INTRODUCTION

Poverty Impact Analysis: Approaches and Methods

Introduction

Background

At the start of this century, poverty remains a global problem of huge proportions. Of the world's 6.0 billion people, 2.8 billion live on less than $2 a day and 1.2 billion on less than $1 a day (World Bank 2000). The latest poverty estimates show an improvement, but the challenge to further reduce poverty remains daunting. In the Asia and Pacific region, for instance, about 1.9 billion people still live on less than $2 a day, and over 620 million survive on less than even $1 a day. This condition is unacceptable and therefore fighting poverty is the most urgent challenge (ADB 2006b). The good news is that most of the Asian Development Bank's (ADB's) developing member countries (DMCs) are on track to achieve the Millennium Development Goal (MDG) No. 1: Halving poverty by 2015 (ADB 2005a). This, however, means that the poverty rate for the DMCs in 2015 would still be around 17 percent, as the starting point of their poverty rate in 1990 was about 34 percent.

In order to reduce poverty and achieve maximum benefit for the poor, there must be global actions by international communities to complement similar actions by countries and local communities. Fortunately, concerns over poverty reduction are evident among various stakeholders at all levels. At the global level, this is reflected by worldwide acceptance of the human development paradigm, in which people are at the center of development, bringing about development of the people, by the people, and for the people.[1] This position is further strengthened by national and international commitments of countries to achieve the MDGs.[2]

1 The United Nations Development Program (UNDP) launched the Human Development Report in 1990 with the single goal of putting people back at the center of the development process in terms of economic debate, policy, and advocacy. The goal was both massive and simple, with far-ranging implications—going beyond income to assess the level of people's long-term well-being.

2 The United Nations (UN), in its Millennium Summit in September 2000, unanimously adopted the MDGs that enshrine poverty reduction as the overarching objective of development. There are altogether eight MDGs, namely: eradicate extreme poverty and hunger, achieve universal primary education, promote gender equality, reduce child mortality, improve maternal health, combat HIV/AIDS and malaria, provide access to safe water, and ensure environmental sustainability (Detailed information about the MDGs can be found on http://mdgs.un.org/unsd/mdg/Data.aspx).

Poverty reduction has become the ultimate goal of many institutions, including ADB, that make considerations on pro-poor growth, growth inclusiveness, and other pro-poor policies very important in their operations. The overall policy paradigm favored by international agencies is pro-poor growth combined with targeted poverty-focused interventions (Fujimura and Weiss 2000).[3] Multilateral development banks–reflecting a serious commitment–have spent billions of dollars and other resources in their programs and projects[4] for helping the poor. However, not much is known about the actual impact on the poor of these efforts. This information gap is partly due to the lack of good and comprehensive poverty impact evaluations.

ADB's Goal of Poverty Reduction

ADB views poverty as an unacceptable human condition that can and must be eliminated by public policy and action. Poverty is a deprivation of minimum essential assets and opportunities to which every human being is entitled. Everyone should have access to basic education and primary health services. Poor households have the right to sustain themselves by their labor, and be reasonably rewarded, and be afforded some protection from external shocks (ADB 1999).

Beyond income and basic services, individuals and societies are also poor–and tend to remain so–if they are not empowered to participate in making the decisions that shape their lives. Poverty is thus better measured in terms of basic education, health care, nutrition, water and sanitation, in addition to income, employment, and wages. Such measures must also serve as a proxy for other important intangibles such as feelings of powerlessness and lack of freedom to participate (ADB 1999).

In November 1999, poverty reduction was formally adopted as ADB's primary goal. The poverty reduction strategy followed a framework comprising three pillars–pro-poor sustainable economic growth, social development, and good governance. Hence, ADB adopted an approach that aims to systematically reduce poverty through policy reforms, building physical and institutional capacity, and improving the design of projects and programs in targeting poverty more effectively.

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3 Growth is pro-poor when it is labor absorbing and accompanied by policies and programs that mitigate inequalities and facilitate income and employment generation for the poor, particularly women and other traditionally excluded groups (ADB 2004). See also other ADB publications on the pro-poor growth issue.

4 *Programs* and *projects* are used interchangeably in this book to refer an array of activities designed to improve the quality of life in its many aspects.

All ADB loans and technical assistance are expected to contribute to poverty reduction. Each proposal is subjected to an assessment of its poverty impact, and the logical framework that accompanies each proposal will commence with poverty reduction as its ultimate objective. Accordingly, projects or programs may be designed to accelerate pro-poor growth or focus directly on poverty.[5] Figure 1 shows how ADB's operational cycle in reducing poverty would work with poverty impact analysis (PIA) playing an important role in poverty-focused project identification, poverty analysis concept paper, poverty analysis and monitoring progress, and finally on poverty impact. Box 1 provides an example of pro-poor checks for intervention in ADB projects to ensure that the poor are not left behind, while Box 2 summarizes the benchmark criteria for preparing effective pro-poor projects.

In view of ADB's adoption of its poverty reduction strategy, which was further enhanced in 2004, there remains an urgent need for tools that provide mechanisms by which PIA can be conducted. This is at the core of ADB's Operational Cycle, as depicted in Figure 1, in which monitoring progress and impact analysis should be an integral part of each stage of the operational cycle.

Current methodologies to measure poverty impacts by examining net present value (NPV) distribution to the poor of a project's benefits,[6] present only a partial analysis of how interventions affect the poor, ignoring the project's effects on the overall economy and on other aspects of the lives of the poor. The current practices also rely very much on household income and expenditure survey data.[7] This approach can be overly demanding on time

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5 Subsequently, ADB took several initiatives, including major revisions in important policies, new operational business processes, and reorganization of its operational structure, to effectively implement the poverty reduction strategy (ADB 2004). The ADB poverty reduction strategy indicates that all public sector loans will aim to reduce poverty, directly or indirectly. The strategy also specifies a target: from 2001 onward, not less than 40 percent of lending volume should be directed at fighting poverty, including core poverty interventions (ADB. 2000. *Loan Classification System: Conforming to the Poverty Reduction Strategy*. Manila).

6 See De Guzman (2005) and ADB 2001a for more details about this issue, especially the discussion on the poverty impact ratio of a project.

7 Household income and expenditure data across countries available for PIA include data from living standards measurement surveys, household income and expenditure surveys, household expenditure surveys, socioeconomic surveys, and rapid monitoring surveys.

Box 1 **Propoor Checks for Asian Development Bank's Projects**

In line with ADB's thrust to reduce poverty, the project officers should ensure that project-induced growth effects lead to poverty reduction in two contexts: macroeconomic, public expenditure, and governance and at geographical disaggregated levels.

The macroeconomic context includes controlled inflation and fiscal stabilization that could have an adverse impact on the poor. Public services are often translated into a measure of welfare as an approximation of true benefit incidence. Tax incidence analysis can be applied in combination with public spending analysis. For the institutional or governance context, governance indicators can be divided into neutral and proactive indicators. Neutral indicators include accountability and credibility of the institutions in terms of finances, efficiency, and anticorruption framework and enforcement, while proactive indicators include asset distribution, voice of the poor, social and environmental protection, social safety net systems, etc.

In the context of geographical disaggregated levels, the project analyst is responsible for collecting and complementing information specific to local situations and examining whether the project environment is conducive to facilitating the poor's access to services generated by the project.

Source: ADB 2001a.

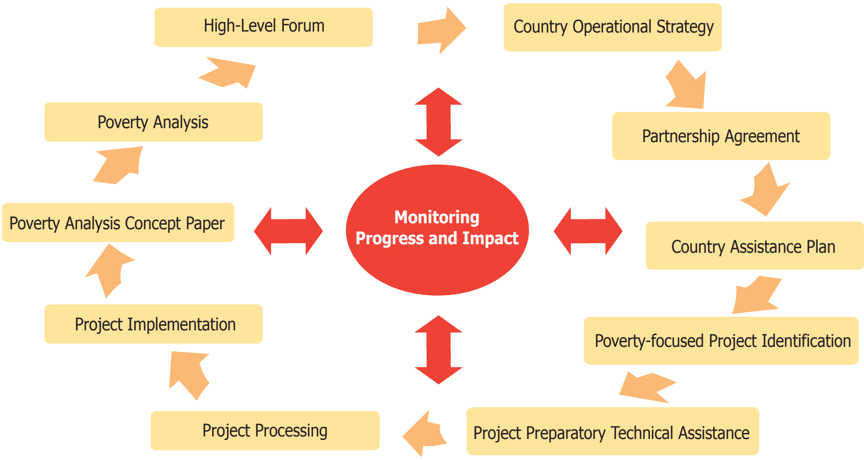
and resources. Household surveys' geographical coverage is usually so broad as to make project PIA in a specific location difficult and impractical.[8]

Furthermore, the timing of household surveys may not be in line with program implementation. Most household surveys in developing countries are not conducted annually and their main purpose is not necessarily to analyze poverty-related issues. Accordingly, the surveys may not have the necessary detailed information on income and expenditure. In addition, the surveys may have specific topics or modules such as health, education, and others that could make them less useful for PIA, especially if the modules are not related directly to the project's concerns. As a result, the timing, topics, and coverage of the household surveys may not be directly related to PIA.

In addition, as there is no standard method for assessing impact, each assessment has to be specifically designed for each project, country, institution, or stakeholder group. This situation requires using a survey and tool designed specifically for assessing a particular project or policy intervention.

8 Household surveys in Indonesia, for instance, are designed to generate reliable poverty indicators at the provincial level. In some cases, the indicators can still be estimated with a high degree of confidence at district level in Java and other populated islands. The similar geographical representation is also observed in the Philippines and other developing countries. Accordingly, any effort to generate poverty indicators for smaller areas using the existing household surveys must involve adding a substantial number of household samples at the start of the data-collection stage.

Figure 1 **Operational Cycle of the Asian Development Bank**



Source: ADB 1999.

Motivation for and Impediments to Conducting PIA

PIA[9] has received considerable attention in recent years partly due to the previous experience in pro-poor programs.[10] The interest in PIA has also been fueled by mounting pressure on governments and donor agencies to broaden their development strategies to address issues such as poverty, environmental quality, and the economic, social, and political participation of women in developing countries. Resource constraints have also heightened interest in the use of more cost-effective analysis to help identify the more cost-effective and equitable ways of delivering services to priority target groups, including the poor.

Good PIAs will help multilateral development banks better allocate their resources in the future. This is particularly important for the developing countries, where resources are relatively scarce. Knowledge about project impact is essential and has great bearing on the availability of resources.

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9 The terms *poverty impact analysis* and *poverty impact assessment* are used interchangeably in this book. One might argue, however, that poverty impact analysis covers more aspects than poverty impact assessment, which is also quite often considered as more ex post than poverty impact analysis.

10 Empirical evidence shows that the portfolio performance of projects supported by the World Bank from 1981 to 1990, for instance, deteriorated steadily with the share of projects having "major problems" increasing from 11 to 20 percent (World Bank 1991a). Such figures may not even indicate the real size of the problem, as they refer only to project implementation with no account of how well the projects are able to sustain the delivery of services over time or to produce their intended impacts.

Box 2 **Benchmark Criteria for Preparing Effective Propoor Projects**

The criteria for preparing effective propoor projects can be examined with questions such as whether the project has drawn on evidence about and addressed the causes of poverty, explicitly addressed poverty reduction, been developed to reduce possible adverse impacts on poor people, been aligned with poverty-focused policy reforms and institution building, been a part of integrated project and programs, addressed and assessed the possibility that the project will crowd out other poverty reduction projects, assessed the extent of the situation of the poor in general and that of target groups in particular, and carried out incidence assessments on poverty impact distribution and benefits.

Based on these criteria, the following checklists are recommended to identify weaknesses and shortcomings in the project design:

- The project selection, design, and implementation arrangements should incorporate key social issues and the views of major stakeholders, as determined through a participatory process.
- The project's social impact should be disaggregated by social group, including gender and adequate provision should be made to mitigate any adverse impacts.
- The project should be consistent with the ADB's poverty reduction strategy and its design should ensure that the project benefits the target beneficiaries.
- The project's direct and indirect impacts on the poor should be clearly articulated and quantified.
- There should be adequate arrangements for monitoring and evaluating social impacts, including poverty impacts that include a baseline survey, clearly specified targets, provision for data collection on outcome indicators, and ex post evaluation of project impact.
- In addition, the project design should comply with ADB policies on indigenous peoples, involuntary resettlement, and cultural property.

Source: Summarized from ADB 2001a.

The poor also benefit from good evaluations, which weed out defective anti-poverty programs and identify the effective ones (Ravallion 2005).

There have been many attempts to conduct PIAs but they mostly suffer from insufficient analytical rigor, faulty questions, and use of wrong time frames (Baker 2000). As a result, there is no comprehensive PIA of any project which can be used as an example on how PIAs should be conducted. The case studies of PIAs included in Baker (2000), for instance, were selected not for their exemplary features but as an attempt to cover a broad mix of country settings, types of projects, and evaluation methodologies, from a range of evaluation activities carried out by the World Bank, other donor agencies, research institutions, and private consulting firms.[11]

One main reason for the lack of a comprehensive evaluation–defined here to include cost-benefit, monitoring, process, and impact evaluations–is the difficulty in conducting such evaluation (Baker 2000). This is true even for a project specifically designed to assist the poor.[12] Getting the key stakeholders to agree to actually implement the comprehensive evaluation is the first problem. Second, PIA is technically very complex and difficult, especially in identifying a project's beneficiaries and actual impact. This is compounded by the more difficult tasks of isolating and then measuring the actual impact, which should be attributed only to the project and free from biases due to "selection" of participants or other factors. The biases may arise from observable or unobservable factors, spillover effects, and data and measurements (Ravallion 2005).

There are also other major issues contributing to the difficulties in conducting PIAs such as the following:

- PIAs can be very costly and time consuming, which may not be consistent with the main purpose of the project since the money spent for conducting PIAs could be used to further help the poor.
- PIA results can be politically sensitive, especially if the results turn out to be negative.
- In developing a comparison group necessary for PIA, there might be compelling ethical objections for excluding an equally needy group such as the elderly, malnourished, unemployed, and uneducated from participating in a program under evaluation.
- There is always a timing issue–whether PIA should be conducted ex ante, ex post, or at both junctures.
- Regarding methodology, there is the difficult task of answering questions of "with" and "without" as well as "before" and "after" the project. This is essentially providing the project's counterfactual, which is intrinsically unobserved since it is physically impossible to observe someone in two conditions at the same time, i.e., participating and not participating in the program (Ravallion 2005). In addition, there is no single method that dominates others, thus, anyone designing policy-

11 The Organisation for Economic Co-operation and Development (OECD, 1986) has estimated that an average donor agency conducts 10 to 30 evaluation activities a year, while the United States Agency for International Development (USAID) and the World Bank conduct as many as 250 (Baum and Tolbert 1985). The OECD study also concluded that interest in evaluation generally tends to be stronger among those allocating resources than among those using them.

12 As a result, many have given up doing the ex ante impact evaluation and concentrate instead on improving the quality of project at entry (Gajewski and Luppino 2004).

relevant evaluations should be open minded about methodology, including the use of quantitative or qualitative methods, or both (Baker 2000, Ravallion 2005).
- Whatever approach and methodology are used, there is an issue on the availability and quality of data necessary for conducting a PIA.

Key Issues in Poverty Impact Analysis

The first thing to note about PIA is that there is no standard way of doing it. The design of each PIA should be unique, depending on many factors such as the main purpose of the project or program, data availability, local capacity, budget constraints, and time frame. PIA should be made part of a comprehensive evaluation, which includes cost-benefit, monitoring, process, and impact evaluations (Baker 2000, Bourguignon and Pereira da Silva 2003a). PIA can also be a part of other impact assessments such as economic and environmental assessments. PIA should occur at strategic junctures of and follow closely a program's life cycle–ex ante, mid-term, terminal, and ex post. Therefore, PIA should ideally begin at the earliest stage of project design and continue through the disbursement cycle and beyond (JICA 2004). The best ex post evaluations, for instance, should be designed ex ante, often side by side with program implementation (Ravallion 2005).

ADB's *Guidelines for the Economic Analysis of Projects* (ADB 1997) states that the main purpose of PIA is to bring about better allocation of resources. In addition, PIA should include sensitivity and risk analyses to enhance project quality at entry. In this context, learning from PIAs of previous projects to design better projects in the future can also be seen as enhancing project quality at entry. ADB also recognizes the difficulties in conducting PIA, especially given the variety of projects across sectors with their own characteristics. This is highlighted further in Box 3.

PIA is used essentially to examine whether a project or program has generated the intended effects on the targeted low-income group. For a pro-poor project, this means answering the question of whether the project really benefits the poor. The poor may be characterized by low skill, illiteracy, unemployment, working in low-productivity sectors, located in underdeveloped regions, or belonging to certain ethnic groups. In the case of complex targets, there would be primary, secondary, and other targets. This is consistent with ADB's view on poverty as a multidimensional issue including, for instance, lacking access to employment, health care, and education. Accordingly, poverty analysis cannot be conducted in isolation but it should include many aspects as summarized in Box 4.

Box 3 **Variety of Projects and Difficulties in Conducting Poverty Impact Analysis**

One obvious limitation in the distribution analysis of PIA is that it cannot cover all types of projects. The use of distribution and poverty analysis for projects in sectors such as power, water, and irrigation, where full benefit-cost analyses are regularly applied, may be a natural extension of the current work.

But economic internal rate of returns (EIRR) are rarely calculated in social sectors such as health and primary education. Such projects can be subject to cost-effectiveness analysis. Alternative criteria can also be applied to poverty-focused projects where monetary estimation of benefits is not possible and beneficiaries must be measured in terms, of number of poor patients or poor pupils, for instance.

Between these edges, there will be a range of intermediate situations where there may be technical difficulties in conducting distribution and poverty analysis. Projects for which the methodologies are very difficult to apply include institution building and private sector development. This is due to the difficulty in relating investment expenditures with tangible outputs and income flows.

Source: Summarized from ADB 2001a.

Box 4 **Poverty Analysis Coverage**

In the poverty analysis of a country, the following information should be covered:

- Macroeconomic stability and its trend, including inflation and exchange rates and their impact on the poor in urban and rural settings.
- Asset distribution, including landownership with geographical breakdown and its implication on the poor's capability to participate in market activities.
- Labor market condition, such as market competitiveness and the location and density of labor-intensive industries and small and medium enterprises and their implications for employment of the poor.
- Public spending and tax incidence, preferably with geographical breakdown.
- Government antipoverty programs, including their magnitude, location, sectors, and types.
- Social safety nets for the poor, preferably with geographical breakdown.
- Effectiveness of the regulatory regimes and implications on the poor, such as the existence and enforcement status of anticorruption laws.
- Indicators of risk-coping capacity of the poor and social indicators, such as education levels and health status, preferably with geographical breakdown.
- Support of civil society and the private sector, including the existence of nongovernment and community-based organizations that represent and promote the interests of the poor, with geographical breakdown.
- Ongoing and planned external assistance, including the existence of targeted poverty reduction initiatives, preferably with geographical breakdown.

Source: Summarized from ADB 2001a.

PIA results also serve as instruments for public accountability to the donor community and general public about the relevance and management of the project or program. A systematic and comprehensive PIA can ensure that benefits of the programs reach the right beneficiaries.

The implementation of PIA should start by identifying the main objective of the project, followed by identification of the intended beneficiaries. The next steps are measuring the project's impact, to ensure that the impact is due to the project only, and that the measurement used is the right one. These are key issues that must be taken into account in conducting PIA.

Identification and Measurement of Impact

After identifying the project's beneficiaries (i.e., the poor), the next crucial step in conducting PIA is how to identify and measure the impact. Some of the issues related to this step are discussed below.

Impact is different from output or outcome. A project's impact is a consequence of its output and outcome. PIA studies the impact of an intervention on the final welfare outcomes for the target groups, rather than the project outputs or project implementation process. More generally, project impact evaluation establishes whether the intervention had a welfare effect on individuals, households, and communities, and whether the effect can be attributed to the project. Figure 2 is a simplified framework of the project implementation process, emphasizing how impact is different and goes beyond output. The misunderstanding over what constitutes impact results in the fact that many impact analyses actually examine project outputs or outcomes. In some cases, the impact analyses even refer to input, such as measuring the number of a project's participants and beneficiaries. Figure 3 shows a sample framework of impact analysis on the effect of education on women. The difference between impact and other project components may be deduced from the figure.

Identifying, isolating, and measuring impact are difficult tasks. Project impact could depend greatly on the project purpose and only effects that result from project implementation should be measured in a PIA. The project's impact should not be mixed with the impact of other interventions or factors. In some cases, the project impact simply cannot be measured quantitatively. The social impact of education on women identified in Figure 3, for instance, cannot be completely measured. Impacts on attitude and control over own life, for instance, cannot be fully represented by quantitative indicators.

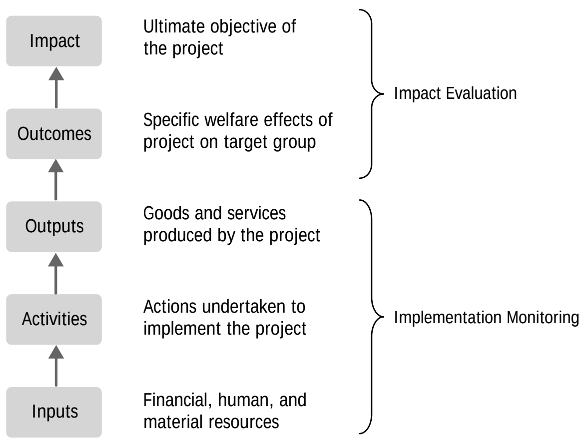
Some benefits cannot be represented as monetary units. The standard procedure of measuring poverty impact by estimating project benefits that accrue to the poor suggested by cost-benefit analysis (i.e., estimating the NPV of the benefits that go to the poor) may not reflect the actual impact of the project on the poor. Box 5 summarizes a distributional analysis of project impact which is calculated and presented as poverty impact ratio.

The transmission mechanism is not always straightforward. The transmission mechanism of impact, i.e., how project benefits reach the beneficiaries, can take different forms that can be very difficult to trace. There are direct and indirect effects, as well as multi-round effects or even general equilibrium effects of the project that should be taken into account in measuring the overall project impact.

Project impacts can materialize in the short or long term. It is important that the impacts should be examined in the right time frame. The time frame used for measuring a food subsidy program to boost school attendance of targeted pupils, for instance, should be different from the time frame used for measuring programs with more long-term impacts, such as training and other employment-generation programs for the labor force.

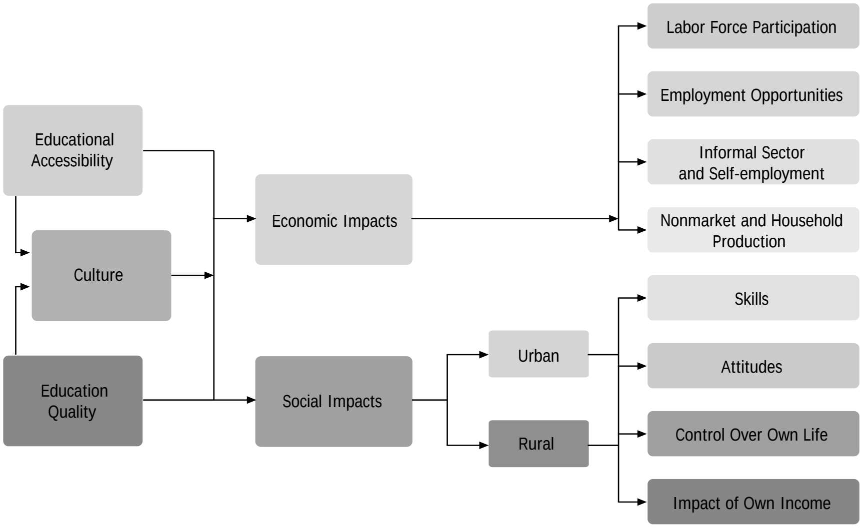
Timing is always an issue in conducting PIA. At what stage the impact analysis should be conducted–either ex ante or ex post, or both–needs to be determined. As mentioned before, a good PIA should consider the project life cycle, following closely its different stages, i.e., ex ante, mid-term, terminal, and post evaluations (JICA 2004).

Figure 2 **Simplified Model of Project Monitoring and the Evaluation Framework Process**



Source: Nguyen and Bloom 2006.

Figure 3 **Sample Impact Analysis Framework**



Note: This is a framework for the analysis of the impacts of education on women.
Source: Valadez and Bamberger 1994.

Methodology for Conducting Poverty Impact Analysis

The choice of methodology used in PIA is not straightforward because the methods are not mutually exclusive. There is always a trade-off for each method selected. In addition, no method is perfect and no single method dominates, making a triangulation of methods a good option. In general, the methods available can be classified into quantitative and qualitative methods.

Quantitative Methods. Quantitative methods are analytically more thorough than qualitative methods and can facilitate project impact comparison. Theoretically, the most accurate quantitative method is the experimental design, in which the program beneficiaries of a concerned project are randomly assessed. Therefore, the design can answer questions of impact with and without the intervention, as well as impact before and after the project. The experimental designs are considered the optimum approach to estimating project impact, providing the most robust of the evaluation methodologies. There may, however, be some practical objections to their implementations as summarized in Box 6.

In practice, the experimental designs are conducted by randomly allocating the intervention among eligible beneficiaries such that the assignment

Box 5 **Steps to Conduct a Distributional Analysis of a Project: Calculating the Poverty Impact Ratio**

In calculating the poverty impact ratio (PIR), the following procedure is suggested:

1. Set out financial data by showing the inflows (revenue and loan receipts) and outflows (investment, operating costs, loan interest and principal repayment, and taxes both on profits and purchased inputs).
2. Discount each annual inflows and outflows to derive present values for each category and a net present value (NPV) (discount rate is normally set at 12 percent). The NPV will be the income change due to the project.
3. Identify the economic value to be used for each project input/output category.

   The ratio between economic value and financial value for actual transaction is the conversion factor (CF) for the items concerned. Normally where CF=1, economic appraisal is in domestic price numeraire. However, if a world price numeraire is required to calculate economic value, all financial values from steps 1 and 2 must be converted to world prices by using the standard conversion factor.
4. Express all project items in economic terms. This can be done by applying CF to revalue the financial data from step 1.
5. Allocate any difference between financial and economic values to particular groups to get the net benefit generated by the project. The net benefits to different groups must add up to the economic NPV of the project, since this measures the total net benefits of the project. This can be seen as an identity: Economic NPV= Financial NPV+(Economic NPV-Financial NPV).
6. In analyzing poverty impact, estimate the net benefits for each group affected by the project that belong to the poor category. Groups vary according to projects but typically include consumers, workers, producers, government, and the rest of the economy.

   For the government, the counterfactual is estimated by calculating what proportion of government expenditure diverted from other uses by the project under consideration would have otherwise benefited the poor. Similarly, if a project generates government income, a proportion will benefit the poor—indirectly caused by the project.
7. Finally, add all net benefits going to the poor and divide by the total net benefits (economic NPV). This is the PIR.

Caution on the Interpretation of PIR

- PIR is not a summary indicator for PIA. It is a proportion of NPV accruing to the poor against the total project NPV. PIR does not inform poverty impact ranking or efficiency of poverty reduction among alternative projects designs.
- A project should maximize NPV going to the poor (absolute poverty impact) or the NPV going to the project cost (efficiency of poverty impact) not PIR.
- While PIR is superior to headcount, PIR is usually sensitive to assumptions which are uncertain. Sensitivity tests are therefore recommended with respect to uncertain parameters.

Source: Summarized from ADB 2001a.

Box 6 Implementing Experimental Designs: Some Challenges

Even though there is a little doubt that experimental design will generate the most plausible results of impact analysis, its implementation could give rise to some problems such as:

- It could be unethical, owing to the denial of program benefits or services to otherwise eligible members of the population for the sake of the study;
- It could be politically or even socially difficult to provide an intervention to one group and not to others;
- It could be technically difficult to identify who should be in the nontreatment (control) group. If the scope of the programs, projects, and policy changes are too broad, this may mean that there will be no control group;
- Individuals in the control group may change their identifying characteristics during the experiment that could invalidate or contaminate the assessment results;
- It may be difficult to ensure that the assignment of the project participants is truly random; and
- It can be expensive and time consuming in certain situations, particularly in data collection.

Source: Summarized from Baker 2000, Bourguignon and Pereira da Silva 2003, Ravallion 2005, and JICA 2004.

process will create comparable groups: the treatment and control groups. Both groups are statistically equivalent to one another and, theoretically, the control group made through this random assignment serves as a perfect counterfactual to the treatment group, free from selection bias that exists in most other designs. Having control and treatment groups also allows the evaluators to clearly determine the impact on the targeted beneficiaries. The main benefit of using experimental designs is the simplicity in interpreting the results as the program impact can be measured by the difference between the means of the samples of the treatment and control groups.

Other quantitative methods are classified as nonrandomized designs that include matching methods or constructed controls, double difference or difference-in-difference, instrumental variables or statistical control, and reflexive comparison. Detailed information about each method is beyond the scope of this book.

Qualitative Methods. Qualitative and participatory methods can also be used to assess project impact. These techniques often provide critical insights into beneficiaries' perspectives, the value of programs to beneficiaries, the processes that may have affected outcomes, and a deeper interpretation of results observed in quantitative analysis. As there is no constraint on predetermined categories of analysis, qualitative methods permit an in-depth and detailed study of issues.

Qualitative techniques are used with the intention of determining impact by relying on something other than the counterfactual to make a causal inference (Mohr 1995). The focus of this method is on understanding processes, behaviors, and conditions as they are perceived by the individuals or groups being studied (Valadez and Bamberger 1994). For example, qualitative methods and particularly participant observation can provide insight into the ways in which households and local communities perceive a project and how they are affected by it. It should be noted that some qualitative data can also be quantified in a limited manner, enabling the development of different measures. Moreover, the validity and reliability of the qualitative method depend on the methodological skill, sensitivity, and training of the evaluator.

According to Patton (1984), a typical qualitative evaluation will provide:

- a detailed description of the program implementation;
- an analysis of major program processes;
- descriptions of different types of participants and participations;
- descriptions of how the programs have affected participants;
- observed changes (or lack of them), outcomes, and impacts; and
- an analysis of program strengths and weaknesses as viewed by different stakeholders of the project.

Different methods require different data and information that may depend on answers to the questions: Who will need the information and use the evaluation findings? What kind of information is needed? How is the information going to be used and for what purpose is the evaluation conducted? When is the information needed? What are the resources available for the evaluation?

Recent developments in evaluation have led to an increase in the use of multiple methods, including combinations of qualitative and quantitative approaches to ensure robustness and to provide for contingencies in implementation. A qualitative method, for instance, can be incorporated in a quantitative approach to allow for the triangulation of findings.

Counterfactual and Non-Counterfactual Methods of PIA

Another way of looking at PIA is that it can be done using counterfactual or non-counterfactual methods but the non-counterfactual method may systematically contain bias. The counterfactual approach removes bias by providing the appropriate comparison. Therefore, to ensure methodological rigor, PIA must be able to estimate or construct the counterfactual to provide the condition of what would have happened had the project never taken place. Box 7 summarizes how to minimize selection and other biases in PIA.

Box 7 **Minimizing Selection and Other Biases in Poverty Impact Analysis**

A major concern in PIA is how to measure project impact correctly. This process includes properly identifying the beneficiaries and measuring the impact. The impact measurement must be obtained through methods that eliminate or minimize bias.

Bias is essentially the difference between the actual and the expected or observed impact. The program effect is the difference between outcomes of with and without the project. A failure to provide a counterfactual, i.e., the condition without the project, will make the PIA biased. Bias can also originate from measurement and research design issues. Design issues include selection bias, which literally means errors because of bias in selecting the beneficiaries. Selection bias is due to un-observables, which are either not known by the researcher or are not easily measured. The problem of selection bias arises because of missing data on common factors affecting both participation and outcomes. Other external factors may also produce bias, such as the existence of trends, interfering events, and maturation.

An example of selection bias is shown in figure 2.3 in which project impact on increasing female participation in the labor market is measured. If the model used in the impact assessment uses data on female workers and their wages, the result assessment might be biased. This is because the decision to work among women might not be made randomly. The women's reservation wage might be greater than the wage offered in the market, preventing them from working. This bias can be corrected by introducing some variables that strongly affect the reservation wage but not the outcome of project (the offer wage) such as the number of children at home.

Randomized design may solve the selection bias by basically generating the perfect control group whose access to the program was randomly denied. The random assignment does not actually remove the selection bias but it balances the bias between the participant and nonparticipant groups.

In nonrandomized designs, various statistical techniques can be used to create the representative control group. This includes matching, double differences, and instrumental variables. In principle, these methods try to copy the random design condition by modeling the selection processes to arrive at an unbiased estimate using nonexperimental data. The general idea is to compare program effects on participants and nonparticipants by holding the selection process constant. The validity of these models depends on how well the models are specified.

Source: Summarized from Baker 2000 and Rossi, Lipsey, and Freeman 2004.

To develop a counterfactual, it is necessary to isolate the effects of interventions from other factors. This could be accomplished by using a comparison or control group, i.e., those who do not participate in a program or receive benefits. They are subsequently compared with the treatment group, i.e., those who participate in the program or receive benefits. Randomized or nonrandomized designs can be used to develop the counterfactual which is at the core of evaluation design. As mentioned before, it is difficult to develop a counterfactual, especially in isolating the program impact from the impact of other events. In addition, the counterfactual can be affected by history, selection bias, and other contaminations.

Developing counterfactuals using a quantitative approach of randomized design is best for measuring impacts in scenarios of with and without, before and after, and their combinations. Impact analysis using an economic modeling approach such as a computable general equilibrium (CGE) model can also produce a counterfactual by generating scenarios of impact with and without the policy or project.

Different Measures of Impact

The impact of a project can be measured in different ways. As in conducting PIA, there is no standard way of measuring the impact. To some extent, the measurement of impact depends on the main purpose and characteristics of the project and the target beneficiaries. Moreover, the impact measurement on the poor is not limited to Foster-Greer-Thorbecke (FGT) poverty indicators such as the headcount ratio (HCR), poverty gap index (PGI), and poverty severity index (PSI), but it may reflect a broader concept of poverty measures, including measures such as improvements in education, morbidity, employment, and basic services.

In addition, there could also be non-poverty income measures of benefits obtained by the targeted beneficiaries. The impact of a rural road project, for instance, can be in the form of reducing travel time, transport costs, and other costs. The impact can also be reflected in the growing number or availability of economic facilities that can be accessed by the beneficiaries. The framework for measuring impact of an education project on women shows that the impact can take the form of economic and other social impacts (Figure 3).

Measuring project impact is also different from measuring project results or output, and the impact could be intended or could be by-products. Accordingly, as mentioned before, a project could have main, secondary, and other targets. Furthermore, project impact can be measured in terms of total, average, or marginal, and the effect can be measured at individual, household, or other social group level.

How a project impact is channeled to the beneficiaries–its transformation mechanism–is also an important issue in PIA. Project impact can be channeled through market and nonmarket mechanisms, in formal or informal ways. Labor and factor markets are examples of market channels through which projects can affect employment levels and wages. In commodity markets, changes may be reflected in the fluctuations of supply and demand of products as well as on their prices. Nonmarket channels can be in the form of transfers that affect access to services.

Developing Tools for Poverty Impact Analysis

To address the limitations of current PIA methodologies and related issues described above, the Economics and Research Department (ERD) of ADB developed a new PIA approach by conducting a series of research studies under regional technical assistance (RETA) 6073 for developing tools for assessing the effectiveness of ADB's operations in reducing poverty, and RETA 6042 for poverty mapping in some selected DMCs. The studies could subsequently help ADB better understand the interlinked nature of poverty impacts at macro and household levels; and to be able to conduct PIA with sufficient analytical rigor by examining the general impacts at the macro level and more specific effects at the micro or household level.

The importance of including PIA in project and policy analysis has long been recognized by ADB, as summarized in Box 8. The problems with methodologies, however, remain–especially given the types of questions that must be considered in poverty-reducing projects.

The research for and development of PIA tools and their applications are presented in this book. The tools were developed by maximizing available information from various censuses and surveys. As mentioned before, the availability and quality of data have become one of the main issues in the PIA, especially with regard to the timeliness and appropriateness of the geographical aggregation. On the other hand, there is also a concern that the existing impact assessments have not been maximizing the existing data available in each country (ADB 2001a). The method currently in use of examining the distribution of NPV benefits, for instance, only needs limited data on the share of the poor among the project beneficiaries. Therefore, ADB research discussed in this book answers both concerns by demonstrating that rigorous impact assessment can still be conducted in a second-best situation, where not all desirable data are readily available.

The five different PIA tools developed by ERD and discussed in this book (Figure 4) are:

- poverty predictor modeling (PPM) for identifying the poor at the household level;
- poverty mapping for identifying the poor over geographical areas or developing poverty indicators at lower-level administrative regions that cannot be produced using household survey data;

Box 8 **Poverty Impact Analysis for Propoor Projects in the Asian Development Bank**

The ADB, as early as the 1970s, recognized the importance of including beneficiary identification and distribution impact analysis in project analysis (ADB 1978). Poverty intervention projects are subjected to specific analysis of poor beneficiaries, in addition to the standard criteria using economic internal rate of return or net present value . Ideally, a consistent yardstick could be applied to rank all interventions by using a weighting system, but the methodological problems fall short of this theoretical ideal. Due to the diverse nature of poverty interventions, efficiency-based analysis is the common practice in standardized PIA.

Economic analysis uses a money-metric measure, calculating project effects of economic benefits and costs in monetary units. Hence, poverty can be defined as income or consumption as opposed to headcounts. For ADB appraisals, the poverty line should be the national poverty line agreed upon by ADB and the developing member country concerned. However, if household surveys are not available, proxy indicators that correlate to poverty can be used.

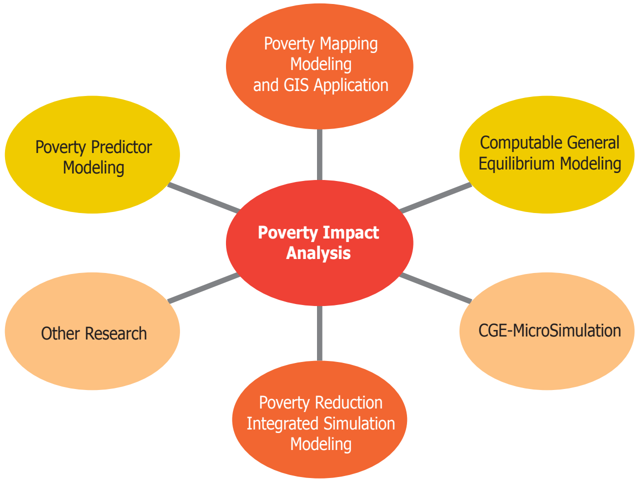
Initial issues that should be considered in the pre-project preparatory stage of poverty intervention include:

- Description of envisaged poverty impact by defining, identifying, and estimating poverty and its correlates. The description also explains the mechanism through which the poor are affected, i.e., as consumers through lower prices, nonpaying users, workers through new jobs, and producers using services of the project as inputs.
- Explanation of critical assumptions required to conduct PIA (e.g., policies for targeting, uptake by the poor, willingness to pay by the poor, financial sustainability of project).
- Explanation of the risks involved in achieving poverty objectives, such as benefit leakages to nonpoor, financial difficulties, and available measurements.
- Detailed socioeconomic assessment and questions on poverty impact.

Source: Summarized from ADB 2001a.

- CGE modeling for assessing the economy-wide effects and distributional implications of wide-ranging issues on the economy with representative household groups (RHGs);
- CGE-microsimulation modeling for conducting assessments such as those in CGE modeling but with a complete household data set instead; and
- the poverty reduction integrated simulation model (PRISM), which is essentially an integration of CGE-microsimulation and poverty mapping with its dynamic, interactive, and user-friendly geographic information system (GIS) application.

Figure 4 **Tools for Poverty Impact Analysis Developed by ADB's Economics and Research Department**



Source: Author's framework.

The first two tools are for identifying the poor, and can be used at the project level while the three other tools are more relevant for PIA at the national or sector level given the data aggregation used in the models. In some cases, the modeling coverage of the three tools can be expanded at the provincial level, if the database is available. The use of the correct tool and appropriate aggregation level is very important since PIA can be done at national, regional, sectoral, and household levels.

The poor can be identified at the household level or over a geographical area. Household poverty indicators can also be used as a basis for estimating poverty indicators of a small geographical area provided the sample size of the household survey used is representative. The development of household poverty indicators is done by implementing PPM, while the area approach is developed through the application of poverty mapping.

Poverty Predictor Modeling

Poverty indicators at national or other aggregated levels available from official publications are often not suitable for PIAs of specific programs, projects, or policies. Therefore, there is a need to develop tools that can be used to generate poverty indicators for a small geographical area relevant to the PIA. In this context, PPM was developed to identify the poor household based solely on predictor variables. PPM is based on a regression analysis of household income and expenditure and other predictor variables that can accurately predict household income and poverty status. The data used are from the national household income and expenditure surveys. The estimated regression coefficients form the basis for indirectly estimating household income and poverty status based solely on the predictor variables.

The predictor variables should be easy to collect and not be computed from a large number of variables nor rely heavily on respondent recall (ADB 2001a). As a result, the predictor variables can be transformed into a short questionnaire, which can be used for developing household poverty indicators that would be very useful for PIA and monitoring. PPM, therefore, provides an efficient way of collecting baseline data and following up with poverty measures necessary for PIA.[13] In this context, PPM can be used for developing a practical alternative to the time-consuming and expensive way of collecting income and expenditure data through a complete household survey.

The implementation of PPM was pilot-tested in the People's Republic of China (PRC), Indonesia, and Viet Nam through small-scale surveys to examine their appropriateness and effectiveness. The number of samples included in the pilot surveys in the three countries were around 600, 1000, and 500 households, respectively. In each country, the household samples consisted of the newly selected households and the households selected in the previous national household survey, the results of which were used in the PPM. This was to ensure that the PPM results were representative and applicable to the new households.

Overall, PPM results can be used for: (i) estimating household poverty indicators; (ii) selecting program participants by using a proxy means test, in which all potential participants are assigned based on a score calculated as a function of observed characteristics (Ravallion 2005); (iii) targeting directly poor households by identifying variables highly correlated to income and expenditure that are easy to measure, not expensive to collect, and less prone to manipulation; and (iv) conducting PIA and monitoring of a project.

The idea of using only poverty predictor variables to derive poverty estimates is actually not new. It had previously been attempted by the World Bank (Africa Region) in collaboration with the United Nations Development Program (UNDP) and the United Nations Children's Fund (UNICEF).

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13 This is in line with the need to develop cost-effective and rapid monitoring data–collection instruments, along with recommended administrative procedures for national agency cooperation, sampling methods, standard questionnaires, data processing programs and manuals, and guidelines for statistical analysis and poverty assessment based on non-income data.

This is documented in the Core Welfare Indicators Questionnaire (CWIQ) survey.[14] In this survey, data on income or expenditure were not collected, but variables strongly correlated to poverty. CWIQ survey results can be used to estimate the proportion of the poor within the project-affected area. This information is useful for identifying the likely effects of the project on the poor and other groups. The CWIQ survey is primarily designed for use in a limited geographic area to collect data needed for project monitoring and evaluation.

In addition to PPM, a different way to assess household poverty status is also introduced in the pilot surveys, such as by classifying the households into poor and nonpoor based on assessments made by respondent, enumerator, neighbor, and village chief. Results of these assessments could complement the survey result and be useful as a basis for setting priorities in poverty-targeting programs.

The use of proxy indicators in poverty targeting, however, raises the possibility of misidentifying a poor household as nonpoor (under coverage) or a nonpoor household as poor (leakage). Therefore, further refinement and pilot surveys of the PPM may be necessary before the PPM results are implemented across countries or regions, considering the extent of variations among them. It should be noted here that PPM was developed using national data sets and pilot-tested in some small regions. Therefore, PPM results may not be representative for each region covered in the national survey. Nonetheless, the overall results show the potential use of PPM.

Poverty Mapping and the GIS.

Poverty mapping is used to generate poverty estimates for geographical areas that the household survey cannot produce. The main purpose of poverty mapping is to maximize the rich information of surveys and the wider coverage area of censuses to estimate reliable poverty indicators of more disaggregated areas. The estimation is based on a modeling relationship between poverty indicators and some common variables available in both surveys and censuses. The results are then used to estimate more disaggregated poverty indicators from census data.

14 CWIQ Survey was first conducted in 1997 in Ghana. Its variations have been implemented in many African countries. For details see http://www4.worldbank.org/afr/ poverty/ databank/survnav/default.cfm and http://www.surveynetwork.org/ plannedsurveys/index.php?request=SURVEY_BROWSE.

Poverty mapping technique has been implemented successfully in a number of countries and its application is not limited to poverty but also includes other welfare indicators such as child malnutrition and unemployment.

The application of poverty mapping to Indonesian data results in reliable estimates of district poverty indicators in both urban and rural areas. The results have also been interfaced with a GIS application of the Poverty Reduction Information System for Monitoring and Analysis (PRISMA) to provide an interactive tool that can be used to conduct spatial analysis of poverty in relation to other variables. In the application, poverty indicators are presented as dynamic maps, which can be combined with graphs of other variables to produce graphical representations of the poverty and other variables concerned. The maps use a "traffic-light classification system", in which red, yellow, and green colors represent high, average, and low poverty incidences. Users can change the default cut-off points to reflect their own preferences.

CGE Modeling

ERD has been developing individual country CGE models for the PRC, Indonesia, and the Philippines to examine the economy-wide effects and distributional implications of wide-ranging policies or shocks, or both, on the economy, sectors, factor markets, and income and consumption of RHGs included in the models. These models provide tools for PIA at the macroeconomic, sectoral, and RHG level. Some desirable characteristics such as reasonable disaggregation on sectors, factors, and households useful for poverty and income distributional analysis have already been included in the models. The models were also developed specifically for economies concerned with some common characteristics such as open economies with a possibility of substitution between imported and domestically produced products (Armington specification), and other country-specific characteristics. These features are important for making PIA results more meaningful. The CGE modeling for Indonesia is to address issues related to trade liberalization, while for the PRC, it is for assessing the effects of infrastructure development on poverty reduction. The Philippine CGE is used as a basis for PRISM.

CGE-Microsimulation Modeling

In this modeling approach, the CGE models for the Philippine and Indonesian economies are linked to their corresponding household data sets in a top-down method. In this way, microsimulation at the household level can be conducted as part of the CGE model simulations. In doing so, the poverty and other economic impacts of simulations introduced in the models can be traced at the household level. As a result, the commonly used FGT class of poverty measures such as the HCR, PGI, and PSI can be calculated before and after the simulations along with other results from CGE modeling at the macro, sectoral, foreign sector, and factor market.

The CGE-microsimulation of the Philippine economy was integrated in the PRISM, while the model for Indonesia is used for assessing the economic and poverty effects of trade liberalization, by highlighting the more complete results for poverty indicators from the CGE-microsimulation compared with those of the CGE model.

PRISM: An Integrated Modeling Approach

The latest tool developed by ERD is the PRISM.[15] It is an online modeling tool that combines the CGE-microsimulation model with a poverty-mapping GIS application to view poverty impacts by region. All complexities of the modeling aspects have been interfaced in a user-friendly way, so that users can run simulations and conduct analyses with ease. Users can run various "what if" scenarios of important issues related to taxes, foreign sector economy, factor market, and household income. The impacts can be examined on the macro economy, the external sector, the factor market, household income, and poverty. All simulation results are presented in graphs and tables that can easily be downloaded or copied to other computer program applications. Moreover, the poverty impacts of the simulations are also presented in an interactive GIS map on a dual-window viewing system to enable a poverty impact comparison between two different scenarios.

Other Research

In addition to the series of research studies described above, ERD has also been conducting independent research, outside the technical assistance support, which can also be useful for PIA. These activities include research on applied econometric and CGE models to address various policies relevant to ADB and DMCs. Detailed information about research topics studied by ERD can be found on the ERD website (http://www.adb.org/Economics/default.asp). Moreover, ERD has also systematically developed a survey data depository of DMCs for further research.

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15 PRISM is available at the ADB portal http://prism/adb_prism.

Modeling Developments of the Tools

Identification of the Poor

The poor are usually identified using a benchmark level of income or consumption. The most widely used data for measuring poverty in developing countries is household consumption expenditure. The main reason for this is that income data are hard to collect and are not accurate. On the other hand, expenditure data is available for different kinds of products, such as for food and nonfood commodities. Like income, expenditure data is also expressed in monetary units making it very intuitive, easily understood on a comparative scale, and useful in providing a basis for developing poverty indicators.[16]

For calculating poverty indicators using a poverty line, the poverty line is commonly based on certain expenditure equivalents to food, nonfood, and total poverty lines. The HCR, PGI, and PSI indicators can then be calculated based on the poverty line.

Collecting data on household consumption expenditure, however, is not simple. It involves plenty of effort, time, and resources. In addition, it also demands patience and cooperation from respondents. The survey enumeration for each household, for instance, may take as long as a week or more. To record in-house consumption of food during the survey reference period, respondents have to note all kinds of food expenditures by considering the food available at the beginning and at the end of the survey reference period. This is to ensure that the actual consumption by family members inside the house is recorded. Enumerators also need to ensure that food consumed outside the house is included in the enumeration to constitute the total food consumption.

For nonfood commodities, data collection would involve a longer memory recall, ranging from consumption for one month to one year, depending on the type of nonfood products. Memory recall will affect data quality–in general, the longer the recall period the more likely respondents will forget, hence reducing data quality.

Considering the problems and difficulties in conducting household surveys mentioned above, researchers have tried to develop a proxy variable

16 The ratio of expenditures on food to total expenditure, for instance, has been widely used in various demand analysis and is known as the Engle ratio. The ratio can be used as a welfare indicator, showing that the higher the income, the lower the ratio.

for expenditure and, therefore, for poverty. This proxy is based on easy-to-collect variables derived from household characteristics that have proven to significantly influence poverty. The variables may include asset ownership, employment status, and educational level of the household head. The main purpose of using a proxy variable is to get a comparatively cost-effective and easily verifiable variable that ranks households in more or less the same order as they would have been ranked using per capita consumption expenditure.

One of the widely cited studies on estimating household expenditure is a study by Filmer and Pritchett (1998a). The study uses the principal components analysis (PCA) method to calculate long-term household wealth, which is also used as an explanatory variable of school enrolment. Abeyasekera and Ward (2002) and Ward, Owens, and Kahyrara (2002) use the regression method on survey data from Tanzania to predict expenditure and income poverty. A similar study in Africa was reported in Geda et al. (2001), which uses data from Kenya to test the model's performance in predicting welfare by comparing the ranking of households using the new index with the ranking of households based on consumption expenditure.

Identifying the Poor Household

The existing literature suggests that there are at least three methods commonly used to identify the poor household by creating non-income or consumption poverty predictors: PCA, to determine the main components of variables that correlate to poverty; the multiple linear regression (MLR) model, to identify variables that can predict household living standards; and the logistic regression model, to predict the probability of a household being poor or not. These three methods are discussed in turn below, while their applications in selected DMCs are further discussed in Chapter 1.

Method 1: Principal Component Analysis. Data on asset ownership are relatively easy to collect, especially if asset ownership can be observed directly by enumerators. This data can be used as household socioeconomic indicators by ranking households by asset ownership. Unfortunately, asset ownership is usually only available in the form of binary variables, indicating whether a household owns a certain kind of asset or not. For ranking, additional information on the quality or price of each asset owned by the household is necessary purposes. To deal with this problem, the weight of each asset is determined by the data itself using the PCA method.

Intuitively, PCA is a technique for extracting variables that best capture common information from a large number of variables with few orthogonal linear combinations (Filmer and Pritchett 1998b). The technique's application is to reduce the dimensionality (number of variables) of the data by summarizing the most important parts while simultaneously filtering out noise. The first principal component is the linear index of variables with the largest amount of information common to all variables and each succeeding component accounts for as much of the remaining information as possible.

PCA is also a way of identifying patterns in data, and expressing the data in a way that highlights their similarities and differences. Since patterns in data can be hard to find, especially in high-dimension data with no graphical representation, PCA is a powerful tool for analyzing data (Smith 2002). Zeller (2004) also pointed out that the major advantage of PCA is that it does not require a dependent variable such as household's consumption level or poverty status. PCA, however, can only measure relative poverty, whereas absolute poverty should be measured by consumption level.

The PCA index can be calculated as:

$$A_j = f_1 \times \left(a_{j1} - a_1\right) / \left(s_1\right) + \ldots + f_N \times \left(a_{jN} - a_N\right) / \left(s_N\right)$$

Or simply

$$A_j = \sum_{i=1}^{N} \frac{f_i (a_{ji} - a_i)}{s_i} \qquad (1)$$

where

f_i is the 'scoring factor' for the i^{th} asset determined by the method

a_{ji} is the j^{th} household's value for the i^{th} asset and

a_i and s_i are the mean and standard deviation respectively of the i^{th} asset variable over all households.

A_j = An asset index

PCA results rank households' socioeconomic level from the lowest to the highest. To test the reliability of this ranking in predicting poverty, a cut-off point is required to separate the predicted poor from the nonpoor. Since there is no a priori poverty line that can be determined objectively from the PCA results, the cut-off point used can be determined such that the proportion of poor households based on PCA is the same as that based on the actual consumption expenditure.

The asset measurement or asset index is a good proxy for income and consumption (Filmer and Pritchett 1998, Montgomery et al. 1997, Wagstaff, Van Doorslaer, and Paci 1991). The asset index, however, defines poverty purely in economic terms, ignoring other factors such as gender, education, and ethnicity. Moreover, a fixed list of assets is not necessarily adequate to measure wealth in all environments (Falkingham 1999). In response to this limitation, McKinley (1997) has suggested a shift toward measuring capability poverty, which incorporates access to public services, assets, employment, and income poverty. Capability poverty can be measured directly in terms of capabilities themselves, e.g., the level of malnutrition in a population, or indirectly in terms of access to education and public services.

Method 2: Multiple Linear Regression. In this approach, poverty predictors are developed based on the regression of variables that correlate with household consumption. The predictor variables can be obtained by estimating a correlate model of household consumption, where the left-hand side of the equation is per capita consumption and the right-hand side is a set of variables which are expected to be correlated with household consumption. Chapter 1 further discusses this issue in the case study that uses the PPM.

The model takes the form of:

$$y_i = \alpha + \sum_{k=1}^{n} B_k x_{ki} + e_i \tag{2}$$

where

y_i is the dependent variable

α is the model intercept or constant

β_k are vectors of estimated coefficients

x_{ki} are independent/predictors variables

e_i are random errors or residuals, capturing effects of all variables excluded in the model.

Method 3: Logistic Regression. Logistic regression is similar to multiple regression, however, the dependent variable used is not per capita household consumption but the household poverty status such as poor or not poor which is transformed into variables of *1* and *0*. The dependent variable is, therefore, a binary variable that makes the model a type of limited dependent-variable model of logistic regression (logit model).

Therefore, a logit model is a univariate binary model where the dependent variable *yi* can only be *1* (poor) or *0* (not poor), as a function of a continuous independent variable *xi* such that *Pr (yi=1) =F(xi'b)*. Here, *b* is a parameter to be estimated, and F is the logistic cumulative density function. In the modeling estimation, the probabilistic model (probit model) might be used instead of the logit model. In this case, the logistic cumulative density function for F in the equation above is replaced by the normal cumulative density function.

The logit model takes the form of:

$$\ln\left(\frac{p_i}{1-p_i}\right) = \alpha + \sum_{k=1}^{n} B_k x_{ki} + e_i \qquad (3)$$

where,

$p_i = P(y_i = 1 \mid x_{1i}, x_{2i}, ..., x_{xki})$ is the probability of an event given $x_{1i}, x_{2i}, ..., x_{ki}$

$\frac{p_i}{1-p_i}$ is the odds of experiencing an event.

α is a constant

β_k is vector of estimated coefficients

x_k are independent variables/predictors

Whether it is best to use multiple regression or a logit or probit model in predicting poverty is always an issue. The logit or probit model may be criticized for the loss of information that occurs in transforming household consumption data into a binary variable of household poverty status of poor and nonpoor. On the other hand, the regression model has also some weaknesses. First, the model does not directly produce a probabilistic statement about household poverty status. Therefore, one cannot directly determine whether the household is poor or not. Second, the model's main assumption is that consumption expenditure is negatively correlated with poverty. Therefore, variables that are positively correlated with consumption are assumed to be automatically negatively correlated with poverty. Some variables, however, may be positively correlated with consumption but only for those who are already above the poverty line. Although positively correlated with welfare in general, such variables will not be correlated with poverty.

Modeling Estimation and Variable Selection. In the estimation, some variables were included in the model to take into account other factors excluded in the model, as well as anomalies in the data set. The variables include control and dummy variables of provincial and community characteristics. To have better estimation results, transformed variables were used, such as the logarithmic form for per capita expenditure. This issue is further discussed in the application of PPM in the PRC.

In the modeling estimation, similar sets of initial variables were used which were then narrowed down using the stepwise method. In this case, a variable is incorporated in the model only if its inclusion significantly adds to the explanatory power of the regression. Therefore, in case the estimation is conducted separately for urban and rural areas, the final sets of predictor variables for each area will differ.

The use of the stepwise method to get a manageable number of poverty predictors may be criticized for lacking economic reasons. This concern, however, may be less relevant since the potential variables were already preselected for their expected role in explaining poverty, such as asset and livestock ownership, as well as characteristics of house building, and household and consumption patterns. In the PRC, community characteristics variables were also included in the model such as village physiognomy, number of natural villages with a road for motor vehicles, and distances to countryside, township, and nearby market.

In conducting PPM in Indonesia, the three methods discussed above were used. Based on the results, the most robust method in determining poverty predictors was selected. It was found that PCA is the least successful at predicting the poor and that results from multiple regression and the logit model were not significantly different. The use of PCA was not further explored in the second pilot country of PRC. Instead, efforts were concentrated on multiple regression and the logit model. Results from PRC further confirm that the use of multiple regression and the logit model will produce similar results in terms of poverty predictor variables generated. The application of PPM in Viet Nam, therefore, involved use of only the multiple regression model.

Furthermore, since it is widely recognized that household welfare conditions in urban and rural areas differ significantly, the modeling estimations in Indonesia and Viet Nam were implemented separately for urban and rural areas. This separate estimation could not be conducted in the PRC since the data available from the National Bureau of Statistics of the PRC was only for rural areas.

Independent Assessment. A more participatory approach (mentioned earlier on p. 21) to assess poverty at the household level was also introduced in the PPM pilot surveys in the PRC, Indonesia, and Viet Nam. In addition to classifying households into poor and nonpoor based on household expenditure data or survey results, the participatory approach involved asking respondents to assess themselves–whether they thought they were poor or not. This self-assessment was then complemented by independent assessments conducted by enumerator, neighbor, and village chief. Results of these assessments could provide a more participative way of classifying the poor. They could be used as complementary indicators to survey results or to provide alternative ways of assessing the poor. The different assessments could also be useful for setting resource allocation priorities in poverty targeting and other programs.

Table 1 summarizes how different assessment approaches have been used in a variety of programs. As can be seen, in addition to relying on the survey result, the assessments of project beneficiaries can include self-assessment,

Table 1 **Applications of Different Poverty Assessment Approaches**

Approach	Tool	Project Description	**Country/**Reference
Self-assessment	Self-selection	TRABAJAR project – employment generation program offering relatively low wages to attract only the poor, unemployed workers as participant	**Argentina** Baker (2000)
Self-assessment	Self-selection	School Autonomy Reforms – schools enter the program through a self-selection process involving a petition from teachers and school directors	**Nicaragua** Baker (2000)
Community assessment	Municipal poverty index	Bolivian Social Investment Fund – developing areas historically neglected by public service networks, i.e., poor communities	**Bolivia** Baker (2000)
Community assessment	Participatory wealth ranking – community defines its own concepts of poverty and relative wealth	Tshomisano Programme of the Small Enterprise Foundation – offering loans to poor areas as determined by villagers themselves	**South Africa** Simanowitz and Nkuna (1998)
Participatory assessment	Participatory poverty assessment – focused on the causes of poverty and how to reduce it from the perspective of citizens and local officials	Results are input into the Social Economic Development Strategy 2001–2010 and the Comprehensive Poverty Reduction and Growth Strategy (CPRGS)	**Viet Nam** Koos and Hoang (2003)
Independent assessment	Project leaders to screen participants/beneficiaries	Microfinance programs – providing loans to households who own less than one-half acre of land Food for Education program – helping households who are landless, female-headed, and low-income and located in economically backward areas with low schooling levels	**Bangladesh** Baker (2000)
Independent assessment	Project leaders to screen participants/beneficiaries	Dropout Intervention Program – for all grade levels in selected schools from a low-income municipality with a high dropout rate and no school feeding program in place	**Philippines** Baker (2000)
Independent assessment	Project leaders to screen participants/beneficiaries	Structural Adjustment Program – helping large-sized, unemployed and low-education households	**Papua New Guinea** Gibson (1998)
Qualitative assessment	Proxy for welfare	CASHPOR House Index – simple, observable, and verifiable information based on external housing conditions assumed to have a strong relationship to poverty	**Bangladesh** Simanowitz, Nkuna, and Kasim (2000)
Surveys	Asset indicators to determine socioeconomic status	Demographic Household Surveys – identifying the poor based on indicators: has electricity, source of drinking water, time to water source, type of toilet facility, main floor material, number of persons per sleeping room, and household possessions	**50 countries in Africa, Asia, the Arab World, Latin America and the former Soviet Union** Falkingham and Namazie (2002)
Surveys	Proxy indicators used for proper targeting of food subsidies	International Food Policy Research Institute – assessing poverty using variables: household demographic make-up, education, utility use, dwelling characteristics, asset ownership, occupation, and location	**Egypt** Ahmed and Bouis (2002)

Source: Authors' compilation.

community assessments, and other independent assessments including assessments from the project leader. A major limitation of this method is that it is based on perception and there is no verification whether the perception is consistent.

In terms of methodology, the different assessments provide practical alternatives to measuring poverty that may be more relevant at the local level and for project purposes, in addition to being more cost-effective and quicker to complete. Recall that the official poverty line used for classifying households into poor and nonpoor is usually based on consumption expenditure at national and provincial levels, with a possibility of estimating separately for urban and rural areas. Given the regional variations of consumption expenditure, the official poverty line estimates may not be representative for some small regions below the provincial level. The poverty line set at the provincial level, for instance, will not be representative for an individual district in the province and even less so for subdistricts and villages.

Identifying the Poor over a Geographical Area. In addition to poverty indicators at the household level, poverty indicators for specific geographical areas may be needed for various reasons. The indicators can be estimated by using poverty mapping (mentioned earlier on p. 23). The method originates from small-area poverty estimation (Ghosh and Rao 1994, Rao 1999) to develop estimators of population parameters for a smaller geographical area. The poverty-mapping technique is used to mine detailed information about living standards from a household income and expenditure survey and to derive estimates from the extensive geographical coverage of a census of disaggregated poverty or other welfare indicators. The rich information of the census is also used to develop poverty indicators for smaller geographical areas and lower administrative boundaries than the household survey can produce. The methodology is described in detail in Elbers, Lanjouw, and Lanjouw (2000, 2002, 2003a, and 2003b).

Poverty mapping applications have been implemented successfully in some countries as summarized in Table 2. The results show that the technique's applications can be expanded to include other welfare indicators such as malnutrition, education, and health. In many cases, the application can produce reliable estimates of the desired indicators at the lowest administrative level, such as communes, villages, or *jamoat* (local self government), while the official poverty and other welfare estimates are mostly reliable only at the provincial level.

Figure 5 is a schematic representation of the poverty-mapping technique. The horizontal line represents the number of variables, in which household surveys contain much more variables than the population census. The vertical

Table 2 **Applications of Poverty Mapping in Some Countries**

Country/Reference	**Focus of Estimation**	**Lowest Disaggregation Level**
Cambodia Fujii (2005)	Children malnutrition indicators	Commune
Ecuador Hentschel et al. (2000)	Basic needs and welfare indicators	Parish (lowest administrative area)
Indonesia Suryahadi and Sumarto (2003a)	Poverty incidence	Village
Madagascar Mistiaen et al. (2002)	Welfare indicators	Commune (lowest administrative area)
Mozambique Simler and Nhate (2003)	Welfare, poverty (incidence and gap), and inequality measures	Village
Philippines World Bank (2005)	Poverty incidence, gap, and severity	Municipality (urban and rural)
South Africa Alderman et al. (2003)	Poverty incidence	Magisterial district and transitional local council
Tajikistan Baschieri and Falkingham (2005)	Poverty incidence based on estimated consumption and food consumption expenditure	Rayon (district) and Jamoat (lowest administrative area)
Viet Nam Minot (1998)	Household characteristics as poverty indicators	District

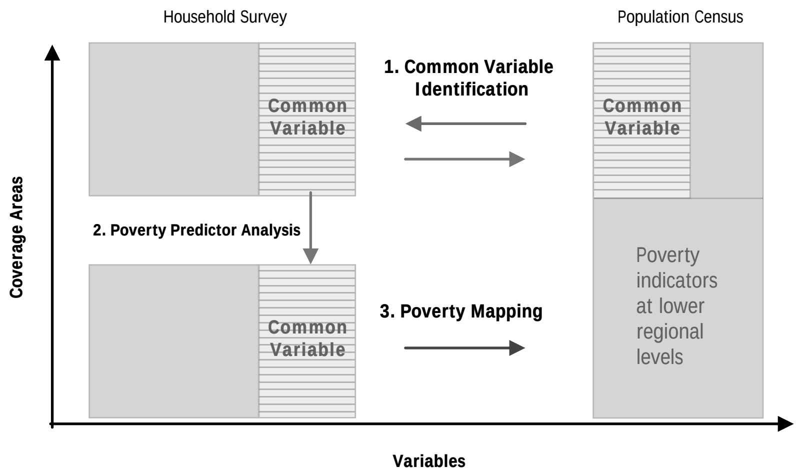
Source: Authors' compilation.

line shows coverage areas, in which the population census covers much more area than household surveys. The rich information collected in the household survey is achieved at the cost of less geographical coverage due to the amount of resources needed to collect data from each household. Thus, household surveys always have limited sample sizes and sample distribution. As a result, many poverty and other welfare indicators derived from household survey data are reliable only at aggregate levels, such as at national and provincial levels with a possibility to disaggregate further into urban and rural areas.

The application of poverty mapping consists of three main steps, i.e., common variable identification, poverty predictor analysis, and actual poverty mapping as shown in Figure 5. In common variable identification, all strictly comparable variables from the household survey and population census are identified. With the household data set, a PPM is then developed using these variables. The results are then mapped using population census data to generate poverty indicators at lower regional levels. Detailed methodology on how to apply the technique is discussed in Chapter 6, which also describes the interactive and user-friendly GIS application developed from the poverty-mapping results. Poverty-mapping technique was implemented in Indonesia by using data sets of the 1999 National Socioeconomic Survey (Susenas), 2000 Population Census, and 2000 Village Census (Podes).

It should be noted, however, that the reliability of the estimates also depends on the sample size and distribution of the household survey used as the basis for the poverty mapping. In general, if the sample size is not representative, the predictability of the poverty predictors will be reduced,

Figure 5 **Poverty Mapping Technique**



Note: Common variable is available from both census and household survey.
Source: Author's framework.

and, therefore, the resulting indicators will be less reliable.[17] In addition, poverty mapping results may also contain some errors such as idiosyncratic, model, and computational errors (see Elbers, Lanjouw, and Lanjouw 2002 for a detailed discussion on this issue).

The term "poverty mapping" has been used interchangeably to refer to three different things: (i) an econometric modeling for estimating poverty indicators for smaller geographical areas, i.e., poverty mapping modeling; (ii) development of maps of existing poverty indicators, i.e., mapping of existing poverty indicators using GIS; and (iii) a combination of (i) and (ii), i.e., estimating the poverty indicators and then generating their GIS maps. The combined approach provides more detailed poverty estimates and GIS maps, which can be used for spatial and distributional analysis. The maps can also be made interactive and dynamic by incorporating some flexibility and user friendliness in the GIS application, as well as by overlaying other socioeconomic and poverty-related indicators to provide more meaningful information.

ERD uses the combined approach, including the development of PRISMA based on the poverty-mapping modeling results. PRISMA interactively combines district poverty indicators of household or population

17 Elbers, Lanjouw, and Lanjouw (2002) and Elbers et al. 2003 show that poverty mapping estimates of welfare measures are quite reliable for an area with populations as small as 15,000 households. The reliability of the poverty-mapping estimates, however, also depends on the sampling design and variations in household characteristics across regions.

with other poverty-related indicators, such as population density, share of agriculture household, average urban score, average distance to the center of the subdistrict, family welfare status, and accesses to communication facilities, television networks, schools (secondary and high school), hospitals, electricity, and safe water facilities. As mentioned earlier (p. 23), the poverty-indicator maps are presented in a "traffic-light" classification system, in which red represents high poverty incidence, yellow stands for average or moderate incidence, and green for low incidence. In addition to the default cut-off points that represent the actual results from poverty mapping, users can change the cut-off points and do spatial analysis using the new levels of poverty incidence. Accordingly, poverty indicators are presented in dynamic maps, which can be combined or overlaid with graphs of other relevant variables. This interactive GIS application, can therefore be used as a tool for, and provides examples of, doing spatial analysis of poverty in a meaningful and interactive way.

Poverty Impact Analysis using CGE Modeling Framework

Overview of the Model. The general equilibrium model has played an important role in theoretical and empirical economic analysis. Several aspects of economics have been enriched and aided by past work on general equilibrium modeling. The value of this modeling approach is not as a universal mathematical structure, but rather as a diagnostic tool. It has been quite fruitful in the intuitive end of science, hypothesis creation, but rather less successful in normal science or in work of hypothesis falsification (Weintraub 1982).

The main characteristics of general equilibrium modeling and analysis are its endogenous price, sectoral consistency, and behavioral specifications for each economic actor included in the model. The model specifications are derived from microeconomics, reflecting its theoretically solid basis. It views the economy as a system of mutually interdependent markets and seeks to analyze the economy from the microeconomic viewpoint of individual markets considered simultaneously. Therefore it is a complete microeconomic model and, simultaneously, a detailed approach to macroeconomics.

Macroeconomics and general equilibrium analysis are likewise intertwined. The interrelationship is even more specific since macroeconomics can be thought of as a "general equilibrium theory with some of the many markets grouped together for expositional clarity and convenience (Weintraub 1974, 15)." Macroeconomics can be categorized into five markets of "consumer goods, investment goods, labor services, financial assets, and money (ibid.)." Therefore, a general equilibrium system may be viewed as a disaggregated macroeconomic model.

The fast development of computer technology, especially in the last three decades, has enabled modelers to find solutions even for very complex and large-scale general equilibrium models. From this fact, the CGE term emerged, replacing the commonly used term of applied (multisectoral) general equilibrium for models. This led to developments and applications of CGE modeling that made it one of the most innovative and flexible advances in applied economics in recent decades. It is an approach that attempts to simulate numerically the general structure of an economy (Greenaway et al. 1993).

The central idea of CGE modeling is to convert the Walrasian general equilibrium structure–formalized by Kenneth Arrow, Gerard Debreu, and others in the 1950s–from an abstract economy into realistic models of actual economies by specifying production and demand functions (including behavioral specifications of economic actors as well as the "accounting" equations for balancing the models) and incorporating data reflective of real economies. These types of models provide an ideal framework for appraising various effects of policy changes that are not well-covered by empirical macro models. The models have been widely applied to a range of policy considerations (Shoven and Whalley 1992). Table 3 summarizes the use of CGE modeling in DMCs for addressing various issues.

CGE's Features and Relevance for PIA. The CGE model is a flexible tool for modeling complicated problems. A carefully designed CGE model will have a transparent and theoretically consistent structure, and will be useful for policy analysis. The great strength of general equilibrium analysis is that it models the whole economy explicitly, albeit under restrictive assumptions. The model, however, also has some shortcomings since it relies heavily on secondary data and offers no formal facility for testing the model's structure. The underlying assumption that the benchmark data should be in equilibrium, since it is a solution to the model, implies the crucial relationship between the quality of data and results from model simulations. This is not to undermine the important role of functional specifications embodied in the model. Box 9 summarizes the problems of using the CGE model for PIA.

There are two approaches to translating the theoretical framework into a numerical model. The Johanson approach uses linear approximation in deriving the counterfactual solution from the initial equilibrium. The second approach derives the solution from the full model. The Johanson approach has been used for developing the ORANI[18] model of the Australian

[18] ORANI is an applied general equilibrium model originally developed for Australian economy. The framework has now been applied to many countries including Brazil, China, Denmark, Indonesia, Ireland, Japan, Pakistan, Philippines, South Africa, Taipei,China, Thailand, Venezuela, and Viet Nam. For more information, see http://www.monash.edu.au/policy/oranig.htm.

Table 3 **Applications of Computable General Equilibrium Modeling in Developing Member Countries**

Country	Indonesia	Indonesia	Indonesia	Indonesia
Model	Sugiyarto, Blake, and Sinclair (2003)	Behrman, Lewis, and Lofti (1989)	Lewis (1991)	Devarajan and Lewis (1991)
Benchmark Data	1993	1980	1980 and then 1985	1985
Main Purpose	To examine the effects of globalization as a stand-alone case and in conjunction with tourism growth	To analyze macroeconomic, sectoral, and distributional consequences of price fluctuations in international markets for primary products	To examine tax policy and government revenue performance, the consistency of the medium-term plan, macroeconomic implication of real exchange rate management, and the structural impacts of export-oriented industrial growth	To examine the appropriateness of rule of thumb commonly used as guidance for conducting economic reform packages; namely; devaluation, trade and capital account liberalizations, and fiscal and monetary policies
Dimensionality	18 production activities, 8 groups of labor, 5 categories of capital, and 10 household groups	12 production sectors/activities, 5 factors, 4 households, 4 other institutions (government, firm, capital account, and the rest of the world)	18 production sectors/activities, 6 factors, 4 types of households, and 3 borrowing institutions	13 production sectors/activities, 5 factors, 4 types of households, and 4 other institutions
Functional Forms/ Main Characteristics	The tourism-CGE model 1) encapsulates the main characteristics of the economy, in terms of foreign tourism and globalization; 2) facilitates analysis of economy-wide effects and distributional implications of the two	Similar to the model of Lewis (1991)	Introduction of imperfect substitutability characteristics on the demand side and imperfect transformability on the production side for the export and domestic markets	Follows closely Lewis (1991). In addition, there is also a two sector analytic model for clarifying the impact of policy simulations
Simulation	Two main macroeconomic policy scenarios were considered: 1) partial globalization; 2) far-reaching globalization	Changing world prices of oil and agricultural products in the context of flexible and fixed exchange rate	See Behrman, Lewis and Lofti (1989); Devarajan and Lewis (1991); Devarajan, Ghanem, and Thierfelder (1997)	Devaluation, changing world prices and lowering tariff mean level and dispersion
Main Results/ Conclusions	Tourism growth amplifies the positive effects of globalization and lessens its adverse effects. Production increases and welfare improves, while adverse effects on government deficits and the trade balance are reduced	There are trade-offs in assessing the impacts of price instability since there is no case in which the impacts are only good or bad	See the summary of each model in Behrman, Lewis and Lofti (1989); Devarajan and Lewis (1991); Devarajan, Ghanem, and Thierfelder (1997)	The rule of thumb is based on models that bear virtually no resemblance to the economy in question. Therefore, they can be justified only on the grounds of administrative simplicity and reduced rent seeking, rather than on the argument that they improve economic welfare

(continued on next page)

Table 3 continued

Country	Indonesia	Indonesia	Indonesia	Indonesia
Model	Devarajan, Ghanem, and Thierfelder (1997)	Roland-Holst (1992)	Thorbecke et al. (1992)	Temenggung (1995)
Benchmark Data	1985	1980	1980	1985
Main Purpose	To examine whether the presence of labor unions strengthens or weakens the benefits to be gained from economic reform	To evaluate Indonesian adjustment policy over the period 1980–1986, with particular attention to the growth and distributional implications of adjustment	To compare alternative adjustment packages to the ones actually adopted by the government in terms of their effects of on the socioeconomic system (income distribution)	To examine the impacts of the tax sharing system currently adopted by the government
Dimensionality	Follows the Lewis 1991 model. Production sectors (30 activities) were split into two categories: Unionized (17 sectors), and non-unionized (13 sectors)	6 production sectors/activities, 8 factors, 8 types of households, and 4 other institutions (Government, firm, capital account, and the rest of the world)	14 production sectors, 9 factors (4 types of labor and 5 kinds of capital), 8 types of households, and other institutions	Two regions: Java and Outer Islands. In each region there are 2 factor accounts, 9 production sectors/ activities, and 10 types of households and other institutions
Functional Forms/ Main Characteristics	Follows closely the Lewis 1991 model with a modification in the labour market specification for introducing a labour union, which is assumed to have a Cobb-Douglas utility function	Based on the micro-macro general equilibrium model developed by Bourguignon, Branson, and de Melo (1990)	Integration of financial sector to portray the impact of stabilization policy through both the real and financial markets. Output is a CES function of a composite labor and capital (fixed in short-term and flexible in long-term)	Follows closely the Lewis 1991 model, but with the additional introduction of regional issues
Simulation	20% reduction in the government spending	Three alternative policies are considered, reflecting the actual fiscal policy adopted during the period concerned, trade reorientation, and using monetary policy for stabilization	Equi-proportional budget retrenchment, increased government investment and reduced government current expenditures, accelerated devaluation, and monetary contraction and expansion	Calculating multiplier effects as well as running a set of counterfactuals reflecting a presumably better tax policy
Main results/ Conclusions	Greater freedom of unions is superior to the current minimum wage policies and is also preferable on equity grounds	More efficacious policies could have been implemented, resulting in more moderate primary export dependence and less terms of trade instability. The policies reflect a deliberate attempt to shift the export orientation of Indonesia toward more diversified and sustainable trade patterns	The adopted adjustment strategy conformed best to the prevailing preference function of the government, which included among its major objectives growth, equity, and the restoration and maintenance of internal and external equilibrium	The existing tax policy, in which central government collects 'major' taxes, provides a means to strengthen economic performance (GDP growth and current account balance). A revenue sharing system favoring outer islands may however result in a better, regionally-oriented fiscal policy

(continued on next page)

Table 3 continued

Country	Indonesia	Indonesia	Indonesia	Nepal
Model	Azis (1996)	Wuryanto (1996)	Robinson, et al. (1997)	Cockburn (2002)
Benchmark Data	1985	1990	1990	1995
Main Purpose	To examine the impacts of economic reform on various macroeconomic variables and the income distribution	To examine the impacts of a more decentralized fiscal system on the Indonesian economy	Analysing economy-wide impacts of changes in production technology, protection and market structure on resource allocation, production and trade	To evaluate impacts of trade liberalization on conventional poverty and distributional indicators, specifically on individual households and how these impacts feed back into the general equilibrium of the economy
Dimensionality	30 production sectors/activities, 8 factors, 8 types of households, and 3 borrowing institutions	Two regions: Java and Outer Islands. In each region there are 2 factor accounts, 15 production sectors/activities, and 10 types of households and other institutions	34 activities/commodities, 12 factors, and 11 institutions	5 factors, 12 agents, 16 branches of production, 17 goods for domestic consumption, and 9 export goods
Functional Forms/ Main Characteristics	Imperfect substitutability on the demand side and imperfect transformability on the production side as well as short and long run characteristics. Introduction of two parameters: 'degree' (reflecting the intensity of government controls on capital flows) and 'risk' (to capture the fast emergence of the capital market)	Output is specified as a CES function of intermediate inputs and value added. The consumption of intermediate inputs is treated as a Leontief function with no substitution possibilities either intra- or inter-regionally	Incorporates a specification of the rice market and models the behaviour of the Indonesian Logistic Agency (BULOG). CES and CET functions are used to represent production and trade aggregation functions. Consumer expenditures are determined using Stone-Geary utility functions for each household	The method was able to bridge the gap between CGE models and poverty/distribution analysis by constructing a CGE model that explicitly models all households from a nationally representative household survey
Simulation	Comparative static (one period) and dynamic (multi-period) simulations	Changing the existing fiscal policy of the central government	An adverse productivity shock, a favourable productivity shock and a favourable productivity shock without BULOG interventions	Household data and a standard CGE model are combined to simulate the elimination of all tariffs
Main results/ Conclusions	The presumably actual policies adopted by the government are not optimal	Decentralizing the existing fiscal system would generate greater national economic growth and a lower amount of government foreign borrowing	There is inefficient allocation of resources within the agriculture sector and the rest of economy if BULOG maintains its price support programmes when there are significant increases in the rice productivity	Trade liberalization has quite complex poverty and distributional impacts, which can only be properly understood in this fully disaggregated model

(continued on next page)

Table 3 continued

Country	India	Thailand	China	Philippines
Model	Naastepad (2003)	Wattanakuljarus (2006)	Zhang (1998)	Cororaton, Cockburn, and Corong (2005)
Benchmark Data	Fiscal year 1989–1990	2001	1987	1994
Main Purpose	To evaluate the trade-offs in macroeconomic stabilization policies associated with budget deficit reductions	To investigate the economic and environmental impacts of tourism, specifically on social welfare, industry outputs, labor market, income distribution, and usages of land, forest and water	This study analyzes the macroeconomic effects of abating CO2 emissions by using a dynamic CGE model of the Chinese economy	To examine the poverty impacts of trade reform under the Doha Development Agenda, as well as more comprehensive trade reforms
Dimensionality	Real side: 3 types of production sectors [household (4 sectors), private corporate (2 sectors), and public sectors (4 sectors)] and 3 categories of private income Financial side: household (4 sectors), the private corporate (2 sectors), the government, the banks, non-bank financial institutions, and the central bank	81 activities, 81 commodities, 3 margins services, 18 types of occupations, one land, two capitals, one forest benefits, four classes of households, one corporation, the government, 8 types of taxes and subsidies, one savings/investment, one total tourism, 5 regional tourisms, ROW, and one inventory	10 producing sectors and is made up of 9 blocks, 4 energy use, 4 energy inputs, and one explicit time dimension	35 production sectors, with 13 sectors for agriculture, fishing and forestry, 19 for industry, and 3 for service sectors including government service
Functional Forms/ Main Characteristics	Incorporating credit rationing, recognizing the dual role of credit to finance working capital as well as investment, and allowing for endogenous shifts between credit-constrained and demand-constrained regimes	Adapted from Löfgren, Harris, and Robinson (2001)	Time-recursive dynamic CGE model (Gunning and Keyzer 1995)	Based on detailed economy-wide Computable General Equilibrium (CGE) model with an emphasis on the agricultural sector (no reference)
Simulation	Financial sector adjusts to production and prices in the real sector or production and prices adjust to the financial sector	10% tourism consumption expansion, 5% technical regress in primary factors of agriculture and piped water sector and 10% tourism price reduction to pricing promotion of the government	Corresponding reduction of CO_2 emissions in 2000 and 2010 and alteration in indirect tax rates	Global and local fiscal policy adjustment
Main results/ Conclusions	Macroeconomic effects of budget deficit reduction depend crucially on the interaction of: (i) the manner in which the deficit is reduced; (ii) sectoral supply and demand conditions; and (iii) credit creation process	Tourism expansion stimulates real GDP and improve current account deficits but it can also cause real exchange rate appreciation, trade balance deterioration, and inflation	A larger absolute cut in CO2 emissions will require a higher carbon tax and GNP drops by 1.5% and 2.8% and its welfare drops by 1.1% and 1.8%, indicating that the associated GNP and welfare losses tend to rise more sharply as the degree of the emission reduction increases	Poverty is found to increase slightly with the implementation of the prospective Doha scenario, especially in rural areas and among the unemployed, self-employed and rural low-educated

(continued on next page)

Table 3 continued

Country	Bangladesh and Zambia	Armenia	Vietnam	Singapore
Model	Fontana (2004)	Rutherford and Light (2004)	Nguyen Manh Toan (2005)	Siriwardana and Iddamalgoda (2003)
Benchmark Data	1994 and 1995	2002	2000	1998
Main Purpose	To assess how trade affects women, i.e., how trade expansion affects gender inequalities in terms of resource endowments, labour market characteristics and socio-cultural norms in two countries	To evaluate factors influencing the efficiency cost of raising revenue from different tax bases	To explore the links between trade liberalization and income distribution among household groups, that is, to investigate whether trade liberalization will increase or decrease inequality in the context of Viet Nam	To examine the impact of the Asian economic crisis and the effects of proposed policies. In particular, wage reduction, domestic demand stimulation, and exchange rate policies are examined
Dimensionality	10 price blocks, 19 production and commodity blocks, 11 institution blocks, and 10 system constraint blocks	24 sectors, 4 primary factors (capital, skilled and unskilled labor, and land), 25 industries, the government, and a single representative consumer	26 sectors, 8 household groups, and 13 factors of production	45 regions and 50 sectors in each region
Functional Forms/ Main Characteristics	Dervis, de Melo and Robinson (1982) while the underlying gender application is based on Fontana and Wood (2000)	Constant elasticity of substitution (CES) functions by Mathiesen (1985)	Multi-sector dynamic CGE model and the corresponding Social Accounting Matrix (SAM)	Comparative-static multi-regional CGE model comprising a system of linear equations of percentage change of variables and ORANI modeling of each region for GTAP
Simulation	Main experiment is the abolition of all tariffs	Different types of tax reforms and some scenarios for increasing tax revenue by between one half and two percent of GDP	Tariff reduction up to 5%, assumed to be offset by the introduction of a uniform increment in indirect tax rates, endogenously determined so as to maintain government revenue neutrality	Imposition of negative investment and factor employment shocks, that is, wage reduction policy, policies to stimulate domestic absorption via increased government and private demand, and devaluation
Main results/ Conclusions	Highlights how differences in resource endowments, labor market institutions, and socio-cultural norms shape the way in which trade expansion affects gender inequalities, resulting in more favorable effects in two	Highlights the efficiency cost of informal activity. The marginal cost of public funds from any of the direct and indirect tax instruments are increased when a substantial fraction of the tax base is able to avoid payments, or when individuals are more willing to substitute informal goods and services for formal goods and services	Trade liberalization negatively affects total national welfare. Rural-unemployed and farmer households, which is estimated to contain more than 70% of the country population, incur loss. On the contrary, urban self-employed households seem to gain the highest benefit from trade liberalization	Lowering the wage costs results to restoration of international competitiveness via depreciation of the real exchange rate. Real GDP growth is likely to return to pre-crisis levels. The policy increases employment

Sugiyarto (2000) developed CGE models based on the Indonesian SAMs in 1985, 1990, and 1993 to examine the economic effects and distributional implications of economic reform policies such as stabilization, trade liberalization, and tax reform. The first policy leads to economic contractions and welfare reduction but it has favourable impacts on income distribution since government consumption favours the higher income households. The trade liberalization brings benefits to the economy and also has favourable impacts on income distribution for rural households since urban households are the ones benefiting from the existing tariff protection. Comparing results of the three different years shows that the economy is getting more benefits from trade liberalization implying an increasing distortion in the economy. The sequencing simulations show that initial conditions are crucial in determining the results of any policy changes and the policy choices that can favourably be adopted. A sensible choice is to start with reducing distortions in the domestic market followed by trade liberalization and stabilization type policies. By having a less distorted domestic market, the benefits from trade and other reform policies can be better realized.

Sources: Authors' compilation.

Box 9 **Problems in Using Computable General Equilibrium Models for Poverty Impact Analysis**

Despite the benefits of having a computable general equilibrium (CGE) modeling framework for policy analysis, there are some obvious problems in the implementation of this technique for conducting poverty impact analysis (PIA).

- **Model development.** It is not easy to develop the model. Developing CGE model is relatively complicated and cumbersome. Its development requires substantial data that can only be generated from various established censuses and surveys as part of a national statistical system. In this context, CGE model development in a country with a weak statistical system seems very unlikely. A good indicator on this issue is the capability of the country's statistical office to (regularly) produce input-output tables and then a social accounting matrix (SAM).
- **Timeliness of data.** The data used for developing the model must be current and regular. It takes time to develop an input-output table or SAM, which are used for CGE modeling. In some countries, the development of an input-output table or SAM is only a one-off activity—this could make the corresponding model even more outdated.
- **Simulating program effects.** It is difficult, sometimes impossible, to accurately simulate the program effect in the model. One of the main reasons for this difficulty is that the program may produce many kinds of outputs that cannot all be fully translated into changes in the model. A simple infrastructure program to improve economic infrastructure, for instance, can be translated in many ways—such as into reductions in trade and transport margins, production costs, and other things. This problem is, however, not peculiar to the CGE model since other methods are beset with the same problem.
- **National coverage.** The model may not be relevant for projects and policies for administrative districts below the national level. The model usually covers projects and policies that are national in scope.
- **Poverty impact measurement.** The structure of the CGE model and available data may affect the type of poverty impact measures that can be generated by the model. In a CGE model with representative household groups, for instance, Foster-Greer-Thorbecke poverty and income distribution indicators cannot be generated without assuming a specific distribution on income such as lognormal distribution. In the absence of such an assumption, other measures of welfare such as equivalent variation, compensating variation, and real income or consumption are commonly used.
- **Classifications.** Classifications of household, workers, and sectors used in the CGE model may not be exactly in line with direct policy targeting of the government, donor, and other interested parties. In this case, the poverty and other indicators resulting from the model may not be as useful as they could be.

Source: Author's summary.

economy, while the second approach can be seen in most of the current CGE applications (Greenaway et al. 1993). The CGE models used in this book adopt the second method.

In the context of other modeling systems, CGE models combine the advantages of econometric, input-output and social accounting matrix (SAM)–type frameworks. Compared with fixed-price input-output or SAM-multiplier models, for instance, CGE's flexible price structure and behavioral equations can approximate long-term equilibrium adjustment in addition to short-term analyses. The CGE model also imposes consistency characteristics among sectors, which is lacking in macro econometric models (Azis 1996).[19]

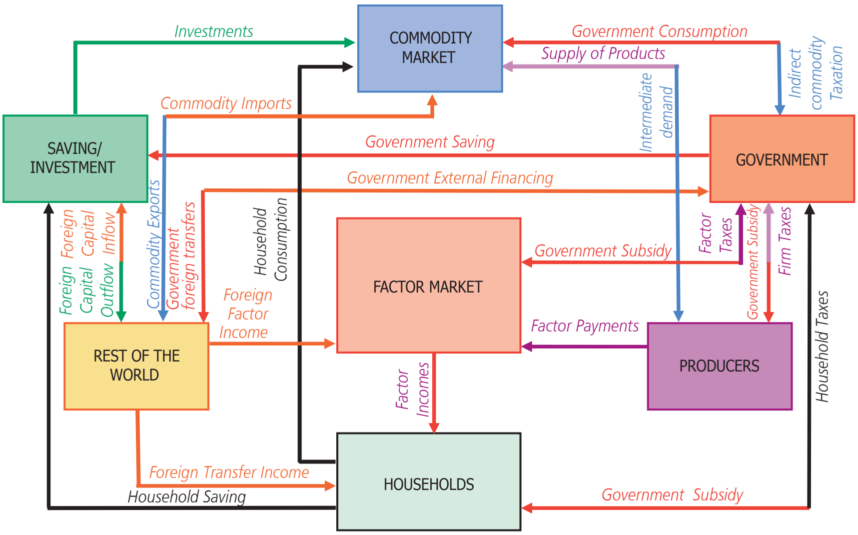
The structure of a CGE model is consistent with neoclassical economic theory but flexible enough to incorporate structural characteristics such as the introduction of factor and commodity substitution into the production and demand structure. The Walrasian system of equations of the model represents the equilibrium of factor, commodity, and foreign exchange markets. The system can simulate economic responses to changes in policy variables vis-à-vis the base scenario. The model's endogenous prices adjust to any exogenous changes until factor and commodity-market equilibrium conditions are satisfied and consistent with endogenous factor incomes.

Another consideration why CGE models are useful for PIA is that this framework explicitly accommodates households in the model. Among other features, the models show how aggregate income is distributed among various RHGs that make it possible to calculate welfare changes as a result of various policy changes or programs. The simultaneous feedback and link between product and factor markets is best captured by CGE models. Moreover, the types of economic interventions by international organizations such as ADB tend to generate multisectoral effects on the rest of economy that cannot be ignored.

Figure 6 provides an intuitive picture of the economy described by the CGE model. In this framework, households and government maximize their utility functions subject to their budget constraints, and producers maximize outputs subject to intermediate inputs and available factors. These factors include labor and capital, as well as production technology to specify the input requirements per unit of output. The producers supply goods and services in response to domestic and foreign demand and, in doing so, generate income for households and government from factors used in the production process. The factor incomes, in addition to other transfer incomes, are used to finance

19 Stochastic equations in any econometric model always contain residual errors or error terms.

Figure 6 **The Interlinked Nature of the Economy Represented in a Computable General Equilibrium Model**



Source: ADB PRISM (http://prism/adb_prism).

consumption expenditures and other expenses, including savings. Therefore, in addition to the economic transactions, the model also captures transfer payments among institutions in the form of taxes or subsidies and other transfers. The institutions in the model include households, government, enterprises, and the rest of the world.

All transactions are recorded in a consistent way in the sense that expenditure of an economic actor always corresponds to income for another actor, and vice versa. The model produces equilibrium solutions with aggregate spending being equal to total income since all consuming institutions spend all their respective incomes, including savings. In other words, there is no excess demand and supply in the model, and the equilibrium is achieved in all markets. Auxiliary equations can be added to depict departures from the standard neoclassical assumptions and to incorporate some structural characteristics of the economy (see Robinson 1989 and Taylor 1990 for examples of discussions on this issue).

Households in the model can be classified in different ways, depending on the modeling purpose and available data, as well as on the requirements of policy makers. For PIA, household classifications should ideally be based on PPM results to make the CGE modeling results consistent with other poverty-targeting efforts. A commonly used alternative is to classify households, based on their income level, into groups of quartiles, deciles, and so on, for easy calculation of household income distribution. Another common way to classify households is based on available information from various surveys and censuses such as the job and occupational status of the household head combined with other characteristics of education and skill level, as well as location in urban or rural areas. In some cases, the gender aspect of household head can also be incorporated in the classification as can be seen in the Philippine model discussed in this book. The general rule of thumb is that the more detailed the household classification, the better the model results–especially if the classification can then be used as the basis for policy targeting.

On the other hand, analyzing project impacts in partial equilibrium may not be adequate, as this approach does not take into account the sectoral links of an economy. The economy-wide approach cannot be replaced by a multi-market, partial-equilibrium approach, which may also be operationally more cumbersome.

CGE Model Applications. Policy analysis using CGE modeling is basically tracing the effect of a change introduced in the model by comparing two equilibrium states of the economy. First is the benchmark equilibrium state, which is calculated without changes in the model and second is the counterfactual, which is the outcome of all variables concerned after introducing the changes. The differences in equilibrium values before and after the changes are attributed to the interventions.

CGE modeling has been implemented to examine the economy-wide effects and distributional implications of a wide range of applied policy issues and interventions.[20] The effects of any changes introduced in the model can be examined at macro, sector, factor, and household levels. Moreover, the impact can be examined in a static and dynamic context, for short- and long-run scenarios, in isolation or in combination with other policies as shown in the applications of the CGE modeling in DMCs summarized in Table 3. Such flexibility has been found to be an important practical advantage in the use of CGE models.

A numerical CGE model is developed using mainly data from a SAM. (See Box 10 for a discussion on SAM.) Some models' parameters such as elasticities of substitution between different commodities and factors cannot be computed from the SAM and need to be estimated independently or

20 Examples are for structural adjustments, international trade, public finance, agriculture, and energy and environment. In addition, the model has also been used to examine various exogenous shocks such as changes in commodity and oil prices.

Box 10 **The Social Accounting Matrix**

A statistical accounting matrix (SAM) is basically a system of presenting the economic and social structure of a country (or region) at a particular time by defining the representative actors or economic agents in the underlying economy and recording their transactions. The transaction values are presented in a square matrix (as opposed to the double-entry format in standard T-type accounting reports) with its rows representing detailed receipts by each particular account and its columns recording the corresponding expenditures. Every income item entered has a corresponding expenditure entry, and the incoming and outgoing items of any account must always balance.

The SAM is essentially constructed to correspond to the underlying economy and entries in a SAM can be categorized into two groups: one that reflects flows across markets to represent transactions in the product and factor markets, and the other that reflects transfer payments from one agent to another.

There is, however, no standard SAM so that the disaggregation level and choice of representative actors depend entirely on the motivation underlying SAM's development and the availability of data. For poverty impact analysis, the classifications of factors (especially workers) and households should be relatively detailed to enable the models to capture the changes in factor income allocation and, therefore, welfare status of different household and worker groups.

In a statistical system, a SAM provides complementary economic indicators, which relate not only to the macroeconomic aggregates of the system of national accounts but also to the socioeconomic structure and distributional aspects of the economy. Accordingly, SAM can be thought of as a further development of input-output accounts, which concentrate only on the production side of the economy. It must be noted, however, that every SAM is only a static image or snapshot of an economy.

Nevertheless, SAM can provide the statistical basis for the development of plausible models when more than a static image is needed (King 1985). Table 4 provides a schematic representation of SAM for Indonesia as an example. As can be seen in the table, the matrix records a comprehensive transaction conducted by economic actors in the economy for a period of time that includes economic and transfer payments.

On the down side, constructing SAM can be very time consuming and burdensome, involving reconciliations of various data from the input-output tables, national income accounts, foreign trade, and other sources. If the basic data are not readily available, some specific surveys must first be conducted before developing a SAM.

Source: Author's summary.

borrowed from the literature. This is where the modeler's expertise and common sense play an important role.

The first operational general equilibrium model was developed for the Norwegian economy in 1960 using tractable log-linear specifications. Subsequent applications of CGE models developed by World Bank

Table 4 **Schematic Representation of the Indonesian Social Accounting Matrix (SAM)**

	EXPENDITURE								
	Factors	**Institution**	**Activities**	**TTM**	**Domestic Commodities**	**Imported Commodities**	**Capital**	**Net Indirect Tax**	**ROW**
Factors			Value Added						
Labor			Wages						
Capital			Profits/Rents						Remittance
Institution									
Households	Factor Income	Transfers							Transfers
Firm	Factor Income	Transfers							Transfers
Government	Factor Income	Direct Taxes						Indirect Tax Transfers	Transfers
Activities					Production Allocation				
TTM					Mark-up for TTM	Mark-up for TTM			
Domestic Commodities		Final Consumption	Intermediate Consumption	Transfers/ Consumption			Investment		Exports
Imported Commodities		Final Consumption	Intermediate Consumption				Investment		
Capital		Savings							
Net Indirect Tax					Indirect Tax Payment	Indirect Tax Payment			
ROW	Remittance	Transfers				Imports	Capital Outflows		

TTM = trade and transport margin, ROW = rest of the world
Source: Authors' summary.

researchers on the developing countries are summarized in Dervis, Melo, and Robinson (1982). Decaluwé and Martens (1988) compared the structure of 73 CGE applications in developing countries, including some DMCs. Table 3 summarizes CGE modeling applications in DMCs to address various issues such as the effects of globalization in conjunction with tourism growth, consequences of price fluctuations in international markets for primary products, tax policy and government revenue performance, and others.

To be able to conduct policy simulations and PIA with CGE models, the model first needs to be developed. In doing so, the main purpose of the modeling activities should be given utmost consideration since there is no single model that can answer all questions. In other words, there is no black box CGE model that is useful. The model has to be developed for a specific purpose and the level of aggregations in the production sectors, factors, and households, as well as the other structural features incorporated in the model, have to be carefully specified. Equally important to consider is how the kinds of policy instruments under examination are introduced in the model.

Any changes due to a combination of a new project or policy change, or both, as well as other external factors or shocks, will affect resource allocations in the economy. This is reflected in the changes in volume of sectoral output, uses of labor and capital, and factor and commodity prices which, in turn, affect household income distribution and poverty. The effects of changes on the RHGs in the model can be used as an indication of the household welfare condition. This approach, however, assumes that the policy changes will not alter the intra-group income distribution, which can be a restrictive feature in some cases.[21] This leads to the integration of a complete household data set in the CGE models that results in a CGE-microsimulation model.

CGE-Microsimulation Model. Unlike conventional CGE models, the CGE-microsimulation model incorporates actual households in the model. The link provides much more information, especially with regard to household income and poverty as their indicators can be developed more precisely. The approach has become feasible to implement with recent gains in computing efficiency.[22] The CGE-microsimulation model can calculate income distribution and poverty indicators that can not be conducted in CGE models with RHGs.

The CGE-microsimulation model has improved the capability of CGE models to measure the effect of policy reforms on poverty. Previous work focused on the efficiency effects rather than on income distribution and poverty

21 The issue is how representative is the representative household in the CGE models.

22 See Decaluwé et al. (2000); Cockburn (2002); and Cororaton (2003a and 2003b).

impacts of policy reforms.[23] CGE microsimulation has been increasingly used to address various issues on household income and poverty.

Two approaches have emerged from the integration of a complete household survey data set into CGE models. One is a top-down recursive approach, in which the economic effects of any changes introduced in the model are first computed with the conventional CGE models with representative households. The counterfactual equilibrium variables are then used in a separate micro-household simulation model to calculate the changes of poverty and income distribution indicators.[24] The microsimulation is not necessarily conducted in the general equilibrium context, providing greater flexibility[25] in tracking the effects of policy changes on poverty and income distribution than in conventional CGE models. The incomes and expenditures calculated in this way, however, will not be consistent with corresponding figures in the CGE model solution.

Another variation of this top-down approach is to use only changes in price vectors generated from the CGE model and impose the changes on the microsimulation model. This variation guarantees consistent results between CGE and microsimulation models. In other words, this approach is similar to replacing the RHGs of the CGE models with complete households from a survey. In the process, the complete households must be classified following exactly the same classification method used in developing the RHGs. All poverty and income distribution indicators can then be developed from the complete household data set.[26] The CGE microsimulation and the PRISM discussed in this book adopted this top-down but consistent approach (see also Chapter 9 and 10 of this book).

The second approach is a refinement of the top-down approach–it incorporates the possibility of bottom-up feedback. In this top-down, bottom-up approach, CGE results are transformed into the household microsimulation model. The solutions obtained from the microsimulation at the household level are then fed back to the CGE model and, through

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23 See, for example, Shoven, J. and J. Whalley, (1992); Dervis, K., J. de Melo, and S. Robinson (1982); and Clarete, R. and J. Roumasset (1986).

24 Dervis et al. (1982) have applied this approach, as well as de Janvry, Sadoulet, and Fargeix (1991a and 1991b); Chia, Wahba, and Whalley (1994); and Decaluwé et al. (2000).

25 As there is no consistency constraint, changes in the household behavior can also be introduced in the microsimulation model.

26 See Bourguignon, Robillard, and Robinson (2002); Mitton, Sutherland, and Weeks (2000); Bourguignon, Fournier, and Gurgand (2001); and Alatas and Bourguignon (2001).

a series of iterations, a convergence solution between CGE model and the microsimulation is attained.[27] This approach appears to be most useful for PIA as it continues to take advantage of the analytical strength of the CGE model. The numerical specification work in setting up the model, however, becomes more tedious because of the thousands of households that must be included in the calculation.

PRISM: An Interactive CGE-Microsimulation and GIS Model. PRISM is developed by basically linking a CGE-microsimulation model with a GIS application and then interfacing them in a user-friendly way (see also p.24). Therefore, PRISM is a modeling tool that maximizes the capability of the CGE-microsimulation model at the household level and the GIS application of poverty mapping for its poverty-impact components. All complexities of the modeling aspects of CGE-microsimulation and the GIS application have been hidden in the system and interfaced in a way that allows users to easily run simulations and conduct some online analyses, including PIA. For an introduction to PRISM, users can examine the economy-wide and poverty effects of the preset simulation scenarios, selected for their relevance, in each country incorporated in the system. The Philippines economy was selected as the prototype that can be expanded to include other countries.

The GIS application is basically a way of presenting geographical information using a map or picture, which can then be combined with color in different gradations to represent different levels of measurement.

As mentioned earlier, users can run online their own “what if” scenarios of important issues related to taxes, foreign sector economy, factor market, and household income. Once the simulation is completed, a notice that contains a refreshed link is sent out by the system to the users so that they can view the results independently or in comparison with the preset scenarios and other selected simulation results.

The impact analysis can be examined on macroeconomy, external sector, factor market, household income, and poverty. All simulation results are presented in graphs and tables that can easily be downloaded or copied to other computer program applications. Moreover, the poverty impacts are also presented in an interactive GIS map of a dual-window viewing system to enable a comparison of poverty impact analysis between two different simulations.

27 See Savard (2003) for discussion on this issue.