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planning in the STPI countries

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Science and Technology for Development:

Planning in the STPI Countries

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Contents

4. Science and Technology in Brazilian Development Plans: 1956–73

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This chapter aims at assessing the importance given to S&T in the Brazilian government's development plans elaborated between 1956 and 1973. In particular, an attempt is made to identify to what extent the technological needs originating from development in Brazil are reflected in those plans, and to determine whether the plans propose measures that can be characterized as constituting an S&T policy.

The Brazilian government's emphasis on S&T planning is recent and is increasing. On the one hand, this fact may lead observers to conclude that no worry has existed in the past about the country's S&T and/or to assert that in the past too high a value has been placed on the accumulation of physical capital, as opposed to the formation of human capital, in economic development. On the other hand, observers may exaggerate the government's possibilities for promoting the country's S&T development, such development often being considered as an exogenous factor capable of affecting economic growth independently from, or despite, other government policies. Both conclusions are mistakes, stemming from two causes. First, the people who subscribe to them have read only government documents that explicitly refer to S&T and have not examined the technological implications of other government policies. Or, the people fail to consider that an S&T policy can have various objectives (aside from the hypothetical autonomous ones) and that the concrete directives associated with each objective have distinct aspects in each of the stages of economic growth.

In this chapter we intend to avoid these mistakes and to analyze, besides the S&T policies explicitly outlined in each of the government's plans, the technological implications of the directives associated with economic policy proposed in these plans, as well as to characterize the objectives of the explicit and implicit S&T policies.

Basic Propositions

It seems necessary to identify, together with an explicit S&T policy, or in view of the lack of such a policy, the dispersed but specific elements in the government's plans that form an implicit and specific S&T policy, as well as the technological implications of other sectorial policies that characterize an implicit and derived S&T policy. Such a study will allow us

to assess to what extent government plans in which an S&T policy was not outlined were permeable to the technological needs of growth, and also to detect incompatibilities between the S&T policies formally stated and the general development strategy of the government plans.

At this point it is worth stressing that government plans are not always totally implemented; that the most important measures of economic policy are often adopted only when not in opposition to such plans; and that sometimes the planning documents do not express the consensus and the intentions of the government team. Thus, evaluation of the S&T policy in a certain period demands an examination of the measures specifically related to S&T, as well as the consequences of actions in other areas of economic policy. Such comprehensiveness is not intended in this chapter, which is restricted, in general, to analysis of the policies found in the government plans.

A second point to be stressed refers to the objectives of an S&T policy. Unless the policy defines its own objectives, two alternative objectives could be considered, with technological dependence as the criterion of differentiation: (a) to answer the technological needs of the production system by speeding up the incorporation of innovations into the system, without consideration of whether technology should be produced domestically or imported; and (b) to reduce the use of imported technology by enlarging the national capacity for the creation, adaptation and incorporation of technical knowledge. To make future reference easier, a policy devoted to objectives of the first kind can be called a policy of response; the alternative is a policy of relative autonomy.

A policy of relative autonomy can have different objectives. On the one hand, it can reflect the intention of inducing, or creating conditions for, reorientation of the process of growth, aiming at reaching new patterns of development. On the other hand, it can aim only to answer the needs derived from the production system using domestic sources of technology to reduce the dependence on foreign sources, but without intending to modify the prevailing framework and direction of growth.

The basic approach of this chapter is to distinguish between the two types of policy. However, with government plans that contain an S&T policy of relative autonomy, we must examine what was intended in the policy's formation from the viewpoint of the more general characteristics of growth.

When distinguishing between the two types of policy, one must consider that each stage of economic growth has specific technological needs. It is also possible to distinguish the ways in which these needs are satisfied, whether domestically or through the transfer of know-how from abroad. Furthermore, a policy of relative autonomy, even when successful, will not necessarily lead to a decrease in the technological dependence on foreign countries, for it can be linked to the emergence of technological needs of another kind and, therefore, of new forms of dependence; in this sense, such a policy would refer to a specific kind of transfer of technology. Therefore, it is necessary to define the elements of a policy of response and the feasible objectives of a policy of autonomy in each stage of development.

In the first stage of industrialization in Brazil the demand for technology was not explicit but was implicit in the demand for capital

goods and for technical personnel with certain qualifications. The ways in which the demand was satisfied were the importation of the capital goods required, the incorporation of qualified immigrants into the production process, and the domestic training of individuals to operate the existing industrial plants. With the undertakings that involved more complex technologies there were also no internal resources capable of making the necessary investments, usually with a long period of maturation. Not only the technology and the capital goods but also the capital that made the undertaking possible were obtained abroad. Nor was the demand for technology made explicit once the transfer of technology constituted a byproduct of the investment of capital (Biato, Guimaraes, and Figueiredo 1973).

As industrialization went ahead, those kinds and channels of supply of technology became insufficient for an increasingly complex demand. The purchase of capital goods no longer provided the production units with the technology required; "the new productive processes and the new products required more than mere instructions supplied by the producers of the capital goods utilized" (Biato et al. 1973). What became necessary was the mastery of more sophisticated technology than that required for the operation of the industrial plants. As a consequence, besides resorting to the already mentioned forms of transfer of technology, the Brazilian production system began to resort to contracts with foreign agents, trying to obtain engineering projects and services necessary to the solution of specific problems, as well as to ensure permanent technical assistance to the operation of the country's production units. Furthermore, for products protected by patents and the use of trademarks, the mastery of the technology involved was not enough. The Brazilian enterprise was forced to contract the cession of the legal privileges with their foreign owners (Biato et al. 1973). In this context, the demand for technology by the country's production system became explicit.

In the first stage of industrialization a policy of response would consider above all making possible the importation of capital goods, promoting the formation of human resources needed for the operation of the production system, and attracting foreign capital for the productive activities requiring a more complex technology. On the other hand, among the possible objectives of a policy of relative autonomy, taking into account the prevailing form of transfer of technology, the substitution of domestically produced capital goods for imported goods stands out.

In the second stage of industrialization one objective of a policy of response, in addition to those mentioned for the first stage, would be to increase the flow of new technical knowledge from abroad through contracts with foreign agents. With a policy of relative autonomy the basic directive would be to promote the domestic production of the technical knowledge required by the production system.

Such considerations reappear in our examination of government plans formed in the period 1956–73. In fact, the following analysis is outlined by the attention to the specific needs of each stage of industrialization in Brazil; by the preoccupation with identifying, besides the propositions spelled out in the plans, elements that characterize implicit S&T policies; and by the acknowledgment that other orientations and objectives of the S&T policy may be designed and implemented.

The Target Program

A set of sectorial objectives drawn up by the government in late 1956 made up the target program for the period 1956–60 (presidencia da república — conselho de desenvolvimento, 1958). The program had as its frame of reference a stage in the process of substituting domestically produced goods for imported goods in which the segments of the production system producing nondurable and less complex durable consumer goods had already been consolidated; these segments, together with some undertakings in the spheres of intermediate products and capital goods, characterized Brazil's new industrial nucleus. The program established absolute priority for improving the industrial structure by setting up industries producing basic and capital goods, as well as for forming the capital that should support that structure; the targets proposed were grouped in five sectors — energy, transportation, food, basic industries, and education.[13]

The orientation proposed in that document for Brazilian development led to a significant increase in the technological needs of the country's production system. The mere listing of the segments included in the targets related to basic industry suggests the additional supply of technology required: steelmaking, aluminum, nonferrous metals (lead, tin, nickel, copper, and zinc), cement, alkalis, cellulose and paper, exportation of iron ores, automobile industry, shipbuilding, mechanical industry, and heavy electrical material.

Moreover, the sophisticated technology demanded in the new stage of industrialization required more frequent and more intense use of disembodied technical knowledge of greater complexity, and resort to new sources and forms of supply of know-how.

In fact, the technology required by the existing industrial enterprises — in general restricted to the technology embodied in the capital goods used and to relatively simple and diffused technical knowledge — had thus far been supplied by the importation of such goods and the instructions provided by their producers, by the learning in the industrial plants, the reading of technical literature, and the training and theoretical education supplied by the engineering colleges in the country. However, these sources were insufficient to meet the needs of the new phase of industrialization.

In spite of this, the target program was timid in its explicit S&T policy. Besides a marginal preoccupation with the S&T aspects of the nuclear power program, the target program restricted itself to the target of training sufficient technical personnel; this target, however, was emphasized more as a way of satisfying the need for technical cadres to operate the expanding production system than as an effort to have more effective national participation in the supply of the technology linked to the new wave of investment.

The program acknowledged that economic development presupposes an increase in productivity through techniques, such as better use of the

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[13] For an analysis of the Brazilian economy in the 1950s and an assessment of the proposals and the implementation of the target program see: Candal (1969), Ianni (1971), Lafer (1970), Lessa (1964), and Tavares (1972).

factors of production, labour, and capital by means of technological advancement, and spoke of education for development. Among others, it established as targets to increase the capacity of the schools of engineering to 1 000 new students per year, to strengthen industrial and agricultural secondary education, and to set up 14 institutes of research, education, and development (2 each of mechanics and chemistry, and 1 each of mathematics, physics, electrotechnics, geology, mining and metallurgy, genetics, economics, agricultural mechanics, rural technology, and rural economics).

The targets of training sufficient technical personnel and establishing a nuclear power program exhausted the portions of the plan that can be characterized as constituting a specific S&T policy, though some references are made to agricultural research and to the technological problems in the production of paper and cellulose. However, the other directives of economic policy in the target program contained implicit solutions for acquiring the technology required in the new stage of industrialization. The solutions appeared in the context of the policies relative to foreign capital and to the production and importation of capital goods.

As to the former, the liberal treatment of and the incentives granted to foreign capital — including the setting up in Brazil of subsidiaries of enterprises based in more industrialized countries — led to effects of two kinds. On the one hand, they created a channel for the transfer of technical knowledge into the country as a consequence of the necessity that the mother companies provide their subsidiaries with the technology required for their setting up and operation. On the other hand, they affected favourably the national capacity for importing capital goods, whether through the inflow of foreign exchange brought about by foreign investment or through the entry of machines and equipment into the country as part of the foreign investment.[14]

Another important concern during the implementation of the target plan was to render feasible the importation of the capital goods necessary for industrial expansion. This concern was reflected not only in the enphasis on overcoming the economy's foreign constriction through the attraction of foreign investments and financing, but also on the concession of a more favourable exchange rate for the importation of machines and equipment, and on the reduction of the customs tariffs applicable to capital goods whenever the impossibility of obtaining the product domestically was proved.[15]

The measures and policies mentioned above — both those specifically related to technology and those having indirect consequences on technological matters — outlined an S&T policy that can be characterized as one of response, for if on the one hand they were aimed at satisfying the

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[14] Foreign investment in the form of machinery and equipment, a mechanism widely used during the period of the target program, had been regulated through the superintendency of money and credit of the Bank of Brazil, instruction 113, January 1955. For a discussion about the importance of that instruction in the formation of physical capital and in the participation of foreign capital in industrialization, see Bonelli and Tolipan (1974).

[15] These regulations were introduced in the Law of Customs Tariffs in August 1957. On this subject see Lessa (1964).

requirements arising from growth, on the other they proposed to do so without changing the country's dependence on the external world.

However, the implications of the target of developing the Brazilian capital goods industry defined, from the technological viewpoint, a different picture and suggested themselves to be elements of a policy of relative autonomy, for they suggested the replacement of external sources of supply of embodied technology. But it remains worth asking whether such a proposition should be seen as an autonomous objective or as a result of the logic of the process of import substitution, as well as whether the fulfillment of such a target really means a reduction of the technological dependence on foreign countries.

As to the first question, it should be stressed that, in contrast to the targets related to transportation and energy, the success of which was indispensable to the successful working of the economy, the substitution of domestically produced capital goods for imported goods was not necessary for the correction of the disequilibria in the external sector; when the plan was being implemented import substitution acted as another source of pressure on the demand for imports. Although not necessary in this sense, the adoption of those objectives was undoubtedly induced by the country's economic evolution. On the other hand, the repressed demand for those goods — above all, items of transportation — gave rise among their former exporters to a structure of interests favourable to the internal production of such goods, the free importation of which was then impossible (Lessa 1964).

In any case, even if such objectives are understood as being autonomous, their relation to the increase in the domestic capacity for technological development and to the reduction in technological dependence on foreign countries was not explicitly considered when they were being designed.

As to the second question, the way in which domestically produced capital goods were substituted for imported goods reduced the importance of the inflow of foreign embodied technology but led to an increase in the inflow of foreign disembodied technical knowledge because of the presence of foreign enterprises in the sector and contracts of technical assistance signed by the national enterprises.[16]

This way the policy of relative autonomy implicit in the policy of substitution for imported capital goods must be understood in its strict technological meaning. The reduction of the dependence on external sources was certainly not the aim of the government's global policy, which in reality was promoting a new mode of inserting the Brazilian economy in the international capitalist system. It was not by accident that the effort to reduce the importation of incorporated technology was accompanied by the consolidation of new forms of transfer of technology: such forms corresponded to the new economic links between Brazil and the rest of the world.

[16] National enterprises counted mainly upon two foreign sources of disembodied technology: engineering firms and industrial enterprises that neither had nor intended to set up subsidiaries in Brazil but wanted to participate in the country's market in view of the restrictions on imports, the presence of foreign competitors in Brazil and the possibility that national enterprises could be set up with know-how from other sources. On this point see Biato et al. 1975. As regards the specific case of the capital goods industry see Erber et al. 1974.

The 3-Year Plan

The 3-year plan of economic and social development for 1963–65 (presidencia da república, 1962) was designed when inflation was accelerating and the rate of growth of the national product was declining in a reflection of the worsening tensions and disequilibria and the exhaustion of the possibilities of expansion through import substitution. On the other hand, the years preceding and the year following the elaboration of this plan were characterized by marked political and institutional instability, which, together with the problems faced by the economy, brought about the absence of perspectives and the indefiniteness and transitoriness of the proposed economic policies.

The 3-year plan was affected by such instability, its implementation being gradually abandoned in 1963, and so before the institutional changes caused by the 1964 political events. In this sense, the remarks that follow refer to the intentions and directives outlined in the plan rather than to the economic policy implemented in this period.

Although among the plan's basic aims the maintenance of a high rate of growth of income ranked higher than the gradual reduction of inflation, the focus of the preoccupations, in contrast to that of the target program, moved from industrial development to the slowdown of inflation. On the other hand, in what are referred to as "long-term preoccupations . . . it is possible to distinguish a vague tendency to the diversification of the objectives proposed . . . be it on account of the demand for basic reforms or on account of the requirements of a diversified structure . . . together with a preoccupation with the complementation of the industrial system, partial measures oriented towards regional development, the transformation of the agricultural sector, the encouragement of industrial exports and so on" (Lessa 1964).

From the viewpoint of its technological implications, the proposed development strategy of the 3-year plan, in contrast with that of the target plan, would not have caused a significant increase in the demand for technology by the production system. It is true that the Brazilian economy's technological needs were then significantly more complex and more intense than in the middle of the previous decade. This situation, however, was a result of the evolution of the Brazilian economy, especially of the expansion of the mechanical and electrical industries and of the segment producing intermediate goods. With the 3-year plan, it was only the intention of promoting the restructuring and modernizing of the agricultural sector that led to the changes in the demand for technology; the other indications of sectorial policies, such as the expansion of the capital goods industry, pointed only to the need for increasingly sophisticated technology which was already apparent.

Moreover, in the course of the Brazilian economy's evolution, channels of transfer had been established that ensured the supply of the technology required for industrialization. The problems the economy faced in the early 1960s threatened the efficiency of operation of these channels: the reduction in the importation of capital goods also reduced the access to the embodied technology; in addition, the loss of dynamism from the growth process, the unfavourable economic situation, and the political instability discouraged the entry of foreign capital.

From the viewpoint of a policy of response, however, such obstacles did not imply the necessity of adopting specific measures in the area of S&T. The barriers to the continued supply of needed technology from foreign sources were caused by problems that could be overcome only through the adoption of more general measures of economic policy.

Therefore, it is worth pointing out the government's actions in those areas, as well as identifying the meaning they had for technology.

First, the importance attributed to foreign capital in Brazil's economic growth was less in the 3-year plan than in the target program. A measure adopted outside the framework of the 3-year plan, Law 4131, regulated foreign investment and the remittance of profits abroad (restricting to a maximum of 5% in 5 years the rebates allowed in the income tax statements of corporations for remittances corresponding to imported technology), and had a neatly restrictive and disciplining effect.

Although the target program did not emphasize this aspect in its policy on foreign capital, the setting up and operating of foreign enterprises constituted an important channel of transfer of technology into the country; with the 3-year plan the supply of technology obtained through this channel was to be reduced.

As to the difficulties in the balance of payments and the consequences in relation to the use of the technology embodied in the imported capital goods, the 3-year plan was clearly preoccupied with advancing the substitution of domestically produced machines and equipment for imported; this was evident from the large proportion of resources devoted to this aim and from the target of producing domestically two-thirds of the equipment necessary for the implementation of the plan's industrial policy.

Thus, the apparent intent of the 3-year plan was to promote the directions that economic development was taking, both in the area of import substitution (a proposal of the target program) and in the area of basic reforms, especially agrarian reform. Moreover, the government's political discourse emphasized these perspectives of change. It was therefore to be expected that the changes indicated by the more general political directives would be accompanied by a reorientation of the S&T policy that would support the new course of events. That is to say, although from the viewpoint of a policy of response the need for specific measures in the area of S&T was limited, a vigorous policy of relative autonomy was required to make feasible the proposed changes in the patterns of development.

The 3-year plan made clear its attention to the country's S&T development by listing among its basic objectives:

> . . . To intensify substantially the government's action in the fields of education, of scientific and technological research, and of public health, in order to assure a rapid improvement of man as a factor of development and to allow the benefits of cultural progress.

And, in its basic directives relative to nuclear power the plan indicated that this objective was not restricted to ensuring that the technological demand be satisfied, but also included the intention of promoting the country's ability to produce its own technology:

> . . . To the extent that one considers industrially developed a country which can satisfy its basic needs by means of a technique and resources of its own, Brazil will not overcome (not even in the long run) the cycle of underdevelopment if, on account of a deficiency of the government program, of industrial technique and aptness, it remains dependent upon the importation of experience, techniques, equipments and nuclear fuel — with the resulting outflow of foreign exchange — for the production of electricity on a nuclear basis.

Although the plan did not present an explicit S&T policy, segments of such a policy were identifiable in the directives related to the nuclear power program, the technological needs of agricultural sector and the training of technical personnel.

In relation to nuclear power, the plan outlined a set of initiatives that characterize well a sectorial program of S&T development of obvious importance to the planners. The program, which should be implemented by the National Nuclear Power Committee in cooperation with research bodies and private industry, established, together with the construction of nuclear power stations, the production of nuclear fuel and the prospection, mining and processing of nuclear minerals, that S&T research should be carried out, especially in the field of reactors and of materials for reactors, and that the technology of radioisotopes should be developed, with the aim of their production and application.

As to the agricultural sector, the plan stated the intention of promoting its modernization and restructuring, identified the country's deficient agrarian structure as the most serious obstacle to the rational use of the land and to the permanent technological improvement of agricultural activity, and included among its basic aims "to gradually eliminate the institutional barriers responsible for the wastage of factors of production and for the slow assimilation of new techniques." Moreover, the plan recognized that increasing the incorporation of technology into agriculture depends to a large extent on the intensity and continuity of the works of research, experimentation, demonstration, and incentive, which, owing to their nature and cost, can only be carried out through government agencies. It also stated the need for a new structure and new norms of operation of the government apparatus and proposed to expand government expenditure in programs of research and incentive. The plan, however, did not go beyond this indication of directives, nor did it specify more concrete measures.

The training of technical personnel received less attention in the 3-year plan than in the target program. The brief program of education concentrated on primary and secondary education, although 31% of the proposed budget was devoted to university education. Resources allocated to S&T research constituted 1.2% of the total planned expenditure of the program, but the application of these resources was not specified.

Although less emphatic than the target program, the 3-year plan did not ignore the production system's need for specialized personnel, and outlined these needs in the context of the industrial development program with more clarity than the target program. It acknowledged the shortage of qualified personnel at all levels as an obstacle to the acceleration of industrial development and stressed the need for training technicians,

especially engineers and project designers, to satisfy the expected expansion of the mechanical industry.

The directives related to the training of technical personnel were geared to supplying the technical cadres required for the production system. The previous expansion of the capital goods industry had resulted in a greater demand for technicians in that industry because it had become convenient for the industry to develop its own capacity for planning nationally. Furthermore, the 3-year plan stated that foreign participation in the installation of new industrial units had reduced the competitiveness of the national capital goods industry because of the difficulty of untrained individuals in following the specifications; besides the training of engineers and project designers, the plan proposed the organization of specialized bureaus to assist in the installation of new industrial units.

Finally, one should stress as an initiative parallel to the 3-year plan the approval of Law 4131, which not only regulated foreign investment and the remittance of profits abroad but also defined for the first time the legal situation of contracts with foreign parties related to the transfer of technology and established norms about the payments to be made. This legal text, although part of a law whose basic concern was restricting the remittance of earnings abroad, aimed at fostering the absorption of technology and created a structure of incentives differentiated according to how essential the industry was that would be using the technology (Biato et al. 1973). The decree of the executive power that regulated this law introduced important changes in relation to the transfer of technology by limiting to 5 years the period in which contracts with foreign parties would be allowed to generate remittances and restricting the amount of such remittances to 2% of the cost or of the gross earnings of the product.

The measures specifically related to S&T were undoubtedly insufficient to replace the foreign sources of technology and thus support an overall policy of transformation of the economic links between Brazil and other countries.

Nor was it possible to identify an implicit S&T policy in the other directives of economic policy of the 3-year plan that could lead to the necessary transformations. In contrast, the target program, though not containing an explicit S&T policy, presented the answers to the needs of that stage of Brazil's growth in other instruments and measures of policy.

The policy of the 3-year plan of maintaining the level of public investment had favourable effects on the capital goods industry because the state was the main (and in some cases sole) buyer of capital goods. In the same way, the favourable attitude toward this industry was translated into proposals of more rigorous application of the idea of domestically producing machinery and equipment that had been imported.

In the same line, the 1961 exchange reform was introduced to establish a more efficient market reserve for the national capital goods industry by raising the relative prices of those goods (Lessa 1964).

The Government's Program of Economic Action

When the government's 1964–66 program of economic action (ministério do planejamento e coordenacao económica, 1965) was elaborated, the Brazilian economy was much the same as it had been when

the 3-year plan was drawn up; however, the tensions and disequilibria had increased, and, as a consequence, the rate of inflation had increased and the slowdown in economic growth had worsened. The differences between the two plans seemed to stem rather from the important politicoinstitutional changes of 1964.

The basic aims of the economic policy outlined in the program of economic action were close to those presented in the 3-year plan: to speed up economic development; to contain inflation gradually; to reduce the sectorial and regional economic imbalances and the tensions generated by social disequilibria; through the investment policy, to ensure opportunities for productive employment to the growing labour supply; and to correct the tendency toward uncontrolled deficits in the balance of payments. Among those aims the fight against inflation was undoubtedly given the highest priority, under the assumption that improvement in the rate of growth would follow.

The program of economic action did not outline a specific S&T policy; moreover, it presented very few measures specifically linked to S&T activities. Those presented were in the area of educational policy and were aimed at increasing access to education, rationalizing the use of available resources, and adjusting the educational structure to the technical and cultural needs of modern society.

The lack of an explicit policy for the promotion of the country's S&T development did not mean, however, that the program ignored the Brazilian economy's needs in that field. In fact, the document stated that "technological improvement is as important as, or even more important than, the increase in the rate of capital formation itself in the process of development." But the planners apparently considered that those needs should be satisfied from foreign sources, and their proposed answers to the technological questions in Brazilian development are implicit in the other directives of economy policy.

In this sense it is worth stressing the policy of encouraging the entry of foreign capital, a policy based on the recognition that foreign capital was important because of the marginal growth of the investment rate and because of the need for reinforcement of the country's import capacity, for technological contributions to the modernization of the Brazilian economy, and for increased national productivity. This policy aimed at correcting, even by means of changes in the profit remittance law, the inadequate treatment of and hostile climate to foreign capital, which had contributed to stopping its inflow in the recent past, after it had made an important contribution to the development of the national economy in previous years, chiefly in the period 1957–61, in response to less restrictive legal treatment.

This way the program of economic action resumed the opening of the Brazilian economy to foreign countries promoted by the target program, deepened the Brazilian economy's insertion in the international economic system, and emphasized the advantages of maintaining a certain degree of international division of labour.

From the viewpoint of technological contributions to the country's production system, the policy of encouraging the inflow of foreign capital had a twofold objective: first, to increase the importation of capital goods and of the embodied technology, and, second, to supply more technological knowledge and thus save Brazil from substantial expenses in research.

International connections represented the most accessible way for Brazil to become updated in that basic requirement of economic progress.

The proposed solutions of the program of economic action for the technological problems associated with growth and with the operation of the country's production system characterize a policy of response that corresponded at the technological level, to the reopening of Brazil to the external world proposed by the economic policy. In this sense the problem was to reconstitute the now less efficient channels of transfer of technology created by the target program and thus make it possible to go on satisfying the production system's demand for technology.

The reconstitution of the channels of transfer was not restricted to attracting foreign capital, but included the creation of conditions favourable to the establishment of contracts of transfer of technology and to the importation of capital goods. With the reform of the profit remittance law the 5-year limit during which contracts of technical assistance were allowed to give rise to remittances was abolished, as was the limit on the amount of such remittances of 2% of the cost or of the gross earnings of the product.

As regards the strengthening of the Brazilian capital goods industry, a fund was created for the financing of the purchase of industrial machinery and equipment. The support given by this fund to the industry was, however, initially limited because of the short terms and the not very favourable conditions of payment in comparison with those of the international market. Other measures were aimed at reactivating the demand for capital goods without specifically establishing privileges for the national producers. Among these measures several stand out: the policy of public investment in the economic and social infrastructure; the immediate incentive to investment in several sectors represented by the permission to accelerate the depreciation of new equipment; the textile industry's program of modernization and re-equipment; and the programs of investment in the steel and chemical industries, particularly in the areas of petrochemicals and fertilizers. The facilities granted for the importation of equipment required by high priority projects often reduced the impact of such programs upon the Brazilian capital goods industry.

In fact, the metallomechanical enterprises were in a general state of recession, with much of their capacity idle and with serious financial difficulties. Hence, any attempt to advance the process of substitution of domestically produced capital goods for imported was not feasible. In the planning of policy for this sector, the recovery of its level of activity should be considered.

The Strategic Development Program

The strategic development program for 1968–70 (ministério do planejamento e coordenacao geral, 1968), though very close to the government's program of economic action in its objectives, had signifi-

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[17] See on this subject Biato et al. (1973). Although the legislation did not impose any limits on the amount of remittances, in practice the percentages adopted for income tax rebates were established as the limits for the earnings remitted.

cantly different emphases and priorities. The new program presented as its basic aims the acceleration of economic development at the same time as the containment of inflation, social progress, and the expansion of employment opportunities; but, in fact, it put in second place reducing the rate of inflation and concentrated its efforts on the resumption of growth.

Starting from a diagnosis of exhaustion of the process of import substitution as the cause of the slowdown in growth, and of cost pressures as the chief obstacle to the elimination of inflation in the recent past, the program proposed increasing the overall rate of savings and investment, both public and private, and maintaining a high level of private consumption and of overall demand.

As regards industrial development, the program stressed the need for diversifying the sources of dynamism by expanding the internal market, developing import substitution in the mechanical, electrical, chemical, nonferrous metals, and steel industries, and promoting exports. This required an increase in the national industry's competitive power through an increase in its efficiency, the expansion of a certain number of dynamic sectors, and the reorganization and modernization of traditional industries.

From the viewpoint of S&T this program was an important landmark: not only were the needs of the Brazilian economy in this area emphasized, but also the document proposed the first explicit, systematic S&T policy for the country. No longer were the answers to the technological problems of Brazilian development simply implied in diffuse measures or in the other directives of economic policy. The new program devoted two chapters to an assessment of the role of technological progress in a country's development and to the programing of initiatives in this field. Moreover, the emphasis on technology also appeared in the indications of sectorial policies, especially industrial policy.

The directives based on the S&T policy — a policy that incorporated in its justification the experience of more economically developed countries — stressed not only the need to speed up the incorporation of imported technology in the production system, but also the importance of the country's undertaking its own research because "imported technology is not always adequate to the importing country's constellations of productive factors" and "as industry becomes integrated, the absorption of technology itself requires local research and development." In fact, as the program noted, it would be difficult to cite an example of a country in which fast and self-sustained growth has not been supported by domestic technological development.

The strategic development program emphasized the importance of the development of S&T research, its main objectives being to stimulate the knowledge of the country's natural resources and to solve the specific technological problems, to support and develop national technology, and to follow S&T progress elsewhere. Its guidelines were the principles of coordination of government action, decentralization of implementation, concentration of national financial resources, and provision of incentives to the participation of the private sector. It was recognized that, more so than in more industrialized nations, in Brazil the government would play the chief role in the financing and directing of research, in view of "the global insufficiency of knowledge, the scales of production and the

predominance of foreign enterprises with substantial research plans in the mother companies."

These objectives would be pursued through the activities of the National Research Council; the coordination of a basic plan of S&T Research, which would put together priority programs and projects to receive preferential financing; the strengthening of national research institutions; the concentration of public resources and the collection of private resources for the research programs; the financial support of the training and the work of researchers; and the reorientation of university education.

The financial support of S&T development would be strengthened through the National Research Council (which managed funds aimed mostly at basic research) and the National Development Bank (which from 1964 ran the Fund for Techno-Scientific Development, a fund geared almost entirely to training programs), as well as the creation of the National Fund for Scientific and Technological Development. Lastly, basic government programs in the S&T area were set up, to be coordinated by the National Research Council, the National Fund for Scientific and Technological Development, the National Committee of Space Activities, and the National Nuclear Power Council.

These measures were essentially the same as those advocated in subsequent government plans, though various improvements were introduced in the later plans.

The persistence of the directives proposed in the strategic development program is even more remarkable when one considers the pioneering nature of the propositions. Not that there had never been in Brazil government action in the S&T sphere (the National Research Council was created in 1951), but such action, besides being sparse, was radically distinct from what the government intended to do, according to the directives in this program. Previous action had been oriented, above all, to scientific research in universities and had paid no attention to the research needs of the national production system (Biato, Guimaraes, and Figueiredo 1971). In this sense, the government, with its S&T policy, planned to have a significant influence on the practices of scientists and researchers by emphasizing technological research and attributing priority to the activities more directly linked to the needs of Brazilian development.

On the other hand, the S&T policy of the strategic development program was a policy of relative autonomy, for among its objectives was not only the more rapid incorporation of imported technology but also Brazil's creation of its own technology so as to reduce the dependence upon foreign sources of know-how. Such a directive constituted a radical change from the implicit orientation of the program of economic action, with its exclusive emphasis upon the contribution of foreign technology. That directive deserves, therefore, closer examination, to identify whether it corresponded to new needs linked to changes in the more general directives of economic policy.

The two programs differed in the priorities given to the several aims of the economic policy. This reshuffling of priorities, however, did not imply on its own the need for greater technological autonomy. However, the strategic development program went further when it emphasized, as a necessary condition for fast and self-sustained economic growth, the

creation of a mass market — a large percentage of the urban and rural population that had an income capable of allowing them regular consumption of industrial goods, chiefly nondurable ones, so as to sustain the growth of the traditional industries.

The directives in the strategic development program related to S&T seem to be associated with the creation of a mass market through the development of technologies more adjusted to the country's production factors and, therefore, capable of ensuring greater absorption of labour without threatening the growth of the product.

In this context, the reorientation of the S&T policy proposed in the strategic development program could be understood as a requirement of the program's overall development strategy.

Nevertheless, such an interpretation deserves some qualifications. First, given a certain structure of demand and consequently a certain structure of production, the existing technological options are not unlimited. In the same way, the use of more labour-intensive techniques depends not only on their availability but also on the entrepreneurs choosing them. In this sense, emphasizing the development of labour-intensive techniques from the viewpoint of their contribution to the expansion of employment and to the enlargement of the domestic market could mean overestimation of the potential influence of S&T development on the pattern of economic growth — even more so if the expansion of the domestic market finds no support in other areas of economic policy.

The planners of the strategic development program were not unaware of these matters, for the program pointed out the factors that, in the course of industrialization, reduced the rate of absorption of labour, and outlined some measures aimed at speeding up the expansion of employment. In the same way, it proposed a policy of income distribution that considered both the employment policy and the rise in the workers' real income to be brought about by programs of housing, education, health, sanitation, and changes in the tax policy.

Nevertheless, the evolution of the industrial sector in that period, especially the growth in the demand for nondurable consumer goods, reflects the failure of this policy of enlargement of the domestic market through the incorporation of the strata with less purchasing power. The maintenance of the level of private consumption stemmed chiefly from the increased demand for sophisticated goods — above all, durable consumer goods — by the upper income groups. This way, in contrast to what was planned in the target of creating a mass market, not only did the high degree of income concentration become a factor making feasible the expansion of private consumption, but also this expansion was directed to sectors that are characteristically capital-intensive. In the same way, the increase in industrial employment was a consequence of the dynamism of those sectors; the low growth rate and the modernization of production in the traditional branches resulted in a small expansion of employment in most of these branches and, in some cases, a reduction in the number of people employed.

In presenting such evidence, it is not our intention to point out a failure of the S&T policy. This policy could not — and was not designed to — give results in the short term. Our evidence suggests, however, that the Brazilian economy's evolution — which was markedly influenced by the economic policy implemented in the period — was following a pattern

other than that envisioned by the planners of the country's S&T development.

Thus, beside the propositions regarding S&T, the strategic development program contained a technological policy implicit in the directives and measures related to economic policy adopted in the period and distinct from that specified in the program.

The Targets and Bases for Government Action

The government's plan for 1970–71, targets and bases for government action (presidencia da república, 1970), responded to the need of more time for the setting up of the first national development plan and of the new planning procedures established in the 1969 legislation. Its transitory character would make a detailed examination of this document a fruitless exercise. Moreover, from the viewpoint of the actions proposed in the S&T sphere such an analysis is not necessary.

The document defined as the national priorities for the period a revolution in education, agriculture, and food supply, an acceleration of the health and sanitation program, and of S&T development, and a strengthening of the national industries' competitive power; it retained the emphasis on S&T of the strategic development program.

As regards the last field, the 1970–71 plan had the following basic aims: to keep abreast of S&T progress, particularly in areas with wider technological perspectives; to adapt imported technology to the national conditions of production; and to solve technological problems specific to Brazil, chiefly in the spheres of industry, agriculture, and research into natural resources.

The initiatives suggested for promoting S&T development were basically the same as those of the strategic development program. They aimed at creating the physical, institutional, and financial bases for making development feasible. Moreover, the objective of more significant participation by the private sector in S&T development was given more emphasis than in the strategic development program. The attainment of this objective was to be supported by the following: fiscal incentives for the promotion of research and the use of innovations; encouragement of the development of product engineering and, gradually, of process engineering; the search for ways of leading foreign enterprises actively to participate in national research; and the integration between university and industry.

Lastly, on account of their later development into the directives of the first national development plan, one should take note of the technological initiatives directed at strengthening the national industry's competitive power: the definition of technology-intensive sectors that the country might develop in a rational way to participate in the new industrial revolution, and the analysis of technological evolution in the other industrial branches to consider how to make this evolution compatible with the policy of expanding employment; the adoption of special measures of support to the national entrepreneur, including the financing of and the provision of incentives to S&T research; the transfer of the results of domestic S&T research to industry.

The First National Development Plan

The first national development plan (República federativa do Brasil, 1971), intended for the period 1972–74, corresponded to a new economic conjuncture. The program of economic action had been drawn up during a period of economic recession and uncontrolled inflation, and the strategic development program had been drawn up when inflation was reasonably contained but the recession still existed, and economic activity fluctuated during the program's term. The first national development plan, in contrast, was designed following the resumption of growth and the maintenance of a high rate of expansion for 4 years.

In this context the new plan presented the following as the great national objectives of Brazilian development: to raise Brazil within a generation to the category of a developed nation; to double the country's per capita income by 1980; and to reach, while the plan was in force, a growth rate of between 8% and 10% per year in association with expanding employment, a decreased rate of inflation, and an international economic policy that would accelerate the country's development.

The objectives were to be reached through the greatest possible exploitation of the country's potential for growth, the growth and expansion of the market, and the consolidation of Brazil's competitive power. The last was to be accomplished through the development of a basic nucleus of expansion to ensure the supply of essential input at prices near those of international competitors; a capitalization policy to give the financial system a more important role in the formation of the enterprises' real capital; the creation of a Brazilian model of industrial capitalism aimed at creating the large national enterprises or at leading Brazilian enterprises to participate in large-scale undertakings; and a policy of modernization of the national enterprise (public and private) in both technological and managerial respects.

The plan's main directives for industrial strategy, besides the strengthening of the national industry's competitive power, were the strengthening of national private enterprise (by equalizing the conditions under which it and foreign enterprise operate) and the enlargement of industry's role as an instrument of technological change in the other sectors. The technological implications of those directives were emphasized by the plan when it gave a strategic importance to the capital goods sector and when it proposed the development of new sectors with a high technological intensity, the modernization of the traditional industries, and the expansion of the exportation of manufactured goods from industrial branches with more refined technology.

Starting from this reaffirmation of the importance of the country's S&T development for the fulfillment of the national objectives, the plan defined its S&T policy, associating it with the strengthening of the national competitive power in priority sectors, among which were certain industries with a high technological intensity.

Such a policy emphasized, together with the acceleration and orientation of the transfer of technology, the supplementation of importation of technology with technological adaptation and the creation of a local technology, because an increase in the national industry's competitive power depended on greater domestic production of technol-

ogy. The incorporation of the so-called product and process engineering to create national models and processes allowed on the one hand better adaptation of the products to the market conditions, and on the other better use of the country's comparative advantages as regards production costs.

The directives of the S&T program were: to direct and speed up the government's action in the area, chiefly through the operation of the supporting financial system for technological development and the coordination of the actions of the main government research institutions by means of a basic plan of S&T development; to develop priority technological areas (nuclear power, space research, oceanography, technology-intensive industries, infrastructure technology, and agricultural research); to strengthen the technological infrastructure and the capacity for innovation in the national enterprises, private and public; and to accelerate the transfer of technology, through integration of industry, research, and university.

This program of government action constituted, in fact, a reaffirmation of initiatives established in the strategic development program, though improvements were incorporated that had been suggested by the implementation of some measures proposed in that program. It unfolded into the first basic plan of S&T development for 1973–74 (presidencia da república, 1973), a plan that was really a detailed version of the policy directives and the lines of action defined by the first national development plan, and presented, besides an S&T budget, the priority programs and projects to be implemented during 1973–74.

The first basic plan of S&T development was significant because it represented both a reaffirmation of the government's preoccupation with the country's S&T development and an effort at coordinating the various segments of the national S&T scheme.

The new development plan emphasized two areas that had received little attention from the first national development plan: the development of technology applied to social development, and the activity of fundamental research and postgraduate courses.

From the viewpoint of the analytic framework presented initially, the S&T policy made explicit by the first national development plan and reasserted by the first basic plan of S&T development, in the same way as the one outlined in the strategic development program, can be characterized as a policy of relative autonomy. It was intended to reduce the technological dependence on the external world through greater adaptation of imported technology and the creation of local know-how.

Nevertheless, the objectives and the direction of technological development were distinct in each plan. The strategic development program emphasized adapting imported technology to the country's production system, chiefly aiming at a higher rate of expansion of employment and thus growth of the market. This implied that the effort to develop local technology should be within the traditional segments of the industrial sector, where the potential technological options were wider; in fact, good results would be unlikely in the more dynamic industrial sectors, characteristically the capital-intensive ones.

The first national development plan did not refer to such adaptation.[18] In the context of an economic policy that concentrated on the maintenance of fast growth, postponing the problem of income distribution (and opposing growth and redistribution), such a preoccupation would undoubtedly be out of place. The country's technological development was covered in the plan's directive of increasing the national industry's competitive power, particularly in sectors using advanced technology.

In both the strategic development program and the first national development plan technological development appeared to be necessary for expansion of the market: in the former, the link was on the demand side; in the latter, it was on the supply side, through the intention of reducing costs so as to enlarge the domestic market and penetrate foreign ones, and of adapting the products to the conditions of demand and to the changes in consumption habits. The technological development proposed by the latter was to be in the most dynamic segments of that demand, domestically and abroad.

The S&T policy of the first national development plan gained in realism when it abandoned the preoccupation with inducing the growth of employment. Although one could find a justification for the strategy outlined by the strategic development program, the orientation proposed in the first national development plan for the country's technological development, besides overestimating its potential for promoting changes, reflected preoccupations alien to the economic policy implemented in this period. One could ask, however, whether this orientation was part of the plan's overall strategy as well as whether it was in accord with the economic policy implemented in the period. Such questions deserve to be treated separately.

The directive of strengthening the national industry's competitive power implied the demand for deep changes in the country's industrial set-up through intense and permanent technological updating. But such a requirement did not lead to the necessity for domestic creation of technology. The presence — often dominant — of foreign enterprises in the most technologically dynamic sectors and the relatively easy access to the know-how available in the international technology market undoubtedly made possible a supply of the innovations required for the fulfillment of that directive — that is, the links between the Brazilian economy and the nucleus of the international capitalist system were favourable to continuing economic growth of Brazil without the need for domestic creation of technology.

In this sense, when it proposed that the country reach greater technological autonomy, the first national development plan went beyond the mere preoccupation with satisfying the needs stemming from economic growth and made explicit its intention of reducing — or, at least, of avoiding the growth of — Brazil's dependence on world economic centres. Thus, technological development also appeared to be associated

[18] The proposals linked to the expansion of employment did not consider the development and use of labour-intensive technologies, and the first basic plan of S&T development referred only marginally to the importance of associating technological policy with employment policy, aiming at ensuring the compatibility of the former with expanded employment.

with the intention of strengthening national enterprise, both public and private.

As a matter of fact, with the recognition that technological progress rapidly changes the structure of production and management, leading in particular — together with economic and financial factors — to an increase in the number of large-scale projects, conglomerates, and multinational enterprises, the S&T policy aimed at the strengthening of the capacity of absorption and creation of technology by national enterprise, both public and private.

The contribution of foreign enterprise was not discarded, but it was considered that foreign enterprise should orient its investments chiefly to areas with more refined technology, where the transfer into the country of new technologies and modern managerial methods would be more important; the plan stressed, however, that the action of foreign enterprise in fields already occupied by national enterprise having adequate know-how and capacity for investment was particularly undesirable. In this context it seems reasonable to infer that a growing technological qualification of national enterprise would mean a progressive limitation of the field open to the foreign enterprise.

However, technological changes are certainly necessary conditions, but not sufficient ones, in the determination of significant alterations in the patterns of economic growth. Moreover, S&T development can be unsuccessful when its direction does not converge with the natural evolution of the economic system or when the development is not supported by measures of economic policy in the same direction.

The previous characterization of the S&T policy made explicit in the two development plans as one of relative autonomy implies the recognition of the nonexistence of that convergence. Therefore, we should now examine the economic policy implemented in the period and its implications from the viewpoint of S&T development.

The Economic Policy of 1967–73

The economic policy implemented in 1967–73 did not correspond entirely to what was contained in the government plans in force, in some instances because the way the programed action was conducted led to results distinctly different from those expected, in others because policy instruments and measures whose use was not predicted were employed, and in others because the economic policy was not implemented according to the principles and directives proposed in the plans.

These "disadjustments" were not specific to the period in question, but they seem to have been important enough to characterize an S&T policy implicit in the economic policy implemented in the period, an S&T policy distinct in several respects from those outlined in the strategic development program, the first national development plan, and the first basic plan of S&T development.

However, even when such divergence has been verified, it does not exclude the possibility that the actions planned in the S&T area will be carried out. But discrepancies of this kind not only restrict the efficiency of the program as regards the fulfillment of its objectives, but also can

perpetuate the autonomous nature of the S&T policy, isolating this policy from the government's policy.

Some of the aspects of the period's economic policy, especially the industrial one, that relate to the questions asked in the text and whose technological implications are more apparent and immediate will now be examined.

The examination — a partial and incomplete one — will be developed therefore, at two levels. First, we will identify the degree of convergence between the economic policy of the period and the objectives pursued in the proposals for the promotion of S&T development — that is, assess to what extent the preoccupation with the increase in the rate of labour absorption and the consequent growth of the internal market, as well as with the strengthening of national enterprise, manifested itself in the economic policy of the period. After that we will evaluate the technological implications of some of the policy instruments and measures adopted.

The question of increasing the rate of labour absorption was previously related to the structure of demand, which can direct the expansion of production to sectors that present few technological alternatives, and to the effective choice by entrepreneurs of the most labour-intensive alternative. In particular, the option of postponing the efforts toward income redistribution with the aim of maintaining the accelerated growth undoubtedly resulted in directing the expansion of the industrial sector to its most capital-intensive segments. This tendency, on the other hand, was reinforced by the promotion of consolidation and growth of the financial system and the resulting expansion of financing operations for the consumption of durable goods.

As to the strengthening of national enterprise, it is possible to identify policy instruments and measures that were mobilized in this direction, among which stand out the policy of the government financial agencies, especially the national development bank, and the procedures adopted in the expansion of the petrochemical industry. The government financial agencies were restricted to financing national enterprise as well as creating specific funds for industrial financing. As regards the petrochemical industry, the formula of coparticipation of the state, national private capital and foreign capital in the newly formed companies ensured the participation of national entrepreneurs.

The concession of fiscal incentives to the merger and incorporation of enterprises and the institution of bodies aimed at giving administrative and managerial assistance to small and medium-sized enterprises were initiatives that could lead such enterprises to become more efficient and thus strengthen their competitive power.

Nevertheless, the results of the efforts undertaken in that direction were not very significant. Their positive effects were compensated by the foreign enterprises' greater dynamism in a context in which the most significant incentives offered to the private sector — the incentives to industrial development and to exportation — benefited national and foreign enterprises equally.

The industrial policy of the period had as its central instrument the subsidy to capital formation in the priority industries by means of exemption from the import tax and from the tax on the circulation of commodities in the case of purchases abroad of machinery and equipment

when similar goods were not produced domestically, and, from 1970, exemption from the tax on industrialized products and imported capital goods, credit to the buyer of national equipment in the value of the corresponding tax on industrialized products, and the right to consider accelerated depreciation of domestically produced goods for income tax purposes.

But the implementation of this policy by the Industrial Development Council was not very selective: not only were such incentives extended to nearly the entire manufacturing industry, but also the approval of projects submitted to the council was practically automatic, the reasoning being that the basic responsibility of the investment decision remained with private enterprise.

Although this policy of cheapening the cost of capital was efficient in the sense of encouraging the expansion of investment in industry, the indiscriminate concession of incentives prevented this instrument from being used to adjust the investment flows to the objectives of government policy. Instead, the investment options suggested by the market were merely made more profitable, and the incentives were granted equally to national and to foreign enterprises.

The policy of incentives to exportation was characterized by the continual mobilization of new instruments and measures, which implied the raising of burdens, the granting of subsidies, and the encouragement of the enlargement of productive capacity.

Among the incentives aimed at increasing the competitiveness of Brazilian products in the international market, which benefited both national and foreign enterprises, some stand out: the fiscal credit of the taxes on the circulation of commodities and industrialized products relative to the products exported; the exemption from the import tax and the tax on industrialized products in the purchase of capital goods, input, and raw materials by exporting enterprises; and the government financial assistance to the export activity.

Other incentives adopted in 1972 were aimed at inducing export-geared investment decisions: with the concession of exemption from the import tax and the tax on industrialized products and the abandonment of the law of the domestically produced similar article, new and second-hand equipment and whole industrial sets could be imported, even after being in use abroad, under the condition that in Brazil they produced essentially for the foreign market. Such benefits had as their main target the big multinational corporations installed in the country and those that might settle in Brazil in the future, which would be better able to bring about substantial increases in exports. But essentially national firms, especially small and medium-sized ones, could occasionally find themselves, as a consequence of those measures, in a position of relative disadvantage, not only in the foreign market but also in the domestic market. In fact, these incentives did not affect the relative performance of national and foreign enterprises (Doellinger, Faria, and Cavalcanti 1974).

With the strong incentives that benefited equally national and foreign enterprises, the greater flexibility and operational dynamism of the multinational enterprises allowed them to respond more promptly to the market indications and to the government incentives; thus, their position in the Brazilian economy relative to the national enterprises was strengthened. There were undoubtedly some exceptions, but these were

mainly in sectors such as steelmaking and petrochemicals in which the implementation of industrial policy had particular characteristics. In these sectors, despite the high capital density and the high degree of technological complexity, the position of national capital was preserved and its participation reasserted. The fact was, however, that government action here was not restricted to the manipulation of indirect incentives but included the mobilization of more concrete instruments, the definition of targets, the delimitation of the roads open to private enterprise, and the effective participation of public enterprise.

Lastly, among the instruments and measures of economic policy adopted in this period, were those with more immediate repercussions on the country's S&T development.

Let us first consider the central aspect of the policy of encouraging industrial development — that is, the policy of cheapening the cost of capital implemented by the Industrial Development Council. The unfavourable effects of that policy as regards the consolidation of the capital goods industry have been widely emphasized. This was especially true up to 1970, when the incentives referred only to imported goods, although the effects were still apparent, albeit milder, after the changes introduced that year. In stressing the preference for imports the policy of subsidy to capital formation undoubtedly limited the expansion of the capital goods industry; above all, it discouraged the substitution of domestically produced goods for imported goods through the production of technologically more sophisticated machines and equipment. Even after 1970 some discrimination remained against domestically produced capital goods, represented by the tax on the circulation of commodities, which was rebatable in the case of imports, although this should have been compensated by the accelerated depreciation allowed only to nationally produced capital goods. As regards the incentives to export-geared investments, their significance from the viewpoint of the national industry of machinery and equipment is obvious.

Although several government documents emphasized the importance of giving priority to machinery and equipment produced in the country in the case of government purchases, public enterprises nearly always ignored this directive, and an important instrument was thus lost that might have helped to improve the technological level of the country's mechanical and electrical industry. In fact, because one of the main obstacles to technological progress in this sector is the uncertainty about the evolution of the demand and the resulting disinclination to face the risks involved in the development or the purchase of new technologies, the long-term programing of government purchases and a clear statement of preference for national products could stimulate entrepreneurial initiatives in this sphere. In particular, the anticipation of future demand seems to be, particularly for capital goods made to order, indispensable in the support of the expansion of this industrial segment by domestically developed technology.

On the other hand, an initiative that reflected favourably on the capital goods industry was the introduction, by the fund for the financing of the purchase of industrial machinery and equipment, of new schemes of financing the production and sale of capital goods made to order, in which longer terms and lower interest rates were established.

Another point to be stressed in relation to the technological implications of the experience in the petrochemical sector is that new relationships between the state enterprise and national and foreign private capital were created. At first this consolidated a new system of transfer of technology in which the contribution of foreign technology was not linked to the setting up of a subsidiary of a foreign enterprise (thus appearing as a result of the investment made) nor did it result from mere contracts signed between enterprises in the country and abroad. Part of the foreign participation in the capital of the enterprise was paid for with the technology itself; the process know-how and part of the engineering services were paid for with shares of the enterprise.

The new system allowed the setting up of a sophisticated industrial branch that would probably operate according to the most recently updated international technical standards, with enterprises controlled by national capital and without the resort to state monopoly for their setting up. On the other hand, it could be said that the enterprises were acquiring capacity much more in the sense of operating their factories than of mastering the knowledge that was being incorporated into them, owing to their lack of contact with the central problems in engineering and production. Nevertheless, the contracting of engineering services to be carried out in the country had been concentrated upon a small number of engineering firms, and this might have allowed the strengthening of a nucleus of engineering enterprises that, though not playing as important a role in the absorption of technology, might have become an important instrument in overcoming these restrictions (Araujo and Dick 1974).

Although these considerations do not constitute a detailed analysis of the economic policy in 1967–73 and its technological implications, they seem sufficient to allow us to answer some of the questions we posed before presenting them.

The directives to increase the rate of labour absorption and strengthen national enterprise, linked respectively to the S&T policies of the strategic development program and the national development plan and first basic plan of S&T development, were not dominant preoccupations of the economic policy of the period. It is possible to show measures aimed at supporting national enterprise but such measures were not within the mainstream of the economic policy in force.

That is why if one cannot consider the S&T policy proposed in the government plans as an isolated aspect of the government's policy one must at least recognize that such a policy articulated itself precariously with the overall aspects of the economic policy implemented in the period.

The central objective of this policy — the maintenance of a high rate of economic growth — could dispense with significant advancements in the country's qualification for the creation and adaptation of technology once the required rhythm of incorporation of new technologies could be, as it was, assured by means of the importation of know-how and of capital goods. The principal instruments and measures of economic policy that were mobilized were directed only to the intensification and acceleration of the transfer of technology. Therefore, it would be correct to characterize as a policy of response the solutions for the technological needs of the process of growth implicit in the economic policy implemented in the period.

Conclusions

The target program and the program of economic action, although not presenting an explicit S&T policy, contained, implicit in directives of economic policy, answers to the technological needs in the respective stages of industrialization, besides proposing diffuse measures in the field of S&T. The policy was unmistakably one of response, for it aimed at ensuring the supply of technology required by the production system from foreign sources. It corresponded to the proposition of opening the economy to foreign countries and of deepening the links that connected Brazil to the world economic centres.

Similarly the 3-year plan did not contain an explicit S&T policy. On the other hand, although its economic strategy showed the need for a vigorous and clearly autonomous S&T policy, it proposed actions that were insufficient from the viewpoint of defining an alternative to the foreign sources of technology that would support the changes intended in the form in which the country was inserted in the world economic system.

The strategic development program defined an explicit S&T policy and presented a program of action that basically reappear in the following plans — the targets and bases for government action and the first national development plan. The policy proposed in those plans was one of relative autonomy, for it included among its objectives the country's qualification for the creation and adaptation of technology so as to reduce the dependence on foreign sources of know-how.

The strategic development program emphasized the development of technologies more adjusted to the country's endowment of production factors, so as to ensure greater absorption of labour. The program's preoccupation with the creation of a mass market as a means of ensuring self-sustained growth was absent from the economic policy implemented in the period, and the evolution of the Brazilian economy reflected the failure of this policy of enlargement of the domestic market by the incorporation of strata with less purchasing power.

This preoccupation was also ignored in the S&T policy proposed in the first national development plan (and expressed in detail in the first basic plan of S&T development), which, while reasserting the intention of reducing the dependence on foreign know-how, linked this directive to the propositions of strengthening Brazilian industry's competitive power and strengthening national enterprise. The increase in Brazilian industry's competitive power did not justify on its own the directive of promoting the country's greater qualification for the creation and adaptation of technology, because the technical knowledge that should be incorporated continually by the production system to reach that aim could be supplied by foreign sources, either through the participation of foreign enterprises or through the importation of technology. In this sense that directive appeared to be necessary only when linked to the proposition of strengthening national enterprise and ensuring its participation in the economic growth of Brazil.

Nevertheless, despite the government's initiative of support to the national enterprises, the strengthening of such enterprises was not the dominant preoccupation of the economic policy of the period, which was directed mainly to the maintenance of a high growth rate. In the same way,

the solutions for the technological problems linked to the country's growth that were implicit in the chief instruments and measures of economic policy were aimed, above all, at ensuring the transfer of technology, and thus characterized a policy of response.

The evolution of the Brazilian economy in recent years shows that the measures of support to national enterprise were counteracted by the greater dynamism of multinational enterprise in a context in which the most important incentives offered to the private sector — the subsidy to capital formation in industry and the encouragement to exportation — benefited national and foreign enterprise equally. On the other hand, the position of national enterprise was effectively strengthened in the sectors in which government action was specific and mobilized more concrete instruments.

From this viewpoint, one should stress that, although the adoption of an adequate S&T policy is one of the factors making feasible a certain pattern of economic growth, government action in the sphere of S&T is not on its own capable of determining this pattern. This is so because the efficiency of an S&T policy depends on its degree of convergence with the natural evolution of the economic system or with the economic policy in force, or both, as well as on the support it receives from the other policy instruments and measures.

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