Mimap Training and Technical Support
Project 03773-97-1055
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Recipient Institution:

Université Laval, Centre de recherche en économie et finance appliquée (CRÉFA)

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Technical Final Report
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I. Summary of Major Activities and outcomes of the project

I.1. Training activities

From January 1998 to June 2000, the consortium CRÉFA-CECI executed the project « MIMAP Training and Technical Support » funded by IDRC. Under this project, two training sessions were delivered, one on the methodology of Poverty Monitoring Systems (PMS), in Quebec City on Aug-Sept. 1999, the second one on CGE modeling on Macroeconomic Structure and Analysis (MSA), in Manila on Feb-March 2000. Both training sessions were conducted in English.

I.2. Training material

Considerable training material was developed and technical support was provided, especially at the interim meeting of modelers in Dhaka in May 99. We quickly review the training tools already developed during this phase 1 of the MIMAP Training Program.

I.2.1. Training tools for PMS methodology

We can briefly list the training tools developed until now in English:

a) Training documents: twenty-five documents were distributed to the trainees at the Quebec session. The titles and the classification of these documents by module are given in Appendix I.

b) A software package (DAD), which is unique in scope, is now technically fully operational, although it is still subject to a number of validating tests. It is available in English and in French, although the more recent versions are in English. A technical manual and a comprehensive user guide are also available. A description of the functions of the software can be found in Appendix II and on the web page http://www.crefa.ecn.ulpal.ca/dad.

c) A simulation laboratory, the “Butare Mayaga Region”, is available as an SPSS file, and can be directly converted to other statistical software using StatTransfer. It allows users to conduct Monte Carlo experiments on a full population to illustrate sampling theory underlying standard household surveying techniques, and to illustrate the impact of survey design on the estimation of poverty profiles. Its use is described in Doc # II.1.2, Simulation Laboratory for Sampling Techniques.

d) A database of micro data from different MIMAP countries. This database allows MIMAP researchers to apply the numerous methodologies presented in the training modules using real data. This ensures that they are fully operational in analyzing their own national household surveys. This database currently includes:
I.2.2. Training tools for MSA methodology

a) Training documents: A substantial amount of work has been devoted to the development of the basic material needed to efficiently train young researchers in the basic principles and techniques required to develop a computable general equilibrium model. We started with the material already prepared in the context of the PARADI School of modeling. This material was reviewed completely, taking into account the experience accumulated up to now. In particular, four volumes and four technical notes were prepared for and distributed at the Manila modeling workshop (see Appendix 2). Three of the volumes contain readings on a variety of issues related to CGE modeling. The fourth volume, elaborated by us, is a pedagogical tool containing a series of progressively more sophisticated CGE models. Researchers are first introduced to a theoretically simple CGE model to help them make the link between standard micro economic theory and CGE modeling in their own country. The development of a series of more and more complex pedagogical CGE models and the identification of policy scenarios is then used to facilitate the learning process and assist young researchers to develop their skills in the interpretation of simulation results. These developments include the construction of a pedagogical SAM that reflects more adequately the structure of «archetypal» semi-industrial economies. This material, which was initially prepared in French, was translated into English and revised for the Manila session. The technical notes cover a variety of modeling issues such as SAM multiplier analysis, the RAS technique for balancing SAMs and a variety of training exercises.

b) Development of micro-simulation techniques: In addition to this basic material, an operational procedure was developed to integrate detailed household survey data directly into CGE models. Using this methodology, households are modeled individually rather than through a representative agent. The advantage of this technique is to make it possible to simulate, using a CGE model, the impact of macro policies on poverty using the full range of poverty and distribution measures developed in the PMS component. In particular, we are able to examine the impacts within, as well as between, standard household categories. This innovation creates a solid link between the MSA and PMS components of the MIMAP projects, which we propose to develop further during the second phase. It was presented for the first time during the interim meeting of modelers in Dhaka in May 99. Further developments in micro simulation analysis were presented at the interim meeting of modelers in February 2000. (See appendix 2)
I.3. Technical support

Technical support activities have quickly become a significant aspect of this project, particularly for the MSA component, as researchers apply the techniques they have learned in the training sessions:

a) **Distance support:** Researchers maintained regular email contact with CREFA researchers in order to obtain replies to technical questions and detailed written comments and suggestions concerning their SAM, GAMS coding, reports and general research directions. The Laval group of modelers has spent a significant part of its time to review, run and reproduce the results obtain by MIMAP researchers. This activity will extend into the future.

b) **Interim meeting:** An interim meeting was held in Dhaka in May 1999 to allow CGE modelers to present their research and receive comments and suggestions from a CREFA researcher, other MIMAP personnel and members of other MIMAP teams. A second interim meeting was held in conjunction with the first training workshop on Modeling in Manila in February-March 2000.

II. Implementation of the objectives of the project

According to IDRC guidelines on the required final technical report, activities and results are first briefly described for the general objective and then more details are given relatively to each of the five specific objectives, as they appear in the grant agreement.

II.1. General objective

The general objective is to bring about a training program on MIMAP related methodologies and issues for the national MIMAP teams

A training program was effectively developed and implemented during the project. It consists of two major components, «Poverty Monitoring Systems» (PMS) and «Macroeconomic Structure and Analysis» (MSA).

The PMS component includes six units, each unit being subdivided in modules. Different documents and training tools were produced for most of the 14 planned modules. They are listed in Appendix I. This PMS component is essentially methodological, but an important policy issue is covered directly (the conceptual framework) or indirectly (the numerous methodological choices): what is to be understood, philosophically and operationally, by «poverty» and «inequity» in a given society. A large part of the PMS component modules were tested through the «MIMAP...
Training Session on Poverty Measurement and Analysis held in Quebec from August 30 to September 17, 1999 (see the program in Appendix II).

The MSA component is essentially a modeling component. It consists of three components covering training, research and direct support activities to modelers in the different countries where MIMAP is active.

II.2. Specific objectives

II.2.1. Objective #1

Where technology transfer is desirable, to give junior and senior teams support to secure the sustainability of the program or the institutionalization of MIMAP.

Support to junior and senior teams has been provided through a three-week training session in September 1999 and a two-week training session on Modeling in Manila in 2000, as well as through the training tools developed and accessible to all MIMAP researchers.

- The « MIMAP Training Session on Poverty Measurement and Analysis »

In May 1999, an invitation was sent to all MIMAP national teams and thematic networks to participate in a training session on PMS, with a request to comment on a tentative program. The MIMAP community expressed great interest and we received an important number of demands. Twenty-four researchers, from eleven (11) countries, were selected:

- Pakistan (1)
- Bangladesh (3)
- Nepal (3)
- India (1)
- Sri Lanka (2)
- Laos (2)
- Vietnam (4)
- Philippines (3)
- Burkina Faso (2)
- Benin (2)
- Morocco (1)

Some senior researchers were also invited as resource people for some components of the program to prepare them to eventually repeat this training in their own country (« training of trainers » approach). One of the main constraints was to give computer access to each participant, an important requirement for the practical exercises. We thus had to refuse many candidates. Eleven participants were financed by their own national budget, and thirteen came under a special IDRC budget.
A computer room with 20 computers was made available to the participants during the session, including evenings and weekends. They could then access their e-mail through Internet. An office with a computer was reserved for some senior participants, and for the last part of the session, four more computers were made available to all participants. All these computers were equipped with basic and specialized software, as required for the different exercises.

- The « MIMAP Training Session on Modeling »

The general objective of this training session was to organize a basic training session on modeling involving around 25 participants from MIMAP country teams (see list in annex). This session lasted for nine days (February 28th–March 8th).

The main specific objectives pursued were the following: 1) train young researchers so that they will be able to take part in the on-going efforts of the MIMAP teams to develop an expertise in computable general equilibrium modeling; 2) provide a special focus on techniques for evaluating the impacts of macroeconomic policies on income distribution and poverty; 3) train senior researchers to be themselves trainers, familiarizing them with the pedagogical material which has been developed. Twenty-five researchers, from seven (7) countries, were selected:

- Pakistan (3)
- Bangladesh (3)
- Nepal (3)
- India (2)
- Vietnam (5)
- Philippines (3)
- Vietnam VEEM (2)
- Ghana (2)
- India Gender (1)
- Philippines IMAPE (2)

- The basic training session preceded the biannual meeting for MIMAP modelers (March 9th–11th, 2000).

During this part of the program we presented some more advanced modules and gave the opportunity to every MIMAP team to expose and discuss their ongoing work. Some senior researchers were invited as resource people for some components of the program to prepare them to eventually repeat this training in their own country. (« Training of trainers » approach).

- Training tools

For PMS Activities

During the reference period, considerable effort was devoted to researching and synthesizing the literature on the measurement of poverty and welfare and on the
design of poverty monitoring systems. This involved a number of aspects, mostly the philosophical foundations, the political economy, the normative tools, the issues involved in using micro data, statistical inference, poverty perceptions, poverty indicators, etc. This required: substantial literature reviews; a fair amount of original fundamental research; the writing of pedagogical material; field research to test the methodology of poverty perceptions measurement; the acquisition and technical evaluation of specialized software for micro-data analysis; the programming of a user-friendly software package specifically designed to assist in the measurement and comparisons of living standards across time, societies, or economic environments; the programming of a simulation laboratory for sampling survey theory; the implementation of an important micro data base; etc. We can briefly list the training tools developed until now:

- Training documents: 25 documents were distributed to the trainees at the Quebec session. The titles and the classification of these documents by module are given in Appendix I.

- A software program (DAD), which is unique in scope, is now technically fully operational, although it is still subject to a number of validating tests. It is available in English and in French, although the more recent versions are in English. A technical manual and a comprehensive user guide are also available. A description of the functionalities of the software can be found on the web page http://www.crefa.ecn.ulaval.ca/dad.

- A simulation laboratory, the “Butare Mayaga Region”, is available as a SPSS file, and can be immediately converted to other statistical software with StatTransfer. It allows users to conduct Monte Carlo experiments on a full population to illustrate sampling theory underlying the most common households survey design, and to illustrate the impact of survey design on the estimation of poverty profiles. Its use is described in Doc # II.1.2, Simulation Laboratory for Sampling Techniques.

- A database of micro data from different MIMAP countries to allow users to apply the numerous methodologies presented in the training modules using real data and to render MIMAP researchers fully operational in analyzing their own national large households surveys. This database presently includes:
  a) Vietnam Living Standard Survey 1992-93
  b) Burkina Faso Enquête Prioritaire 1994-95
  c) Nepal Living Standard Survey 1995-96

For MSA activities.

A substantial amount of work was devoted to the development of the basic material needed to efficiently train young researchers in the basic principles and techniques required to develop a computable general equilibrium model. We
started with the material already prepared in the context of the PARADI School of modeling. This material was reviewed completely, taking into account the experience accumulated up to now. In particular, four volumes and four technical notes were prepared for and distributed at the Manila modeling workshop (see Appendix 2). Three of the volumes contain readings on a variety of issues related to CGE modeling. The fourth volume, elaborated by us, is a pedagogical tool containing a series of progressively more sophisticated CGE models. Researchers are first introduced to a theoretically simple CGE model to help them make the link between standard micro economic theory and CGE modeling in their own country. The development of a series of more and more complex pedagogical CGE models and the identification of policy scenarios is then used to facilitate the learning process and assist young researchers to develop their skills in the interpretation of simulation results. These developments include the construction of a pedagogical SAM that more adequately reflects the structure of «archetypal» semi-industrial economies. This material, which was initially prepared in French, was translated into English and revised for the Manila session. The technical notes cover a variety of modeling issues such as SAM multiplier analysis, the RAS technique for balancing SAMs and a variety of training exercises.

II.2.2. Objective # 2
To reinforce the network and the scope of support activities for the national MIMAP teams.

Four types of activities can be seen as supporting more specifically this objective:

- Involvement of national MIMAP researchers as trainers in some modules of the two training programs organized during the project. For example, some MIMAP researchers were invited to present some methodological work in the following modules of the PMS workshop:
  - Module II.3C: Poverty lines computation
  - Module III.4: Poverty comparisons and poverty alleviation policies
  - Module III.5: Monitoring poverty through time and space: Poverty Monitoring Systems

This involvement increases the opportunities for the MIMAP researchers to share their experience.

- The training of trainers approach

Senior researchers from three countries - Philippines, Bangladesh, Nepal - were invited to the Quebec session as potential future trainers in their respective countries and regions. On the modeling side, three senior researchers were involved in the delivery of the training. As the basic training program was organized in conjunction with the interim meeting of modelers, young researchers got a chance to participate in more sophisticated and advanced discussions of ongoing work by senior researchers.
Cooperation with the World Bank training program on poverty

A close relationship was developed with The World Bank, especially EDI, since the Katmandu International Workshop in 1998. For the PMS component of the training program, one researcher (L.-M. Asselin) has attended, as an observer, a session of the EDI training program on poverty given in Washington in December 1998. Collaborative work in this area of training was then discussed with some Bank researchers. During the preparation of the Quebec session, there was regular communication with the Bank. They expressed their interest in our original training approach in the area of poverty measurement and analysis. As the Bank’s methodology was presented in our session, they cooperated in providing us with some detailed information. The emerging MIMAP secretariat in Manila is also interacting with the Bank concerning eventual cooperative training on poverty. This clearly widens the scope of future support activities for the national MIMAP teams.

Participants’ interaction during the training session.

The training session in Quebec as well as the two interim meeting of modelers and the training session in Manila were good opportunities for MIMAP researchers to exchange on their methodologies, especially through open discussions during the different presentations.

II.2.3. Objective # 3

To improve the linkages between the two research components of MIMAP: Poverty Monitoring and Modeling.

A large part of the data collection and analysis methodological work developed by the PMS component is oriented to providing multidimensional poverty profiles disaggregated according to more and more refined household classifications based on human capital, asset ownership, socioeconomic environment (accessibility to markets and public services, etc.) through the region, etc. All these refined poverty profiles are not always possible with data generated from heavy and costly standard national households surveys. The MIMAP PMS methodology tries to develop light poverty indicators, eventually applicable on a large scale with local resources, so that refined poverty profiles become possible. But we also link this work with developing national capacity to analyze the micro data generated by in-depth surveys like LSMS, income/expenditure surveys, etc. so that analytic work be done trying to link light poverty indicators and traditional money-metric ones. All this underlies the methodological work already done and is expected to contribute to more relevant household classifications in the social accounting matrices on which the modeling research is frequently based, particularly for model calibration. The Module III.6: PMSs and the disaggregation of households in the social accounts matrix is conceived as being an operational result of these research issues and is still to come in the future.
Links between the PMS and the MSA components were developed during the project. In particular, an operational procedure was developed to integrate detailed household survey data directly into CGE models. Using this methodology, households are modeled individually rather than through a representative agent. The advantage of this technique is to make it possible to simulate, using a CGE model, the impact of macro policies on poverty using the full range of poverty and distribution measures developed in the PMS component. In particular, we are able to examine the impacts within, as well as between, standard household categories. This innovation creates a solid link between the MSA and PMS components of the MIMAP projects, which we propose to develop further during the second phase. It was presented for the first time during the interim meeting of modelers in Dhaka in May 99. Further developments in micro simulation analysis were presented at the interim meeting of modelers in February 2000. (See appendix 2)

II.2.4. Objective # 4
To encourage networking activities with the MIMAP Program Initiative.

In formulating this objective at the beginning of the program, we had in mind that junior MIMAP teams should benefit from the research work done by senior teams. This objective was partly reached by the involvement of national MIMAP researchers as trainers in some modules, described above, and also by the fact that the training material refers as frequently as possible to national MIMAP research work as case studies. We already see some junior teams, e.g. in Africa, referring to «MIMAP Asian PMS methodology» in their research proposal for a new phase.

Also, as a result of the Quebec session, the idea is emerging of asking each national MIMAP team to present, at the international workshop to come, a poverty profile of their country in a standard format, using comparable methodologies. On the modeling side the interim meeting of Dhaka has already launched an initiative to apply the same approach to common interests. In this spirit, the group of Modelers decided to analyze trade liberalization episodes in their respective countries using their models.

The fact that the MIMAP Gender Initiative sent a participant to the Quebec session as well as the Manila workshop on modeling facilitates and expands methodological exchanges with this research group.

II.2.5. Objective # 5
To increase the national and international visibility of the Program Initiative and to broaden the MIMAP network to include Canadian university students.

- International visibility

The international visibility of the Program Initiative was increased through collaboration with the World Bank, one of the most influential organizations in
the area of poverty measurement and analysis. Some more concrete joint training operations can be expected in the future, on the basis of the originality of our training material and of our approach. Other organizations like UNDP are still to be more informed of our training resources, in addition to the linkages developed in different countries through the research work on PMS methodology.

This visibility is also increased by the publication of research papers in scientific journals. As an example, a paper "Statistical Inference for Stochastic Dominance and for the Measurement of Poverty and Inequality" (co-authored by Jean-Yves Duclos and Russell Davidson) has just been accepted for publication in Econometrica. It comes out the academic research done in the context of the MIMAP training program.

- National visibility and inclusion of Canadian university students

The research work of four students (two Ph.D. and two M.A.) has helped (and continues to help) to develop the conceptual and statistical tools for this project (though only two of these students were financed by MIMAP Training). A Ph.D. chapter in Paul Makkinnis's thesis has recently developed some normative tools that are useful to test the multidimensional dimension of poverty. The Ph.D. thesis of Anyck Dauphin will contribute to our understanding of income distribution within the household and will help to identify gender-specific poverty indicators. The M.A. thesis of Sébastien Larochelle-Côté investigates the validity of the asymptotic results of a large number of poverty estimators under finite samples using bootstrap techniques. The M.A. thesis of Steve Fecteau will derive the basic parameters of the sampling distribution of relevant poverty estimators under more complex sampling structures than the simple random sampling that is assumed in DAD.

III. List of documents and products developed during the project

III.1. Poverty Measurement and Analysis

Module I.1: A logical framework for the methodological development of a PMS.
- Doc # I.1.1 The Logical Framework Analysis applied to a results-based research program on PMS methodology

Module I.2: Conceptual framework for poverty measurement and poverty alleviation policies
- Doc # I.2.1 Poverty Measurement, A Conceptual Framework
- Doc # I.2.2 Poverty Measurement, A Conceptual Framework, Readings

Module I.3: Perceptions of Poverty: survey techniques and analysis
Module II.1: Household surveys: Basic Techniques
- Doc # II.1.1 Basic Sampling Techniques
- Doc # II.1.2 Simulation Laboratory for Sampling Techniques

Module II.2: Methodology for the collection and analysis of poverty indicators by the local population.

Module II.3: Construction of synthetic indicators and poverty lines

II.3A: Standard money-metric poverty indicators from household survey data
- Doc # II.3A.1 Building money-metric poverty indicators from household survey data. Case Studies.
- Doc # II.3A.2 Documentation on the database Vietnam Living Standard Survey 1992-93
- Doc # II.3A.3 Documentation on the database Burkina Faso Enquête Prioritaire 1994-95
- Doc # II.3A.4 Documentation on the database Nepal Living Standard Survey 1995-96
- Doc # II.3A.6 Constructing an Indicator of Consumption for the Analysis of Poverty (LSMS Working Paper 124)

II.3B: Synthetic poverty indicators from multidimensional qualitative data
- Doc # II.3B.1 A Synthetic Indicator from Multidimensional Qualitative Data

II.3C: Poverty lines computation
- Doc # II.3C.1 Poverty Lines in Theory and Practice (LSMS Working Paper 133)
- Doc # II.3C.2 Exercises for the Computation of Poverty Lines

Module II.4: Small area statistics

Module II.5: Optimal sample design for household surveys on poverty

Module III.1 Geographic Information Systems (GIS) on poverty

Module III.2: Poverty measures, poverty indices and poverty profile construction
III.2. The DAD software

**DAD**: a software for **Distributional Analysis** / **Analyse Distributive**

DAD is written in JAVA, which makes it compatible with any operating environment, and which will also eventually make it suitable for use through the Internet. It is the only software available that focuses on the measurement and comparisons of metric living standards across distributions. It offers a large range of facilities, including:

**Provision of descriptive tools:**
- Basic statistics: mean, quantiles, variances (with their standard errors)
- Non parametric estimation of density, joint density, regression between two variables
- Fitting of parametric distributions to consumption or income data

**Estimation of indices:**
- Poverty indices (absolute and relative)
- Social welfare indices
- Inequality indices
- Indices of equity: of the incidence of taxes, transfers, or of the impact of MAP on progressivity, redistribution, and vertical and horizontal equity

**Estimation of tools for the decomposition:**
- Of poverty across population subgroups
- Of inequality across population subgroups or by factor (consumption of income) components
• Of indices of equity across different MAP, taxes, subsidies, etc...

Checking the robustness of poverty, social welfare, inequality and equity comparisons
• Estimation of stochastic dominance (or poverty gap) curves for:
  o Poverty
  o Social welfare
  o Inequality (normalized stochastic dominance) and relative poverty
  o Directions for socially efficient MAP and tax reforms
  o Robustness of decomposition of inequality and poverty
• Estimation of ordinary and generalized Lorenz curves
• Estimation of Cumulative Poverty Gap (CPG) curves
• Estimation of concentration curves for:
  o Progressivity
  o Vertical and horizontal equity
  o Socially efficient directions for indirect tax reforms
  o Non-parametric estimation of the income elasticity of the demand for various goods
• Estimation of critical poverty lines for absolute and relative poverty
• Estimation of crossing points for Quantiles, Lorenz, CPG and concentration curves

Statistical inference: checking the precision and the robustness of distributional conclusions when using sample data:
• Provision of standard errors on estimates of:
  o Descriptive tools
  o Indices
  o Points on curves
  o Differences in indices and curves
  o Elements of poverty and inequality decompositions
  o Critical lines and crossing points
• Standard errors computed
• For independent or dependent variables and samples
• For poverty lines estimated with a sampling error (within or outside the relevant sample), and for absolute and relative poverty indices
• Under the simplifying assumption of iid observations, and eventually under the assumption of more complex sampling structure.

III.3. Modeling and Policy Impact Analysis

I) Basic training

Volumes (in English)
- Volume I: Methodological Foundations of CGE Modeling (Readings)
- Volume II: Basic CGE Models
DOCUMENT 1: Model 0: A Theoretical Model
DOCUMENT 2: Model AUTA: A Closed Economy Without Government
DOCUMENT 3: Model AUTETA: A Closed Economy With Government
DOCUMENT 4: Model EXTER: An Open Economy With Government
   Model EXTER 2: Non-Infinite Foreign Demand for Exports
   Model EXTER 3: Quantitative Restriction on Imports

- Volume III: CGE Applications to Trade Liberalization (Readings)
- Volume IV: CGE Application to Poverty and Income Distribution Analysis (Readings)

Volumes (in French)
- Volume I: Fondements Méthodologiques des MEGC (Lectures)
- Volume II: MEGC de base
   DOCUMENT 1: Modèle 0: Un modèle théorique
   DOCUMENT 2: Modèle AUTA: Économie fermée sans gouvernement
   DOCUMENT 3: Modèle AUTETA: Économie fermée avec gouvernement
   DOCUMENT 4: Modèle EXTER: Économie ouverte avec gouvernement
      Modèle EXTER 2: Demande étrangère non-infinie pour les exportations
      Modèle EXTER 3: Restrictions quantitatives pour les importations
- Volume III: Applications MECG à l’analyse de politiques commerciales (Lectures)
- Volume IV: CGE Application to Poverty and Income Distribution Analysis (Readings)

Documents
- Dumont, J.-C. and V. Robichaud (2000), An Introduction to GAMS

Technical notes
- SAM Multiplier Analysis
- Example of the RAS technique
- Exercise 1 on SAM
- Exercise 2 on SAM
- Exercises on Multiplier Analysis

II) Advanced training: micro-simulation

Documents
- Decaluwé, B., J.C. Dumont and L. Savard, Measuring Poverty and Inequality in a Computable General Equilibrium Model
- Decaluwé, B., J.C. Dumont and L. Savard, Mesurer la pauvreté et les inégalités dans un modèle d’équilibre général calculable
IV.  Recommendations: MIMAP Training and technical support

Phase I

In phase I of the MIMAP Training and Technical Support project, a large number of MIMAP researchers participated in comprehensive training workshops in addition to receiving substantial technical support and advice during MIMAP meetings and through electronic communication. In this process, a considerable but still incomplete set of training materials and methodologies was developed and tested. New perspectives were opened in terms of partnership with other training institutions. Also, training and technical support needs have been specified more clearly and appear as being different for the PMS and MSA components. Thus, it is highly recommended to implement a phase II with the following objectives, although the goal remains the same. The general objective of the phase II could be to increase the national research capacity in PMS and MSA methods. A number of specific objectives could also be pursued: train MIMAP researchers in the concepts and techniques required for conducting meaningful research in the areas of PMS and MSA, finalize a well-recognized and internalized training program on MIMAP-related methodologies and issues for the national teams, provide MIMAP researchers with on-going technical support and advice throughout the various stages of their research projects and finally disseminate training material widely in international and local academic and policy circles.

During phase I research activities of the PMS and MSA components are developing an increasing number of points of convergence, particularly in the area of micro-simulations and the PMS module on “poverty monitoring systems and the disaggregation of households in the social accounting matrix”. However, the training strategy for each is conceptually distinct and will remain so in the future. Dissemination activities are common to the two components and more emphasis should be put on dissemination strategies.
Appendix I

MIMAP Training Session
on Poverty Measurement and Analysis

Québec, August 30-September 17 1999

Programme (2nd draft)

Place: Laval University, Pavillon La Laurentienne, rooms 2416 and 2430
Schedule: 9h-12h, 13h30-17h.

Monday August 30
a.m.
- Welcome and presentation of the participants
- Presentation of the programme, training facilities, work organisation, etc.
- Comments and expectations from the participants
- Module 1.2: Conceptual framework for poverty measurement and poverty alleviation policies
  a) The concept of poverty: presentation of reading material and comments.

p.m.
- Module 1.2: Conceptual framework for poverty measurement and poverty alleviation policies (cont.)
  b) Poverty and poverty alleviation policies: modeling issues in public economics
  c) A table of poverty indicators: presentation and discussion

17 H.: cocktail, room 2229, Pavillon De Sève
Tuesday August 31

a.m.
- Module 2.3A: Building standard money-metric poverty indicators from survey data
  
  **Resources:** The World Bank, J.-Y. Duclos.
  Synthetic indicators (hld. consumption aggregate, etc.) from LSMS and PHS surveys. World Bank methodology.

p.m.
- Module 2.3A: Case studies
  
  **Resource:** L.-M. Asselin
  a) VLSS-1 (Vietnam)
  b) NLSS (Nepal)
  c) PHS-1 (Burkina Faso)
  Description of data files, exercises on access to data and data transformation with SPSS.

Wednesday September 1

a.m.
- Module 1.3: Poverty perceptions: qualitative survey techniques (1st part)
  
  **Resource:** A. Dauphin
  a) usefulness of poverty perception measurement and basic distinctions
  b) first principles in qualitative surveys
  c) focus group techniques, data analysis

p.m.
- Module 2.3A: practical exercises on survey data (cont.)
  
  **Resource:** L.-M. Asselin

Thursday September 2

a.m.
- Module 1.3: Poverty perceptions: qualitative survey techniques (2nd part)
  
  **Resource:** A. Dauphin
  a) individual ordering: interview techniques
  b) key informant interview
  c) nominal groups

p.m.
- case studies
  
  **Resources:** A. Dauphin, J.A. Morasse
  a) Burkina Faso
  b) Bénin
Friday September 3

a.m.
- Module 2.1: Basic quantitative survey techniques (1st part)
  Resource: L.-M. Asselin
  a) fundamental concepts of probability sampling
  b) basic sample structure: s.r.s., without replacement
  c) categories of estimators used in a poverty profile

p.m.
- Module 2.1: practical exercises
  Resource: L.-M. Asselin
  a) presentation of a simulation laboratory
  b) exercises with SPSS

Monday September 6

a.m.
- Module 2.1: Basic quantitative survey techniques (2nd part)
  Resource: L.-M. Asselin
  a) unequal probability sampling
  b) multi-stage designs
  c) stratification

p.m.
- Module 2.1: practical exercises (cont.)
  Resource: L.-M. Asselin
  Complex sample designs, poverty profiles estimated with SPSS

Tuesday September 7

a.m.
- Module 2.3: Poverty lines computation
  Resources: The World Bank, J.-Y. Duclos, M. Mujeri
  a) categories of poverty lines (FEI, MBN, etc.)
  b) steps in the computation

p.m.
- Module 2.3: Poverty lines computation: case studies
  Case studies and practical computations from Vietnam, Nepal and Burkina Faso survey data.
Wednesday September 8
a.m.
- Module 2.3B: building synthetic poverty indicators from multidimensional qualitative data
  Resource: L.-M. Asselin
  a) review of some approaches already used in poverty analysis
  b) factorial correspondence analysis.
  c) case study: analysis of Nepal MIMAP PMS data

p.m.
- Module 2.3B: applications
  Resource: L.-M. Asselin
  a) the Nepal case study (cont.)
  b) exercises from other databases: hld. surveys from Vietnam, Burkina, etc.

Thursday September 9
a.m.
Continuation of practical exercises proposed since the beginning of the session.
Resources: A. Araar, L.-M. Asselin.

p.m.
- Module 3.2: Poverty measures, poverty indices and poverty profile construction
  Resource: J.-Y. Duclos
  a) Basic theory of poverty measures and indices.
  b) Practical exercises with DAD software, on data introduced in preceding modules.

Friday September 10
a.m.
- Module 3.4: Poverty comparisons and poverty alleviation policies
  Resource: J.-Y. Duclos
  Stochastic dominance and robustness of poverty comparisons. Significance for poverty alleviation policies.

p.m.
- Module 3.3: Statistical reliability of poverty profiles estimated from survey data
  Resource: L.-M. Asselin
  a) Sampling error estimation of simple poverty profiles estimated from the most usual complex survey designs.
  b) Introduction to IMPS software and practical computations
Monday September 13
a.m.
- Module 3.3 : Statistical reliability of poverty profiles estimated from survey data.
  Resource : J.-Y. Duclos
  Statistical reliability of complex poverty profiles, assuming iid data.
  Theory and applications with DAD

p.m.
Continuation of practical exercises proposed since the beginning of the session.
  Resources : A. Araar, L.-M. Asselin.

Tuesday September 14
a.m.
- Module 3.4 : Poverty comparisons and poverty alleviation policies
  Issues in poverty alleviation policies.
  Resources : The World Bank, J.-Y. Duclos
  The link between household surveys and the operation side of the World Bank

p.m.
- Module 3.4 : Poverty comparisons and poverty alleviation policies
  Issues in poverty alleviation policies (cont.)
  Risk and vulnerability, impact assessment of social programs, measuring benefits of public spending, etc.).

Wednesday September 15
a.m.
- Module 3.5 : Monitoring poverty through time and space : Poverty Monitoring Systems
  a) 1st case study : Philippines
  b) 2nd case study : Bangladesh

p.m.
- Module 3.5 : Monitoring poverty through time and space : Poverty Monitoring Systems (cont.)
  c) 3rd case study : Nepal
Thursday September 16

a.m.
- Module 1.1: The Logical Framework Analysis applied to the design of a results-based research program on PMS methodology
  
  Resource: L.-M. Asselin
  
  Presentation of the LFA as a project management tool

p.m.
- Module 1.1 (cont): application to case studies taken from the MIMAP research program of some countries participating in the session.

Note: subject to change.

Friday September 17

Open program, to be defined during the session, including evaluation, continuation of practical exercises, etc.

Evening (19h.): cocktail, dinner
Appendix II

First MIMAP training session and second biannual meeting on modelling

Manila
February 24th - March 12th 2000

Mission Report
Bernard Decaluwe
Jean-Christophe Dumont
Veronique Robichaud

Organisation and objectives of the mission

Bernard Decaluwe: February 26th-March 12th
Jean-Christophe Dumont and Veronique Robichaud: February 24th-March 12th

The general objective of this mission consists on the organisation of a basic training session on modelling involving around 20 participants for MIMAP country Teams (see list in annex). This session lasted for nine days of basic training (February 28th - March 8th).

The main objectives pursued were the following: 1) train young researchers so that they will be able to take part in the on-going efforts of the MIMAP teams to develop an expertise in computable general equilibrium modelling; 2) give a special focus on techniques for evaluating the impacts of macroeconomic policies on income distribution and poverty; 3) train senior researchers to be themselves trainers, familiarising them with the pedagogical material which has been developed.

The basic training session preceded the biannual meeting for MIMAP modellers (March 9th - 11th). During this part of the program we have presented some more advanced modules and give the opportunity to every MIMAP team to expose and discuss their ongoing work.

Detailed report

Monday February 28th:
After an introductory speech by Dr. Casear Cororaton and Prof. Bernard Decaluwe the participants presented, country by country, their background and expectations. The program for the next two weeks was also discussed in details.

During lunch time, we organised a meeting with the Team leaders of each country (Ghana, India, Nepal, Pakistan, Philippines, Vietnam), in order to prepare the organisation of the specialised session. The potential contribution of every one has been discussed and we decided to meet again after few days to conclude on that matter.

*Overview of modelling techniques for economic development analysis.*
*Description of Social Accounting Matrix (SAM) principles. A Basic SAM was presented and the participants had to construct two supplementary SAMs through some exercises.*

**A bag was provided to each participant with the volume II of the material and a detailed program**

Two copies of the volume I, III and IV (reference text) were provide to each of the MIMAP Team (on supplementary to Vietnam and India as there were two teams)

**Tuesday February 29th:**

During the morning session Bengalis, Indian, Pakistanis and Nepalese teams have presented their SAM. The construction hypothesis, data problems and results were deeply discussed among the participants. The Vietnamese team presented their on-going work as they have no SAM yet. (for individual comments see annex)

SAM multiplier analysis has been introduced and an application to poverty alleviation in India as been exposed by Dr. Basanta Pradhan. In the second half of the afternoon session a set of exercises on that subject using Excel was proposed. Only the first part of those exercises was completed by the participants who will have to finish them later on during the week or during the clinic session Saturday morning.

**A memo on multiplier analysis was provided**
**A memo on RAS method was also given to each of the participants**
**The participants received a floppy disk in order to be able to save their file along the week**

**Wednesday March 1st:**

The morning presentation reviewed some elements of the basic micro-economic theory needed for CGE analysis. Mathematical properties of the principal behaviour functions were recalled. This session was shared between Dr. Caesar Coronat and JC Dumont.

In the afternoon, the GAMS software was presented with a particular emphasis on the new features of GAMSIDE (Window version of GAMS). A set of 20 technical exercises
on GAMS was distributed in order to familiarised the participants with the software particularities.

*A limited time full GAMS software on CD was provided to each of the participants*

*A copy of the ‘GAMS User’s Guide’ was given to each of the MIMAP team*

*A Internet access was arranged in the computer room so the participants would be able to check their messages during the breaks.*

**Thursday March 2nd:**

The morning session started with the presentation of a simple theoretical model (model 0). Equations and simulations results were discussed. This presentation intended to make the link between the standard economic text book and Computable general equilibrium model. This simplistic framework also gave the intuition of the general equilibrium mechanisms and of the way simulation results can be interpreted.

The equations of the second CGE model (closed economy without government-Auta model) was presented and discussed. During the afternoon session the participants constructed their first CGE model based on the SAM and equations of the Auta Model. The GAMS code writing has been assisted step by step. As this exercise was not completely finished it was continued on Friday morning.

During the lunch time we had another meeting with the leaders of the MIMAP teams in order to organised the Specialised session. The consensual proposal that was considered is given below and will be submitted to Randy Spence by Bernard Decaluwé:

**Open meeting**

**Thursday morning:** Each of the MIMAP team will present a paper on the historical evolution of the trade liberalisation policies in their country.

**Thursday afternoon:** The Bengalis, Indian, Pakistanis and Nepalese teams will present the results of their simulation exercises. We may have another presentation from Philippines on CGE and a supplementary presentation from India on Multiplier analysis.

**Friday Morning:** We will have three presentations from Madanmohan Ghosh, Bernard Decaluwé and Jean-Christophe Dumont.

**Technical meeting**

**Friday Afternoon:** In deep discussion with all the MIMAP team modellers on the way to homogenise their modelling exercises in order to facilitate the comparison of inter-country results; definition of a precise agenda for the presentation of the September Meeting; technical discussions on the manner to reconcile trade data and national accounts.
Saturday:

Three technical subjects were identified by the team leaders for which they would like to have some specialised sessions. Those will be done in plenary or parallel sessions. The senior modellers ask that the juniors can assist to those presentations. The three subjects are: (i) income distribution and poverty analysis, (ii) financial CGE models, (iii) Dynamic CGE models.

During the evening we met Ms. Rizwana Siddiqui to review her model and article. We had a very constructive discussion on both of them and planned to work even more closely together in the near future (see annex).

Friday March 3rd:

Today the program was slightly modified in order to allow the participants to finish the implementation the Auta Model. Thus, we started with a session on GAMS and continued in the afternoon with the interpretation of some simulations.

During the morning session we verified individually that there was no more compilation error neither specification error in the model. We showed to each participant how to verify that the model behaves properly and how to perform a simulation. An exercise on GAMS has then been provided that consisted in the introduction of new equations in the Auta Model and to do some sensitivity analysis.

During the afternoon session we interpreted two simulations with the Auta Model. The first one consisted in an increase of the capital stock in the service sector and the second one in the increase in the total labour supply. A significant time has been given to the participants for analysing the results before we proposed a detailed interpretation.

Saturday March 4th:

On the Saturday we had a session in the morning only. The objective was mainly to make some time available for the participants to finish the exercises that have been proposed during the first week. Each one had the opportunity to choose to work whether on multipliers, GAMS error models or sensitivity analysis. At the end of this session we noticed that every one has completed, at least, the later two exercises.

Sunday March 5th:

A one-day excursion to a resort in the countryside has been organised by the MIMAP Philippines team. Everyone has joined this quite exciting trip.

Monday March 6th:

Monday started with a major technical problem because of a power failure at the Asia Pacific College. Initially, we had arranged a session on GAMS starting at 10h30, but the
electricity was planed to be restored not before 3 o’clock in the afternoon so we decided
to move at the Dusit Hotel in a conference room and to re-organised the program. The
Tuesday morning session has been repositioned and the construction of the code of the
Auteta Model has been first developed on paper (the implementation on GAMS was left
for Tuesday morning).

During the morning session we discussed the implication of introducing the government
into the Auta Model and presented in a very detailed manner each of the equations
(closed economy with government – Auteta Model). Just before the lunch break a set of
practical recommendations and hints were given in order to help the interpretation of the
simulation results.

During the afternoon the participants had more than one hour to interpret and write down
their interpretation of two simulations. Once again a detailed analysis has been discussed
putting much emphasis on the rules or principles enlighten in the morning.

All along this day, technical discussions were held sporadically with the Nepalese team
while we looked at their model. We corrected many specification and compilation errors
in the GAMS code. Each of the problems were solved (identified and described in the
program) and discussed with Prakash Raj Sapkota.

Tuesday March 7th:
The morning session was spent on computers trying to implement the AUTETA Model
on GAMS, starting from the AUTA version and using the first draft that has been
prepared the day before on paper. Most of the participants completed the calibration but
had not enough time to finish the exercise. Two sessions should have been planed for
this activity. The printed GAMS code has then been provided to every one.

During the afternoon we presented the EXTER Model (open economy with government).
The SAM and the equations were discussed for two versions of the model. The first one
applies a small country hypothesis whether the second one specifies an export demand
equation. The calibration of the CES and CET functions was also described. Finally, the
teams were asked to prepare a simulation (reduction of tariff duty on industry by 50 % -
Sim 1) that they had to present on the next morning session.

During the evening a meeting was held with the Nepalese team at our hotel in order to
discuss their paper and their model (see annex).

Rm: the participants asked that we provide one complete set of documents individually
instead of two sets for each national team.

_The Excel add-on for GAMS has been provided to each of the participants who have
requested it._
Wednesday March 8th:

The last day of the basic training session gave the opportunity at each of the MIMAP country team to present their own interpretation of one simulation with the EXTER model. The results have been deeply discussed so that we were sure that the mechanisms in force in the open economy model were perfectly understood by every one.

During the afternoon session Madam Gosh discussed two issues related to (i) welfare analysis in CGE models and (ii) closure rules. The presentation was quite succinct but somehow help the participants to understand those important points. An exercise on GAMS have also been proposed which had mitigate success.

*A full set of the schematic representations of the three models that we have studied during the session were provided*

*A questionnaire was also distributed so that we will know what the participants have thought of the training.*
ANNEX 1 : List of participants

MIMAP-Bangladesh
1. Dr. Mustafa K. Mujeri
2. Dr. Bazlul Khondker
3. Mr. Md. Abul Bashar

MIMAP-Ghana
4. Dr. Nii Kwaku Sowa
5. Ms. Ivy Aryee

MIMAP-India
6. Dr. Basanta K. Pradhan
7. Mr. Amarenda Sahoo

MIMAP-Nepal
8. Ram Krishna Sharma
9. Ram Sharan Kharel
10. Prakash Raj Sapkota

MIMAP-Pakistan
11. Dr. Ather Maqsood Ahmed
12. Ms. Rizwana Siddiqui
13. Dr. Zafar Mueen Nasir

MIMAP-Philippines
14. Dr. Caesar B. Cororaton
15. Mr. Rex Aurelius C. Robielos

MIMAP-Vietnam
16. Ms. Tran Thi Kim Dung
17. Ms. Pho Kim Chi
18. Dr. Hoang Minh Hai
19. Dr. Nguyen Chan
20. Mr. Ngo Dinh Quang

VEEM
21. Dr. Nguyen Thang
22. Ms. Nguyen Thi Kim Dung

Gender
23. Ms. Anushree Sinha

IMAPE (Environment)-Philippines
24. Mr. Erwin Corong
25. Ms. Rafaelita Aldaba
ANNEX 3: Material provided to the participants

Volume I: Methodological Foundations of CGE Modelling

CGE Modelling


SAM and Multipliers


Macroclosure


Functional Forms


DOCUMENT 17: Dissou, Y., 1993, Functional Forms Used in CGEs, in Martin, M.C., M. Souissi and B. Decaluwe, Ecole PARADI de modélisation de politiques économiques de développement, Québec, Université Laval.

GAMS

# Volume II: Basic CGE Models

| DOCUMENT 1: | Model 0: A Theoretical Model | 1 |
| DOCUMENT 2: | Model AUTA: A Closed Economy Without Government | 21 |
| DOCUMENT 3: | Model AUTETA: A Closed Economy With Government | 41 |
| DOCUMENT 4: | Model EXTER: An Open Economy With Government | 61 |
| Model EXTER 2: | Non-Infinite Foreign Demand for Exports | 85 |
| Model EXTER 3: | Quantitative Restriction on Imports | 101 |
Volume III : CGE Applications to Trade Liberalization

Standard Models


Non Standard Models


Multi-Country Models

**DOCUMENT 9**: Decaluwé, B., Y. Dissou and V. Robichaud, 1999, Regionalization and Labour Market Rigidities in Developing Countries: A CGE Analysis of UEMOA, Cahier de recherche du CREFA, #9917.

**DOCUMENT 10**: DeRosa, D. A., 1995, Regional Trading Arrangement among Developing Countries: The ASEAN Example., IFPRI Research Report 103.


Volume IV: CGE Application to Poverty and Income Distribution Analysis

Standard Models


Microsimulation


SAM Multiplier Analysis

Social accounting matrix and multiplier analysis

Principles
The Social Accounting Matrix (SAM) is a comprehensive data system but it is not a model as such. To come to this point we must specify which variables are exogenous and endogenous and link them through a set of mathematical relations. This is exactly what is done in a proper CGE model.

The easiest manner to transform a SAM in some kind of an economic model is to assume that all the relations are of linear type and that prices are fixed (at least in the short run). In that case the SAM can be used directly to simulate the effects of shocks on some exogenous variables or accounts. This type of exercise is known as SAM multiplier analysis and can be seen as an extension of Input-Output models.

Depending of which account are set exogenous different implicit closure hypothesis are possible. Usually we will consider three accounts as potentially exogenous: the government, the rest of the world and the capital accounts. Endogenous capital account reflects some kind of internal flexibility and endogenous Rest of the World account assumes that trade is relatively free.


In order to describe the main principles let us first consider a simplified Schematic Social Accounting Matrix as shown in Defourny & Thorbecke (1984):

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Factors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Institutions</td>
<td></td>
<td>T_{21}</td>
<td>T_{22}</td>
<td>T_{13}</td>
<td>X_{1}</td>
<td>Y_{1}</td>
</tr>
<tr>
<td>3. Productive activities</td>
<td></td>
<td>T_{31}</td>
<td>T_{32}</td>
<td>T_{33}</td>
<td>X_{3}</td>
<td>Y_{3}</td>
</tr>
<tr>
<td>4. Exogenous accounts</td>
<td></td>
<td>L_{1}</td>
<td>L_{2}</td>
<td>L_{3}</td>
<td>LX</td>
<td>Y_{4}</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$A_{n}$ is define as the matrix of average expenditure propensities. It can be obtained by dividing a particular element in any of the endogenous accounts by the total for the column account in which the element occurs. $X_{n}$ represents the exogenous accounts and $Y_{n}$ the total of each endogenous account. With those notations it comes:
The multiplier matrix $M_a$ can be decomposed, as Pyatt and Round (1978) suggested, into three economically meaningful additive (or multiplicative) components: (i) a transfers matrix that picks up the net multiplier effects induced on a given set of accounts by exogenous transfers accruing to the given set; (ii) an open-loop matrix that captures the cross effects between different groups; and (iii) a closed-loop matrix detailing the multiplier effects of an exogenous inflow on an endogenous account and return to the original recipient.

First of all, let us note $\hat{A}$ as the diagonal bloc matrix extract from the matrix $A_n$:

$$
\hat{A} = \begin{bmatrix} 0 & 0 & 0 \\
0 & A_{22} & 0 \\
0 & 0 & A_{33} \end{bmatrix}
$$

then it comes:

$$
y_n = A_y y_n + x_n = (A_n - \hat{A})y_n + \hat{A}y_n + x_n \\
= (I - \hat{A})^t (A_n - \hat{A})y_n + (I - \hat{A})^t x_n \\
= A^t y_n + (I - \hat{A})^t x_n
$$

Multiplying both sides by $A^t$ and substituting for $A^t y_n$ on the left hand side now gives:

$$
y_n = A^t y_n + (I + A^t)(I - \hat{A})^t x_n \\
= (I - A^t)^t (I + A^t)(I - \hat{A})^t x_n
$$

Similarly, multiplying both sides of the initial equation by $A^{t2}$ yields:

$$
y_n = A^{t2} y_n + (I + A^{t2})(I - \hat{A})^t x_n \\
= (I - A^{t2})^t (I + A^t + A^{t2})(I - \hat{A})^t x_n
$$

More generally:

$$
y_n = (I - A^{tM})^t \left( \sum_{j=0}^{M} A^{tj} \right) (I - \hat{A})^t x_n
$$

At this stage, it is worth noting that the three steps decomposition that will finally be retained reflects the sequence of substitution that corresponds to one complete cycle in the circular flow of income within the economy and thus that it is not an arbitrary choice.

If we note $M_{a1} = (I - \hat{A})^{-1}$, $M_{a2} = I + A^t + A^{t2}$ and $M_{a3} = (I - A^{t3})^{-1}$ it comes: $M_a = M_{a1}M_{a2}M_{a3}$
But we can also re-write Ma as:

$$Ma = I + (M_{a1} - I) + (M_{a2} - I)M_{a1} + (M_{a3} - I)M_{a2}M_{a1}$$

**Main underlying hypothesis**

Several important hypothesis are underlying the SAM multiplier analysis. They stress the limits of this type of exercises. Especially we must recall that:

- Prices are supposed to remain constant in all time. This means that we implicitly assume that there exist an excess capacity of production.
- Production technology and resource endowments are given. As a result the analysis is necessarily a short term one and no dynamic of any kind can be taken into account.
- Expenditures propensities of endogenous accounts remain constant. In the basic analysis income elasticities are unitary: the prevailing average expenditure propensities in $A_n$ are assumed to apply to any incremental injection ($M_a$ can be seen as the matrix of average expenditure propensities). A more realistic alternative is to specify a matrix of marginal expenditure propensities corresponding to the observed income and expenditure elasticities of the different agents ($M_e$). Average and marginal propensities will not generally be equal for household demand but would correspond for production (as far as there is no scale effect) and for factor payments if the value added price is set as a constant mark-up over labor costs per unit of output. Expressed in another way we would generally specify:

$$\forall (i, j) \neq 32 \quad C_{ij} = A_{ij} \quad and \quad C_{32} = eA_{32}.$$ 

- At least one of the account must be exogenous. The principle of the analysis itself implies that only accounts as a whole can be supposed exogenous (and not variables or cells).

**Poverty inference through multiplier analysis**

**Principles**

We reproduce here an analysis developed by Thorbecke and Jung (1996) that permits to use the multiplier results in order to infer the effect of shocks on poverty. For this purpose let us start with the basic equations:

$$\begin{align*}
\frac{dy_1}{dy} &= A_{31}dy + dx_1 \\
\frac{dy_2}{dy} &= A_{21}dy_1 + A_{22}dy_2 + dx_2 \\
\frac{dy_3}{dy} &= A_{32}dy_2 + A_{33}dy_3 + dx_3
\end{align*}$$

thus
\[
\begin{align*}
\begin{cases}
    dy_1 = A_{12} dy_2 + dx_1 \\
    dy_2 = (I - A_{22})^{-1} A_{23} dy_1 + (I - A_{22})^{-1} dx_2 \\
    dy_3 = (I - A_{33})^{-1} A_{32} dy_2 + (I - A_{33})^{-1} dx_3
\end{cases}
\end{align*}
\]

If we note \( M_{a2} \) the block in the matrix \( M_a \) that links households' income and productive activities in order to test the effect of sectoral growth on poverty (but the part to be considered depends clearly of the question addressed), then it come that \( M_{a23} = RD \):

\[
\begin{align*}
D &= (I - A_{22})^{-1} A_{2n} A_{1n} (I - A_{nn})^{-1} \\
R &= (I - (I - A_{22})^{-1} A_{2n} A_{1n} (I - A_{nn})^{-1} A_{22})
\end{align*}
\]

Now following Kakwani (1993) we have

\[
dP_{y} = \frac{\partial P_{y}}{\partial y} dy + \sum_{k=1}^{l} \frac{\partial P_{y}}{\partial \theta_{y}} d\theta_{y}
\]

The distributional effect of the exogenous shock is suppose to be negligible, so that the preceding formula simplifies to the first term. This means that the distribution intra group is supposed to be constant.

The elasticity of poverty to mean income (\( \eta \)) can be computed as follow:

- \( P = F(z) \) the poverty head count ratio (for other poverty measurement see Kakwani -1993)
- \( z \) the poverty line
- \( f(.) \) the probability density function of income
- \( L(.) \) the Lorentz curve of the type: \( L(x) = x - ax^a(I-x)^b \)

Thus, assuming that the Lorentz curve does not shifts:

\[
\frac{\partial P_{y}}{\partial y} = \frac{z}{\bar{y}^2 L''(P)}
\]

But we know that

\[
L''(P) = \frac{z}{yf(z)}
\]

Because

\[
L'(P) = \frac{z}{\bar{y}}
\]

and finally

\[
\eta_{y} = \frac{\partial P_{y}}{\partial y} \frac{\bar{y}}{P} = - \frac{zf(z)}{P}
\]

The elasticity of poverty to mean income depends positively of the distance between the mean income and the poverty line. As a matter of fact wealthier group will have a higher elasticity.
Following the standard result of the SAM multiplier analysis it comes that:

\[ d\tilde{y}_j = m_{ij} dx_j \]

thus

\[
\frac{dP_y}{P_y} = \eta_y \left( \frac{dx_j}{\tilde{y}_j} \right)
\]

Using an additive decomposable aggregated poverty measure (as the FGT indicator) it comes after few calculations (see Thorbecke and Jung -1996) that:

\[
\frac{dP_y}{P_y} = \sum_i s_i \eta_y m_{ij} \left( \frac{dx_j}{\tilde{y}_j} \right) = \sum_i r_{ij} s_i d_{ij} q_y
\]

with

- \( s_i \) the poverty share of household group \( i \) out of total poverty
- \( q_y \) the sensitivity of the poverty measure to the change in income (poverty sensitivity effect)
- \( d_{ij} \) the element \((i,j)\) of the matrix \( D \) and \( \forall (i,j) \ r_{ij} = m_{ij}/d_{ij} \)

References


Example of the RAS technique

RAS is a methodology widely used to evaluate, balance or update matrices. This technique starts from an initial share matrix from which a final matrix must be derived such as given rows and columns totals are respected. Here is a simple example in order to illustrate the methodology.

The first step consists in building a share matrix by dividing each element of the initial matrix by the total of the column in which it appears:

\[
\text{Initial matrix} = \begin{bmatrix}
3 & 4 & 2 \\
7 & 4 & 3 \\
\end{bmatrix} \Rightarrow \begin{bmatrix}
\frac{3}{10} & \frac{4}{8} & \frac{2}{5} \\
\frac{7}{10} & \frac{4}{8} & \frac{3}{5} \\
\end{bmatrix} = \begin{bmatrix}
0.3 & 0.5 & 0.4 \\
0.7 & 0.5 & 0.6 \\
\end{bmatrix} = A
\]

The total of every row and every column of the final matrix has to be known. Let's suppose that vector \( \text{ROW} \) and \( \text{COL} \) represent respectively the totals to be obtained in row and in column:

\[
\text{ROW} = \begin{bmatrix}
10 \\
12 \\
\end{bmatrix}
\]

Column totals to obtain

\[
\text{COL} = \begin{bmatrix}
4 & 10 & 8 \\
\end{bmatrix}
\]

The first step in evaluating the matrix that will respect all these totals is to multiply the elements in the share matrix by the corresponding total to respect given in \( \text{COL} \):

\[
A' = \begin{bmatrix}
0.3 \times 4 & 0.5 \times 10 & 0.4 \times 8 \\
0.7 \times 4 & 0.5 \times 10 & 0.6 \times 8 \\
\end{bmatrix} = \begin{bmatrix}
1.2 & 5 & 3.2 \\
2.8 & 5 & 4.8 \\
\end{bmatrix}
\]

Then we verify if the sum of each row of this new matrix, \( A' \), equal the ones in the \( \text{ROW} \) vector:

\[
1.2 + 5 + 3.2 = 9.4 \neq 10 \\
2.8 + 5 + 4.8 = 12.6 \neq 12
\]

The following iteration consists in multiplying the elements of \( A' \) by the ratio of the total to obtain (in vector \( \text{ROW} \)) by the actual sum:

\[
A'' = \begin{bmatrix}
1.2 \times \frac{1}{9.4} & 5 \times \frac{1}{10} & 3.2 \times \frac{1}{8} \\
2.8 \times \frac{1}{12.6} & 5 \times \frac{1}{10} & 4.8 \times \frac{1}{8} \\
\end{bmatrix} = \begin{bmatrix}
1.3 & 5.3 & 3.4 \\
2.7 & 4.7 & 4.6 \\
\end{bmatrix}
\]
Symmetrically to the first iteration, we then verify if the total of each column gives the total to be obtained (COL):

\[1.3 + 2.7 = 4\]
\[5.3 + 4.7 = 10\]
\[3.4 + 4.6 = 8\]

Thus, the matrix $A''$ respects both total in column and in row, we stop the iterative process. If we did not obtain the right totals, we would have multiply each element by the ratio of the column total to be obtained on the actual column total and so on.
Exercise 1 on SAM

Adding the government

Place all the following variables in the appropriate cell of the AUTETA SAM.

\( i,j \in \{A,I,S,N\} \) Productive activities and goods (\( A \): agriculture, \( I \): industry, \( S \): services, \( N \): non-tradable services)

\( h \in \{HW,HC\} \) Households (\( HW \): labour endowed households, \( HC \): capital endowed households)

\( CI_{i,j} \) Intermediate consumption of good \( i \) in activity \( j \)

\( DIV \) Dividends

\( DTF \) Direct tax on firm's income

\( DTH_h \) Direct tax on household's \( h \) income

\( E_{i,h} \) Household \( h \)'s expenditure in good \( i \)

\( G \) Public expenditures

\( IT \) Total investment

\( IV_i \) Investment in good \( i \)

\( RK_F \) Capital revenue paid to firms

\( RK_{HC} \) Capital revenue paid to capitalists

\( RK_j \) Return to capital from activity \( j \)

\( RK \) Total capital revenue

\( SF \) Firms' savings

\( SH_h \) Household \( h \)'s savings

\( SG \) Government's savings

\( ST \) Total savings

\( TG \) Public transfers to workers

\( TI_i \) Indirect tax on good \( i \)

\( VX_j \) Output of activity \( j \) (at producer price)

\( VXT_i \) Production of good \( i \) (at consumer price)

\( WL_j \) Wage bill paid by activity \( j \)

\( WL \) Total wage bill paid to workers

\( YF \) Firms' income

\( YG \) Government's income

\( YH_h \) Household \( h \)'s income
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<tr>
<th>Receipts → Expenses ↓</th>
<th>FACTORS</th>
<th>AGENTS</th>
<th>PRODUCTIVE ACTIVITIES</th>
<th>PRODUCTS</th>
<th>ACC.</th>
<th>TOTAL (1 to 15)</th>
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Exercise 2 on SAM

*Adding international trade*

Add the following variables in the appropriate cell of the EXTER SAM.

\[ i, j \in \{A, I, S, N\} \] Productive activities and goods (\(A\): agriculture, \(I\): industry, \(S\): services, \(N\): non-tradable services)

\[ h \in \{HW, HC\} \] Households (\(HW\): labour endowed households, \(HC\): capital endowed households)

- \(CAB\) Current account balance
- \(DIV_{row}\) Dividends paid to the rest of the World
- \(EX_i\) Exports of good \(i\) (excluding taxes)
- \(ET_i\) Exports of good \(i\) (including taxes)
- \(IM_i\) Imports of good \(i\)
- \(R_{row}\) Receipts of the rest of the World
- \(RK_{row}\) Capital revenue paid to rest of the World
- \(TE_i\) Tax on exports of good \(i\)
- \(TI_i\) Indirect tax and tariff duties on good \(i\)
- \(VD_j\) Output of activity \(j\) sold on domestic market (at producer price)
- \(VX_j\) Output of activity \(j\) (at producer price)
- \(VXD_i\) Composite good \(i\) (at consumer price)
## Model Exter: An Open Economy with Government Social Accounting Matrix

<table>
<thead>
<tr>
<th>Receipts</th>
<th>Factors</th>
<th>Agents</th>
<th>Productive Activities</th>
<th>Domestic Market</th>
<th>Export Market</th>
<th>ACC.</th>
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## Exercises on Multiplier Analysis

**Step 1 (Preliminary calculation):**

Modify the following Social Accounting Matrix by aggregating Row, Government, and Accumulation account all in one. Those will be assumed to be exogenous for the multiplier analysis.

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<th>Capitalists</th>
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<th>Government 2</th>
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### Step 2 (Construction of the multiplier matrix):

Calculate the Standard Fixed Price Multiplier Matrix:

1. Create the matrix $A$ by dividing each endogenous cell of the preceding aggregated matrix by the total of the relevant column.
2. Calculate (with excel) the matrix $M_a = (I-A)^{-1}$
Step 3 (Basic Multiplier analysis):
What would be the impact of an exogenous increase of agriculture exports equal to 3% of total demand for that good? Compare this result to the effect of a similar shock on industry.

Step 4 (Multiplier effect decomposition):
- Decompose the multiplier effect in Injection (I), Transfer (T), Open Loop (OL) and Circular Closed Loop (OCL) effects. Using the following formulas:

\[
\begin{align*}
I &= \text{Matrix identity} \\
T &= (M_{a1} - I) \\
OL &= (M_{a2} - I)M_{a1} \\
OCL &= (M_{a3} - I)M_{a2}M_{a1}
\end{align*}
\]

\[
\begin{align*}
M_{a1} &= (I-\hat{A})^{-1} \\
M_{a2} &= I + A^* + A^* \hat{A} \\
M_{a3} &= (I-A^* \hat{A})^{-1} \\
A^* &= (I-\hat{A})^{-1}(A-\hat{A})
\end{align*}
\]

- Verify that:
1. \( Ma = M_{a1} M_{a2} M_{a3} \)
2. \( Ma = I + T + OL + OCL \)

- Explain the decomposition of the impact of an exogenous increase of agriculture exports equal to 3% of total demand for that good.

Step 5 (Poverty analysis):
- Calculate the distributional matrix \( D \) as \( D = (I-M_{a22})^{-1} M_{a21} M_{a13} (I-M_{a33})^{-1} \)
- Calculate the matrix \( R \) as \( R_{ij} = M_{ai}/D_{ij} \)

Assume now that 75% of the poor are in labor endowed households and that the elasticities \( \eta_i \) of the poverty headcount with respect to the mean per-capita income of each household group \( i \) is given as follow:

<table>
<thead>
<tr>
<th></th>
<th>workers</th>
<th>Capitalists</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nu</td>
<td>-0.7</td>
<td>-3.0</td>
</tr>
</tbody>
</table>

- Evaluate the variation of the poverty headcount in each group and in the all population as the result of an exogenous increase of agriculture exports equal to 3% of total demand for that good.
Exercise on Sensitivity Analysis

In the model AUTA, we assumed a fixed labour supply which means that labour supply in perfectly inelastic to changes of the wage rate. In this exercise, we relax this assumption by adding to the model AUTA a labour supply function.

**Step 1: Add the labour supply function**

Here is the labour supply function to be added to the basic AUTA model:

\[
\frac{LS}{LSO} = \left( \frac{w}{w_0} \right)^{\sigma_1} \left( \frac{PINDEX}{PINDEX_0} \right)^{\sigma_2}
\]

where \( PINDEX \) is a price index:

\[
PINDEX = \sum_i PV_i \delta_i
\]

and \( \delta_i \) is the initial share of the value added of activity \( i \) in total value added:

\[
\delta_i = \frac{PVO_i VAO_i}{\sum_j PVO_j VAO_j}
\]

This function implies that labour supply will react positively to an increase in \( w \) but negatively to an increase in \( PINDEX \). For \( \sigma_1 = \sigma_2 \), \( LS \) reacts to changes of the real wage rate, that is \( w/PINDEX \).

**Step 2: Verify the original model**

First, make sure that you can reproduce the simulation 2 results. This will be done by assuming that labour supply is perfectly inelastic, in other words that \( \sigma_1 = \sigma_2 = 0 \).

**Step 3: Sensitivity analysis**

A sensitivity analysis is done to see how simulation results vary for different values of a parameter. Since some parameters, like \( \sigma_1 \) and \( \sigma_2 \), cannot be calibrated but are chosen by the modeller, one may want to verify that the simulation results are robust in the sense that they do not vary to much for different values.

Verify the impact of changing the elasticity values:

1) \( \sigma_1 = \sigma_2 = 0.2 \)
2) \( \sigma_1 = \sigma_2 = 0.4 \)
3) \( \sigma_1 = \sigma_2 = 1 \)