of capital considering the meagre improvement in labour productivity resulting from the increase in capital intensity. Furthermore, the fact that the entrepreneurs' willingness to invest is lower than their self-financing capacity could cause problems in the long run for these undertakings since competition from the large modern firms seems bound to increase, thus reducing the small entrepreneurs' room to manoeuvre in a market which 66% of them already describe as irregular and providing an insufficient volume of sales.

Although so far the majority of the undertakings operate satisfactorily – only 13·6% report frequent selling at a loss – this can mainly be put down to the fact that the formal sector is not well developed in the corresponding production fields. The corollary to this is that the market still has room for the small undertaking if the latter can improve the quality of its products. However, as the survey showed, this possibility is seriously compromised by an underlying weakness that is characteristic of the informal sector's difficulties in adjusting to a changing market. Quite apart from the constraints arising out of behaviour patterns, which are conditioned by a sociocultural environment which is not always receptive to modern ideas,[25] there is no denying that the sector's low standards of technical and financial management and bookkeeping are due to inadequate education and training: 25% of the entrepreneurs are illiterate, 18·6% have at most three years of primary schooling and only 5% have attended secondary school, which means that the majority of them would be incapable of applying advanced management methods unless they received specially designed training. Future prospects are equally disturbing since 36·2% of present apprentices are illiterate.

To sum up, the informal sector in Lomé provides opportunities for the absorption of a considerable number of unemployed young people; it gives productive employment to a sizeable body of workers who would be looked upon as unskilled in the formal sector; it stimulates the development not only of economic activity but also of skills and the use of labour-intensive technology; and it assists the redistribution of income. It is essential that these unique characteristics be preserved, but this must not imply stagnation; on the contrary, it is important to promote the dynamism of the informal sector and its gradual metamorphosis into a national modern sector still firmly anchored in the country's distinctive social, economic and cultural fabric.

III Future Policy

The following paragraphs discuss some of the considerations which should be taken into account in devising a programme of action to strengthen the economic potential of the informal sector and its capacity to provide employment and training. It should be kept in mind that the proposals made here only concern the modern informal sector in Lomé since it is by no means certain that they would be appropriate, or even desirable, for activities not covered by the survey such as tailoring and various types of commerce, or, more particularly, traditional handicrafts. On the other hand, they are probably adaptable in most cases to artisanal production, services and construction in the country's secondary urban centres.

Traditionally, assistance for the development of the informal sector has been provided through the establishment of special (usually state-run) agencies. By their very nature, these institutions are ill-adapted to the dynamics of the informal sector since the reasoning behind their creation is to a large extent alien to the very principles on which this sector functions. It is not surprising therefore, that 59% of the entrepreneurs prefer the state not to intervene in any assistance to be given.[26] And indeed, when these entrepreneurs are in difficulty, they seldom use the official channels of assistance open to them; they rely entirely on themselves or on their relatives. Aid through 'co-operatives' meets the same mistrust; the sole type of assistance whose acceptability was general – 90% of the responses – was the creation of a mutual aid association by the entrepreneurs themselves.

The results of the analysis showed clearly that a systematic recourse to the oft-recommended solution of capital injection and broadening of credit facilities, which are supposed to promote rapid business expansion, should be avoided. The principal reason for this is that the modern informal sector operates in a 'free enterprise' environment, diametrically opposed to interventions of this kind; moreover, the self-financing capacity of the sector exceeds the willingness to invest. Second, any sudden injection of capital would probably encourage the accelerated development of a few privileged enterprises, penalizing small undertakings whose share of the market might be considerably reduced. At the same time, it would thereby disturb the natural process of training and selection of entrepreneurs who are capable of entering the modern small and medium-scale sector, jeopardizing the modern informal sector's unique contribution to national development.

The additional skills required in the informal sector are far from being sophisticated and complex; assistance in this area should therefore focus on supportive and innovative help in the solution of day-to-day problems (in terms of production, management and techniques, etc.), adapted to the needs and the environment in which the sector functions. In this sense, any formal and institutionalized approach to those who have not acquired or retained the necessary technical skills and literacy is likely to fail, alien as it is to the *ad hoc* basis of the sector's functioning. Similarly, training and advice by management and marketing 'experts' would be vitiated by their sheer technicality and their bias towards a certain specialization in the various management functions, which are contrary to the pragmatic approach of the informal entrepreneurs. Moreover, this would upset the internal organization

of the undertakings and hence their versatility, which determines their strength and comparative advantage compared to larger production units.

On the technological side, there would appear to be an important discontinuity in the available range of equipment between basic tools and the more sophisticated machinery;[27] the latter, if available in the undertaking, therefore tends to be under-utilized under present conditions. The considerable drop in capital productivity with increasing capital investment is indicative of the entrepreneur's present inability to optimize his production function.[28] Although little work has been done in the field of alternative production techniques (especially in the urban sector in Africa), there is scope for an investigation into the subject of more appropriate means of production. This should take into account the existing technical environment and the local capacity to develop, build and use this equipment.

To be successful, assistance to the informal sector must be organized within the framework in which the undertakings operate. Such an approach should regard these as self-contained production units, where the artisan's full control of the production process ensures the versatility of the enterprise, both in production and in transmitting skills to the apprentices. It should, therefore, utilize the human, material and technical resources available within the sector, combining them if appropriate with those available generally. Nevertheless, whatever assistance is provided, it must necessarily be selective and temporary, aimed at promoting a system which has stood the test of time but which, given the scale of the problems that developing countries face, will be called upon to increase its contribution and which needs accordingly to be strengthened.

IV Conclusions

A number of facts emerge from our diagnosis of the informal industrial sector in Lomé. The modern informal sector appears to offer an employment and training potential that national policy-makers cannot afford to ignore. Nevertheless, the way the undertakings operate raises some doubt as to their capacity to adapt in the face of a modern sector whose share of the market is still small at the moment but which will probably rise rapidly in the future. The situation therefore requires that assistance be given to these undertakings but the actual details of such assistance are complicated. The optimism currently displayed by the 'evolutionist' school of thought is supported by very few, if any, examples of successful programmes in this field.[29] That is why the recommendations made to the Togolese government stressed the constraints discussed in the preceding section and suggested the setting-up of an experimental unit with the initial task of carrying out a detailed feasibility study. The main object of this operation would be to verify by a combination of research and action the possibility of involving the entrepreneurs in the gradual development of mutual aid bodies which they would eventually be able to run themselves.

Appendix:

Table 19A.1 *Estimation of certain characteristics extrapolated to the parent population[a] of the modern informal sector in Lomé*

Type of activity	Apprentices (1)	Regular employees[b] (2)	Entre-preneurs[c] (3)	Partners working in the undertaking (4)	Total of cols 1 to 4 (5)	Weighted average annual rate of employment growth (%)[d] (6)	Capital assets[e] (7)
Production	*1,324*	*383*	*747*	*56*	*2,510*	*1·8*	*200·4*
Woodworking	816	334	575	56	1,781	0·7	163·5
Metalworking	508	49	172	—	729	4·7	36·9
Services	*1,835*	*84*	*827*	*26*	*2,772*	*3·9*	*130·2*
Vehicle repairs	1,435	84	552	26	2,097	5·1	107·1
Electrical repairs	359	—	158	—	517	2·4	20·1
Small-scale engineering	41	—	117	—	158	−0·8	3·0
Building	*427*	*16*	*289*	*5*	*737*	*1·9*	*21·1*
Building trades	233	16	130	5	384	3·6	16·2
Subcontractors	194	—	159	—	353	−1·1	4·9
TOTAL	**3,586**	**483**	**1,863**	**87**	**6,019**	**2·6**	**351·7**

Type of activity	Weighted average annual rate of growth of capital assets[f] (8)	Turnover[g] per annum (9)	Raw materials used[g] (10)	Wage bill[g] (11)	Net trading results[g] (12)	Gross value added[g] (13)	Self-financing capacity[g] (14)
Production	*5·3*	*1,221·0*	*721·2*	*83·2*	*346·8*	*445·7*	*219·7*
Woodworking	5·9	957·0	559·5	67·5	280·0	360·2	172·6
Metalworking	2·5	264·0	161·7	15·7	66·8	85·5	47·1
Services	*6·5*	*1,155·1*	*700·8*	*39·2*	*316·8*	*366·1*	*224·8*
Vehicle repairs	7·3	742·7	436·5	32·8	209·0	249·6	141·0
Electrical repairs	7·3	354·1	236·0	5·4	83·6	90·6	63·9
Small-scale engineering	−1·7	58·0	28·3	1·0	24·2	25·9	19·9
Building	*6·8*	*514·2*	*380·7*	*9·4*	*112·5*	*123·7*	*93·9*
Building trades	8·4	231·5	158·8	5·8	59·7	67·0	55·1
Subcontractors	0·2	282·7	221·9	3·6	52·8	56·7	38·8
TOTAL	**5·7**	**2,890·3**	**1,802·7**	**131·8**	**776·1**	**935·5**	**538·4**

Notes:

[a] Figures calculated from the survey data as analysed in G. Nihan, E. Demol, D. Dviry and C. Jondoh,[6] 'Le Secteur non structuré 'moderne' de Lomé, République togolaise, Rapport d'enquête et analyse des résultats' (mimeo.), ILO, Geneva, 1978; World Employment Programme research working paper, restricted.

[b] Manual workers skilled or not, plus seven junior employees. In Lomé there were no family helpers or day-labourers in the undertakings surveyed.

[c] Figures equivalent to the number of undertakings.

[d] The average annual rate of growth for each undertaking was calculated using the following formula:

$$\delta_i = \sqrt[y_i]{\frac{N_{it_n}}{N_{it_0}}} - 1.$$

where N_i is the number of workers in each undertaking, t_n the year in question, t_0 the year in which the undertaking was set up and $y_i = t_n - t_0$. (It was possible, by means of the survey, to determine the number of workers employed by the undertaking at its launching and at the date of survey.) The average rate of growth for each type of activity was weighted by the number of workers in the undertaking, calculated at its median point of growth, and by the number of years the undertaking had been operating, using the following formula:

$$\delta_t = \sum_{i=1}^{n} \delta_i \cdot a_i \div \sum_{i=1}^{n} \cdot a_i$$

where $a_i = N_{a_0}(1+\delta_i) y_i/^2 \cdot y_i$.

[e] In millions of francs CFA. The capital assets were calculated from the estimates made by the entrepreneurs of the real resale value at current prices of their tools, materials, furniture, machines, vechicle(s), land and workshop; the calculation therefore takes into account the depreciation of the equipment since its purchase. Separate estimations were made for each of these headings.

[f] Rate of growth calculated by using a formula similar to the one used for employment. The value of the starting capital assets was estimated from the resale value at current prices, without taking into account depreciation since the purchase of the equipment owned by the undertaking at its launching.

[g] In millions of francs CFA. It was possible to calculated these variables with a fair amount of accuracy, thanks to the wording used in the questionnaire, for normal, good and bad weeks, reduced to the average week on the basis of the distribution of these weeks over the year and finally estimated for the year by multiplying by the number of weeks during which the undertaking operated. The following variables were taken into account: turnover and raw materials estimated for the three types of week, the wage bill (payment in cash and in kind for each worker per average week over the year), working expenses (electricity, water and other overheads per average week), rent plus charges for depreciation and taxes. No loan charges were included since not applicable (see technical document cited above, especially pp. 25, 62, 65, 109 and 110).

Notes

This is an adapted version of G. Nihan, E. Demol and C. Jondoh 'The modern informal sector in Lomé' in *International Labour Review*, September–October 1979, pp 631–44 (Copyright International Labour Organization, 1979).

1 Aggregate economic data, when available, are mainly based on the formal sector activities, and often include only rough estimates for the traditional and informal sectors, if at all.

2 *Marchés Nouveaux: Le Togo* (Paris: J. A. Group, 1977).

3 Ministère du Plan, du développement industriel et de la réforme administrative, *Plan de développement économique et social 1976–80* (Lomé, 1976), p. 43 (hereafter referred to as *Plan*).

4 '*Plan*', p. 35.

5 '*Plan*', p. 289.

6 '*Plan*', p. 290.

7 See G. Nihan, M. Carton, E. Demol and C. Jondoh, 'Le secteur non structuré 'moderne' de Lomé', République togolaise, Esquisse des résultats de l' enquête et programme d'action' (mimeo.), Geneva, ILO 1978; World Employment Programme research working paper, restricted; annexe.

8 This research programme was financed with the assistance of the Swiss Technical Co-operation Agency and the Belgian Technical Co-operation Agency and received a major contribution from the participating African states, which agreed to supply the census-takers, technical assistants and material resources needed for the field research. It also draws on the work done by the research group of the Institute of Development Studies, Geneva University, which in association with the ILO has been carrying out investigations in the area of non-formal training.

9 Informal 'industrial' sector as used here is equivalent to 'modern' informal sector 'industrial' is taken in the broad sense, covering also part of the service sector). However, other types of activities such as tailoring or stamp making were not included in the survey.

10 See note 9.

11 For the technical details see E. Demol, 'Analyse des résultats du recensement du secteur non structuré de Lomé, République togolaise' Geneva (mimeo.) ILO, 1978; World Employment Programme research working paper, restricted.

12 There are no figures available on wage-earning employment and apprenticeship for the categories of activity not covered by the survey. However, they are unlikely to change the overall picture much since the number of wage-earners and apprentices in commerce, which represents 86·4% of the activities not covered by the survey, is very small. The labour force participation rate is around 42% according to Ministry of Planning estimates for 1975.

13 For the technical details see G. Nihan, E. Demol, D. Dviry and C. Jondoh, 'Le Secteur non structuré 'moderne' de Lomé, République togolaise, Rapport d'enquête et analyse des résultats Geneva (mimeo.) ILO, 1978; World Employment Programme research working paper, restricted. The survey covered 280 undertakings, chosen at random. These were divided into three 'strata' corresponding to the production, services and construction sectors, and two independent random samples were drawn from each of the production and services sectors. A variance test did not invalidate the representativeness of the samples and they were combined for subsequent data treatment.

14 We use, unless otherwise specified, figures arrived at by extrapolating the parameters of the survey to the parent population, i.e. all the small-scale undertakings in the census of the corresponding categories, since, as already mentioned, there are no particular reasons for doubting the representativeness of the sample.

15 The indicators used to arrive at this conclusion are the entrepreneurs' net profit, gross value added, and the productivity of labour and capital. The results were similar for the other cities studied.

16 The value of such training is confirmed, moreover, by ILO studies on employment in the modern sector which find, *inter alia*, that educated young people do not bother to report to the Manpower Service of the Ministry of Labour to find a job in this sector as long as they have not acquired specific additional training through a 'traditional' apprenticeship.

17 This comparison may seem highly biased, given the relative weight of apprentices in the percentage thus calculated. Apart from the fact that the modern sector uses apprentices as well, the question arises here of the relative importance of training and production in an apprenticeship post. It is clear that all apprentices participate in a very real sense in the undertaking's work, but this does not mean that they are simply an exploited workforce, as some authors would have it. An implicit training cost is incurred by the heads of undertakings, and paid back by the apprentices who accept a wage that falls below their productivity. The situation is equivocal, therefore, but it is characteristic of any human resources training programme which necessarily entails a trade-off between present and anticipated future benefits.

18 This rate takes into account the 'entries' into the modern informal structure (undertakings which have been operating for one year at most, i.e. 15·8%, and the 'departures' from it (undertakings which had been enumerated in the census but had gone out of business by the time of the survey, six months later). Extrapolated to a full year, the result thus obtained enables us to estimate a 'departure' rate of 10·8%. As regards the weighted average rate of growth, the formula used can be found in the appendix.

19 For 1979, for example, the projected figure based on the findings of the survey is 429, broken down into 122 apprenticeship posts and 46 skilled workers due to the natural growth of the undertakings, plus 149 apprenticeship posts, 19 skilled workers and 93 self-employed resulting from the launching of new enterprises. In calculating the last group of figures we extrapolated the average numbers of apprentices and workers that were estimated on the basis of the workforce employed by the undertakings in the survey at the time they were launched.

20 Contrary to what might be thought at first glance, there is no contradiction between the lower productivity of labour in the informal sector (a characteristic we shall consider in a moment) and wages that are competitive with those in the formal sector. Productivity in the formal sector is 'biased upwards' by the high wages paid to expatriate staff and probably by profits as well, while in the informal sector it is 'biased downwards' by the number of apprentices, which is generally greater than that found in the large enterprises, as well as by the type of equipment used.

21 At the time of the survey the rate of exchange was 100 francs CFA = US$0·432.

22 Household expenditure includes rent, food, health care, clothing, transport, children's education and sundries. The average for the survey is 3,135 francs CFA per week (standard deviation: 2,351), with 50% of the entrepreneurs spending more than 2,535 francs CFA per week. In addition, 25·4% of them give assistance to the extended family amounting on average to 824 francs CFA per week. The average weekly household expenditure per person amounts to 475 francs CFA, which is close to the figure recorded in Bamako (1,055 Mali francs). These figures are not invalidated by the results of a family budgets survey conducted in Togo by the *Societé d'études pour le développement économique et social*.

23 Interestingly, the '*Plan*' recognizes similar problems in the Togolese economy as a whole where the main reasons for the present insufficiency of the modern small- and medium-sized enterprises is found to be (1) a preference for speculative investment in real estate, instead of the improvement of productive capacity; (2) the lack of entrepreneurial 'esprit', encouraged by socio-cultural values which do not accept the emergence and progress of the individual; and (3) the imperfections of the present credit system (though the plan stresses the grave problems of credit policies in developing economies which are too liberal and where the distinction between turnover and profit is rather vague). See '*Plan*' pp. 35–6.

24 This point had already been noted by J. K. Hadzi, *L'Artisanat dans le développement togolais* (Paris: Ecole pratique des hautes études, 1968), p. 66, who states: 'In any event, however, the simple rules of enterprise management still baffle (the small entrepreneur). Not only does he fail to appreciate the concepts of forecasting,

co-ordination and planning (since he attaches no importance to economic time) but he also ignores the most elementary rules of management. Studies carried out by experts give grounds for thinking that these difficulties could be overcome; it must, however, be admitted that these notions do not have the same meaning to a *homo economicus* and to an artisan for whom economics is a direct function of social relationships.'

25 Which no doubt explains why the notion of profit maximization plays only a marginal role in determining the attitude of the more capital-intensive entrepreneurs towards productivity. The survey showed that their profits rose less rapidly than their fixed assets.

26 Almost 70% want direct help without having to go through some type of official co-operative body, and more than 35% prefer no assistance to state interference.

27 Currently, in Lomé, informal sector undertakings sometimes use the services of a timber merchant or another small entrepreneur who owns a combine. Nevertheless, this entails loss of control over the production equipment and hence of the comparative advantage provided by operational flexibility and rapid adjustment to the needs of the market; these are important elements in the versatility of small undertakings, which gives the informal sector another advantage over the modern enterprise. In addition, the possible recurrence of this loss of control over the production apparatus at different levels could lead to the 'proletarianization' of the entrepreneur. A solution would be to set up mutual aid associations, which apparently do not have the negative effects noted in the cases where equipment is hired. Nevertheless, the sophistication of this type of equipment generally raises technical management and accounting problems so that it is the best-trained entrepreneur who gradually assumes responsibility for it; the other joint owners are thereby relegated to a sort of bureaucratic dependence.

28 This is observed in all the cities covered by the research programme.

29 It is interesting to read the commentaries on this point in the special issue of *World Development* (Oxford) edited by R. Bromley on the theme 'The urban informal sector: critical perspectives' (September–October 1978). One should also remember the scepticism expressed by Hadzi, op. cit., regarding the possibilities of intervention in a sector in which 'economics is a direct function of social relationships', as mentioned in note 24 above.

PART SIX

INDUSTRY IN AFRICA: A STATISTICAL DESCRIPTION

Steel

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Small-Scale Employment and Production in Developing Countries

Evidence from Ghana

Chapters 1,5+7 only

PRAEGER SPECIAL STUDIES IN INTERNATIONAL ECONOMICS AND DEVELOPMENT

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CHAPTER

1

THE EMPLOYMENT PROBLEM AND THE INTERMEDIATE SECTOR

INDUSTRIALIZATION AND EMPLOYMENT

This study is directed toward resolving the growing sense of conflict between the efforts of less developed countries (LDCs) to industrialize as a means of raising output per capita, and their desires to fully and productively employ their human resources. The central thesis is that increasing the productive use of labor can be complementary to raising the growth of production. Industrialization in LDCs since World War II, however, has generally brought disappointing results in terms both of the ability to sustain economic growth and of an increasing divergence between the growth of the labor force seeking industrial employment and the jobs available. Policy measures have been inadequate to deal with this growing employment gap, and in many cases have reinforced rather than offset it. This study begins by analyzing the impact of industrialization policies on the employment problem, using Ghana as a particular example. Its primary objective is to assess the actual and potential contribution to employment and output growth of those enterprises that are too small to be affected directly by the usual industrialization policies, and that may be defined as the "intermediate" or the "small-scale" sector. The outcome will be an understanding of the role this sector can play in economic development, and suggested policy changes or proposals to promote achievement of its potential.

Underutilization of Labor

Theoretically, the existence of underutilized labor in the rural agricultural sector provides the potential for rapid industrial expansion at low cost to both investors and the economy—if this labor surplus can be transferred to industrial production without substantial wage increases. The international evidence is that the implied rural-urban transfer of labor has been proceeding at a rapid pace in LDCs throughout the world, with urban population growth rates on the order of three times the rural growth rates, and both rising.* The percentage of LDC populations residing in urban areas increased by half (from 13 percent to 20 percent) between 1950 and 1970, with over 50 percent of the urban increase due to migration. The share of the labor force engaged in industry, however, has increased at a slower pace, from 10 to 12.5 percent in 1950–70 for manufacturing, mining, and construction, and from 7.5 to 10 percent for manufacturing alone. As a result, underutilization of labor has become a serious urban problem, with urban unemployment rates on the average of 2.5 times the rural rates.

Measurement of the level of labor underutilization, and the extent to which industrialization has simply shifted it from rural to urban areas, is difficult because the readily measurable definition of "unemployment" used in industrialized economies does not adequately cover the forms of underutilization found in LDCs. There are six categories of labor that might be regarded as underutilized, with respect to either demand or supply potential:

Not employed

Discouraged workers have given up searching for a job but would take one at prevailing wage rates. They are underutilized because of inadequate demand (which may be partly due to failure of wages to fall). They are not included in measured unemployment because they are not actively seeking employment (some may be engaged in education, housekeeping, or armed services).

Unemployed people have no jobs but are actively seeking them and would accept employment at prevailing wage rates. They are underutilized because of inadequate demand.

Employed part-time

Underemployed workers have jobs that employ them for only part of a day, month, or year and would like to extend their period of work at prevailing wage rates. Underutilization is due to inadequate demand or to seasonal fluctuations.

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*Figures in this paragraph are from Bairoch 1973, pp. 1, 22, 43, and 51.

Employed full-time

Underproductive labor is found in situations where the same output could be produced by fewer workers if they worked harder ("disguised unemployed"), or where workers are paid more than the increase in output (marginal product) attributable to adding the last (marginal) worker. Underutilization is due to institutional arrangements that enable labor to receive more than its marginal product.

Overqualified workers would not like to extend their hours of work under existing conditions, although their productivity would be higher in alternative employment, because their training and skills exceed the qualifications for the work they are doing. They are underutilized because labor supply characteristics do not match the pattern of demand requirements.

Underpotential workers are those whose productivity could be raised through greater education and training, including nonparticipants who would enter the labor force if their qualifications and/or wages were higher. Since some investment is implied, only the labor for which a net benefit would result should be included. This group is underutilized because of institutional rigidities that prevent investment in labor supply from matching the pattern of demand.

Statistics normally are collected only on unemployment, and even the relatively clear-cut definition of "unemployment" can have varying interpretations, depending on the length of the reference period and the criteria for "actively seeking work." Comparison of unemployment statistics between more and less developed countries can be especially misleading, because of the greater range of casual and self-employment opportunities in the latter, combined with the absence of income maintenance programs. Unsuccessful job seekers in the former are more likely to be openly unemployed or to become discouraged and drop out of the labor force, whereas in LDCs they are more likely to be engaged in some temporary income-earning activity. Measurement of this underemployed and underproductive labor is, however, relatively difficult because the workers are actively engaged. Hence quantitative assessment must be in reference to some number of hours per year or to an assumed appropriate level of productivity. D. Turnham (1971, p. 69) suggests using a minimum level of income as a reference point for measuring underutilization of full-time workers, but the arbitrariness of the level makes it suitable only in relation to national goals, not for international comparisons.

The concepts of underproductive, overqualified, and underpotential labor are somewhat speculative, and involve policy implications different from the other types of underutilization. Discouraged, unemployed, and underemployed workers could be utilized fully through an expansion of demand, without any change in supply conditions. Saying that workers could be utilized more productively in another job or with more education, however, implies an alteration in supply conditions (or in the pattern of demand), and is directed more at the structure of the economy than at its rate of expansion.*

Rural underutilization consists primarily of underemployed and underproductive labor. Farm workers who are employed only part of the year or who work just part of the day in the off season could be productively engaged during the inactive period at no cost in terms of reduced agricultural output. "Disguised unemployment" is sometimes used to refer to such workers, but applies more precisely to underproductive workers whose work effort and contribution to raising output are low because of a large number of family workers relative to available land (or because of inadequate incentives to tenant farmers); they could be removed with little or no loss in agricultural output if the remaining workers maintained or increased their efforts (Lewis 1954). This rural underutilization poses no direct social or economic problem, insofar as land tenure or institutional arrangements ensure that agricultural output is shared among workers and family members. Open rural unemployment would be expected to be virtually nonexistent in the land-abundant, family-oriented economies of Africa, but is more of a problem for densely populated Asian countries in which many rural residents do not have a claim to land.

Although migration of underutilized rural labor to urban areas is necessary for the shift toward a more productive industrial employment structure, it may lead to serious problems of urban underutilization that can retard economic development. Unemployed urban migrants do not have the family and community support they would have in the rural areas, and are more likely to turn to illegal activities and begging as a source of income. Many of those who find legitimate income sources, such as petty trade, may be adding little or nothing to gross national product (GNP). Nevertheless, their presence increases pressure on the government to spend money on social services in order to deal with readily apparent problems of housing, health, sanitation, water, and crime. The result is likely to be a diversion of funds from development-oriented investment to urban maintenance and welfare. Ironically, such spending only increases the attractiveness of urban areas to rural residents, and may stimulate additional migration to and overcrowding of the cities.

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*Unemployment also can be "structural," if caused by the inability of workers to meet the requirements of jobs that are available.

The Employment Problem

This vicious circle of rising rural-urban migration in the face of increasing urban underutilization of labor characterizes the employment problem in LDCs. In aggregate terms, the problem may be defined as a sustained gap between the growth of labor supply (g_L) and the growth of employment demand (g_E), especially in urban areas:

$$g_L > g_E \tag{1.1}$$

The growth of employment depends on the rate of growth of output (g_Q^j) in each sector or industry (j), the rate (e^j) at which employment grows in response to a given output growth in each sector, and the relative weight (s^j) of each sector in total employment (E):

$$g_E = \sum_j s^j e^j g_Q^j \qquad j = 1 \cdots n \tag{1.2}$$

where

$$s^j = E^j/E \tag{1.3}$$

and

$$e^j = g_E^j / g_Q^j \tag{1.4}$$

The elasticity of employment growth with respect to output growth in each sector (e^j) depends on the variables that determine the rate of productivity increase, including technological change, managerial and organizational improvements, increased labor quality and experience, decreasing production costs per unit of output as scale increases, and substitution between labor and other factors in response to wage changes. An increase in these elasticities would be the normal means by which an economy would adjust to the growing unemployment implied by inequality 1.1, in the neoclassical framework. Declining wages in response to an excess supply of labor would lead to substitution of labor for capital and other inputs, raising (e^j) in all sectors where substitution is possible. In addition, reductions in labor cost would favor more rapid expansion of labor-intensive sectors, resulting in a shift of the employment weights (s^j) toward those sectors and, hence, toward faster employment growth. In a Keynesian situation of demand inadequate for employment of the available work force, the appropriate policy would be to raise the output growth rates (g_Q^j) by stimulating aggregate demand.

Adjustment may also take place on the supply side, which depends in the aggregate on the rate of population growth (g_N) and the labor force participation rate for new entrants (p') as against the overall rate (p):

$$g_L = g_N(p'/p) \qquad (1.5)$$

where

$$p = L/N \quad \text{and} \quad p' = \Delta L/\Delta N \qquad (1.6)$$

Urban labor force growth (g_{LU}) depends, in addition, on the rate of net rural-urban migration, which may be measured by the share (m) of migrants in the urban population, growth of the migrant population (g_M), and the relationship between the participation rate for new migrants (p'_M) and the overall urban participation rate (p_U):

$$g_{LU} = g_{NU}(p'_U/p_U) + m\,g_M(p'_M/p_U) \qquad (1.7)$$

In the Malthusian model, adjustment to the employment gap represented by inequality 1.1 takes place through a decrease in the population growth rate as unemployment drives incomes below the level required for long-term sustenance of life. Historically, voluntary reduction of the birth rate in response to rising income levels and opportunities has helped to avoid a substantial employment gap in those countries that began their development "takeoff" prior to the twentieth century. In LDCs today, at least half of the rapid growth of the urban labor force is due to the migration term of equation 1.7. Participation rates tend to change relatively slowly, but are likely to fall with an increase in population growth that results from decreased mortality rates among children and persons retired from the labor force.

The adjustment mechanisms, however, are not sufficiently effective in LDCs today to indicate any hope of reversing the inequality in 1.1, especially with respect to urban industrial employment. Real wages are maintained, even with growing unemployment, by government minimum wage policies, collective bargaining, and general pressures for rapid increases in income to reach consumption standards of the more developed countries. Indeed, efforts to raise the overall rate of growth are often implemented through subsidies to capital investment, encouraging both substitution of capital for labor (lower e^j) and increasing shares (s^j) in the relatively capital-intensive sectors, thus offsetting the impact of any increase in the sectoral growth rates (g_Q^j) on aggregate employment growth (g_E).

The effectiveness of Keynesian aggregate demand policy is limited by the supply-side constraints and rigidities that characterize less developed economies. If labor and machinery are idle for lack of foreign exchange to buy imported materials necessary to operate the industries that have been built, then increased aggregate demand will only increase the pressure on foreign exchange and will do little to raise utilization rates. Even if foreign exchange and investment funds are available, the technical and managerial ability to allocate large amounts efficiently may be lacking. Prices may not adequately reflect the changes in economic structure that a society desires for the future, and in any case reflect the existing distribution of income. If income is skewed toward people with a high propensity to consume imported goods and manufactured goods that are produced with relatively high capital intensity, then increasing the level of spending may do little to raise the demand for domestic labor. Because of the low responsiveness of domestic supply to changes in prices, increased aggregate demand may tend to increase the rate of inflation rather than to generate the supply increases that would raise employment growth.

The rapid rise during recent decades in ability to control the Malthusian population brake is a mixed blessing that is a primary source of the employment problem in many LDCs. Control of epidemics through vaccination, availability of piped or treated water supplies, and general improvements in health care have dramatically lowered death rates (especially among children) throughout the world. In the more developed countries, the impact of decreased mortality rates on population growth has been moderated by a steadily declining birth rate as development has progressed. In LDCs, however, the death rate has dropped before the birth rate has declined, resulting in a sharp upturn in the net population growth rate. The 1950-70 annual population growth rate of 2.4 percent in LDCs is double that in more developed countries and is expected to increase to 2.6 percent during 1970-2000, whereas a decrease to 0.9 percent is anticipated for the more developed nations (Bairoch 1973, p. 8).* Problems of feeding and providing for a rapidly expanding population make it even more difficult for LDCs to achieve the rising income per capita that would provide greater incentive to reduce the birth rate. Stable or falling income per capita, however, no longer means that the death rate will rise so as to close the gap in inequality 1.1.

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*The gap in labor force growth is slightly less, as a result of an increasing dependency ratio (falling p) as children and the elderly constitute increasing shares of LDC populations. The economically active population is expected to grow at 2.4 percent during 1970-2000 in LDCs and at 1.0 percent in developed countries (Bairoch 1973, p. 10).

Rural-Urban Migration

The upward shift in population growth since World War II has had a double impact on the urban employment problem through a concomitant migration of workers from rural to urban areas (equation 1.7). Some adjustment to rising urban unemployment might be expected in the form of a decrease in migration. As long as the urban income that migrants expect to earn exceeds their rural wages plus migration costs, however, continuing migration is quite compatible with unemployment (Harris and Todaro 1970). Thus, institutional barriers to reducing the urban minimum wage can inhibit supply-side as well as demand-side adjustment to the employment problem.

Once a migration pattern is established, reducing the rural-urban income differential may in any case have relatively little impact, especially in the short run. Potential migrants' perceptions of their individual opportunities tend to be based on the experience of former migrants, and may adjust to current and future realities only after a substantial lag. The presence of a large number of recent migrants in the cities tends to induce "chain migration" of relatives and townspeople by lowering the costs and risks of migration (Caldwell 1969). The availability of water and other amenities, of manufactured goods, and of entertainment and social life are urban attractions that do not depend directly on an individual's rural and urban wage opportunities.* The inability to earn cash to buy desired manufactures in a predominantly subsistence agricultural economy may lead some people to migrate even if they suffer a reduction in measured income. Similarly, the lack of rural opportunities for those with skilled and educated occupations may turn workers with some training or education from rural to urban labor markets. One result is the "unemployed school leaver problem" (Callaway 1963): middle or primary school graduates remain unemployed while awaiting white-collar jobs for which they feel themselves qualified rather than undertaking manual work. Such behavior is in fact much more rational than is sometimes implied, if the earnings differential between the occupations is sufficient to make up for the income loss during unemployment (Berry 1975). The evidence indicates that when the income differential or the probability of

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*These attractions are sometimes referred to as the "bright lights" of the city. "Amenities" seems preferable, in that it suggests a nonwage component of maximizing total welfare rather than an irrational preference for excitement. The difficulty of measuring the rural-urban amenities differential prevents testing its statistical significance as a determinant of migration. R. E. Beals, M. B. Levy, and L. N. Moses (1967) found that migrants tend to go to more urbanized regions in Ghana.

ever achieving a higher income is reduced, school leavers become increasingly willing to take production jobs (Peil 1972).

Attacking the urban employment problem through adjustment of labor supply requires policy measures affecting the opportunities and living environment in both urban and rural areas. Reduction of the income differential alone is unlikely to be sufficient if nothing is done to raise the range and benefits of rural income-earning opportunities and the availability of important amenities, such as water and education, in rural areas.* Rural development and population policies are important components of a long-run solution to the employment problem, although they can have little short-run impact and in any case are unlikely to be sufficient without improvement in the growth of demand for labor.

ABSORPTION OF SURPLUS URBAN LABOR: THE INTERMEDIATE AND INFORMAL SECTORS

Most of the literature analyzing the mechanisms and benefits of rural-urban labor transfer have used a dual economy framework, contrasting rural/agricultural/traditional activities with the urban/industrial/capitalist sector. In a dual economy, labor that is engaged in neither agriculture nor industry is presumed to be unemployed. Recent writings, however, have emphasized the existence of other employment categories. D. Byerlee and C. K. Eicher (1972) point out that dual economy analysis can mislead in its assumption of an identity between different criteria for the dichotomy. That is, rural/urban, agriculture/nonagriculture, and small-scale/large-scale are not comparable ways of analyzing an economy because they divide its activities at three distinctly different points, not at the same point. Byerlee and Eicher suggest dividing the rural labor market into agricultural and nonfarm sectors,† and urban employment into small-scale

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*The cost effectiveness of amenities in rural areas is likely to be low relative to urban investments, given the lower population density and the resulting lower utilization rates. Similarly, location of an industry in a rural area may reduce profits unless there are substantial savings through locally provided raw materials or cheaper labor, since lack of infrastructure and the necessity of transporting materials from and products to urban markets are likely to raise costs. A policy of rural development needs to institute projects in which these costs and any resulting retardation of growth rates do not outweigh the benefits of more equitable distribution of income and reduced migration.

†See S. Hymer and S. Resnick (1969) for a formal model of rural labor choice between producing crops and "Z" goods.

and large-scale enterprises. There is also empirical recognition of the importance of urban income-earning alternatives that lie outside the "modern" large-scale wage sector (Doctor and Gallis 1964, 1966). The analysis of urban employment, however, generally remains dichotomized into productive and nonproductive. The latter activities (legal and illegal) are frequently characterized as the "traditional" or "informal" sector (Hart 1973), and are assumed to represent an urban form of disguised unemployment (that is, underproductive employment).

On the other hand, there is increasing interest in forms of employment and methods of production that are "intermediate" between unproductive "informal" activities and the technologically advanced operations that characterize recent industrialization in LDCs (Child 1973b; Marsden 1970; Schumacher 1973). A growing body of evidence (discussed below) suggests that many existing small-scale enterprises in fact represent quite productive uses of labor and of capital. Hence introduction of a third urban sector may be essential for a correct understanding of the employment and investment options available. The central hypothesis of this study is that such a sector—referred to here interchangeably as "intermediate" and "small-scale"—can provide an effective short-term (as well as long-term) means of alleviating the employment problem, without sacrificing growth of output. Hence four categories for the urban labor force may be defined (see Table 1.1 for a tabular presentation according to different characteristics, and Chapter 3 for further details and empirical criteria).

Modern: Labor employed in large-scale firms that use relatively capital-intensive methods and consequently have high labor productivity; paid a relatively high wage that is determined institutionally (government minimum wage legislation or pressures, collective bargaining, international standards) rather than by market forces. Example: a textile factory with 100 workers and power-driven machinery.

Intermediate: Labor that is combined with some fixed capital* in a small-scale establishment using relatively labor-intensive methods. Additional workers add to the supply of marketable goods and services (the marginal product of labor is positive). Compensation

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*Investment in human capital, through training or apprenticeship, should certainly be included at the conceptual level, although it is somewhat difficult to use as an empirical criterion. In any case, training usually implies working with tools or machinery, so that the more traditional concept of capital as fixed assets is a generally suitable criterion.

TABLE 1.1

Characteristics of Four Urban Labor Force Categories

Category	Wage Determination	Productivity	Employment	Capital	Size, Technology, Organization
Modern	Institutional: Minimum wage = MP (high)	High AP High MP	Wage labor	Capital-intensive	Large Modern techniques Incorporated
Intermediate	Market: Wage = MP (low)	Moderate AP Low MP	Wage labor Apprentice Family Self-employed	Some fixed assets but relatively labor-intensive	Small Intermediate technology Fixed place of business
Informal	Market: Wage = AP (low)	Low AP MP = 0	Self-employed Family	No fixed capital; highly labor-intensive	Very small Simple or traditional techniques No formal business organization
Unemployed	No earned income	Nil	Seeking a job (presumably in modern sector)	None	None

AP = Average productivity (total output per worker).
MP = Marginal productivity (additional output as a result of adding a worker).
Source: Steel and Takagi 1976.

may be by wages or other arrangements (including self-employment). The category may include underemployed, overqualified, and under-potential workers. Example: a seamstress with apprentices, using foot-powered sewing machines.

Informal: Labor in activities (legal and illegal; usually trade and services) that involve little or no fixed capital or formal business organization; underproductive, in that additional workers add little or nothing to the value of output (zero marginal product) but simply share in existing sectoral income. Self-employed or assisted by family members, with no wage labor. Example: 20 cloth sellers in the same marketplace.

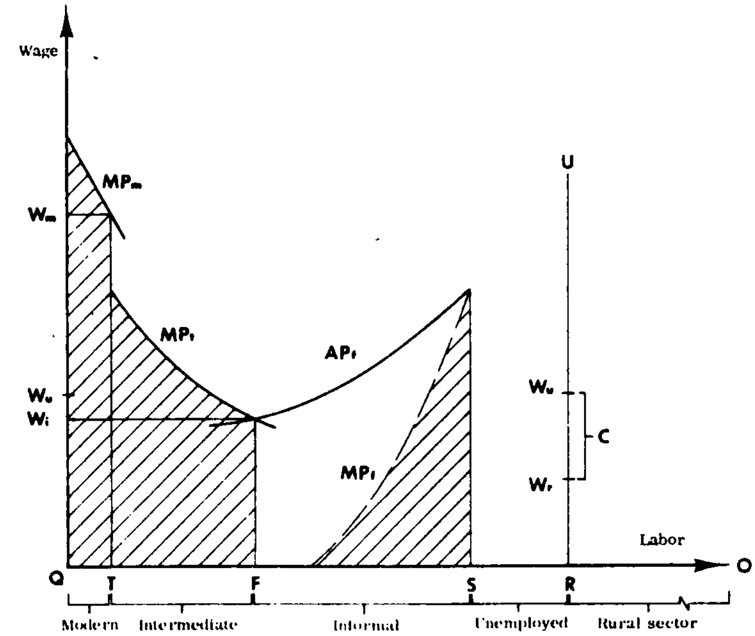
Unemployed: Those doing no work for compensation or for the purpose of selling (legal) goods or services, but who desire income-earning employment (including discouraged workers, although they would be omitted from official statistics based on the criterion of "actively seeking work").

The interrelationship of these categories is illustrated in Figure 1.1a, where the shaded areas represent the total contribution to GNP from each urban subsector. The analysis focuses on unskilled

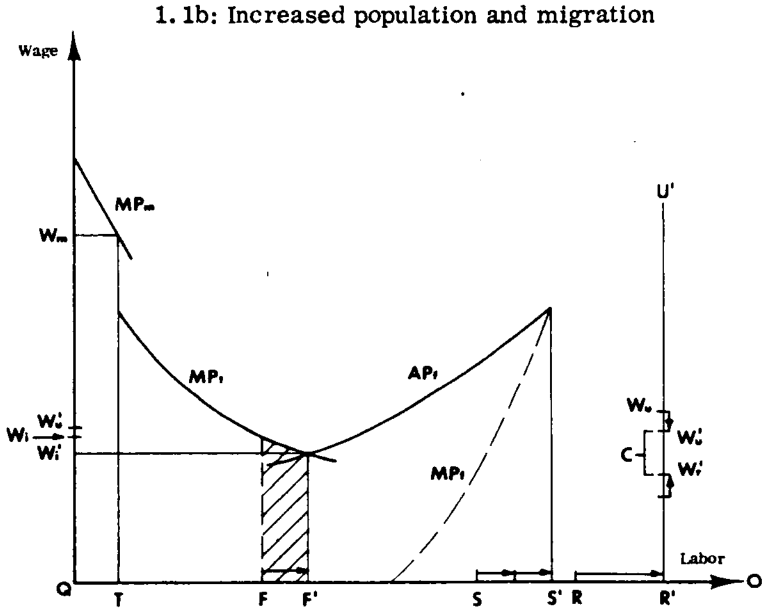
FIGURE 1.1

Interrelationship of Urban Labor Force Categories

1.1a: Employment in three urban sectors

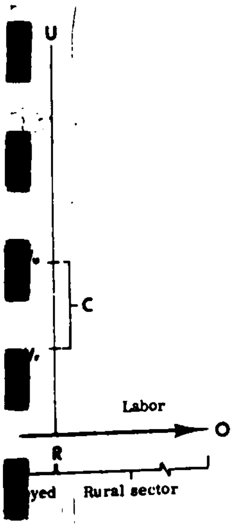


1.1b: Increased population and migration

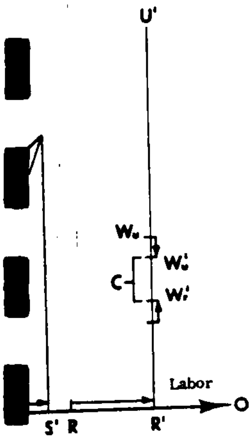


ce Categories

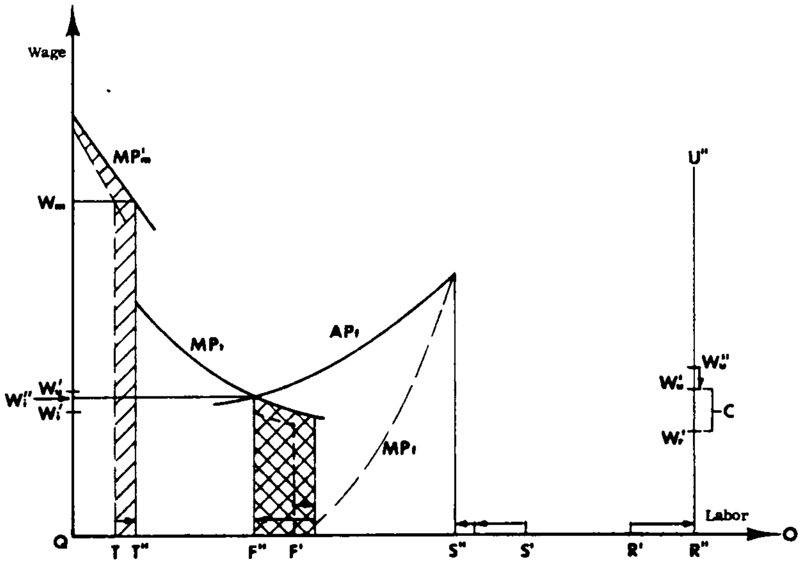
sectors



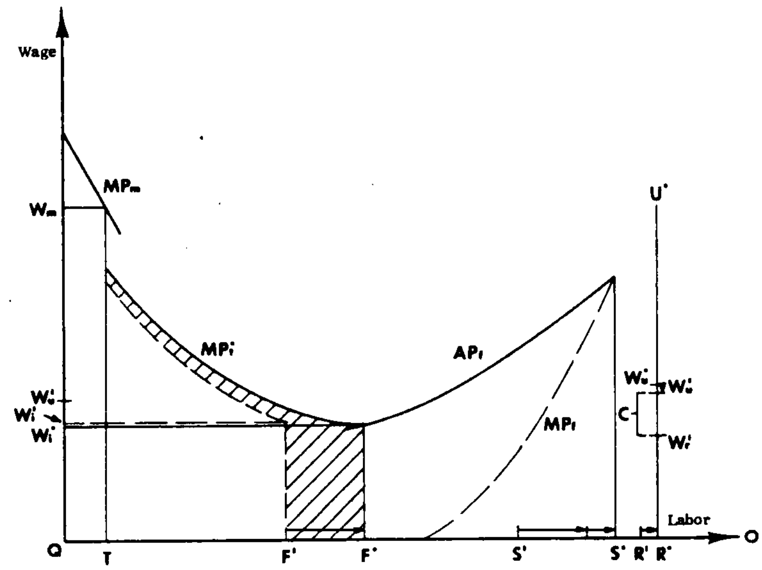
migration



1.1c: Modern sector expansion



1.1d: Intermediate sector expansion



Source: Steel and Takagi 1976.

labor, which can be used in any activity. The wage (QW_i) in the intermediate and informal sectors is approximately the same because of the relative ease of entry into their activities; workers presumably will undertake whichever activity leads to a higher income. The important distinction between the intermediate and informal sectors is that the former involves some fixed capital with the last (marginal) worker hired being presumed to make a positive contribution to output, whereas additional workers in the informal sector have no fixed capital with which to work and make no net contribution to raising GNP.* The average urban wage (QW_u) normally lies between the intermediate/informal wage and the modern sector wage (QW_m), unless open unemployment is exceptionally large. Some people (SR) find it worthwhile to remain unemployed rather than work in informal or intermediate activities because they can search more actively for a modern sector job, which would pay enough to compensate for the period of unemployment.† The larger the number of unemployed (and the smaller the modern sector), however, the lower the probability of obtaining a minimum-wage job, so that at some point additional workers will find working at the lower wage (QW_i) preferable to the risk of waiting for a higher one. Workers migrate from the rural sector (OR) when the expected value of urban income (RW_u, taken as the average urban wage) exceeds the rural wage (RW_r) plus the costs (C) of migration (including initial expenses, cost-of-living differential, and psychic or cultural "costs").

Migration increases if the rural wage falls—for example, if population rises faster than production. In Figure 1.1b, an additional RR' workers migrate until the urban wage falls and/or the rural wage rises enough to restore the original gap (C). The addition to urban labor supply decreases the probability of obtaining a modern sector job (since its wage does not fall), and some migrants seek employment in the informal and intermediate sectors, lowering their wage to (QW_i'). Output increases only slightly in the intermediate sector (shaded area under MP_t); the additional informal workers add nothing to GNP. The number of unproductive workers in the informal and unemployed categories increases (from FR to F'R'), as does the unemployment rate.

In these circumstances, expansion of the modern sector may only aggravate the employment problem in the short run (Figure 1.1c). Additional investment raises the productivity of and demand for labor (to MP_m') at the given wage (QW_m), resulting in some additional

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*The service may already be oversupplied, or it may not be socially productive—for instance, stealing or prostitution.

†For a more formal presentation of this model, see W. F. Steel and Y. Takagi (1976).

employment (TT'') and output (shaded area under MP'_m). The increased probability of obtaining a high-wage job raises the urban expected wage ($R''W''_u$) and thereby attracts new migrants (quite possibly in excess of the number of new workers hired). It also becomes worthwhile for some intermediate and informal workers to leave their jobs in search of modern sector employment (many of them remain unemployed). Thus there is an offsetting loss of production in the intermediate sector (cross-hatched area under MP_t). A substantial increase in the level and rate of unemployment results (from S'R' to S''R''), as well as in the number of unproductive workers (from F'R' to F''R'').

The population increase could be absorbed much more effectively through expansion of the intermediate sector (Figure 1.1d). Increased investment would raise intermediate labor productivity and demand (MP_t^*), and some unemployed and informal workers would be hired. The shift from these unproductive activities to the more productive intermediate sector would raise the expected urban wage (to $R^*W_u^*$), though by relatively little (since $QW_i' < QW_u'$). The additional migration ($R'R^*$) necessary to restore the rural-urban wage gap to the previous level (C) is much less than under a corresponding investment in the modern sector.* The increased size of the urban labor force reduces the probability of obtaining one of the fixed number of modern sector jobs, so more people are willing to engage in intermediate and informal activities than previously. The net effect is an increase in employment in both the intermediate and the informal sectors (from TF' to TF^* and from F'S' to F^*S^*, respectively), and a decrease in both the level and the rate of unemployment (from S'R' to S^*R^*). Productive employment increases by ($F'F^*$), and output increases in the intermediate sector (shaded area under MP_t^*). One hypothesis to be investigated in Chapter 4 is that this increase in output exceeds the net increase attributable to modern sector expansion, for the same investment.

Origins and Nature of the Intermediate Sector

Intermediate sector activities may originate from preindustrial nonagricultural production, or they may derive from demand for modern goods and services that is not met by the large-scale industrial sector. The term "traditional" may be used to refer both to production

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*The gap might be partially closed by a rise in the rural wage as well as by a fall in the urban expected wage, if the supply of rural labor is not in fact "unlimited" (perfectly elastic) at a wage corresponding to the rural wage plus migration costs.

of common domestic consumer goods, such as clothing, processed food, simple furniture, utensils, and tools, and to skilled artisans producing "cultural" goods (Dandekar 1967).* Much of this production may be carried out within the farming household. Complete specialization of labor in manufacturing initially occurs for goods requiring skill and training (especially handicrafts), but extends to common goods as the economy becomes more market-oriented. These activities constitute the preindustrial manufacturing sector and much of postindustrial small-scale manufacturing.†

Intermediate activities also may result from industrialization. The modern, large-scale industries tend to be oriented toward the upper end of the income range, in terms both of what they produce and the quality (Gerry 1974). Given the skewed distribution of income characteristic of LDCs today, and the relatively small size of the manufacturing sector, this orientation toward luxuries and semi-luxuries offers a reasonably safe, high rate of return.‡ Production of these goods tends to be relatively capital-intensive, both because many of them (especially durables) are the products of relatively capital-intensive technologies and because LDCs typically offer a range of subsidies and incentives to capital (whether to promote investment in general, or because of the self-interest of the political-economic elite to subsidize capital-intensive luxury goods).

The contact and communications associated with increasing urbanization create a widespread desire for these industrial products

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*M. C. Shetty (1963), referring to these as "household industries" and "handicrafts," emphasizes their distinctions from each other in terms of degree of specialization and standardization, as well as from "small-scale industries."

†A market-oriented preindustrial economy requires tertiary as well as secondary activities, especially trading. Most "traditional" tertiary activities, however, do not use reproducible fixed capital and hence do not qualify for inclusion in our "intermediate" sector. V. M. Dandekar (1967, p. 153) notes that "village industry [usually] requires at least the same amount of capital, but more labour per unit of output [vs. its modern counterpart]. . . . It is based on a technology which is inferior, in the sense that it uses not less capital but more labour to produce a given amount of goods."

‡In Ghana, for example, the state-owned distillery was established partly to provide a better-quality substitute for locally distilled "akpeteshie," known as "the poor man's gin." Unable to make profits in competition with the traditional distillers in this market, however, it now concentrates on more "modern" spirits consumed by the middle- and upper-income groups.

among the many with incomes too low to afford them. Hence there is a substantial market for low-cost manufactures. At the same time, the capital-intensive nature of large-scale industry assures an excess supply of urban labor seeking industrial employment. Some of them may have enough training and experience to produce a particular good by themselves (for instance, carpenters laid off by construction companies). Others may enter apprenticeship in order to learn the skills necessary to start their own business, or perhaps to obtain an industrial job in the future (Planungsgruppe 1974). Entry into small-scale production of many manufactures, or of other goods and services, is relatively easy, since only simple tools and buildings are necessary. The large size of the market relative to the production unit, ease of entry, and an excess supply of workers looking for income-earning opportunities create the classic conditions for pure competition, ensuring that prices (and quality) will remain low. This portion of the intermediate sector (which V. M. Dandekar [1967] calls "modern small-scale industry") differs from the "traditional" portion in that both products and techniques resemble those of large-scale industry.* The technology may be "intermediate" in the sense of using equipment and methods that were formerly used by industrialized countries or that have been adapted to local conditions; or it may be identical to that used in large-scale industry, but at too small a scale to be included in that sector (especially in official data collection).

The analytical as well as statistical importance of these small-scale activities that are related to modern industrial production makes the commonly used term "traditional" inappropriate to refer to all production outside the large-scale sector. It is often used to connote lack of capital, negligible productivity, and isolation from the industrializing economy, factors that are the opposite of the intermediate sector characteristics as defined here. It reflects the Westerner's inability to recognize the importance and viability of activities not organized according to modern industrial methods of production. The terms "intermediate" and "small-scale" are used in this study to emphasize the presence of capital, moderate levels of productivity, and position on a continuum reaching into the industrial sector. "Traditional" domestic goods and handicrafts are included, and indeed represent a substitute for industrial goods, even though their origins and techniques may not be industrial. The continuum applies in terms

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*Y. M. Ho and D. L. Huddle (1975) argue that such firms are at such a disadvantage in a large market that they must either grow or disappear, whereas the smallness of enterprises producing traditional goods is a major advantage in meeting specialized, individualized demand.

of productivity, capital intensity, size, and employment. Workers may move quite readily between levels: unemployed, self-employed, wage-employed.

The intermediate sector has several advantages in meeting the demands of the lower-income portion of the population. Easy entry brings competitive pressure to keep prices low, in contrast with the frequently monopolistic nature of large-scale industry in small LDCs (Dore 1974). It can obtain idle materials and capital, as well as surplus labor, at relatively low prices (Watanable 1974). The packing materials for inputs imported for large-scale industries may even become an input for small-scale production. Labor-intensive repairs can prolong the life of machinery whose breakdowns would interfere with assembly-line production. These recycling and recouping functions of small-scale production are important means of achieving fuller and more efficient utilization of a country's resources (Gerry 1974). Small-scale enterprises are better able to differentiate products according to individual tastes and needs, and to locate close to the consumer. Similarly, they can process dispersed raw materials or produce construction goods, such as bricks and blocks, close to their site (Morawetz 1974). Hence the intermediate sector is a critical element in any strategy for decentralized and widely distributed industrialization and development (Shetty 1963). There is no reason why intermediate activities cannot be profitable, accumulate capital, and be a dynamically growing sector (ILO 1972; van der Veen 1973; Weeks 1971). Since its products are largely substitutes for industrially produced goods, however, policies that divert resources to the large-scale sector are likely to stunt the growth of the intermediate sector. When these policies focus on capital, the tendency of the modern sector to be more capital-intensive than the intermediate sector will be accentuated.

Dependent Nature of the Informal Sector

Whereas the intermediate sector generally produces substitutes for the goods and services of the modern sector, the informal sector is to a large extent dependent on the modern sector and complementary to it. Provision of personal and trading services represents a major share of informal activity, and the rate of growth of income available to purchase the services is hypothesized by D. Mazumdar (1975) to depend on, and lag behind the rate of growth of, modern sector income.*

*The rate of growth of informal employment, however, is likely to exceed wage employment growth in an economy characterized by

Indeed, A. N. Bose (1974) goes so far as to postulate a colonial relationship between the two sectors, with an underdeveloped informal sector necessary for the domination and growth of the modern sector. These writers, however, do not distinguish between different types of nonmodern activities, and hence ignore the substitutable nature of the intermediate sector. Their analysis is more appropriate to a limited definition of the informal sector, confined primarily to distribution, commerce, transfers (begging, borrowing, swindling, and stealing), and other services, both legal and illegal (see Hart 1973).

INTERNATIONAL EVIDENCE ON THE SIZE AND CHARACTERISTICS OF THE INTERMEDIATE SECTOR

International estimates of the extent of activities outside the modern sector generally focus on defining a lower limit for the modern sector, and do not distinguish between intermediate and informal activities. The number of workers is most commonly used as a criterion, and sometimes is supplemented by the level of output or investment (Ali 1971; Berry 1972; Chuta and Liedholm 1975; Shinohara and Fisher 1968; Staley and Morse 1965). These more readily quantifiable variables serve as proxies for conceptual characteristics, such as ease of entry, labor intensity, low labor productivity, and rudimentary equipment.* The number of workers used as a cutoff is generally in the range of 5-50 for LDCs, with most authors reporting employment in establishments with fewer than 10 workers even if that is not their final dividing line. Variations in definitions and differences in sectors examined in various studies make it appropriate to look only for a general order of magnitude for the intermediate and informal sectors in LDCs, rather than for precise and comparable estimates.

Establishments with fewer than 50 workers account for as much as 70-80 percent of total employment in manufacturing and industry in many LDCs, over half of it in units with fewer than 10 workers. The lower end of the range for LDCs is around 40 percent, while the

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urban-rural wage differentials, since new migrants can readily enter the informal sector (sharing in the total income available to it), whereas modern sector employment grows much more slowly than output because of rapidly rising productivity.

*ILO (1972), p. 6; and P. Castella, "Ville de Bouaké 1969: Résultats d'enquête: Comptes économiques de la ville, Rentabilité de l'étude," Sciences humaines 4, no. 5 (1971): 47, cited in Joshi, Lubell, and Mouly 1974, p. 4.3.

share for industrialized countries ranges from 12 percent to 34 percent. Value added shares in LDCs range from 24 percent to 59 percent (that is, one-third to three-quarters of the employment shares).* For urban employment as a whole, the labor force presumed to be in informal or intermediate activities, by virtue of not being recorded in official statistics as either employed or unemployed, generally accounts for 50-70 percent of total employment (Mazumdar 1975, p. 10). Shares as low as 30 percent have been found, but are considered to be underestimates by those reporting them, especially for smaller cities.†

Intermediate Manufacturing Activities

The predominant intermediate sector manufacturing activity in urban areas is consistently found to be clothing (tailors and seamstresses), which usually accounts for one-third to one-half of small-scale manufacturing employment (Aluko, Oguntoye, and Afonja 1972, p. xi; Berry 1972, p. 18; Chuta and Liedholm 1975, p. 19; Joshi, Lubell, and Mouly 1974, p. 4.5 [excludes construction]; Kilby 1969, p. 18; Liedholm 1973, p. 8; van der Veen 1973, p. 24; Webb 1975, p. 35). Furniture is generally the second largest manufacturing activity, with metalworking (including blacksmiths) and shoes also consistently important. Repairs may constitute an important share of production in these enterprises; and in four cases where vehicle repair is explicitly included, it is one of the top three industries (Chuta and Liedholm 1975, p. 19; Joshi, Lubell, and Mouly 1974, p. 4.5; Kilby 1969, p. 18; Schadler 1968, p. 70). Clothing tends to be less important in rural small-scale industry, furniture and metalworking more important (Child 1973a, p. 3; Chuta and Liedholm 1975, p. 18; Shetty 1963, p. 61). Food (especially baking) and printing are among the top six industries in several studies.

Small size is, with few exceptions, found to be associated with less capital per worker, lower labor productivity, and more output or value added per unit of capital‡ than in larger establishments

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*Preceding data are from D. Kochav et al. (1974) and D. Morawetz (1974), p. 525.

†In Kenya "informal employment accounted for . . . 28-33 per cent of African urban employment. This seems rather low. . . ." (ILO 1972, p. 225). Although 29.3 percent of nonprimary employment in Abidjan in 1970 (26.7 percent in 1965) is "informal," the countryside share is 47.9 percent (Joshi, Lubell, and Moully 1974, pp. 2.17, 4.5).

‡E. N. Dhar and H. F. Lydall (1961) obtain the opposite result, at least in certain industries.

(Berry 1972; Joshi, Lubell, and Mouly 1974; Liedholm 1973; Morawetz 1974; Shetty 1963; Todd 1971). A commonly cited example is that capital is more expensive or less accessible to small-scale entrepreneurs than to large-scale firms that are eligible for government investment incentives and loans. In addition, the cost of labor generally is lower to the smaller firms, especially where there is government or union pressure for a modern sector wage high enough to maintain a minimum standard of living. Given such distortions in factor prices from the true value of capital and labor to the economy, these studies imply that small-scale activities represent a relatively efficient means of utilizing both capital and labor.

Constraints on Intermediate Production

The most important problems generally cited by small-scale producers are inadequate access to financial capital and inability to obtain sufficient raw materials (Ali 1971; Aluko, Oguntoye, and Afonja 1972; Gerry 1974; Kilby 1962; Shetty 1963; van der Veen 1973). Inadequate managerial, technical, and commercial know-how also are cited by these authors. On the other hand, some intermediate workers may be "overqualified," in that they cannot obtain or afford equipment that they are trained to use (Gerry 1974, p. 26), nor can they find an appropriate job in the modern sector. The substantial share of time devoted by small-scale entrepreneurs to the essentially commercial activities of obtaining raw materials at favorable prices and of marketing their products also inhibits the expansion of small-scale production (van der Veen 1973).

These problems are interrelated, and no single policy approach toward increasing efficiency and growth of the intermediate sector emerges from the literature. Although the need for more credit is frequently cited, it is not clear how it can be channeled to those small-scale producers who can use it profitably and repay it. Indeed, "if an enterprise is profitable and if the manager is reasonably aggressive and inventive, capital funds are frequently—though not always—obtainable" (Child 1973a, p. 13). Extension of credit to the intermediate sector must be accompanied by managerial and technical assistance. Infrastructural investment aimed at improving the operation of markets, especially in rural areas, would assist the intermediate sector by reducing the incentive to engage in trading activities that are essentially speculative.* In general, however, researchers indicate that

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*One advantage of small-scale over large-scale production, however, is that its operating costs are less dependent on infrathe first step toward improving conditions for intermediate sector production would simply be recognition of its importance and modification of policies heavily favoring the large-scale modern sector.

FOCUS AND ORGANIZATION OF THIS STUDY

This study focuses on the demand side of the employment problem, investigating the possibilities for raising the rate of growth of productive employment opportunities, either by raising the rate of expansion in relatively labor-intensive productive sectors that employ a substantial share of the labor force or by raising the responsiveness of employment growth to output growth in the faster-growing sectors. That is, (g_E) in equation 1.2 can be raised either by increasing g_Q^j in sectors with a high s^j or by raising e^j in sectors with a high g_Q^j. The basic premise is that policies to promote rapid industrialization (especially when it is implemented through incentives based on capital) are likely to aggravate rather than alleviate urban employment problems, particularly in LDCs where the industrial and urban sectors are relatively small to begin with. Ghana's labor absorption problems under rapid post-independence industrialization are examined in Chapter 2, in order to understand the conditions necessary for successful absorption of surplus labor into productive employment.

The principal hypothesis is that more rapid expansion of small-scale enterprises in the intermediate sector would significantly improve the rate of labor absorption at little or no cost in terms of output growth. Given the capital-intensive bias of existing investment in large-scale industry, the quickest means of absorbing surplus labor is to shift short-term expansion toward more labor-intensive sectors, as long as those activities are sufficiently productive to maintain the overall rate of output growth. Chapter 3 presents the results of a survey of employment in small-scale businesses in Ghana, including the relative size of intermediate employment and the composition of this sector in cities of three different sizes. Small-scale manufacturing firms are compared with large-scale industries in Chapter 4 in order to analyze their relative labor/capital intensities, labor productivity, and potential for generating output and employment growth from a given investment. Chapter 5 assesses the labor absorption potential of the intermediate sector (focusing on manufacturing) if the constraints on its expansion can be removed.

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structure. Rapid expansion of (capital-intensive) infrastructure to promote expansion of the intermediate sector would be a self-defeating strategy.

Substantial efforts must be made if a worsening of underutilization of labor (and capital) is to be avoided. Even if large-scale employers of wage labor can maintain or slightly raise past expansion rates, they are unlikely to absorb more than one-quarter to one-third of new labor supply in major urban areas over the short run of five years or fewer. In order to absorb one-half to three-quarters of the new labor force entrants without sacrificing output growth, rapid improvement in utilization of small-scale manufacturing capacity is essential, along with expansion of other intermediate activities on the order of 10 percent per annum.

Studies of labor-capital substitutability in many LDCs have suggested that large-scale industrial labor absorption rates might be greatly improved if wage growth could be restrained. Ghana was unusually successful in restraining real wages during the 1960s, and Chapter 6 uses this experience to analyze the relative impact that wage policy is likely to have on the rate of employment growth. Although high and rising wages are clearly undesirable, both because they discourage labor-intensive production and especially because they stimulate more rapid growth of urban labor supply through migration, wage restraint does not offer a sufficient means of dealing with the employment problem, especially in the short run. Furthermore, in the long run, output growth rates and policies regarding capital dominate any effects that realistically achievable changes in wage policy can have.

The concluding chapter suggests some policies for stimulating more rapid expansion of the intermediate sector. The very nature of small units of production, as well as their diversity and dispersion, limits the possibilities for direct government intervention. The most important indirect stimulus would be removal of some of the advantages given to large-scale industries, at least for those products and activities in which small-scale production has a high level of performance or potential. In particular, reduction of the virtually exclusive access of large-scale firms to import licenses for raw materials and to loans, both at artificially low rates, would improve the ability of smaller firms to compete for these resources. Direct provision of materials and credit, supplemented by managerial and technical assistance, to intermediate sector firms might best be done through cooperative associations of small-scale producers in various industries.

THE STRUCTURE OF THE GHANAIAN ECONOMY

Ghana's economy is reasonably well developed compared with those of many other countries in the less developed world. Its income per capita in the neighborhood of $300 and its 25 percent literacy rate are among the highest in Africa, and earn it a "fourth world" designation in a five-tier classification of world development.* Its relatively good position is based largely on the development of cocoa production at the turn of the twentieth century. Ghanaian farmers were quick to take up the new export crop after its introduction at the end of the nineteenth century, and by 1911 investment in cocoa trees accounted for almost one-third of domestic capital formation. Between 1891 and 1911, capital formation as a percentage of gross domestic product (GDP) rose from 2 percent to 18 percent and exports from 8 percent to 19 percent (Table A.1). Cocoa has accounted for one-half to two-thirds of Ghana's exports ever since, although its share in GDP declined over time to 11 percent in 1972 (Table A.2).

The structure of Ghana's economy at independence in 1957 was remarkably similar to that in 1911 (Table A.1).† There was some increase in the government and trade sectors, while capital formation declined somewhat and shifted toward buildings and construction, away from machinery and equipment (as well as cocoa trees). The share of cocoa and timber in exports increased at the expense of other agricultural products, and other minerals replaced a large portion of gold's share. On the whole, however, the boom and rapid structural change of the early twentieth century did not continue. One reason is that cocoa had virtually no direct linkage to the rest of the economy (though it was an important source of domestic savings for investment in other activities). Its one linkage, to road transport, was discouraged by the British colonial government, which saw lorries (trucks) as a threat to the profitability of the railroads (built to serve the mines) and distrusted cocoa because the scattering of farms appeared hopelessly disorganized by European agricultural standards (Hymer 1969). The expansion of cocoa was discouraged.

A major public investment program might have sustained the cocoa boom and laid the basis for a new leading sector, but colonial policy dictated expenditures only out of revenues. Governor Gordon Guggisberg finally managed to undertake building of infrastructure in the 1920s—a harbor, a hospital, and a secondary school in particular—but the depression of the 1930s cut off any growth that might have occurred (Hymer 1969). Any possibility of a shift in colonial policy toward development expenditures was set aside in the 1940s by World War II, and in the 1950s by the realization that independence

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*"Poor vs. Rich: A New Global Conflict," Time, December 22, 1975, p. 37.

†For a fuller treatment of this point, see R. Szereszewski, Structural Changes in the Economy of Ghana 1891-1911 (London: Weidenfeld and Nicolson, 1965).

was imminent. The wave of independence for African nations in the 1960s was initiated by Ghana, led by Kwame Nkrumah, in 1957.

President Nkrumah set out to transform the economy by means of an intensive drive to extend industrialization and infrastructure. A large share of spending was for projects with social and political objectives, which did not generate revenues to repay rapidly accumulating debts. The massive scale of this program proved to be beyond the financial and administrative capacity of the government. By the time Nkrumah was overthrown in 1966, the economy was near collapse under the strain of shortages of consumer goods, rapid price inflation, and inability to meet international obligations. The resulting stagnation meant that income per capita did not grow during the 1960s. Nevertheless, the infrastructural and industrial investments did have a substantial impact on the welfare of the society and the structure of the economy. This phenomenon has been described as "development without growth" by Jean Due (1973), who lists 23 indexes of social welfare that increased markedly in the 1960s. Education is one of the main advances: 43 percent of the population over six years old in 1970 had attended school (over half of them currently attending), as against 27 percent in 1960 (1960 Population Census of Ghana, II, Table 1; 1970 Population Census of Ghana, III, Table C16).

The economic structure shifted strongly toward services (reflecting the emphasis on social welfare) and manufacturing (reflecting the drive to replace imports with local industrial products) in 1960-72 (see Table A.2). The impact of import substitution on industrialization is evident in the changing structure of both imports and manufacturing (see Table A.3). Consumer goods fell from 55 percent to 30 percent of total imports over 1958-69, initially under direct control through import licensing and later through an increase in investment goods (from 31 percent to 46 percent of imports over 1962-65) and intermediate goods (from 20 percent to 36 percent over 1965-69) for local production. The large-scale manufacturing sector diversified as it expanded, moving from 80 percent to 42 percent of total output in the food, beverage, tobacco, and wood products industries over 1958-72, and increasing the share of intermediate goods production from 2 percent to 26 percent.

With rapid industrialization came rapid urbanization. The percentage of the population living in urban areas of 5,000 or more rose from 13 percent in 1948 to 23 percent in 1960 and 29 percent in 1970 (see Table A.4). The share of the population living in the largest cities of 50,000 or more almost tripled over 1948-70, while that in towns of 5,000—50,000 doubled.

The implications of industrialization and urbanization for employment are discussed in Chapter 2, and for the development of the intermediate sector in Chapter 3.

CHAPTER

5

EMPLOYMENT STRUCTURE AND POTENTIAL OF SMALL-SCALE MANUFACTURING

THE ROLE AND STRUCTURE OF THE INTERMEDIATE SECTOR

The preceding chapter suggested that certain industries are more suited for small-scale than large-scale production. A higher concentration of small-scale than large-scale employment in certain industries is de facto evidence that such an advantage exists, at least under the economic conditions and policies prevailing in Ghana. This chapter begins by examining in more detail the relative distribution of manufacturing employment and businesses in both the intermediate and the modern sectors. Small-scale industries are also analyzed in terms of the categories of workers employed. Analysis of economic characteristics in Chapter 4 led to the conclusion that small-scale furniture, printing, and cement block industries have a "comparative advantage" for expanding employment at the least cost in terms of investment and output. This chapter analyzes the realistic opportunities for expansion of these and other small-scale industries by examining the major constraints on their production and the magnitude of employment increase that could actually be expected.

Transitional Role of Intermediate Activities

A strategy of expanding the intermediate sector has both short-run and long-run objectives. The immediate goals are to absorb surplus labor productively, and to avoid both the output-employment conflict associated with a large-scale industrialization strategy and the unproductive overflow of labor into informal income-earning activities. In the long run, the intermediate sector can lay a foundation of manufacturing skills and entrepreneurial experience for growth of the highly productive modern sector, when the latter has become sufficiently large both to lead the development process and to absorb a major share of urban labor force entrants. In both roles, the intermediate sector can smooth the transition from a rural to an urban labor force and from relatively unproductive self-employment to industrial wage employment.

The analytical introduction of the intermediate sector into the modern-informal dichotomy is intended to emphasize the existence of a continuum of types of business activity and employment. Analysis of the employment structure of the intermediate sector at a point in time can help illustrate its hypothesized transitional role over time. Small-scale firms with one or more wage employees might be considered relatively "modern," as would all wage employees and their employers. Self-employed workers, their family members, and their establishments might be termed "informal." There remain the categories of apprentice and part-time workers, their employers, and firms containing nonwage employees, which may be termed "transitional" for the sake of the argument presented here. Then the structure of the small-scale sector as presented at the beginning of Chapter 3 may be reformulated as in Figure 5.1. There is some overlapping between the business and employment classifications, because some "modern" firms employ apprentices and part-time workers as well as wage workers, and because "informal" family members may be active in "transitional" firms.

A dynamic model of transition is suggested by the stepladder form of Figure 5.1. Unsuccessful job seeks and laid-off workers* must go into business on their own in order to earn enough income to survive, often trading on skills such as carpentering, sewing, or cooking. Those who meet with some success may use family members for assistance, and eventually engage part-time help or apprentices. Apprentices have the advantage of requiring little cash outlay, since the master usually provides only room and board plus a minimal amount of spending money.† Apprentices provide the dynamic mech-

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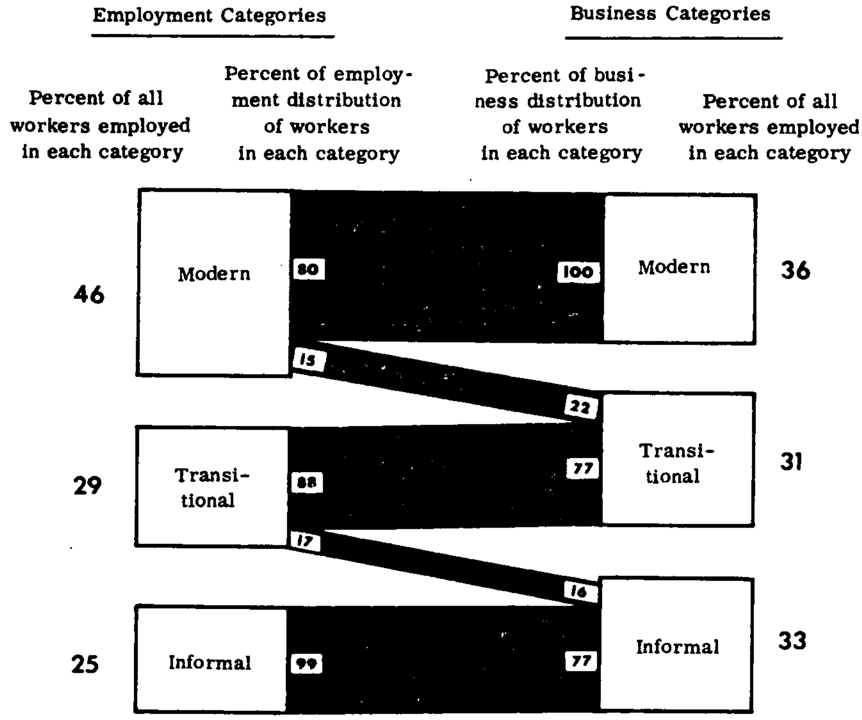
*C. Gerry (1974) finds that over half of the small-scale furniture makers and mechanics in Dakar had previously been employed for wages.

†In many trades, the apprentice's family normally pays an agreed-upon sum to the master at the beginning and/or end of the apprenticeship. Compared with the costs of maintaining the apprentice over the three to six year training period, the fees tend to be small, on the order of ¢50-100. A few seamstresses in the survey, however,

FIGURE 5.1

Distribution of Intermediate Workers by Modern, Transitional, and Informal Business and Employment Categories: Accra, 1973 Survey



Note: Distributions under 10 percent of a category are not shown.
Source: 1973 Accra manufacturing survey.

anism for perpetuating this model, since they can use their acquired skills to go into business for themselves if they, too, are unable to find wage employment. Certain noncraft activities, such as corn milling, provide a relatively inexpensive means of investing profits from

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had managed to make apprenticeship a paying proposition (aside from the work produced by the apprentices) by organizing their enterprises as "schools" for day students. See Planungsgruppe (1974) for further discussion of the apprenticeship system.

other activities, such as cocoa farming, and can be operated at low cost by family or part-time labor.

Although many small-scale firms never move past the apprentice stage, some flourish sufficiently to increase the number of apprentices, eventually having to hire additional masters to help supervise the apprentices. Especially in noncraft activities, part-time workers taken on to meet particular orders may become full-time wage workers as the stream of orders becomes steady. Thus the firm enters the modern sector; and as the employer gains business experience, it may grow into a large-scale establishment. The intermediate sector provides the training ground, and the proving ground, for experienced entrepreneurs who can provide the managerial skills needed in a developing economy,* as well as the reinvestment and expansion necessary for sustained growth of output and employment.

This hypothetical model of the transitional role of small-scale enterprises would require longitudinal study of the development of such firms over time for formal testing, and the share of firms that actually go through such a process cannot be further investigated with the data at hand. It does, however, provide a framework for analyzing the impact on the employment structure of expanding particular industries. The extent to which different small-scale industries overlap the modern, as against the informal, sectors will be compared after analyzing the distribution of different types of employment across these industries.

Industrial Distribution of Employment

Comparison of the distribution of manufacturing employment across industries within the small-scale and the large-scale sectors, as well as for total manufacturing employment, indicates the activities that are most likely to provide employment in small-scale enterprises. Table 5.1 presents this comparison for Accra, using the small-scale employment and manufacturing surveys described in Chapters 3 and 4. Industry 32 (clothing, travel bags, shoes, and other textile products) is the largest industry in all three cases, but the share is over

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*In many LDCs, the dominance of alien businesses in the small-scale sector (often introduced by the colonial power) inhibits the development of an indigenous entrepreneurial class and stands as a barrier to sustained, self-contained growth. Hence the economic rationale for expelling aliens (as in Kenya, Uganda, and Ghana in the early 1970s, though the latter focused more on non-Ghanaian African traders than on non-African businessmen).

TABLE 5.1

Industrial Distribution of Manufacturing and Repair Workers by Employment Category: Accra, 1973 Survey
(percent of total employment in category)

ISIC Code and Industry	Accra Small-Scale Business Employment Survey: Full-Time Wage Employees	Working Employers	Apprentice, Part-Time, Family	Purely Self-Employed	Total, Small-Scale	Large-Scale Industries (1971)	All Manufacturing Workers (1970)
31 Food,[a] beverages, tobacco	14.0	7.0	4.0	17.9	9.3	13.5	27.4
Baking (3117)	8.4	2.4	0.9	6.6	4.1	0.9	4.0
Other foods plus chop bars[b]	16.4	16.4	7.6	25.9	14.4	2.2	19.3
32 Clothing, travel bags, shoes, other textile products	24.0	42.9	43.8	57.6	39.8	25.1	39.1
33 Furniture, wood products	4.0	14.6	7.6	12.3	8.2	7.3	9.3
34 Printing, paper products	14.9	5.8	4.3	0.3	7.0	21.6	8.9
35 Chemical products	9.7	2.7	1.1	1.3	3.9	14.5	6.0
36 Concrete blocks, nonmetallic mineral products	2.0	1.2	0.8	0.0	1.1	5.2	1.6
38 Metal products, machinery (except vehicle repair)	12.0	11.6	13.1	3.5	11.2	11.4[c]	5.6
Electrical and welding repairs	1.2	7.9	9.5	2.8	5.9	—	—
384 Vehicle repair	15.8	12.2	24.2	0.0	16.5	—[c]	—
39 Jewelry, watch repair, other	3.8	2.1	1.3	7.2	3.0	1.3	2.0
Subtotal							
Manufacturing only[c]	81.0	75.1	64.7	83.6	73.7	—	—
Repairs only	19.0	24.9	35.3	16.4	26.3	—	—
Total, all industries	100.0	100.0	100.0	100.0	100.0	100.0[c]	100.0

[a]"Food" does not include "chop bars," which primarily prepare and serve food. Nevertheless, they do carry out some processing of food (other than just cooking), and appear to be included in the census as a manufacturing activity. They are included here only with "other foods," for comparison.

[b]Percent of total employment including chop bars.

[c]Vehicle repairs are not included in the Industrial Statistics.

Sources: Table C.2, large-scale industries from Ghana, Industrial Statistics, 1971 quarterly worksheets; all manufacturing workers from Ghana, 1970 Population Census, preliminary worksheets.

half again as high in the small-scale as in the large-scale sector (40 percent versus 25 percent). Vehicle repair provides the second largest employment among small-scale activities, quite probably higher than the large-scale share, although no comparison can be made because this activity is excluded from the Industrial Statistics* and is not listed separately in the available census figures. Baking and other foods—especially when including "chop bars," which process as well as prepare and serve foods—constitute the other important small-scale activity with a substantially larger share of small-scale than large-scale employment. Industry 31 (food) claims an even larger share of informal sector employment, as indicated by the higher share for all workers than for either small-scale or large-scale employment. Industries 31 and 32 provide two-thirds of total employment, but about half of small-scale employment and not quite 40 percent of large-scale employment.

The furniture industry accounts for over 8 percent of small-scale employment (slightly more than in the large-scale sector), making it the fourth largest two-digit industry. In addition, it has the second largest share of working employers (15 percent). Although a majority of the employees are apprentices, as will be shown, the presence of a substantial number of employers provides the potential for future expansion of wage employment, under the appropriate economic conditions and with a management assistance program. The printing industry, on the other hand, is relatively much more important in the large-scale sector; it is the second largest employer in Accra. This suggests that if present conditions prevail, small-scale printing is likely to remain subordinate to the large-scale sector. If, on the other hand, the difference is due primarily to artificial constraints (such as import licensing) and subsidies, then alteration of these conditions would offer high potential for gain through a long-run shift from large-scale production (an assumption based on the analysis of the preceding chapter). Concrete block production at present accounts for only 1 percent of small-scale employment, though, as with printing, this share might be usefully increased somewhat through a long-run shift from the modern sector.

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*One reason for exclusion is the recognition that vehicle repair is largely a small-scale activity, and cannot readily be enumerated on a regular basis or provide reliable statistics. Furthermore, most of the employees are apprentices or part-time labor rather than wage workers, and double-counting would be inevitable since many part-time workers also hold jobs in larger vehicle repair establishments.

TABLE 5.2

Employment Distribution of Small-Scale Manufacturing and Repair Workers by Two-Digit Industries: Accra, 1973 Survey

(percent of total employment in each industry)

TABLE 5.2

Employment Distribution of Small-Scale Manufacturing and Repair Workers by Two-Digit Industries: Accra, 1973 Survey
(percent of total employment in each industry)

ISIC Code and Industry	Accra Small-Scale Business Employment Survey: Full-Time Wage Employees	Working Employers	Apprentice, Part-Time, Family	Purely Self-Employed	Total, Small-Scale	Percent of Industry's Workers[a]: Small-Scale	Large-Scale
31 Food,[b] beverages, tobacco	44.0	11.0	17.7	27.3	100.0	13.7	17.1
Baking (3117)	59.8	8.7	8.7	22.8	100.0	41.3	7.6
Other foods plus chop bars[c]	34.3	17.3	20.9	27.6	100.0	33.4	3.9
32 Clothing, travel bags, shoes, other textile products	17.7	15.8	46.0	20.5	100.0	40.9	22.1
33 Furniture, wood products	14.1	26.1	38.6	21.2	100.0	35.4	27.1
34 Printing, paper products	62.0	12.0	25.3	0.6	100.0	31.8	83.7
35 Chemical products	73.6	10.3	11.5	4.6	100.0	26.0	83.6
36 Concrete blocks, nonmetallic mineral products	54.2	16.7	29.2	0.0	100.0	26.6	111.5
38 Metal products, machinery (except vehicle repair)	31.5	15.1	49.0	4.4	100.0	80.7	70.6
Electrical and welding repairs	6.1	19.7	67.4	6.8	100.0	38.2	—
384 Vehicle repairs	28.0	10.8	61.2	0.0	100.0	—	—
39 Jewelry, watch repair, other	37.3	10.5	17.9	34.3	100.0	60.2	22.4
Subtotal							
Manufacturing only	32.3	14.9	36.7	16.1	100.0	—	—
Repairs only	21.2	13.9	56.2	8.8	100.0	—	—
Total, all industries	29.4	14.7	41.8	14.2	100.0	40.2	34.6

[a]Total employment in each industry has been projected to 1971 and 1973 using 1960-70 growth rates for comparison with large-scale and small-scale figures, respectively. Large-scale figures are exaggerated because some head offices located in Accra reported the entire firm's employment as in Accra, even though the plant may have been outside the city, whereas census figures are based on place of residence. Thus, the sum of small-scale and large-scale employment attributed to Accra may exceed the number of workers in a particular industry enumerated as residing in Accra, resulting in a total exceeding 100 percent. Totals over 100 percent may also reflect problems of sampling small industries and differences between 1970 and 1973 that were not accounted for in the extrapolation.

[b]"Food" does not include "chop bars," which primarily prepare and serve food. Nevertheless, they do carry out some processing of food (other than just cooking), and appear to be included in the census as a manufacturing activity. They are included here only with "other foods," for comparison.

[c]Percent of total employment including chop bars.

Sources: Table C.2; total employment from Ghana, 1970 Population Census, preliminary worksheets, and 1960 Population Census, IV; large-scale employment from Industrial Statistics, 1971, quarterly worksheets.

Major Type of Employment by Industry

Both printing and cement blocks have larger shares of total full-time wage employment (15 percent and 2 percent, respectively) than of other small-scale employment categories shown in Table 5.1. Indeed, wage workers constitute well over half (62 percent and 54 percent, respectively) of total small-scale employment in these industries (Table 5.2). Chemical products (74 percent) is the only two-digit industry with a larger share. These three industries, along with the baking subindustry (60 percent) are the most "modern" intermediate industries by the wage employment criterion. A given employment expansion in these industries would modernize the employment structure more than would a corresponding increase in other small-scale industries.* They also are the industries in which the large-scale sector has the greatest employment shares relative both to the small-scale share and to total employment in industry.

The dominant type of small-scale manufacturing employment in general is the "intermediate" category of apprentices (35 percent; plus part-time and family employees, 42 percent), especially in repairs (51 percent; plus others, 56 percent). The electrical and welding, and vehicle repair, industries have more than 60 percent of their employment in this category, followed by clothing and furniture. These industries have somewhat larger shares of their total employment in small-scale than in large-scale firms. The industries with the largest ratios of small-scale to large-scale shares—food and jewelry—also have a significantly higher proportion of small-scale workers who are purely self-employed.

Small-scale manufacturing appears to have a more "modern" employment structure than does repairs, with wage labor accounting for 32 percent of its total employment, as against 21 percent for repairs (Table 5.2). In terms of numbers of firms (Table 5.3), however, manufacturing has only 16 percent with wage employees as against 21 percent for repairs. Manufacturing's high wage employment share is attributable to its greater share of firms with ten or more workers (principally in chemicals and nonmetallic mineral products). If the intermediate sector were defined with an upper limit of ten employees, then wage workers would count for only 22 percent of small-scale manufacturing employment and 18 percent of repairs. In addition to chemicals and nonmetallic mineral products, more than half the firms in printing and in vehicle repair employ wage workers. Promotion of these industries would have relatively more impact on wage employment than would expansion of other industries.

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*It must be remembered that a given investment will not provide the same employment expansion in all industries, so that more wage employees may actually be hired through investment in an industry with a less "modern" structure.

TABLE 5.3

Distribution of Small-Scale Manufacturing and Repair Establishments
by Size Category and Industry: Accra, 1973 Survey
(percent of firms in each two-digit industry)

ISIC Code and Industry	Purely Self-Employed[a]	Firms with Other Employees Only	Firms with Full-Time Wage Employees 1-9	10-29	Total	Percent of Subsector Firms
Manufacturing						
31 Food[b] and beverages	57.7	20.6	18.6	3.1	100.0	19.3
32 Clothing, travel bags, other textile products	56.7	37.3	3.5	2.5	100.0	56.6
33 Furniture, wood products	44.9	43.5	11.6	0.0	100.0	13.7
34 Paper, printing	5.3	5.3	73.7	15.8	100.0	3.8
35 Chemicals, plastics	0.0	0.0	0.0	100.0	100.0	0.8
36 Nonmetallic mineral products	0.0	11.1	44.4	44.4	100.0	1.8
38 Metal products	22.2	55.6	22.2	0.0	100.0	1.8
39 Jewelry, other	63.6	18.2	9.1	9.1	100.0	2.2
Total						
Manufacturing only	51.4	32.9	11.4	4.4	100.0	100.0
Number of firms	2,580	1,650	570	220	5,020	—
Repairs						
32 Shoes, other textile products	71.4	21.4	7.1	0.0	100.0	24.6
33 Wood products	100.0	0.0	0.0	0.0	100.0	1.8
35 Chemical products (tires)	50.0	50.0	0.0	0.0	100.0	5.3
38 Metal products and electrical (except 384, vehicles)	26.7	56.7	16.7	0.0	100.0	26.3
384 Vehicles	0.0	46.7	46.7	6.7	100.0	26.6
39 Watches, other	88.9	5.6	5.6	0.0	100.0	15.8
Total						
Repairs only	43.0	36.0	19.3	1.8	100.0	100.0
Number of firms	490	410	220	20	1,140	—

[a]Includes both "established" and "casual" self-employed.
[b]Excluding chop bars.
Source: Table C.2.

Half or more of the firms in metal, electrical, and tire repairs, and in manufacture of metal products, employ apprentices or other workers but no wage employees. The vehicle repair and furniture industries also have over 40 percent of firms depending on apprentice labor. Expansion of these industries would tend to have a greater impact on employment relative to output than would expansion in other industries, since apprentices are undergoing training that will raise their productivity in the future. Further study of these industries and of apprenticeship would be desirable, in order to investigate ways of assisting the employers to become wage employers and to provide their apprentices with business management training as well as skill in the craft. Intermediate sector enterprises offer a fertile ground for developing the entrepreneurial abilities that are essential for the efficient development of the private—and the public—sectors of the economy.

The industries that are dominated by single-person establishments are closer to being "informal" ways of earning enough income to survive, and offer less potential for development through the reinvestment of profits to expand production and hire more workers. Watch and shoe repair, and manufacture of clothing and food products (especially milling), are the major industries in this category; minor industries include jewelry and repair of tires and of wood products. Furniture is the only other industry with a substantial share of firms in this category. These activities are important as a source of subsistence income to people without wage employment or as supplemental income to those with low-paying jobs. Policies that restrict entry into these industries or that subsidize large-scale producers are likely to worsen the distribution of income by reducing income-earning opportunities, and should be avoided. On the other hand, the relatively large shares of existing small-scale employment in these activities suggests that entry is relatively easy and that no special promotion measures need be adopted.

Constraints on Expanding Production and Employment

Analysis of the structure of industries by size category indicates that the chemical, vehicle repair, concrete block, and printing industries are the intermediate activities most likely to provide wage employment. The latter two, in particular, offer substantial opportunities for shifting from large-scale to small-scale production. In addition, the furniture industry and most repair activities have high potential for absorbing labor, and raising its future productivity, through apprenticeship. The next question is what factors constrain the expansion of these industries, and of the intermediate sector in general. This information will serve as a basis for projecting employment increases if policies are adopted to remove these contraints and, in the final chapter, for proposing appropriate policy areas and measures.

Firms interviewed in the Accra small-scale employment survey were asked for the most important problem that prevented them from increasing production. The responses are categorized as inability to get enough laborers, skilled workers, raw materials, spare parts, cash or credit, customers or sales; high prices of materials and spare parts; and other. If several answers were given, only the two most important were recorded. The responses for manufacturing and repairs are summarized separately in Table 5.4.

Lack of sufficient raw materials or spare parts is cited by 52 percent of the firms, and insufficient working capital by 42 percent, as the most important constraints on expanding production. In industries dependent on imported or seasonal materials, these two problems interact. Many small businesses complained that materials were available only at irregular intervals, and that they did not have sufficient working capital to carry the stocks needed to maintain production through periods of unavailability. The high prices of materials and spare parts cited by 25 percent of the respondents further limit the ability of small businesses to stock up on materials. To some extent, however, concern about the high price of inputs may arise from an inability to pass on increased costs to the consumer. This suggests that demand might be a constraint on expansion even if materials and spare parts were readily available (at the higher prices). Although only 18 percent cited inadequate demand or too much competition as limiting their ability to expand, they were referring to marginal expansion of their individual firms. Demand would certainly be a more serious limitation if all small-scale firms in most industries were to expand to full capacity production in a short period of time, unless they were replacing imports or large-scale production.

Repair establishments are much more severely constrained by spare parts limitations than are manufacturing firms (34 percent, as against 9 percent), principally because spares are crucial to the important vehicle repair industry. Many vehicle repairmen complained of the time and expense involved in going around to the larger firms that import the spare parts, to "accident car" dealers, and even over 100 miles to Lomé, Togo, searching for needed parts.

Lack of raw materials is the single most important constraint on small-scale manufacturing firms (46 percent) and is much more serious for firms with wage employees (cited by over 60 percent of such firms) than for smaller firms (under 30 percent). This apparent association with size, however, largely reflects the fact that over 90 percent of the printing, chemicals, and cement block firms surveyed engage wage employees. These industries were particularly hard-hit by materials shortages at the time of the survey; 85 percent of printing firms cited materials as the most important constraint, and 69 percent of firms in industries 35-39. These establishments depend on large-scale firms in the same industry for their imported materials, given the time and knowledge of procedures (as well as financing) necessary

TABLE 5.4

Constraints on Ability to Utilize Capacity in Small Businesses
by Size Category and Industry: Accra, 1973 Survey
(percent of firms responding in each category)

Industry and Firm Size Category[a]	Working Capital[b]	Raw Materials	Spare Parts	High Prices: Materials and Spare Parts	Demand	Skilled Labor
Manufacturing Two-Digit Industries						
31 Food and beverages (16)	6	56	31	32	19	0
32 Textiles (26)	42	31	4	38	12	8
33 Wood products (21)	53	19	5	34	24	10
34 Paper, printing (13)	54	85	0	0	31	0
35-39 Miscellaneous (16)	37	69	0	6	38	0
Manufacturing firms engaging						
Self-employed only (22)	39	27	3	32	9	9
Nonwage workers[c] (24)	37	29	13	33	25	0
1-9 wage workers (32)	37	63	13	19	22	6
10-29 wage workers (14)	43	64	0	7	43	0
Total manufacturing (92)	39	46	9	25	23	4
Repair Firms Engaging						
Self-employed only (6)	50	33	17	17	17	0
Nonwage workers[c] (16)	37	6	44	32	12	0
1-9 wage workers (16)	56	13	31	26	0	0
Total repairs (38)	47	13	34	27	8	0
Total, repairs and manufacturing	42	36	16	25	18	3

[a]Number of firms responding is given in parentheses.
[b]Primary need for working capital was to buy materials when available.
[c]Firms employing apprentices, part-time workers, and/or family members, but no full-time nonfamily wage workers.
Note: Percentages in each row may total more than 100 percent because some firms gave two responses.
Source: 1973 Accra manufacturing survey.

Total repairs (38)	47	13	34	27	8	0
Total, repairs and manufacturing	42	36	16	25	18	3

[a]Number of firms responding is given in parentheses.
[b]Primary need for working capital was to buy materials when available.
[c]Firms employing apprentices, part-time workers, and/or family members, but no full-time nonfamily wage workers.
Note: Percentages in each row may total more than 100 percent because some firms gave two responses.
Source: 1973 Accra manufacturing survey.

to obtain an import license, and the tendency to issue licenses only to large, well-established firms. The large-scale firms are understandably reluctant to sell their raw materials when they are facing production cutbacks themselves. In comparison, the domestically supplied furniture industry places a relatively low priority on raw material availability (only 19 percent of the firms); owners are more concerned about the prices of those materials and obtaining the funds to buy them and maintain stocks.

The shortage of materials and spare parts in many industries is directly related to the system of rationing foreign exchange through import licensing, in order to maintain a low official price of foreign exchange. Licenses are allocated on an annual basis, and generally go only to large-scale firms. A decrease in foreign exchange earnings can mean a cutback in allocations for materials and spare parts, or restricted issuance of the letters of credit needed to utilize licenses. The average import component for raw materials of 61 percent reported in Table 5.5 is an underestimate of the true dependence of small-scale firms on imports because both milling and cement products in fact depend on imported materials (wheat, clinker) that are simply processed in Ghana. Furniture and metal products are actually the least dependent, since lumber is produced locally and scrap metal is available. Printing and jewelry are the most completely dependent, with virtually 100 percent of their supplies imported. Over 89 percent of spare parts are imported in all industries except cement, which can obtain about half the parts for simple blockmaking machines locally. The argument that smaller firms must depend on larger ones for these imported materials and parts is confirmed in Table 5.6. Only 3 percent of the firms with fewer than ten workers import any materials or spare parts themselves, whereas imports are the primary source of materials in 55 percent of firms with 10-29 workers and of spare parts in 63 percent. Half of the smaller enterprises depend on larger importing firms for most of their raw materials, primarily firms in the same industry that have import licenses. These firms are also the major supplier of spare parts to 82 percent of the smaller ones. New methods must be found to make materials and spares more directly available to small-scale businesses if they are to be able to compete on even terms with larger ones, especially when foreign exchange is scarce.

Working capital is the most consistently important constraint across all categories and industries, mentioned by 37 percent or more of respondents in all cases except the food industry.* Solution of this

*The small-scale food industry is dominated by milling, which requires no stocks because customers supply the materials to be milled, and baking, which generates funds quickly through very short production and sales periods.

TABLE 5.5

Imported Share of Raw Materials and Spare Parts for Small-Scale Manufacturing: Accra, 1973 Survey (average percentage share for firms in each industry)

ISIC Code and Industry		Raw Materials	Spare Parts
3116-17	Milling, baking	11.4[a]	94.2
322-23	Clothing, travel bags	61.9	89.3
332	Furniture	42.4	100.0
342	Printing	99.9	89.2
352	Paints, chemical products	75.0	95.0
369	Cement products	0.0[b]	50.0
381-82	Metal products	57.4	99.0
390	Jewelry, miscellaneous	98.5	99.3
Total, all industries		60.7	91.1

[a]Imported wheat is milled in Ghana to produce flour for baking.

[b]Cement for block making is purchased from a factory in Ghana that grinds imported clinker into cement. Hence, the true import content is quite high.

Source: 1973 Accra manufacturing survey.

problem would help reduce the importance of the others, since firms would be better able to stock up on materials and spares when available, in order to maintain steady production through periods of unavailability.

Insufficient demand was stated as a major problem primarily by the larger metal products and printing establishments, for somewhat different reasons. The former were suffering from a depressed construction industry and the consequent lull in derived demand for gates, window grates, metal furniture, and similar metal products. Small-scale printers were severely affected by a government order that all government printing must be done by the state-owned Ghana Publishing Corporation. Many small printers had previously earned enough from receipt books and similar small jobs for government ministries or agencies to keep them in business, and private demand alone was proving insufficient to provide them with steady work.* It

*The government order was an attempt to improve the financial position of the Ghana Publishing Corporation. Some people complained,

TABLE 5.6

Sources of Supply of Raw Materials and Spare Parts for Small-Scale Manufacturing: Accra, 1973 Survey (percentage of firms in each size category)

Size Category of Firm	Local Producer	Imported Directly by Firm	Large Trading Firm[a]	Other Importing Firm[b]	Middlemen, Bought in Market
			Raw Materials		
Primary source					
< 10 workers	12.5	3.1	18.9	31.3	34.4
10–29 workers	18.2	54.5	13.6	13.6	0.0
Primary plus secondary source					
< 10 workers	21.9	3.1	31.3	46.9	53.1
10–29 workers	50.0	63.6	18.2	22.7	27.3
			Spare Parts		
Primary source					
< 10 workers	7.7	2.6	25.6	56.4	7.7
10–29 workers	0.0	63.2	0.0	36.8	0.0
Primary plus secondary source					
< 10 workers	17.9	2.6	33.3	56.4	12.8
10–29 workers	15.8	63.2	0.0	42.1	5.3

[a]Ghana National Trading Corporation, United Africa Company, and Union Trading Company.

[b]Including large-scale manufacturers in the same industry.

Source: 1973 Accra manufacturing survey.

is not clear whether the importance of insufficient demand in printing reflects excess supply of printing services in general and an excessive number of small printers in particular, or artificial restriction of demand for small printing jobs which could be done more efficiently by small-scale printers.

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however, that it already had more work than it could handle, and could not get lower-priority government jobs out quickly.

The relatively small proportions of textile (12 percent) and food (19 percent) firms listing demand as a constraint is somewhat surprising, in view of the relative ease of entry and the abundant number of establishments in both (plus the consumer alternatives of sewing and of pounding corn in the home). It may be, however, that demand limitations were seen primarily in terms of passing on the rising costs of materials—the second most important constraint in these industries—and that these industries would be unable to expand greatly at the higher prices necessary to cover increased costs.

Potential Expansion from Removing Constraints

The general impact of these constraints was summarized in Table 4.4. Small-scale firms were producing only half as much output as they were capable of with existing capital stock and workers, and a third of what they could achieve with no limit on materials and demand (at prevailing prices). Employment was only 60 percent of what it would be with no materials/demand constraint, given the capital stock, and 53 percent of what existing firms would hire if they had access to credit for additional working and fixed capital. Details of the employment increase by industry and firm size, if all firms in each industry could simultaneously achieve full utilization of existing fixed and working capital, are presented in Table 5.7.

Textiles and furniture are the industries with by far the largest capacity to absorb additional labor in the short run, if possible aggregate demand limitations are ignored. In both cases, the overwhelming majority of new employees would be in firms currently employing only apprentices, many of which would hire wage labor under more favorable demand and material supply conditions. Among firms currently employing wage labor, textiles, printing, chemicals, and metal products would have the largest absolute increases (all over 800), while chemicals and cement blocks would have the largest percentage increases.

Not only can smaller firms potentially absorb a greater number of additional workers than larger ones within the intermediate sector, they also have a higher maximum rate of increase in response to removal of constraints: over 80 percent for firms employing fewer than 10 workers, as against 62 percent for those with 10-29. Large-scale firms with 30 or more employees would increase employment by only about 25 percent if they were able to achieve full capacity

TABLE 5.7

Additional Employment by Firm Size and Industry if No Constraints: Accra, 1973 Survey

ISIC Code and Industry	Current Size Category of Firms: No Wage Workers[a]	Wage Employees 1-9	Wage Employees 10-29	Total Additional Workers	1973 Employment	Average Percentage Increase: Accra Weights[b]	Average Percentage Increase: Survey Weights[c]
31 Food	343	501	78	722	2,090	34.5	40.8
32 Textiles	4,814	541	851	6,206	8,450	73.4	68.6
33 Wood products	2,115	402	0	2,517	1,810	139.1	111.4
34 Paper, printing	40	503	364	907	1,580	57.4	61.8
35 Chemicals	0	0	834	834	490	170.3	170.3
36 Mineral products	97	223	0	320	240	133.3	163.2
38 Metal products	146	435	390	971	1,190	81.6	78.6
39 Miscellaneous	119	90	270	479	680	70.4	74.5
Total	7,674	2,495	2,787	12,956	16,530	78.4	67.5[d]
1973 employment	9,050	3,010	4,470	16,530	—	—	—
Percent increase	84.8	82.9	62.3	78.4	—	—	—

[a]Owner only, or apprentices, part-time, or family workers engaged, but no full-time, nonfamily wage workers.

[b]Using the total number of workers enumerated in each category (see Table C.2) and the corresponding utilization rates (see note to this table).

[c]Average of firms actually reporting in the Accra manufacturing survey.

[d]Corresponds to 60 percent in Table 4.4, line 2a, since 67.5 = 40.3 percent/59.7 percent.

Note: "If no constraints" means if materials and customers were readily available, at current prices and with existing assets. Expansion for each industry and size category is estimated by using the corresponding employment capacity utilization rate in Table E.2 (or an average of the row and column averages if the utilization rate is not available or is exceptionally low on the basis of one observation). The additional employment would be almost entirely full-time wage workers.

Source: 1973 Accra manufacturing survey.

TABLE 5.8

Manufacturing Employment-Output Growth Elasticities
if Constraints Removed: Accra, 1973 Survey

ISIC Code and Industry	Ratio of Employment to Output Growth If No Constraint on Materials	Demand	Credit
3116 Milling (corn, flour)	.00	.30	.62
3117 Baking	.47	.17	.54
3220 Clothing	.35	.28	—
3233 Travel bags	.34	.79	.12
33 Furniture	.12	.16	.29
34 Paper products, printing	.59	.15	.46
35 Chemical products, paints	.92	—	—
36 Cement blocks	.33	—	.36
38 Metal products, machinery	.48	.57	.53
39 Jewelry, miscellaneous	.64	.31	.58
Total	.45	.49	.48

Notes: Growth elasticity is the estimated percentage increase in employment if materials (or demand, or credit) were readily available at prevailing prices, divided by the percentage increase in output under the same conditions.

"Total" is average of firms responding.

Source: 1973 Accra manufacturing survey.

utilization,* or only about a third as many new workers as the small-scale maximum.

Although estimates based on capacity utilization suggest that small-scale employment would increase by a third of any output increase (as against a quarter for large-scale firms), averages of individual firm expansion projections indicate that the ratio may be as high as half (Table 5.8). The average ratio is virtually the same, regardless of which constraint is removed (materials, demand, or

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*Full utilization here is defined as the optimum long-run production level. If all large-scale firms were to operate on three shifts, the employment increase might reach 50 percent, Much of any employment increase in large-scale firms would actually occur as overtime rather than as hiring of new workers.

working capital), although there is some variation within each industry. Furniture and clothing, the two industries with the largest potential labor absorption, have consistently low employment-output growth "elasticities," which implies that a very large expansion of output would be necessary to support the scale of employment expansion indicated in Table 5.7. Once again, this raises the likelihood that rapid expansion of employment in these industries would be limited by the size of the market before full capacity utilization could be reached. Chemicals, jewelry, metal products, printing, and baking may be expected to have above-average employment increase associated with a given output growth in response to easing the two primary constraints of raw materials and credit.

PRODUCTIVE ABSORPTION OF HALF THE URBAN LABOR FORCE INCREASE

Although intermediate manufacturing, repairs, commerce, and services presently constitute only 15 percent of total nonagricultural employment in Accra, policies to stimulate expansion of these small-scale industries could absorb twice that percentage of additional labor force entrants in the short run (approximately 6 percent a year, or 18,000 in Accra in 1973), as follows:

17 percent from closing the utilization gap in small-scale manufacturing by half of the potential amount over a three-year period (adding about 2,000 workers a year) and adding new establishments at the rate of 5 percent per annum (increasing employment by over 800)

14 percent from expansion of output in existing firms and addition of new ones in small-scale repairs, commerce, and services so as to increase employment by 10 percent a year (2,500).*

In addition, improved utilization and expansion of small-scale transport and construction establishments (not included in this survey) might be expected to absorb another 10 percent or more of new job seekers.

Of the small-scale industries, printing offers especially high potential for rapid expansion of production and employment in major urban areas—partly at the expense of the large-scale sector, though with only marginal impact, given the much greater relative size of the latter. Printing tends to involve wage employment more than most

*This is on the order of double the past growth rate.

other small-scale industries, and it would have a high elasticity of employment growth in response to an increase in output. Its problems are clearly defined: dependence on large-scale, competing firms for exclusively imported materials and diversion of minor government printing work to the Ghana Publishing Corporation. The problems and structure of the nonmetallic metal products (cement block) industry are similar, except that it offers a much smaller potential employment increase and depends on derived demand from the construction industry.

Intermediate sector production of furniture might be especially suitable for long-run development. It is a major employer and has a high potential for additional labor absorption. Furthermore, the high proportion of apprentices among its employees means that future expansion is essential if these workers are to be able to utilize their skills. Since most owners of furniture businesses are craftsmen rather than businessmen, management assistance might raise both present productivity of employers and future entrepreneurial ability of the apprentices. Since inadequate availability of credit is a major constraint on small-scale furniture production, a program combining credit with management training might be especially effective.

The clothing industry is similar to furniture, except that its substantially large size and its large number of single-person enterprises (many simply a table in the market) raise some skepticism as to how much of its labor absorption potential could be achieved even under ideal credit and raw material conditions without running into a severe demand constraint. Perhaps one of the most important approaches to encouraging small-scale clothing, as well as printing and furniture firms, would be to prohibit new investment in "modern," large-scale operations, and instead provide financial and managerial support and ensure a steady flow of materials to assist the growth of small-scale employers. A similar policy was adopted with respect to baking, by requiring foreign-owned bakeries to sell out to Ghanaians, with the assistance of the Office of Business Promotion. Financial assistance would be a more productive use of government funds than the present "support" in the form of vocational training in sewing for young girls, which will only aggravate the oversupply of seamstresses and tailors who are presently being trained through private apprenticeship.

Vehicle repair is another industry with a clear problem: availability of spare parts. Small repair businesses depend on large-scale importers for their spares, and have no recourse other than wrecked cars when new parts are not available. The source of the problem is the shortage of foreign exchange and the rigidity of the import licensing system. The best short-run solution would be to shift foreign exchange expenditures from new cars to spare parts and to give small repair firms direct access to the parts or to import licenses. It might be argued, however, that the continuing shortage of parts benefits small-scale entrepreneurs by stimulating the growth of domestic spare part production.

Metal repairs and products, and electrical repairs are industries that offer good potential for absorbing additional labor through apprenticeship, although they are neither large enough nor afflicted with sufficiently clear problems to warrant individualized policy attention. The small-scale industry least in need of support is milling, which consists primarily of single-person establishments and faces no competition from large-scale firms because of the importance of proximity to the customer.*

Although rapid expansion of the intermediate sector would most likely be offset somewhat by diminished growth of the large-scale sector, the evidence of Chapter 4 indicates that the net effect on both employment and output would be beneficial. If large-scale firms in manufacturing, commerce, and services can simply maintain their existing 20 percent share of the nonagricultural labor force, then half of the increase in urban labor supply could be absorbed productively in small-scale and large-scale enterprises in these sectors. The modern sector might be expected to absorb additional workers as follows:

5-11 percent from growth of large-scale manufacturing employment at 5-10 percent per annum (the 1962-71 average was 11 percent)
10 percent from growth of large-scale commerce and service employment at 5 percent per annum.

In addition, growth of employment in large-scale transport, construction, and utilities at 5 percent would absorb another 12 percent of new labor supply. This would bring intermediate and modern labor absorption to as much as 75 percent of new job seekers, thus minimizing the growth of unproductive informal activities and laying a basis for eventual absorption of the entire increase into productive activities.

This scenario must be qualified in two important ways. First, the role of the intermediate sector is likely to be even greater throughout the country as a whole, since the concentration of large-scale industry in Accra overstates its importance in the entire urban economy. Hence measures to promote expansion of small-scale

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*This includes small-scale flour mills, which make bread dough from the wheat flour milled by the large-scale firms.

employment are even more crucial for productive labor absorption in smaller towns. Second, large-scale manufacturing and other activities may not be able to sustain the employment growth they achieved during the 1960s, especially if policies continue to favor capital intensity. Chapter 6 analyzes the prospects for raising the rate of labor absorption with respect to output increases in the large-scale sector, in order to better evaluate what role it can play.

CHAPTER

7

SUMMARY AND CONCLUSIONS: POLICIES FOR AN INTERMEDIATE APPROACH TO THE EMPLOYMENT PROBLEM

CHAPTER SUMMARIES

Chapter 1: The Employment Problem and the Intermediate Sector

Rising rates of population growth and rural-urban migration have resulted in urban labor force growth in LDCs on the order of 50-70 percent per decade since 1940. Industrialization policies have attracted this increased urban labor supply without providing for its absorption. The excess supply of labor is underutilized in a wide range of activities that do not fit the Western definition of unemployment. Although activities outside the modern sector are commonly presumed to be negligibly productive at best, there is growing evidence of a productive intermediate sector that should be distinguished from purely income-sharing informal activities. These intermediate (or small-scale) enterprises have value added per worker and capital/labor ratios in the middle range of a continuum, and they represent a potentially more efficient use of both capital and labor than the alternative of large-scale industrial investment. The competitive labor and product markets facing small-scale entrepreneurs mean that prices more accurately reflect economic scarcity than they do for the monopolistic, subsidized industrial sector. Expansion of the intermediate sector should absorb more labor, attract fewer additional migrants, and possibly generate greater output growth than a corresponding investment in the modern sector.

Chapter 2: Limited Labor Absorption Under Industrialization

An all-out industrialization effort such as Ghana undertook in the early 1960s is an attractive development strategy because of its apparent potential to achieve the rapid economic transformation needed to break the vicious circle of poverty and low productivity and the colonial or neocolonial dependence on more developed countries for manufactures. The transfer of surplus agricultural labor to industry at low wages can, theoretically, both raise productivity and generate a high return to capital for reinvestment and self-sustained growth. The import-substitution strategy, which provides the easiest and least risky means of industrializing, however, typically involves patterns of protection that bias investment incentives and shield inefficient production. Ghana's tariff structure established very strong incentives to produce consumer durables and luxuries, and to undertake only final-stage processing rather than establish vertically integrated industries. Overinvestment meant that capacity soon outstripped Ghana's diminishing ability to finance import deficits, and industrial growth became hampered by underutilization and costly production that was inefficient when valued in terms of world prices. In addition, investment incentives favored capital-intensive products and techniques. High and increasing capital intensity, aggravated by capacity underutilization problems and combined with economies of scale, is expected to lead to a low ratio of employment growth to output growth. International evidence suggests that manufacturing employment tends to grow on the order of a third to a half as fast as output, with a lower ratio in higher-growth countries.

Although wage employment grew rapidly during the initial post-independence industrialization period (1957-61), it fell behind labor force growth after 1961 as Ghana's economy stagnated, barely keeping pace with the rise in supply of workers over the entire period 1957-71. The urban labor force grew at twice the overall rate because of rural-urban migration, and the large-scale wage sector was unable to absorb even its share of increases in urban labor supply, despite a sustained rapid expansion of government services. Large-scale manufacturing was the most dynamic sector, with 7.6 percent compound annual growth over 1957-71, but could contribute little to total labor absorption because of its small size. Ghana lacked the conditions necessary for a strategy of vigorous public sector expansion and industrialization to successfully absorb increasing labor supply and sustain itself: (1) ample and rising availability of foreign exchange and finance; (2) a relatively large share of employment in the dynamic wage sector; (3) productive, profitable investments; and (4) continuing expansion of other productive sectors—especially the intermediate (as opposed to the informal) sector.

Chapter 3: The Small-Scale Alternative: Comparative Urban Employment Data

The intermediate (small-scale) sector may be defined operationally as involving investment in fixed assets (buildings, tools, or equipment) in a fixed place of business, but employing less than a specified number of workers. An upper limit of 30 workers is used in this study because that is the lower limit for inclusion in the official Industrial Statistics, which covers the large-scale or modern sector. Economic activities without fixed assets or a permanent place of business are classified as informal, on the presumption that additional workers would add virtually nothing to GNP. Calculated as a residual from census data, informal employment is found to predominate in the commercial and service sectors of Accra, the capital city. Intermediate employment exceeds modern wage employment in both manufacturing and commerce, and is slightly larger than that in the informal manufacturing sector. Total recorded modern sector employment exceeds intermediate employment only because of the large size of public service employment in Accra.

The relative size and composition of intermediate sector employment is hypothesized to be related to city size. Major differences are found between a city of under 10,000 population and a "medium-size" city of just over 25,000; the latter has an employment structure reasonably similar to that of Accra (over 500,000). One conclusion for further study is that a decentralized, "growth pole" strategy of urbanization can provide productive employment opportunities as effectively as concentrated urban growth, although that employment may be more in intermediate forms of employment than in modern wage employment. Within the intermediate sector, self-employment and family workers predominate in the smallest city; apprentice and part-time relationships in the medium-size city; and wage contracts in the largest city. Apprentices constitute a major share of employment in the latter two cities, indicating that future expansion of the intermediate sector is crucial if their skills are to be employed productively. Sales, food, drink, and lodging constitute larger shares of intermediate employment in the smallest city, while repairs are more important in the larger two; the share of services increases steadily with city size. Manufacturing is the largest employer of intermediate workers enumerated in all three types of cities.

Chapter 4: The Trade-Off Question: Small-Scale and Large-Scale Manufacturing

The notion of a conflict between employment and output growth is not applicable in the general, unconstrained case, since employment and output normally can be maximized, or at least increased simultaneously. Within the limited context of two specific policy alternatives, however, there may be a trade-off in the sense that the one generating more output over a given period of time creates less employment. Such a choice is alleged to occur between growth-oriented industrialization and labor-intensive development projects. The intermediate sector is hypothesized to resolve the issue by supporting both more employment and more output for a given investment.

Small-scale manufacturing firms in Ghana are found to have substantially lower capital/labor ratios and productivity per workers, especially when firms having under 10 employees are compared with those having over 100, except that small-scale printing and cement block manufacture appear to be more productive than their large-scale counterparts if they can utilize their capacity fully. The amount of capital required for a given level of intermediate production is approximately equivalent to that in the modern sector at actual utilization rates, but would be substantially lower if all capacity were fully utilized (except in milling, baking, clothing, and travel bags). Thus intermediate sector investments can employ more than four times as many workers as a corresponding large-scale investment, with no cost in terms of output and a potential increase of more than 50 percent. The inability of small-scale firms to use their capacity fully is the major limitation on their ability to use labor and capital productively, though this may stem from high competition due to easy entry as much as to the overwhelming advantages of large-scale firms in obtaining raw materials and capital. The industries in which small-scale firms predominate have significantly lower productivity, have capital/labor and capital/output ratios within the large-scale manufacturing sector, tend to be smaller in size, and tend to have lower profit rates. The comparative advantage of the intermediate sector is especially strong in the furniture, printing, and cement block industries.

Chapter 5: Employment Structure and Potential of Small-Scale Manufacturing

The intermediate sector portion of the continuum between informal self-employment and wage employment in modern industries focuses on the dynamic transition from small to large business. The different combinations of workers within the sector suggest a movement

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from self-employment, with or without assistance from family members, to additional assistance from apprentices or part-time employees, to some full-time wage employment along with other types of labor, and finally to a purely wage employment operation. Support for the intermediate sector can develop potential entrepreneurial talent in small-scale businesses through such a transition; further research is needed on the nature and importance of this process.

Within the intermediate sector, chemicals, printing, baking, and concrete blocks are the most "modern" industries, in the sense that wage labor constitutes over half of their employment. Apprentices are the dominant form of employment in repairs (predominantly vehicles, electrical, and welding), clothing, and furniture. Self-employment is a relatively more important form of intermediate employment in jewelry, food, furniture, and clothing than in other industries. Industries in which apprentices and the self-employed are more important tend to be those in which intermediate employment as a whole is large relative to employment in large-scale firms. Apprentice, part-time, and family labor constitute 42 percent of intermediate sector employment; full-time wage labor 29 percent; and working owners 29 percent, equally divided between employers and self-employed.

The best opportunities for absorbing more labor while achieving a transformation toward a more productive employment structure are found in the printing, concrete block, vehicle and other repair, chemical, and furniture industries. The first two offer the greatest potential for simultaneously raising both output and employment through a substantial shift from large-scale to small-scale production. Over half the firms interviewed cited inability to obtain raw materials (especially manufacturing firms with wage employees) or spare parts (especially repair firms) as the major constraint on expanding production. Inadequate working capital was the other major constraint, making it difficult for small-scale firms to take advantage of periodic raw material availability or to build up sufficient stock as a basis for expansion. Although lack of demand and excessive competition were not often cited as a direct constraint, they may be more important through their indirect limitation on the ability of small-scale firms to pass on rising input costs. If materials and demand were no constraint, intermediate output could triple and employment could increase by three-quarters (or more, if credit were available).

The largest potential for short-run wage labor absorption is in the textile, printing, chemical, and metal industries. If underutilization in small-scale manufacturing could be cut in half over three years while new firms increased at a 5 percent rate, 17 percent of new urban labor force entrants could be absorbed. The intermediate sector as a whole could absorb as much as 40 percent of the labor supply increase with a 10 percent expansion rate in intermediate repairs, commerce, services, transport, and construction, or 30 percent with 5 percent growth. Large-scale manufacturing cannot be expected to absorb more than 10 percent of new labor supply even if it can maintain past rapid growth. Other large-scale activities could absorb as much as 20 percent only if they reached a historically high rate of 5 percent annual employment growth.

Chapter 6: Policies to Increase Labor Absorption in Large-Scale Industries

The view that technologically determined capital/labor ratios are a major reason for inadequate employment demand in LDCs has been challenged by empirical estimates of substantial substitutability between labor and capital, which point toward high relative wages as the culprit. The hypothesis that wage restraint is the appropriate solution to the employment problem can be tested in Ghana, which had declining real wages over 1962-71. Although some evidence of positive elasticities is found, in general the impact of wage restraint on employment growth is marginal compared with the importance of output growth and productivity changes due to improved managerial and organizational ability, "learning-by-doing," and economies of scale. Wage changes are important determinants of labor demand only in a few relatively labor-intensive industries. Even if a significant reversal in the bias of wage, investment, and foreign exchange policies toward capital-intensive methods could be achieved, little short-run impact would be expected. Such measures are recommended more for their long-term impact on the product mix and on the ability of small-scale firms to compete with larger ones. Prospects for raising employment absorption in the modern sector are dim, given the primary role of output growth in determining employment growth and the likelihood that large-scale manufacturing growth will decline.

APPROACHES TO THE EMPLOYMENT PROBLEM

Emphasis on the employment problem runs the risk of neglecting its relationship to problems of income distribution, economic growth, and structural transformation. Measures to improve labor absorption are only partial solutions and cannot be effective in the long run without corresponding attention to the political, sociological, and economic contexts that determine the patterns of labor demand and supply. The distribution of income is a crucial determinant of the structure of demand, and hence of the direction of transformation of an economy's production. Ghana's experience is not untypical: inheritance of a colonial pattern of trade and consumption that emphasizes imported and capital-intensive products; a growth-oriented industrialization strategy that increases the economic power of the middle and upper income groups, who have a high propensity to consume these products; a corresponding political power to this elite,* resulting in policies that establish artificially lower prices of foreign exchange and capital for the goods they consume; and, consequently, a pattern of demand and incentives favoring production that is intensive in scarce capital and foreign exchange resources and that inhibits growth of employment and incomes for those at the lower end of the income scale. In this context, "it is hardly consistent to argue that today's unemployment or the skewness in the distribution of income in the LDC's was unintended. . . . The outcome was a predictable result of policies which were frequently advocated" (Jarvis 1974, pp. 168-69).

The critical strategy for solving the unemployment problem is therefore a commitment to efficient use of scarce resources to achieve a more equitable distribution of income and welfare. This general prescription for attacking poverty is as applicable to more developed as to less developed countries, and prospects for such a commitment are equally small, since it implies use of power on behalf of the powerless.† There is little reason for optimism that most countries

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*Where direct government controls (for instance, over allocation of imports and capital, and over incomes and prices) are important, political power may be a means of entry to the middle and upper consumption levels. None of Ghana's governments—socialist, democratic, or military—has proved resistant to this pattern in terms of policies actually adopted, despite stated concerns for a more equitable distribution of income.

†Democratic governments must pay attention to those who are powerful enough to elect them, and military regimes must ensure the support of those who might overthrow them. Although the attention of socialist systems is aimed more directly at the lower-income masses, their leaders are often more concerned with consolidating and extending power than with using it for the masses. Such concerns, along with a desire to display accomplishments, help explain why President Kwame Nkrumah moved in the direction described in the preceding paragraph, despite attempts to go in the opposite direction.

The community-oriented values of African societies, combined with strong chiefs who are customarily elected (rather than directly inherited), could provide the blend of socialistic, democratic, and autocratic systems necessary for effective pursuit of distributional equity in such a way as to promote both growth and employment. The can achieve the orientation necessary for a fundamental solution to poverty, and hence to the employment problem. Nevertheless, a society that wishes to deal effectively with rising underutilization of labor must include measures to restructure the economy toward the needs and demands of those at the lower ends of the income and employment scales, and away from policies oriented toward the upper-income and powerful elite. Otherwise the policies discussed below will remain only partial, token efforts.

Another risk of overemphasis on employment is that it may focus attention more on finding ways of hiring the unemployed than on combining underutilized labor efficiently with factors that are in scarce supply. The problem "is how to save capital and other scarce resources, not how to use abundant resources (unless the use of the abundant resources helps to save the scarce resources)" (Dhar and Lydall 1961, p. 85). Hence, in devising an employment strategy, estimates should be made of whether particular proposals generate a given output at a net cost or a net saving of capital, skilled labor, management, and foreign exchange.

Given these general caveats about the need for an appropriate development strategy to complement employment policies, the range of approaches available to LDCs for directly increasing the rate of labor absorption or reducing the rate of underutilization may be outlined, with the purpose of indicating the different ways in which expansion of the intermediate sector might contribute.

Policies Affecting the Supply of Labor (Especially to Urban Areas)

Population Control

Reduction of population growth is an essential component of the long-run transformation to a more productive, higher-income structure of employment. This does not necessarily mean that restricting population growth will increase growth of income per capita, since rising incomes have historically preceded, and provided the incentive for, declining birth rates. Indeed, incentives to limit family size could aggravate the employment problem in the short run, since labor force participation by women would tend to rise. Availability of

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colonial powers, however, established economic and political systems that conflicted with, and sometimes consciously attempted to break down, those traditional systems. Only Tanzania has made a serious effort to rebuild a modern society based upon them.

productive employment opportunities in the short run is essential if population control is to be effective in raising incomes and reducing labor underutilization in the long run.

Rural Development

Rural development can provide productive employment opportunities directly, and also can alleviate the urban employment problem by raising rural living standards and income opportunities so as to reduce the incentives to migrate. Possible policy approaches include those listed below.

Wage Employment Opportunities. Location of industries in smaller towns and rural areas—preferably small-scale enterprises based on processing of local resources, or supplying products for which proximity to the market is important (bread, repairs, services). Public service jobs can reduce migration during slack agricultural seasons.

Higher Incomes. Guaranteed price supports can increase the willingness of farmers to specialize in cash crops, thereby raising rural cash incomes (if supported by availability of inputs and of extension services). Subsidies to lower retail prices of locally consumed staples may be needed to avoid helping farmers at the expense of low-income consumers. Food production may represent a relatively efficient form of import substitution in predominantly agricultural countries that have nevertheless become food importers. Higher rural incomes would generate greater demand for goods and services that could most readily be met by small-scale producers.

Infrastructure and Amenities. Community development or public service projects to construct irrigation systems, wells, roads, markets, schools, health facilities, and the like can lay the foundation for increased productivity in the future. Such projects can use labor-intensive methods and pay or make use of local labor in the off season, so as to provide potential outmigrants with employment and income opportunities.

Intermediate Technology. Introduction of tools and simple machinery that can be manufactured domestically will raise productivity while providing a linkage to small-scale industrial production.

Capital Subsidies, Mechanization. Incentives to attract investment or subsidies for mechanization are not appropriate, in that they replicate in the agricultural sector the biases in use of labor and capital, and in income distribution, that have helped to create the urban employment problem.

Restrained Urban Development

Concentrated urbanization creates pressures for public spending on urban maintenance and services that can reduce development expenditures and aggravate rural-urban income inequalities. Resisting the tendency to enhance the substantial advantages of cities in terms of employment opportunities and amenities at the expense of rural or general development can ease the employment problem by promoting a more equitable distribution of income and by reducing artificially high incentives to migrate.

Wage Restraint. The importance of rural-urban income differentials in migration studies suggests that avoiding a high minimum wage is essential if the rural-urban migration flow is to be reduced. It is not certain, however, that elimination of the rural-urban income gap will be sufficient to stem the migration tide. That is, the Harris-Todaro (1970) hypothesis may not be reversible, at least in the short run. Expectations about changes in real wage differentials are likely to adjust only very slowly, while the costs of migration are continually lowered by the chain effect of being able to rely on previously migrated relatives for support. Wage restraint also is likely to be ineffective without reduction of the rural-urban gaps in other sources of migration incentives, such as amenities, cash opportunities, and availability of jobs for those with some skills or education.

Decentralized Urban Development. Although the economies of scale provided by the concentration of population and production in an urban area are essential for the efficient development of many industries and for coordination with financial and administrative services, urbanization need not be concentrated in one or two massive centers. Indeed, such concentration may retard development by draining public spending and by aggravating income inequalities. Chapter 3 gives tentative evidence that cities as small as 25,000 can support a productive, reasonably modern structure of employment, primarily in small-scale industries. A strategy of support for small-scale enterprises and for decentralized urban growth offers a high potential for simultaneous promotion of greater employment absorption, more equitable distribution of income, higher rates of investment and growth, and a smoother transformation from primary to secondary production than does heavily concentrated, large-scale industrialization.

Urban Renewal and Amenities. Attempts to deal with urban poverty by demolishing blighted areas are not likely to improve the urban employment problem—indeed, they may aggravate it by worsening the distribution of income without getting at the root causes (ILO 1972, Chapter 13). Replacement of slums by more attractive housing or other amenities tends to benefit the middle and upper classes, and to increase the incentives to migrate. This does not mean that cities should be left to deteriorate or that amenities should not be provided; rather, such expenditures should be equitably distributed among rural, semiurban, and urban areas, and should be designed to benefit, rather than hurt, the low-income population.

Job Creation. Creation of jobs at the minimum wage level or above is not appropriate, in that the increased probability of obtaining high-wage jobs may actually raise the level of unemployment by inducing more people to migrate or to leave intermediate or informal employment. Furthermore, there is a high risk that such employment will be unproductive (if in the form of increased government services) or will have a high capital cost (if in private large-scale industry). Direct job creation efforts probably are best confined to rural development projects—perhaps including provision of farm land to urban unemployed, if the primary goal is unemployment reduction. Expansion of the urban intermediate sector is a more suitable means of creating jobs at reasonable levels of productivity and at wages sufficiently low to minimize additional migration incentives.

Policies Affecting Employment Demand and Opportunities

Distribution of Income

A highly skewed distribution of income gives primary economic power to those who tend to consume goods intensive in the resources that are scarcest in LDCs: capital, foreign exchange, technology, and skilled labor. Underutilization of labor is the inevitable result. Although this situation creates a role for intermediate production to use surplus labor in producing low-price, low-quality goods for lower-income consumers, there is little basis for dynamic expansion of productive employment in this sector when income and growth are centered on large-scale industrialization. Redistribution of income in favor of lower-income consumers of labor-intensive, domestically produced products would increase labor absorption in the short run through more rapid intermediate sector growth. The result would be a stronger basis for long-run self-sustained growth through more efficient resource utilization, through increased incentives to save and invest,* and through the transition of the most efficient small-scale firms into large-scale industrial establishments.

Faster Growth

The most effective cure for the employment problem is, of course, faster growth of production and, hence, of the derived demand for labor. This does not mean, however, that any policies designed to stimulate growth will necessarily be the most effective means of increasing productive labor utilization. The analysis of Chapter 2 indicates that import-substitution industrialization policies are one source of the demand side of the employment problem. Direct policy intervention to stimulate growth runs the risk of promoting a growth pattern that matches neither the resources of the economy nor the needs of the society. The thesis of this study is that a greater emphasis on the intermediate sector can raise growth while both conserving scarce capital and utilizing surplus labor productively, and will benefit those with lower incomes by expanding their income-earning opportunities and increasing the supply of goods they consume.

Rural Development

Location of Industry. Location of industries in rural areas may generate employment in complementary activities, especially services (Galenson 1963), which in turn may support the growth of new industries (especially small-scale ones). The lack of complementary activities in rural areas, however, means that production costs are likely to be higher than in urban areas, where such activities are already available, so that only those industries that can gain some offsetting cost advantage from rural location should be considered (such as food processing).

Small-Scale Nonagricultural Production. The significant role of rural small-scale industry, producing both "traditional" and "modern" goods, is increasingly being recognized and studied (Chuta

*Reinvestment of profits in the domestic economy by indigenous entrepreneurs will exceed that of the foreign corporations that dominate import-substitution industries in LDCs, and the savings rate of the lower-income population (especially under appropriate incentives) may in fact be as high as that of higher-income consumers who are imitating still higher international standards (Jarvis 1974).

and Liedholm 1975). Employment in these industries probably can best be assisted indirectly, by adopting policies that raise the incomes of the farmers who demand their products, and by avoiding any restrictions on them.

Labor-Intensive Public Works. Construction of infrastructure and amenities can increase employment demand for productive purposes, if financed by taxation at the expense of consumption and if the capital created will in fact raise output in the future (Jackson and Turner 1973).

Urban Industrial Policies

Wage Restraint. The analysis of Chapter 6 indicates that wage restraint by itself is likely to have only a marginal effect on employment demand, at least in terms of substitution of labor for capital in the short run. It is more important as part of a policy package to eliminate distortion of factor prices against labor-intensive products and investments, and as a means of discouraging rural-urban migration. The ability to achieve significant decreases in real wages is severely constrained by political considerations. The hazard of returning to a colonial "cheap labor policy," with its undesirable implications for the distribution of income, must be avoided.

Altering Capital-Based Incentives. Major changes in relative factor prices can more readily be achieved by eliminating incentives that subsidize capital-intensive investments, such as low interest rates, overvalued currencies, accelerated depreciation allowances, import license allocations, and other decisions or concessions based on size of investment. Since these advantages generally are available only to large firms, their reduction or elimination is an important means of improving the ability of small-scale firms to compete. Special investment incentives to stimulate capital accumulation can be retained, but based on criteria other than capital (such as employment or value added).

Wage Subsidies. A wage subsidy is not an effective means of alleviating urban employment, since it is likely to be partially shifted and to induce increased migration in response to the higher wage (Stiglitz 1974). In addition it offers exceptional opportunities for abuse and corruption unless it is based on withholding or wage taxes paid by firms for their employees, in which case it would tend simply to increase the advantages given to large-scale firms.

Small-Scale Enterprises. Elimination of the policy bias in favor of large-scale industries can create more profitable opportunities for entry into productive intermediate activities and can release the resources necessary for their efficient operation and expansion. The data reported in Chapter 4 indicate that a given investment can generate more output, as well as more employment, in this sector than in the modern sector, given the existing policy context. Chapters 3 and 5 demonstrate the importance of the intermediate sector and its potential for rapid labor absorption in the short run.

POLICIES TO SUPPORT SMALL-SCALE ENTERPRISES

Supply of Resources for Efficient Operation

Materials and Spare Parts

The most common problem of small-scale businesses in LDCs is the frequent unavailability of materials and spares, especially imported ones. Rationing systems for imports (or for domestically produced materials) tend to favor the economically and politically powerful, putting small-scale entrepreneurs at a disadvantage. Small-scale producers often must purchase materials from the larger ones, which both raises their costs and puts them in a highly vulnerable position when supplies become scarce and large firms begin conserving their stocks. The general solution to this problem would be to move to market rationing rather than direct allocations, so that all firms would have an equal chance to buy the materials at the same, uncontrolled price.* Given the continuing existence of controls or situations in which large-scale firms have excessive market power, an appropriate approach is to bring small-scale producers together so as to achieve greater market and political power. A manufacturers' association representative can spend the time necessary for the administrative procedures to obtain materials for the members as a group, which a single working owner cannot afford. Government support in the form of readiness to grant licenses and establishment of an office to deal with associations of small-scale producers is essential, since an association that cannot obtain what its members need will soon fail. The government can encourage formation of such associations by setting aside specific allocations to be channeled through them, and it

*A slightly lower price for large-scale firms would be appropriate if real economies of large-scale purchases are involved.

may regulate them by establishing limits such as minimum and maximum size for membership; but it need not, and probably should not, attempt to form and control them directly.

Capital and Credit

The importance of personal and family savings in financing small enterprises (Chapter 4) indicates that the intermediate sector contributes to capital formation by drawing on and stimulating savings that would not be available through established financial intermediaries (Staley and Morse 1965, p. 236). The intermediate sector does, however, need institutional capital both to maintain the stocks of materials and products necessary for smooth operation and sales, and to finance an expansion or shift to a larger, more modern scale of production. Access to credit through the financial system is, however, limited almost exclusively to modern large-scale firms, which can qualify for special incentives and loans, and offer lower risk and administrative cost commensurate with artificially low official interest rates. Partly as a consequence of their limited access to credit, small-scale enterprises are found, on the whole, to be potentially more efficient in utilizing capital than are large-scale import-substitution industries. Hence some rechanneling of credit toward the intermediate sector is economically justifiable, and is essential if that intermediate sector is to expand.

The primary difficulty is that lenders see small-scale loans as more risky and administratively more costly.* The most direct solution to this problem would be to allow lenders to charge differential interest rates according to the size of the loan and the forms of security and assurances that the borrower can provide. Ironically, such a practice may be politically objectionable, in that it explicitly favors the large and powerful over the small and weak, even though the present system does so implicitly and thoroughly. A commonly recommended alternative is to subsidize bank loans to small businesses or to set aside special funds for lending, at the officially maintained low rate. This is not a desirable approach, because it establishes the same capital-intensive bias for the intermediate sector as has been cited as a source of inefficiency in the modern sector. If the same nominal rate must be given to all borrowers for political reasons, then either the rate should be raised closer to the true

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*The problem of extending capital to small-scale enterprises may be "due not so much to the quantity of loan capital available as to the low quality of loan services and the ignorance of bank officials about local problems" (Watanabe 1974, p. 412).

opportunity cost of capital (though this would not offset the preference of lenders for large borrowers), or the effective rate should be raised through service charges to small borrowers or through accounting practices.*

Ghana has attempted to make credit available directly through a government agency serving indigenous entrepreneurs. The Office of Business Promotion (now the Ghanaian Enterprises Development Commission) was established in 1970 to assist Ghanaians in taking over small businesses from non-Ghanaians in sectors that were reserved for citizens, and to assist small businesses in priority activities, such as exports and import substitution. In its first year of operation, it granted over 5,000 loans under ¢500 each, virtually all of them for petty trade.† About 80 percent of the money lent went to over 1,000 larger businesses, three-quarters of them in transport or trade, averaging about ¢5,000 each. Lack of administrative capacity to screen and deal with large numbers of small borrowers soon led the office to abandon the small loan category and concentrate on loans over ¢1,000 to more established businessmen across a wide range of activities. Some of the loans were not so small, averaging over ¢13,000 for Accra as of the end of 1974 and about half that for the nation as a whole.

Ironically, however, the reasonably high 80 percent repayment record of the small borrowers, with less than 3 percent making no payments, was considerably better than the 60 percent payment of the amount due, with over 7 percent nonpayment, by the larger subscribers, thus refuting the notion that smaller loans involve higher risks. A program of making small loans (less than ¢1,000) was reopened in 1975. Although the Office of Business Promotion distributed almost ¢14 million to more than 7,000 businesses over four years, it cannot be acclaimed as a major means of initiating intermediate sector expansion, given its tendency to favor larger, well-established businesses and the fact that this amount represented less than 1 percent of the total government budget during the period. Experience in other countries indicates that government credit schemes generally are not effective in meeting the needs of small-scale businesses (Dunlop 1971; Kochav et al. 1974).

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*Small borrowers can be charged interest on the original loan rather than on the remaining balance. A nominal rate of 8 percent charged on the original value of a loan repaid in four annual installments amounts to a true rate of 12.8 percent.

†Figures are based on estimates provided by the Office of Business Promotion. All loans are at an 8 percent rate of interest (on the original balance).

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The associations of small-scale businesses proposed as a conduit for materials would also provide an effective means for channeling credit. Financial institutions could lend to the associations at the official interest rate, thus avoiding the problems of dealing with small borrowers and charging differential rates. The associations could then relend to members at rates sufficiently high to cover risks and costs and to avoid a capital-intensive bias. The ability of an association to collect payments is likely to be greater than that of banks or a government agency, especially if it also provides the businesses with materials and other resources.

Managerial and Technical Skills

Many small-scale business owners have training in their trade, but not in operating a business. Any scheme to provide credit and materials to the intermediate sector must be accompanied by a program of education in simple business skills, such as bookkeeping and price setting. More advanced management training, plus technical skills such as machine maintenance and repair, are needed to help successful entrepreneurs make the transition to the modern sector; but the needs of the inexperienced business person also should be addressed. Thus a small business extension service is an appropriate means of assisting the intermediate sector.

Infrastructure

Provision of buildings, power, transportation, and other amenities is an attractive means of raising productivity and profitability in small-scale enterprises, but is not a suitable intermediate strategy, in that it uses scarce capital resources and ignores the major economic advantage of the intermediate sector: use of idle resources without heavy overheads (Watanabe 1974).

More Profitable Opportunities for Entry and Expansion

Removal of Legal and Policy Constraints

The tendency of government regulations and policies to inhibit rather than encourage the development of small-scale businesses is frequently cited as an attitude that must be reversed as part of an intermediate strategy (Child 1973b; Dhar and Lydall 1961; ILO 1972; Morawetz 1974; Singer and Jolly 1973; and Watanabe 1974). Licensing should be on a fee basis only, except where health hazards require regulation (ILO 1972, p. 229). Quality standards, if any, need not be set so high that only industrially produced goods for high-income consumers can pass. Regulations such as minimum wage laws should explicitly be applied only to large firms, so that small entrepreneurs need not live in fear of government harassment.* Since taxation of small businesses tends to drive them out of the open market, and in any case is unlikely to be a major revenue source, it should be held at reasonably low levels, perhaps with a reduction or holiday in the initial years of operation.† Taxation might best be confined to firms that have received a direct benefit through membership in a government-assisted association.

No Special Advantages for Competing Large-Scale Firms

The single most important measure to assist intermediate sector expansion would be to terminate tax, lending, and import license advantages given to large-scale producers of goods that small-scale firms can produce at a savings in real resources or already produce in substantial quantities. Particular industries in which the intermediate sector is relatively efficient or large include printing, construction materials (cement blocks), metalworking, vehicle and other repairs, clothing, and furniture. This does not mean that these industries should be reserved exclusively for small-scale firms; only that small and large firms should compete on an equal basis and that low priority should be given to promoting or approving new large-scale investments in these areas. Nor does it mean that all investment incentives should be terminated; only that they should be focused on industries that are not suitable for small entrepreneurs, or should be equally accessible to small and large businesses.

Patronage

The government can greatly assist the growth of intermediate enterprises by permitting, encouraging, or requiring its agencies to make purchases from them. Small-scale printing, furniture, clothing (uniforms), repair, metalworking, concrete block or brick manufacture, and other construction-oriented industries in particular could supply many government needs. Large-scale government contractors (especially in construction) also should be encouraged to subcontract

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*The enumerators for the surveys in this study were suspected of representing a formidable array of government agencies.

†Such a tax holiday would, however, penalize the more successful firms with a permanently established place of business relative to smaller firms that could move and begin a new holiday in a different location.

to smaller suppliers. This policy can, however, be potentially disastrous for small-scale firms if payments are not made immediately in cash, to avoid the long delays often involved in collecting payments from the government.

Marketing Through Cooperative Associations

Associations of small enterprises in an industry can improve marketing prospects, as well as provide better access to materials and capital, as discussed earlier. They can act as intermediaries between individual producers and wholesalers, large contractors, exporters, or government purchasers, thus permitting the intermediate sector to supply large orders. This process may lead toward self-imposed standardization, which is more likely to be successful than standards imposed by government inspectors. The government can foster this role by placing orders through such associations.

The primary drawback to promoting cooperative associations is that it risks leading to elitism and reduced competition within the small-scale sector. C. Gerry (1974, pp. 83, 111) warns:

> . . . the same problems of discrimination are reproduced within the framework of State-cooperative relations, due to the strategic development of an "entrepreneurial" group. . . . the inevitable outcome would be a rapid or gradual concentration of power and production within the small-scale sector. . . . the majority would find their markets severely cut and their access to raw materials even more difficult.

He sees this pattern as likely to develop

> . . . where the interests of self-centered and self-sustained economic growth are subordinated to the interests of a small but prosperous domestic elite who are themselves in turn subordinated to the interests of the foreign capital invested in, and profiting from, production in underdeveloped countries. . . .

Hence income redistribution and an emphasis on self-reliant regional development, rather than import substitution by multinational corporations, are important conditions for an intermediate strategy to be successful in transforming the economy. In more specific terms, care must be taken that small business associations are not dominated by and operated for the benefit of relatively large firms, and that firms large enough to stand on their own are excluded. Government regulations for the charters of cooperative associations, in terms of membership and control, might be suitable.

Income Redistribution

As discussed previously, growth of income in the hands of people at the lower end of the income scale is essential if the market for intermediate goods and services is to expand fast enough to break the vicious circle of excess supply of labor, low productivity, low income, and lack of demand for the services and products of the surplus labor.

Rural Development and Agriculture—Intermediate Sector Linkages

Increased rural incomes directly raise demand for consumer goods and services provided by small-scale enterprises. In addition, if incomes are increased through provision of infrastructure, inputs, and extension services in such a way as to encourage adoption of intermediate technology for cash crop farming, a stimulus will be provided to small-scale producers of the necessary equipment (Child and Kaneda 1975; King 1974).

CONCLUSION

The intermediate sector potentially can play a dynamic role in economic growth and transformation, as well as in absorbing surplus labor. The appropriate role for public policy is to help small-scale entrepreneurs help themselves. Entry into the intermediate sector can best be encouraged indirectly, by removing legal and policy restraints on small businesses and by avoiding special incentives and advantages to large-scale investments in industries where small-scale firms are competitive. More direct support to improve the ease and efficiency of operation of small enterprises can be provided in the form of ready availability of materials, capital, and extension services. These should preferably be provided in a unified package, and channeled through cooperative associations of small-scale producers. It is up to the small-scale entrepreneurs in each industry to form such associations, although government regulations might be appropriate to ensure that members are large enough to provide some employment potential but small enough not to be able to dominate the association. Long-run support for dynamic, self-sustained intermediate sector growth must be provided through a commitment to move toward a more equal personal and regional income distribution, and away from a pattern of incentives that favor concentrated large-scale, capital-intensive production of luxury consumer goods for the upper-income elite.