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Distributional Effects of Trade Reform: An Integrated Macro-Micro Model Applied to the Philippines

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Analyzing the micro impact of policy reforms is essential to understand their impact on poverty and more generally on income distribution, and therefore their social acceptability. When reforms are shown to be beneficial for society as a whole but not to particular groups, such an analysis gives policy makers information on the measures to be taken to compensate losers, and the cost of these measures. The Philippines' government is faced with numerous policy choices that are all the more difficult because of concerns voiced by various pressure groups about the impact of these policies on vulnerable groups. An important policy choice has to do with unilateral trade liberalization. This policy likely will have beneficial aggregate effects in the medium run when markets will have fully adjusted. Domestic agents, however, likely will benefit unevenly from this reform, some of them running the risk of being net losers. Moreover, the presence of market imperfections may substantially modify the overall gain of the reform and increase individual losses.

The identification of the distributional effects of a policy reform, and in particular of the losers and the way they could possibly be compensated, is difficult. The reason for this difficulty is the need to jointly evaluate two types of effect: (1) the aggregate effects of the policy reform, something that is generally done through conventional macro modeling—with more or less sectoral disaggregation; and (2) the heterogeneous effects of the reform on individual agents, an analysis that requires an essentially microeconomic perspective. Recent years have witnessed a flourishing body of literature about this macro-micro nexus in modeling the poverty and distributional impact of macro policies, including trade reforms. The integration of the macro and the micro perspectives remains somewhat imperfect or rather cumbersome, however. The present chapter proposes an alternative approach and applies it to the issue of trade liberalization in the Philippines.

The chapter is organized as follows. The first section discusses the various methodological approaches to the macro-micro link in the analysis of policy reforms and presents the original approach applied in the chapter. The second section presents the original features of the application of that methodology to the Philippines and, in particular, the way it accounts for labor market imperfections. The third section shows the results of simulating the distributional effects of across-the-board trade liberalization in the Philippines. It compares the results obtained from the methodology used in this chapter with those derived from alternative approaches.

An Iterative Top-Down Approach to the Macro-Micro Link

Existing Approaches to the Modeling of the Macro-Micro Link

Three main approaches are being used in the literature to link macro reforms to changes in income distribution and poverty within the framework of economywide computable general equilibrium (CGE) models. The first and most common is the representative household (RH) approach. The population of households is partitioned into groups, and each group is represented by a virtual household assumed to behave as the mean of the group. Income distribution within groups is taken as exogenous, so this approach considers only between-group sources of variations in the distribution of income and poverty. This is a severe drawback given the importance of the within-group components in existing empirical evidence on the sources of change in income distribution.

The second approach may be referred to as the CGE microsimulation sequential (MSS) method. This is essentially a top-down approach. At the top, a conventional CGE model—with or without representative households—is used to simulate policy reforms and estimate changes in prices and factor rewards resulting from the reform. These changes are then fed into a conventional household survey database to yield estimates of the change in the income and expenditures of individual households under the assumption of no behavioral response. It is known that, with perfect markets and marginal changes in the price system, the difference between these two amounts yields a money metric of the change in the individual welfare of households. Applying these changes to initial incomes derives the change in the distribution of real income within the population and in poverty. This simple approach to the micro consequences of macro policy reforms combines conventional CGE modeling and microsimulation and is being used increasingly—see, for instance, chapters 2 and 3 in this volume by Lokshin and Ravallion, and Bussolo et al; Coady and Harris (2001); King and Handa (2003); Vos and De Jong (2003); and Chen and Ravallion (2004). A more complicated approach that considers labor force participation behavior, labor market imperfections, and possibly nonmarginal price changes has been explored by Bourguignon, Robilliard, and Robinson (2005); and Ferreira, Leite, Pereira da Silva, and Picchetti (chapter 5 in this volume).

An obvious critique of the MSS approach is the lack of feedback from the micro side of that methodology (the microsimulation based on household surveys) to the macro side (that is, the CGE model). Household behavioral responses to price changes may well be ignored when computing marginal changes in welfare at the micro level under the assumption of perfect markets. As noted by Hertel and Reimer (2004) or Bourguignon and Spadaro (2006), however, these responses are not necessarily negligible at the macro level, and the approximation may be grossly incorrect in the case of market imperfections or nonmarginal changes in the price system. This top-down approach is also inappropriate when policy changes are specified at the household level, for instance, with cash transfer programs.

A third approach that is being explored in recent work handles the micro and the macro part of the modeling in a fully integrated way, rather than sequentially as with the MSS approach or through intermediate aggregation as with the RH approach. Practically, this approach is simply an extension of the latter. It includes as many "representative households" as there are actual households in the household survey that would be used with the MSS approach. In the prototype model by Decaluwé, Dumont, and Savard (1999), each household is characterized by its share in total factor endowments in the economy (as computed from the income part of the household survey), its saving rate, and the allocation of its consumption budget among the various goods and services appearing in the CGE model. All these shares and rates are fixed, and the model solves for the complete equilibrium of the economy, including saving and consumption demand for each household in the sample. Cogneau and Robilliard (2001) applied this type of integrated approach of micro-macro modeling to the Malagasian economy, based on a set of 2,000 households observed in a household survey and under the assumption of a dualist labor market.

In comparison with the other approaches, this integrated multi-household (IMH) approach appears as the only one based on a rigorous theoretical framework that considers all the observed heterogeneity of the population of households. Yet, it raises several difficulties at the implementation stage. First, reconciliation between the aggregate data in the macro part of the model and micro data coming from the household survey can be problematic—especially concerning the definition of aggregate goods and services to be used in both the micro (household expenditure) and macro (sectoral production) sides of the model; see Cockburn (2006) or Rutherford, Tarr, and Shepotylo (2005). Second, the numerical resolution can be challenging. Boccanfuso, Cabral, and Savard (2004) were able to handle an integrated model including around 3,500 Senegalese households, but Rutherford, Tarr, and Shepotylo (2005) found it almost impossible when including 50,000 households in their analysis of the effect of Russia's accession to the World Trade Organization. Finally, detailed microeconomic behavior or micro consequences of market imperfections can be difficult to model in this context. For instance, the introduction of involuntary unemployment in the modeling of the labor market requires specifying rationing schemes at the individual level that somehow imply externalities among individuals or households. This feature may be difficult to handle within a standard CGE framework. Cogneau and Robilliard (2001) provide an example of such a model that includes externalities among households. This example, however, seems to have been provided at the cost of an oversimplified macro framework.

It is likely that advances in computing power will soon make it possible to include a much larger number of households in a CGE framework. It is less clear whether that will permit solving the other difficulties. It is thus important to explore other approaches to micro-macro modeling that permit the full integration of standard CGE modeling and a detailed representation of a large population of individual households.

The MSS method may be seen as a first iteration in the IMH approach. Introducing some feedback from the microsimulation level into the CGE model, and then applying the whole MSS again seems like a natural iterative way of integrating the micro and macro analysis of policy reforms. Rutherford, Tarr, and Shepotylo (2005) devised such an iterative algorithm and found that, in the case of Russia and with perfectly competitive markets, most of the micro and macro impacts of an across-the-board trade liberalization were satisfactorily accounted for by the first MSS step. This chapter proposes a different and simpler approach that can be applied to imperfectly competitive environments. It examines whether the same practical conclusion can be obtained in the case of trade liberalization in the Philippines in the presence of strong imperfections of the labor market.

An Iterative MSS Solution to the IMH Model

An elementary Walrasian representation of the economy is used here to present and discuss the iterative method proposed in this chapter to solve an IMH model. The model actually used for the Philippines' application in the second part of the chapter is more elaborated.

Let $C_{h,i}(y_h, \eta_h, p)$ be the consumption function of good i (=1, . . ., I) by household h, where y_h is the income of household h (=1, . . ., H), η_h is a set of demographic characteristics, and p is the vector made of the prices of goods and services. Let $L_{h,n}(\pi_h, \eta_h, w, p, R_h)$ be the supply of labor of type n (=1, . . ., N) by household h, π_h, is the vector of the specific productivities of household h in the various types of labor (say, skilled-unskilled), w is the corresponding vector of unit wages, and R_h is nonlabor income. Finally, let $Y_i(k_i, w, p)$, $P_i(k_i, w, p)$, and $L_i^d(k_i, w, p)$ be, respectively, the supply, the profit, and the vector of labor demands of the sector producing good i, with k_i standing for the fixed factors of production.

The competitive equilibrium of that economy is given by the solution in (p, w) of the following system of equations:

$$\sum_{h=1}^{H} C_{h,i}(y_h, \eta_h, p) = Y_i(k_i, w, p) \quad \forall i = 1, \ldots, I$$

$$\sum_{h=1}^{H} \pi_{hn} L_{hn}(\pi_{h\cdot}, \eta_h, w, p, R_h) = \sum_{i=1}^{I} L_{in}^{d}(k_i, w, p) \quad \forall n = 1, \ldots, N$$

$$y_h = \sum_{n=1}^{N} \pi_{hn} w_n L_{hn}(\pi_{h.}, \eta_h, w, p, R_h) + R_h; \tag{6.1}$$

$$R_h = \sum_{i=1}^{I} \alpha_{hi}.P_i(k_i, p, w) \quad \forall h = 1, \ldots, H$$

where α_{hi} is the share of the profits of sector i that goes to household h.

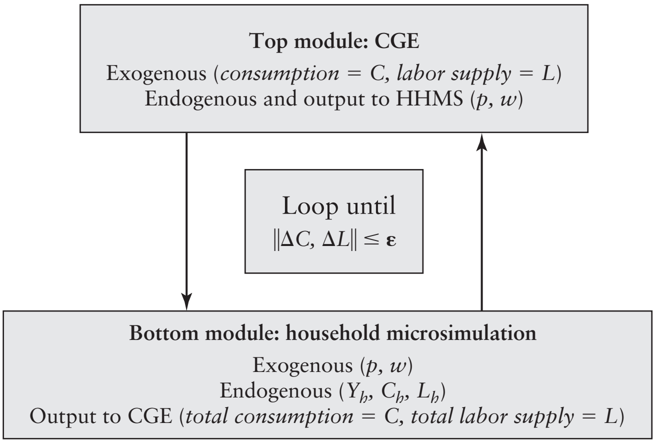
This simple model includes the main features of an IMH model. What makes it somewhat difficult to solve is that the number of H

households, and therefore the total number of equations, may be extremely large. Things would be much simpler if it were possible to group the H households into a much smaller number of aggregate households for which the consumption and labor supply would depend only on their aggregate characteristics, including productivity and nonlabor income. Then, the solution of equation (3.1) could be cast in terms of these RHs and the income and consumption of each individual household could be assumed to be proportionate to that of the RHs in the group to which it belongs. In effect, such an approach combines the RH and the MSS approach into the solution of the IMH model. Introducing some heterogeneity among households, however, or making the consumption functions and labor supply functions nonlinear with respect to income, is enough to make aggregation and the preceding simplification invalid.[1]

A simple algorithm for solving an equilibrium system like (3.1) is the familiar fixed point. The structure of the algorithm is shown in figure 6.1.

Formally, let w^m, p^m be the vector of unit wages and prices at iteration m, and let Γ^m, Λ^m be the corresponding vectors of aggregate household demand for goods and labor supply at those prices and

Figure 6.1 Iterative Resolution of the Integrated Multihousehold CGE Model



Note: CGE = computable general equilibrium.
Source: Authors' representation.

wages, as given by the left-hand side of the first two sets of equations in (6.1):

$$
\begin{aligned}
&\Gamma_i^m = \sum_{h=1}^{H} C_{h,i}(y_h^m, \eta_h, p^m) \quad \forall i = 1, \ldots, I \\
&\Lambda_n^m = \sum_{h=1}^{H} \pi_{hn} L_{hn}(\pi_{h.}, \eta_h, w^m, p^m, R_h^m) \quad \forall n = 1, \ldots, N \\
(6.2)\quad &\text{with} \quad y_h^m = \sum_{n=1}^{N} \pi_{hn} w_n^m L_{hn}(\pi_{h.}, \eta_h, w^m, p^m, R_h^m) + R_h^m \\
&\text{and} \quad R_h^m = \sum_{i=1}^{I} \alpha_{hi}.P_i(k_i, p^m, w^m) \quad \forall h = 1, \ldots, H
\end{aligned}
$$

Simplifying this set of equations, the preceding definition may be rewritten as a bottom-up (BU) equation:

$$
(6.3)\quad \begin{aligned}
\Gamma^m &= \Phi(w^m, p^m) \\
\Lambda^m &= \Psi(p^m, w^m)
\end{aligned}
$$

Equation (6.2) corresponds to the MSS approach to the micro impact of macro policies. It simulates the impact of changes in the price system (p, w) on individual incomes. Aggregating the micro responses to those changes provides the BU part of the iterative algorithm proposed in equation (6.3). This step feeds household responses to price changes back to the top of the CGE part of the algorithm, a feedback that is missing in the standard noniterative MSS approach. Aggregate demand and labor supply being considered as exogenous in iteration $m + 1$, aggregate equilibrium conditions in equation (6.1) can now yield new values for the price system. This particular step of the iteration writes now as a top-down (TD) equation:

$$
(6.4)\quad \begin{aligned}
&Y_i(k_i, w^{m+1}, p^{m+1}) = \Gamma_i^m \quad \forall i = 1, \ldots, I \\
&\sum_{i=1}^{I} L_{in}^d(k_i, w^{m+1}, p^{m+1}) = \Lambda_n^m \quad \forall n = 1, \ldots, N
\end{aligned}
$$

which yields a new vector of prices and wages (p^{m+1}, w^{m+1}). This new vector is then sent down to microsimulation at the household level for a new iteration. This system of equations thus provides the TD part of the algorithm that solves the integrated household model.

Writing the solution of the preceding system as follows:

$$(w^{m+1}, p^{m+1}) = \Psi(\Gamma^m, \Lambda^m)$$

it is now possible to put the two parts, BU and TD, of the algorithm together, leading to the following fixed-point (FP) algorithm:

$$(w^{m+1}, p^{m+1}) = \Psi[\Phi(w^m, p^m), \Theta(w^m, p^m)] \tag{6.5}$$

Convergence of the algorithm is obtained when the distance between two successive iterations on the vectors (p^m, w^m) is below some arbitrary small threshold.[2]

With a single market, the preceding algorithm is the familiar cobweb model. Some conditions must hold for this algorithm to converge, namely, the elasticity of the demand side of the market must be smaller than the elasticity of the supply side near the equilibrium. In a multimarket framework, the condition for multimarket equilibrium stability is that the matrix $(J - I)$, where J is the Jacobian of the system of FP equations (6.5) and I the unit matrix, is definite negative.

An interesting property of this FP algorithm is that its first iteration essentially corresponds to the MSS approach. Starting from some initial equilibrium situation, suppose that a shock hits the economy on the supply side. As a first approximation, the MSS approach is equivalent to supposing that aggregate demand and labor supply are not modified. Then the TD solution of equation (6.4) gives the resulting shocks in the price system. The BU part of the algorithm identifies the effect of this shock on the income and welfare of each household in the sample being used. The MSS approach would stop there, ignoring the possible feedback of the initial shock on aggregate demand and labor supply. An interesting question is whether considering feedback effects of the household sector on the economy, as is done in the iterative procedure proposed here, eventually leads to different estimates from those obtained at the first iteration.

It is possible to get closer to final effects using a single iteration or the MSS approach by introducing some behavioral response on the demand side of the goods markets and on the supply side of the labor markets into the CGE model. This can be done by introducing in that model an RH whose behavior has some similarity with the aggregate behavior of the sample of individual households.[3] The first iteration of the algorithm would thus rely on a CGE model that has a single aggregate household with a demand system. Aggregate income and price elasticities of the demand for goods and services and the supply of labor would have to be close to the elasticity obtained from aggregating individual households' behavior.

The iterative top-down, bottom-up resolution method shown above—which applies to much richer representations of the economy than equation (6.1)—has several advantages over a method that would solve simultaneously for all individual and aggregate equilibrium conditions. First, there is no obligation to make the macro and the micro part of the model fully consistent in terms of consumption or income aggregates. Some rule would be needed that permits converting the aggregates obtained from the BU part of the algorithm into the aggregates used in the CGE part of the model. For instance, the household survey may be underestimating the aggregate consumption of a particular good as given by the national accounts generally used in CGE modeling. No correction is necessary for consistency with national account data if it is assumed that the proportion of underestimation is independent from the price of other goods and unit wages. In other words, income and expenditure data in household income and expenditure surveys can be used as they are. A second advantage is that there is no limit to the level of disaggregation in terms of production sectors and number of households to be included in the model. This issue is discussed in Rutherford, Tarr, and Shepotylo (2005) and Chen and Ravallion (2004). The third advantage is that the flexibility of the functional forms used to model the consumption and labor supply behavior of households is greater than in other approaches. In particular, there is no need to choose functional forms with good aggregation properties. Finally, as can be seen below in the following section, it is possible to introduce labor market imperfections without major difficulty and to explicitly consider the externality among households when rationing occurs on one side of the market.

Labor Market Imperfections

Like many other developing countries, the Philippines is characterized by a dual labor market with a formal sector in which most employees are wage workers, most often under a labor contract, and an informal sector dominated by self-employment and family business (Riveros 1993). Taking this dualism into account is important because workers with the same characteristics are not remunerated at the same rate in the two sectors, and the allocation of workers between the two sectors has a direct impact on poverty and the distribution of income. This feature is introduced in the present micro-macro model using the well-known specification first presented by Roy (1951), revisited by Heckman and Sedlacek (1985), and further enriched by Magnac (1991), in which workers decide which sector, if any, they want to join depending on the wages they are offered or anticipate.

Another feature of the Philippine economy seems to be the wage rigidity in the formal sector of the economy.[4] This implies that some rationing takes place in the formal sector of the economy that forces workers who would have preferred a job in that sector to work in the informal sector or to be inactive. This feature of the labor market is taken into account by following closely the micro framework proposed by Magnac (1991).

Formally, the representation of the labor market in the present model of the Philippine economy is as follows. Assume in a first stage there is only one type of labor but that productivity, π_h, varies across individuals h—who momentarily will be assumed to coincide with household heads. Productivity is assumed to depend on individual characteristics according to a Mincerian model type. Then, the wage, ω_h^j, of individual h in the segment j (=1 for formal, 2 for informal) of the labor market is given by the following:

$$\omega_h^j = \pi_h w_j \quad \text{with} \quad \log \pi_h = H_h.\gamma^j + u_h^j \tag{6.6}$$

where w_j is the general level of earnings in segment j, as given by the solution of the aggregate CGE model, H_h stands for the human capital characteristics of individual h (essentially education, age, and gender), γ^j is a vector of coefficients specific of segment j, and u_h^j is a residual term for the effect of unobserved characteristics on individual productivity in segment j. The key assumption is that the elasticity of individual labor productivity with respect to human capital characteristics is segment specific.

Participation decisions are taken by comparing the potential wages in the various market segments to a reservation wage, ω_h^0 given by the following:

$$\ln \omega_h^0 = H_h\gamma^0 + Z_h\delta + u_h^0 \tag{6.7}$$

where, γ^0 stands for the semi-elasticities of the reservations wage with respect to the observable characteristics of workers, δ is for the semi-elasticities with respect to household characteristics, and Z_h and u_h^0 summarize the effect of unobserved variables. The reservation wage ω_h^0 is not directly observed and must be inferred from the observed participation behavior of individuals in the sample.

With these three distinct wage variables, it is possible to represent the decision process of an individual who has to choose among three alternatives: being inactive, working in sector 1, or working in sector 2. To take into account the possible imperfection of the labor market and entry restrictions in the formal sector, it is convenient to introduce a cost of entry in that sector. A simple assumption is that this cost is proportional to the formal wage, so that it represents something like the waiting time to get a job in the formal sector. Accordingly, the net (logarithm of the) gain in the formal segment of the labor market can be defined as follows:

$$\ln \omega_h^1 + u_h^c \qquad (6.8)$$

where u_h^c stands for the logarithm of the proportion of earnings in the formal sector that is actually received by the worker—after taking into account the cost of entry. The labor market may be said to be perfectly competitive when this cost is nil, which implies that u_h^c is nil instead of negative.

Taking into account the cost of entry into the formal sector, the employment decision process can be described by the following set of conditions:

$$\begin{aligned} &\text{Formal employment: } \ln \omega^1 - u_h^c > \ln \omega^2, \\ &\qquad \text{and} \quad \ln \omega^1 - u_h^c > \ln \omega_h^0 \\ &\text{Informal employment: } \ln \omega^2 > \ln \omega^1 - u_h^c, \\ &\qquad \text{and} \quad \ln \omega^2 > \ln \omega_h^0 \\ &\text{Inactive: } \ln \omega_h^0 > \ln \omega^1 - u_h^c, \\ &\qquad \text{and} \quad \ln \omega_h^0 > \ln \omega^2 \end{aligned} \qquad (6.9)$$

Observing the sector of employment of individuals (and their earnings in that sector) and making some simplifying assumptions on the distribution of the unobserved terms, u_h, it is possible to estimate the parameters of equations (6.6) and (6.7). Under the assumption of a normal distribution of the unobserved terms, Magnac (1991) provides a two-step estimation method of the Heckman type that starts with a bivariate probit on the sectors of employment and participation. It is not possible, however, to estimate precisely the unobserved components, $u_h^{\cdot}$, of the various earning equations. Only one unobserved term may be directly derived from the estimation for employed individuals. It is the residual of the earning equation in the segment of the market where they are employed. For the other equations, these unobserved terms are drawn randomly in the appropriate conditional distributions. For instance, the estimated $\hat{u}_h^1$, $\hat{u}_h^c$, and $\hat{u}_h^0$ terms for an individual employed in the informal sector must be drawn according to the following rule:

$$\begin{aligned} &\hat{u}_h^1 \approx N(0, \sigma_1) \quad \hat{u}_h^0 \approx N(0, \sigma_0) \quad \hat{u}_h^c \approx N(0, \sigma_c) \\ &\hat{u}_h^1 + \hat{u}_h^c \le \ln w^2 - \ln w^1 + H_h(\hat{\gamma}^2 - \hat{\gamma}^1) + \hat{u}_h^2 \\ &\hat{u}_h^0 \le \ln w^2 + H_h(\hat{\gamma}^2 - \hat{\gamma}^0) - Z_h \hat{\delta} + \hat{u}_h^2 \end{aligned} \qquad (6.10)$$

For the sake of brevity and given the scope of the present chapter, the detail of the estimation procedure and the results obtained in the case of the Philippines are not provided. A simplified version of Magnac's (1991) method was applied to household heads with the additional assumption that all employed individuals in a household were in the same segment of the labor market as the head.[5]

This microspecification of the labor market implied several departures from the simple Walrasian model discussed in the previous section. At the top level, formal and informal labor are considered as two different types of labor input in the production process of the various sectors of the aggregate CGE model. A basic labor market imperfection is introduced by postulating a fixed real wage (w^1/P) in the formal segment of the labor market,[6] which results in some rationing, whereas the informal labor market is supposed to clear through a flexible wage w^2. Numerous CGE models actually model the labor market in that way (see, for instance, Fortin, Marceau, and Savard 1997; Decaluwé, Martens, and Savard 2001; Agénor and El Aynaoui 2005). Labor supply in the two segments of the market is taken as exogenous in the first iteration, but it results from the microsimulation part of the algorithm in the subsequent iterations. At the microsimulation level, the general level of wages obtained in the top part of the algorithm is used to scale up or down the potential earnings of individuals in the various segments of the labor market with respect to initial estimates of individual earnings. The reservation wage is reasonably assumed to be scaled up or down using a consumer price index (P). These potential earnings can then be used to revise the employment choices of households. Some rationing will possibly take place if employment in the formal sector is below the spontaneous supply of workers. The rationing scheme is analyzed in further detail below.

The consequences of such a functioning of the labor market have already been analyzed in the CGE literature, particularly in the RH context (see, for instance, Thomas and Vallée 1996; Fortin, Marceau, and Savard 1997; Savard and Adjovi 1998; Devarajan, Ghanem, and Thierfelder 1999; Agénor, Izquierdo, and Fofack 2003). Evaluating the aggregate and distributional impact of this imperfection of the labor market requires more care in a fully disaggregated representation of the population of households.

Evaluating the aggregate supply of labor in the two segments of the labor market at iteration $m + 1$ in the microsimulation module can be done by counting the number of people in the various cases defined by equation (6.9) with the prices and wages of iteration m. Thus, the total labor supply $L_{.1}^{m+1}$ to the formal sector is given by the cardinal of the following:

$$\{\ln \omega_h^{1,m} + u_h^c > \ln \omega_h^{2,m}, \quad \text{and} \quad \ln \omega_h^{1,m} + u_h^c > \ln \omega_h^{0,m}\}$$

which also writes as follows:

$$(6.11) \quad L_{.1}^{m+1} = Card\left\{\begin{array}{l} \ln \dfrac{w^{1m}}{w^{2m}} + H_h(\hat{\gamma}^1 - \hat{\gamma}^2) + \hat{u}_h^1 + \hat{u}_h^c - \hat{u}_h^2 > 0 \text{ and} \\ \ln \dfrac{w^{1m}}{P^m} + H_h(\hat{\gamma}^1 - \hat{\gamma}^0) - Z_h\delta + \hat{u}_h^1 + \hat{u}_h^c - \hat{u}_h^0 > 0 \end{array}\right\}$$

where $Card\{C\}$ stands for the cardinal of the set of individuals defined by the conditions C. Likewise, the labor supply, $L_{.2}^{m+1}$, to the informal sector is given by the following:

$$(6.12) \quad L_{.2}^{m+1} = Card\left\{\begin{array}{l} \ln \dfrac{w^{1m}}{w^{2m}} + H_h(\hat{\gamma}^1 - \hat{\gamma}^2) + \hat{u}_h^1 + \hat{u}_h^c - \hat{u}_h^2 \leq 0 \text{ and} \\ \ln \dfrac{w^{2m}}{P^m} + H_h(\hat{\gamma}^2 - \hat{\gamma}^0) - Z_h\delta + \hat{u}_h^2 - \hat{u}_h^0 > 0 \end{array}\right\}$$

Other people are inactive.

Now consider the case in which the formal labor supply exceeds the demand at the fixed real wage w^{1m}/P^m. Then some people who want to work in that segment of the market will not find a job there. Likewise, it may be the case that the demand exceeds the supply, in which case the formal sector will have to attract workers who were initially inactive or employed in the informal sector. How is this adjustment implemented in the model?

The entry cost in the formal sector is used to adjust the labor supply in the formal labor market to match the actual demand. If the demand of formal labor initially exceeds the supply of workers, then, the cost of entry in the formal sector is reduced in the same proportion for all individuals, so that some individuals will move from the informal to the formal sector and others will switch from inactivity to formal employment. In the opposite case of excess supply in the formal labor market, the adjustment takes place by increasing the cost of entry. Fewer people are then willing to work in the formal sector, some of them preferring the informal sector and others becoming (or remaining) inactive. Modifying the entry cost is like changing $\hat{u}_h^c$ by the same amount for all individuals.

Equilibrating the formal labor market through entry cost thus requires determining the amount ε^{m+1} by which all the $\hat{u}_h^c$ terms must be modified for the constrained labor supply to the formal sector $\overline{L}_{.1}^{m+1}$ (ε^{m+1}) to be equal to the demand, L_1^{dm}. From equation (6.11), it can be seen that ε^{m+2} is given by the solution of the following equation:

$$(6.13)\quad \overline{L}_{.1}^{m+1}(\varepsilon^{m+1}) = L_1^{dm}$$
$$= Card \left\{ \begin{array}{l} \ln\dfrac{w^{1m}}{w^{2m}} + H_h(\hat{\gamma}^1 - \hat{\gamma}^2) + \hat{u}_h^1 + \hat{u}_h^c - \hat{u}_h^2 + \varepsilon^{m+1} > 0 \quad \text{and} \\ \ln\dfrac{w^{1m}}{P^m} + H_h(\hat{\gamma}^1 - \hat{\gamma}^0) - Z_h\delta + \hat{u}_h^1 + \hat{u}_h^c - \hat{u}_h^0 + \varepsilon^{m+1} > 0 \end{array} \right\}$$

This modification of the cost of entry in the formal sector also modifies the labor supply to the informal segment of the market, which now writes as follows:

$$(6.14)\quad \overline{L}_{.2}^{m+1}(\varepsilon^{m+1})$$
$$= Card \left\{ \begin{array}{r} \ln\dfrac{w^{1m}}{w^{2m}} + H_h(\hat{\gamma}^1 - \hat{\gamma}^2) + \hat{u}_h^1 + \hat{u}_h^c - \hat{u}_h^2 + \varepsilon^{m+1} \leq 0 \quad \text{and} \\ \ln\dfrac{w^{2m}}{P^m} + H_h(\hat{\gamma}^2 - \hat{\gamma}^0) - Z_h\delta + \hat{u}_h^1 + \hat{u}_h^c - \hat{u}_h^0 > 0 \end{array} \right\}$$

Taking into account the imperfection of the labor market is thus equivalent to replacing the labor supplies coming from the BU part in the initial algorithm by the constrained labor supplies, $\overline{L}_{.j}^{m+1}(\varepsilon^{m+1})$. In effect, the equilibrium on the formal labor segment always holds—at the prices of iteration *m*—so that, practically, the introduction of a fixed real wage in that segment of the market is equivalent to replacing a quantity variable of the initial model by a shadow price, that is, the cost of entry into the formal labor market.

It is also possible to dispense with this shadow price and implement more directly the rationing process. Consider the case of an excess supply in the formal labor market. The preceding mechanism is equivalent to expelling $N = L_{.1}^{m+1} - L_1^{dm}$ individuals from the notional labor supply in the formal labor market. To see which individuals will be expelled, it is sufficient to rank all people in $L_{.1}^{m+1}$ given by equation (6.11) according to the following criterion, G_h:

$$(6.15)\qquad \begin{array}{l} G_h = Inf\,\lfloor H_h(\hat{\gamma}^1 - \hat{\gamma}^2) + \hat{u}_h^1 + \hat{u}_h^c - \hat{u}_h^2, \\ \qquad H_h(\hat{\gamma}^1 - \hat{\gamma}^0) - Z_h\hat{\delta} + \hat{u}_h^1 + \hat{u}_h^c - \hat{u}_h^0 \rfloor \end{array}$$

which happens to be independent of the price system and thus can be established once for all individuals when estimating the labor supply model in equation (6.9). By definition of the notional labor supply, there are $L_{.1}^{m+1}$ individuals such that the criterion G_h is positive. Rationing employment in the formal segment of the labor market to only L_1^{dm} individuals is equivalent to selecting the L_1^{dm} individuals with the highest G_h. Put another way, it is equivalent to expelling from the notional labor supply the N individuals with the lowest score G_h. Whether those individuals will go to the informal sector or to inactivity depends on which one of the two terms on the right-hand side of equation (6.14) is binding. The opposite procedure can be applied to the case in which there is excess demand in the formal segment of the labor market.

The preceding procedure has to be applied independently for the various types (n) of labor, depending on whether there is a potentially binding minimum wage for both skilled and unskilled workers. Practically, however, the minimum wage is assumed to be binding only for skilled workers. In other words, the market for unskilled workers is assumed to clear through the wage scale factor w_2.

The description of the way the segmentation of the labor market and the rigidity of wages is taken into account in the present IMH model of the Philippine economy is now complete, except for a last detail. The framework that has just been presented is based on the heterogeneity of individual productivities, $\pi_{h.}$. This heterogeneity implies that, at the aggregate level, there is a relationship between the number of people being employed in one segment, j, of the labor market and their productivity. As can be seen from the ranking given by equation (6.14), people who leave the formal labor market in case of a contraction are not taken randomly in the initial population of employees in the formal sector. The same is true of those who would join if the formal sector were expanding, and consequently, it is true of the informal segment of the labor market. This means that the average productivity of workers in the two segments of the labor market depends on the number of people working there. This endogeneity of the labor productivity must be taken into account in the CGE part of the model. Thus, for each type of labor, the BU part of the algorithm must return at each iteration not only the (constrained) total labor supply in the two segments $j = 1, 2$ of the labor market, $\overline{L}_{.j}^{m+1}(\varepsilon^{m+1})$, but also the mean productivity of the two groups of workers, $\hat{\pi}_{.j}^{m+1}(\varepsilon^{m+1})$, which is a function of the cost of entry into the formal segment.

The original algorithm has now been generalized to noncompetitive mechanisms that affect microeconomic agents in a way that depends on their comparative individual characteristics. These mechanisms are likely to matter in determining the distributional impact of a policy reform. The fact that this can be done in a rather simple way within the present sequential algorithm may be an important advantage in comparison with the simultaneous resolution of a fully integrated micro-macro CGE model.

Application to a Trade Reform in the Philippines

This section discusses the results obtained in applying the above described IMH model to the study of the distributional effects of a trade reform in the Philippines. Important details of the actual specification of the model are discussed before focusing on the results of a few simulations.

The CGE model used in this chapter is based on the EXTER model of a standard small developing economy provided by Decaluwé, Martens, and Savard (2001), with extensions that take into account the dualism of the labor market. The CGE model is disaggregated into 20 sectors and includes 873 equations. The bottom part of the overall micro-macro model is based on a sample of 39,520 households.

The main data sources used in that exercise are the 1997 Family Income and Expenditure Survey (FIES), the Labor Force Survey (LFS) for 1997 to 1998, and the 1990 Social Accounting Matrix (SAM). The FIES and LFS were used first to estimate the structural econometric labor supply model described in equation (6.9) and then were used in the microsimulation module. Both surveys are based on the same master sample, and 98 percent of the households are found in the FIES and LFS. The FIES and SAM were used for the macro CGE module. The main data manipulation required was the conversion of the FIES nomenclature into the national accounts nomenclature found in the SAM. This conversion was relatively easy and straightforward, because the level of aggregation was quite high in the FIES. It is not necessary to have perfect consistency between the income and expenditure accounts at the micro and macro levels, because the effects are transmitted from the aggregate results of the micro module to the macro CGE model through percentage variations. This way of linking the micro module and the CGE model also avoids the adjustment of the structure of households' expenditure observed in the micro data.

The household microsimulation module relies on a representation of the spending and labor supply behavior of the household. Household consumption is modeled with a linear expenditure demand system (LES) based on total consumption expenditures. The calibration method proposed by Dervis, De Melo, and Robinson (1982), with all households having the same income elasticity for all goods, as well as the same Frisch parameter, is used. The resulting demand for consumption goods is made consistent with observed spending in the FIES through household-specific additive shift parameters.[7] Total expenditure is derived from total income after savings and income taxes. Both the savings rate and the income tax rate are taken to be fixed and household specific.[8] All transfers received and given are exogenous.

On the income side, capital endowments are supposed to be proportional to the level of capital income observed in the 1997 FIES. Labor incomes are given by the model discussed in the preceding section. Based on information provided in the FIES and LFS, workers were classified as employed in the formal or informal sector depending on their occupation as specified in the survey.[9]

At the macro level, the main features of the CGE model are as follows.[10] Producers in the various sectors of the economy are assumed to maximize profits in a fully competitive environment subject to a Cobb-Douglas production function for effective labor and capital and to a Leontief function for intermediate inputs. In each sector, it is assumed that formal and informal firms produce the same aggregate good and that they can be aggregated in a single representative firm, employing simultaneously formal and informal labor.[11] The aggregate labor input in the Cobb-Douglas production function is supposed to be the cost-minimizing combination of formal and informal labor under the assumption of a constant elasticity of substitution (CES) between them. In all sectors, the model distinguishes between skilled and unskilled labor. Both types of labor are fully mobile across sectors, but capital is assumed to be fixed, which generates branch-specific returns to capital. This assumption is consistent with a medium-term perspective on the effect of trade liberalization.

In terms of trade, the Philippines is assumed to be a small open economy. The demand of imported goods is derived from Armington's (1969) specification of a CES between domestic and foreign goods. Likewise, domestic production is allocated to the domestic or foreign markets (exports) through a standard constant elasticity of transformation (CET) function.

On the consumer side, the income of the RH is composed of earnings from skilled and unskilled labor, capital payments, dividends, and transfers from other agents (households and remittances from abroad). As consumption is determined by the micro module, the aggregate saving rate of households is implicitly allowed to vary.

The government levies an income tax (on households and firms), taxes on goods and services, and import duties and transfers from the rest of the world. Its expenditures include various subsidies, the production of public services, and public investments.

As for closure rules, total investment is exogenous and current government expenditures are scaled up or down to balance investment and savings. The exchange rate is endogenous and adjusts to meet an exogenous current account constraint. Finally, the gross domestic product (GDP) deflator is used as a *numéraire*. These closure rules are equivalent to assuming that the burden of the adjustment to any reform is born by households, either directly through their income or expenditures or indirectly through current government expenditures.

The policy simulation reported in this chapter consists of an across-the-board reduction in import duties of 30 percent. This is a rather conventional exercise in the analysis of the effects of trade reforms. The Philippines is a rather open economy—the average tariff rate is around 12 percent—and thus no large effect is expected from such a reform. Because initial protection is heterogeneous across sectors, such a reform entails some restructuring of the economy, which should have some effect on the price system and on the distribution of welfare.

The simulation is performed under different specifications of the overall micro-macro model and assumptions about the functioning of the labor market (see table 6.1). In a first specification, the labor market is supposed to be fully competitive with market-clearing wages in both the formal and informal segments. In the second specification, the real wage is assumed to be fixed in the formal sector, and adjustments are supposed to take place in the way described in the preceding section. The objective of the third specification is essentially methodological. Only the first iteration of the algorithm described above was performed, which is equivalent to the MSS approach. The objective of the comparison of the second and third specification is to get some idea about the consequences of ignoring the feedback effects from the microsimulation to the macro part of model and to get some idea about the overall precision of the MSS approach. To maximize the precision of the MSS approach, the first iteration at the CGE level was performed with a single RH that

Table 6.1 Definition of Model Specification Used

Definition of specification	*Acronym*
Integrated multihousehold model with flexible wages	IMH-FL_*w*
Integrated multihousehold model with fixed formal wage	IMH_FX_*w*[1]
Microsimulation sequential approach with flexible wages	MSS-FL_*w*
Microsimulation sequential approach with fixed formal wage	MSS_FX_*w*[1]

Source: Authors' classification.

approximated the aggregate consumption and labor supply behavior implied by the micro part of the algorithm.

Aggregate Effects

The direct effect of liberalizing trade is to reduce the price of imports and, therefore, to increase the domestic demand for the most protected goods. Given the fixed current account balance, the real exchange rate has to go up, thus reducing imports and increasing exports to balance out the current account. More important, the government income is negatively affected by the drop in tariffs. As total investment is exogenous, government consumption must be cut down to balance savings and fixed investments. It is this direct revenue effect of the trade reform that produces the most important general equilibrium effects in the model. Other effects are due to the shifting of part of consumption from nontradable to tradable goods caused by change in relative prices (numerical results are shown in the first column of table 6.2).

The strong reduction in government expenditure puts downward pressure on the labor market as civil servants are laid off. In the first and third specification, real formal wages are flexible and they are

Table 6.2 Macro Results

Variable	*Base*	*IMH-FL_w (percentage change)*	*IMH_FX_w*[1] *(percentage change)*	*MSS-FL_w (percentage change)*	*MSS_FX_w*[1] *(percentage change)*
Gross domestic product	104,510.0	−0.04	−0.69	−0.05	−1.27
Real household income	86,476.0	1.45	1.13	1.37	0.64
Household real consumption	72,607.0	1.00	1.40	1.35	1.03
Formal wage (index)	1.0	−3.18	0	−3.86	0
Informal wage (vs. formal)	0.5	0.61	−1.25	0.67	−0.46
Government income	20,367.0	−8.39	−8.43	−8.32	−8.84
Real public spending	16,818.0	−6.63	−11.34	−9.48	−13.02
Real investment	23,684.0	2.25	2.26	2.02	2.17
Firm income	26,172.0	0.60	0.55	0.74	0.14
Firm savings	7,810.0	1.04	0.95	1.29	0.24
Employment rate	0.8316.0	≈0	−0.66	≈0	−2.03
Exchange rate (index)	1.0	0.23	0.30	0.17	0.27

Note: The Base column units are billion pesos, except as otherwise specified.
Source: Authors' calculations.

driven down by this drop in labor demand. This reduces the overall cost of labor and pushes employment up in other sectors, including informal employment. As the public sector is more intensive in formal labor, the end result is a drop in real formal wages and a slight increase in informal wages. This result is partly due to the fact that nontradable sectors, which gain relative to the tradable sectors from the change in relative prices, are on average more intensive in informal labor.

On the supply side, these changes in relative wages induce some workers to move from the formal to the informal segments of the labor market and induce other workers to become inactive, in accordance with the labor supply model discussed above. The change in relative wages is not big enough to produce substantial changes in output. Thus, GDP decreases only slightly. On the demand side, the drop in government expenditures is compensated by an increase in real investment, which is caused by the drop in the relative prices of imports and, to a lesser extent, by the drop in household consumption.

Things are somewhat different when wages are assumed to be rigid in the formal sector (see table 6.2, second column). As before, formal workers are laid off by the government sector, but as formal wages do not fall, these workers do not find jobs in the other sectors and move to inactivity or to informal work at a lower productivity. This excess supply of formal labor in turn leads to a slight drop in informal wages—unlike in the preceding specification. Interestingly enough, this movement of labor comes with some changes in the average productivity of labor in the two sectors. Average productivity, of both skilled and unskilled workers, increases by 1.03 percent in the formal sector and decreases by 0.61 percent in the informal sector. Overall, GDP falls by 0.69 percent in the IMH model, while 0.7 percent of the labor force goes to inactivity. On the demand side, the price rigidity induced by wage rigidity reduces the substitution of public spending by investment or household consumption. In effect, households are more severely affected by the trade reform, and their real income falls by substantially more than with flexible wages. Because of the lack of response of domestic prices in sectors employing predominantly formal workers, the devaluation is more pronounced, amounting to 50 percent more than in the full-employment simulation.

Sectoral Effects

Changes in the structure of production shown in table 6.3 are easily interpreted in light of the preceding arguments. These changes result from the combination of four types of effects: (1) the contraction of public spending, (2) changes in labor costs as analyzed above, (3) changes caused by the drop in tariffs—lower input prices but

Table 6.3 Structural Effects of the Trade Reform, Output (Value Added) Change by Sector

Sector	Base (pesos, billion)	IMH-FL_w (percentage change)	IMH_FX_w[1] (percentage change)	MSS-FL_w (percentage change)	MSS_FX_w[1] (percentage change)
Palay[a] and corn	5,198	0.29	0.41	0.42	0.13
Fruit and vegetable	4,211	0.19	0.51	0.28	0.26
Coconut	1,790	0.38	0.63	0.47	0.21
Livestock	4,474	0.42	0.68	0.57	0.37
Fishing	3,997	0.27	0.81	0.37	0.28
Other agriculture	1,846	−0.26	0.92	−0.20	−0.08
Logging and timber	857	0.54	0.76	0.65	0.40
Mining	1,604	1.50	1.59	1.62	1.16
Manufacturing	13,112	0.83	0.72	0.96	0.30
Rice manufacturing	2,023	0.46	0.56	0.61	0.27
Meat industry	2,081	0.57	0.78	0.77	0.41
Food manufacturing	3,696	−0.03	0.39	0.03	0.06
Electricity, gas, and water	2,341	0.04	−0.52	0.04	−1.05
Construction	6,848	1.15	1.49	1.26	1.24
Commerce	15,150	0.64	0.68	0.77	0.28
Trans and commerce	5,206	0.44	0.46	0.55	0
Finance	3,580	−0.02	−0.81	−0.05	−1.33
Real estate	7,314	0.87	0.49	1.16	0.24
Services	6,960	0.91	0.31	0.98	−0.39
Public services	12,223	−6.06	−10.40	−7.32	−12.24

a. *Paley* is the term used in the Philippines to designate the rice grain in its husk that cannot be consumed directly.

Source: Authors' calculations.

also enhanced competition of imports, and (4) changes caused by the devaluation, which dampens the effect of the tariff cut and favors export sectors. The contraction of the public sector is more pronounced with rigid wages because the effect of lower revenues caused by the fall in tariffs is not compensated by a drop in labor cost. It can be seen that the difference is quite substantial—the drop is 60 percent more pronounced with rigid formal wages. Through backward links, the drop in public spending has a negative effect on various sectors. This effect is uncompensated by other effects in the finance and utility sectors when wages are rigid. Output thus falls in both sectors, but when wages are flexible, it is compensated by the drop in labor cost.

The flexibility of labor costs tends to compensate the reduction of protection in sectors exposed to foreign competition, except when those sectors are relatively more intensive in informal labor, the cost of which was seen to increase in the flexible wage specification. This is the case in the other agriculture and food manufacturing sectors, the output of which tends to decline. This fall is not observed in the case of rigid formal wages, because the cost of informal labor tends to fall, thus compensating the enhanced exposition of these sectors to foreign competition.

Favorable consequences of the trade reform and the accompanying devaluation of the domestic currency can be seen on export-oriented sectors like mining, logging, and some agricultural subsectors. The drop in tariffs is favorable in sectors with import-intensive inputs like construction. In all these cases, the direction and intensity of output changes are comparable across the flexible and rigid formal wage specifications, with the slight differences in output changes being mostly attributable to the differences in labor costs.

Overall, it is interesting to see that assumptions made about the flexibility or rigidity of formal wages do make a difference in both the aggregate and the structural effects of trade reform. The contraction of the public sector is more pronounced in the case of rigid wages, which entails a contraction of GDP and a contraction in sectors that depend on public demand. More than this rather mechanical effect occurs, however. Differences in the changes in labor costs and the asymmetry in the changes in the cost of informal labor are responsible for additional structural effects.

All of these effects would be magnified if the trade reform had been more ambitious, for example, with the total elimination of tariffs. In that case, however, the assumption that most of the adjustment would be borne by recurrent public expenditures would have been untenable. Part of this assumption should have been applied to investment, with the effects being difficult to analyze in an essentially static framework.

Poverty Effects

The main objective of the methodology experimented in this chapter is to derive the impact of policy reforms defined at the macro level on the distribution of income and, in particular, on poverty. Table 6.4 shows the impact of the trade reform analyzed in this section on poverty according to the three specifications that have been used. Poverty is summarized by the three usual Foster-Greer-Thorbecke (1984) indicators. FGT_0 stands for the poverty headcount, which is the proportion of people below the poverty line. FGT_1 is the depth of poverty, which measures the amount of money that should be transferred to the poor

Table 6.4 Effects on Poverty (FGT Poverty Indexes) for the Whole Population and by Education Groups

Poverty index	*Groups*	*Base*	*IMH-FL_w (percent)*	*IMH_FX_w*[1] *(percent)*	*MSS-FL_w (percent)*	*MSS_FX_w*[1] *(percent)*
FGT_0	All	0.311	−2.19	−1.46	−2.21	−1.79
FGT_1	All	0.096	−2.82	−1.67	−2.90	−2.25
FGT_2	All	0.040	−3.63	−1.75	−3.54	−2.68
	0	0.564	−1.33	−1.48	−1.47	−1.55
	1	0.501	−1.91	−1.38	−2.15	−1.58
	2	0.384	−2.02	−0.81	−1.79	−1.25
FGT_0	3	0.317	−2.78	−2.11	−1.84	−2.45
	4	0.184	−3.93	−3.08	−3.97	−3.28
	5	0.092	−2.78	−0.34	−3.38	−2.06
	6	0.021	−3.91	−1.96	−4.63	−3.42
	0	0.185	−2.47	−2.47	−2.13	−2.46
	1	0.168	−2.47	−1.75	−2.59	−2.15
	2	0.116	−2.97	−1.56	−3.09	−2.17
FGT_1	3	0.090	−3.23	−1.79	−3.26	−2.57
	4	0.048	−3.31	−1.68	−3.64	−2.29
	5	0.022	−3.48	1.56	−3.85	−2.51
	6	0.005	−3.78	0.03	−4.76	−3.42
	0	0.080	−3.36	−3.07	−2.87	−3.06
	1	0.075	−3.26	−2.12	−3.28	−2.68
	2	0.048	−3.86	−1.60	−3.74	−2.54
FGT_2	3	0.035	−3.94	−2.07	−3.87	−3.30
	4	0.018	−4.04	−0.62	−4.24	−2.11
	5	0.007	−4.52	6.37	−4.62	−2.19
	6	0.002	−4.04	3.35	−4.44	−3.73

Note: FGT = Foster-Greer-Thorbecke (1984) indicators; FGT_0 = poverty headcount; FGT_1 = depth of poverty; FGT_2 = severity of poverty. Education groups are defined in annex 6B.

Source: Authors' calculations.

to eliminate poverty under perfect targeting. It may be expressed as the product of the headcount and the poverty gap, or the relative distance at which poor people are from the poverty line. Severity of poverty, FGT_2, corresponds to the same concept but uses the square of the distance from the poverty line, and thus gives more weight to extreme poverty. Because micro-macro modeling allows for taking into account the whole distribution, it would be possible to use any other poverty indicator available in the literature. A more comprehensive representation of the change in the distribution caused by the trade reform is shown below. At this stage, the analysis concentrates only on these three poverty measures in the whole population or in groups defined by the education of household heads.

Before getting into the detail of table 6.4, it is worth insisting on the various forces behind changes in the three poverty indexes. There are two sources of changes. The first is purely distributional. It arises because the income of different households changes in different ways and proportions caused by the trade reform and its general equilibrium effects on household incomes. The second is found in the changes that take place in the structure of prices and that modify the real income of households, possibly in different ways depending on their consumption basket. Two possibilities can be used to take this into account. The first one corrects all changes in (nominal) household incomes by a price index that is based on their consumption, maintaining the poverty line (nominally) fixed. The second approach modifies the poverty line only, using a price index meant to fit the average consumption basket of the poor. This second approach is pursued in the calculations summarized in table 6.4, with the price index being based on the minimum basket of consumption goods used in the LES representation of household consumption behavior in the micro part of the micro-macro algorithm.[12]

This effect of the changes in the final price of goods on the poverty line—that is, the price effect—is undoubtedly negative. The trade liberalization directly reduces the price of imported goods and of those domestic goods that compete with them, and indirectly reduces the price of goods that use imported inputs. Other things equal, poverty would thus fall, this being true for all poverty indexes. But one has to consider the income effect, or in other words, the way the nominal income of households is modified through the general equilibrium effects. With flexible wages, it may be expected that the income effect will reduce poverty further. It is true that formal labor incomes are lower because of the trade reform, but the opposite is true of informal labor incomes. Moreover, it was seen that changes in the volume and the structure of employment were minimal. As informal labor incomes are likely to be of greater importance among the poor, it may thus be expected that the income effect also contributes to reducing poverty when wages are flexible.

This pattern is precisely what can be seen in the fourth column of table 6.4. For the whole population, poverty is falling because of the trade reform, and the higher the severity of the poverty index, the higher it falls. This shows that the price effect and the income effect are at work. It can be proven that, by itself, the price effect should reduce FGT_1 and FGT_2 more or less in the same proportion.[13] The fact that FGT_3 falls by proportionally more than FGT_2 means that the relative income of the poorest households is increasing. The same pattern may be observed for the various education groups, except for the most educated ones—for which changes in table 6.4 may not be relevant because of low initial poverty. But the income effect is likely not to be important in those groups for which most labor income is likely to come from the formal segment of the labor market.

The examination of the changes in poverty indexes by education group with the flexible wage specification seems to suggest that the higher the education level of household heads, the stronger the impact of the trade reform on poverty. This correlation must be taken with much care. If, indeed, most of the drop in poverty with flexible wages comes from the lowering of the poverty line, then there may be something purely mechanical may be evident in the fact that the change in poverty indexes increases with the education level. For instance, the elasticity of the poverty headcount (FGT_0) with respect to the poverty line, z, is given by the ratio $zf(z)/F(z)$, where $f(\ )$ is the density of the distribution of income and $F(\ )$ is the cumulative function. It is conceivable that this ratio changes in a systematic way with the level of poverty across education groups. Checking this would require a rather detailed estimate of the density of the distribution of income in the various groups.

More interesting is the fact that different patterns in poverty changes are obtained under the assumption of rigid wages in the formal sector and the rationing scheme that is supposed to apply to the labor market in that case. At the aggregate level, first, it can be seen that the drop in poverty is much less important than with flexible wages. Moreover, the difference tends to be bigger when moving from headcount to depth of poverty and then to severity of poverty. Not only are fewer people lifted out of poverty, but welfare improvements are also lower for the poorest.

As the initial effect of the drop in tariffs on the poverty line is comparable in the two specifications, the explanation of that difference must be found in different income effects. Indeed, the fact that informal labor incomes decrease with rigid formal wages and that some workers withdraw from the labor force has an impact on poverty that goes in the direction opposite of the decline in the poverty line and that is opposite to the income effect seen with flexible formal wages. The same phenomenon is behind the disappearance of the pattern that was present in the drop in poverty by education groups with flexible wages. Opposite income effects affect all groups—not only the low-education groups that are more affected by the drop in informal labor incomes, but also the higher-income groups in which some people are forced into informal work or into inactivity.

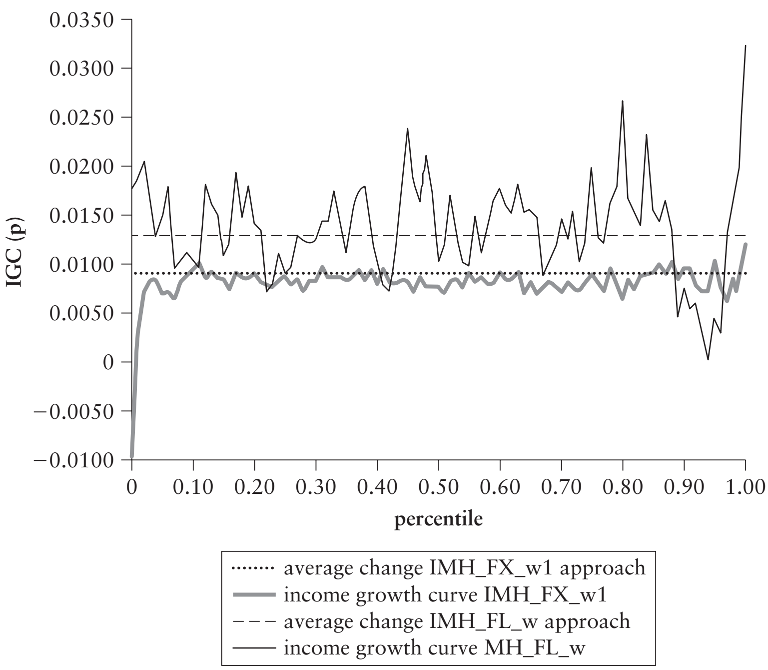
At this stage, the interest of modeling explicitly the effect of the trade reform on the distribution of income at the individual level appears quite clearly. The phenomena just described could not be considered properly using a traditional RH approach. The impact of such a reform on poverty depends on individual household circumstances: how much of the initial income comes from informal labor, how many people are forced out of their job in the formal sector, and so on. An aggregate analysis would, at best, be able to give information on the effect of lower prices on the poverty line, and possibly make a tiny change in the mean income of some household groups.

Changes in the Overall Distribution

Rather than focusing on poverty, the macro-micro framework used in this chapter allows for an analysis of the change in the whole distribution of income within the population. In what follows, this change is described by the growth incidence curve that shows the changes in real income by percentile of households before and after trade reform. Figure 6.2 illustrates the results of the specification with a flexible (IMH_FL_w^1) and a fixed real wage in the formal sector.

Figure 6.2 indeed shows substantial differences in the distributional impact of the reform with these two specifications. The top of the distribution, between percentiles 88 and 97, are the relative losers

Figure 6.2 Comparative Growth Incidence Curves for Total Population: IMH_FX_w^1 versus IMH_FL_w



Source: Authors' calculations.

(although net gainers) in the specification; flexible wage rates and the top two percentiles are relative winners. Conversely, the growth incidence curve is rather flat with the fixed wage rate specification except for the very bottom percentiles, which are both relative and absolute losers.

The explanation of that difference is both simple and interesting. With the flexible wage rates, it was seen in table 6.2 that the trade reform had a negative effect on the wage rates in the formal sector of the economy. Households that derive income almost exclusively from labor in the formal sector belong mostly to the 87 to 97 percentiles of the distribution, whereas other households with members in the formal sector derive income from other sources as well, such as land or capital. Likewise, households in the top three percentiles include business owners in the export and informal sectors.

These effects largely disappear with the fixed wage specification, because costs and profits are essentially rigid. In that case, what drives the negative part of the growth incidence curve in the first percentiles is the fact that, because of the rigidity in the labor market, some households lose their job and end up inactive. In effect, households in the bottom percentiles are being replaced by households that were initially at a higher rank in the distribution but that are affected by job losses. In other words, the relative drop in formal wages with the flexible wage specification is replaced by formal employment contraction, with some workers being absorbed by the informal sector—moving down in the income ranking but with limited impact on average income—and other workers losing jobs.

Comparison of Microsimulation Sequential and the Complete Algorithm

It is now time to examine the third and fourth specifications appearing in tables 6.2–6.4, which are simply the first TD iterations of the micro-macro model rather than its complete resolution. The issue is to determine whether this simpler microsimulation approach used by several authors is a satisfactory approximation of the overall effects of the simulated reform.

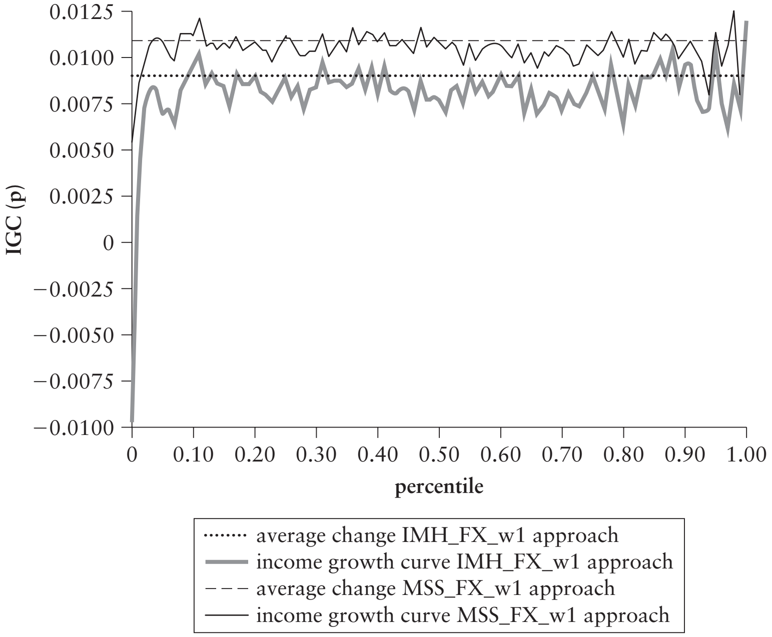
The answer to that question depends on the type of result and the specification that is being examined. With the flexible wage specification, gaps between the first iteration and the complete resolution are quite limited. The first iteration only exaggerates the contraction of public spending, because it misses the household consumption feedback in the complete algorithm, even though the macro model tries to mimic the aggregate consumption behavior of the whole population of households. The same is true with the rigid wage specification except for the fact that, because of this rigidity, the gap in public spending feeds into an equivalent gap in GDP and employment, exaggerating the negative effect of the reform.

The same remark applies to sectoral changes (table 6.3). Gaps are limited in the flexible wage specification, with the first iteration underestimating systematically final changes in the complete model. In the fixed wage specification, differences are bigger in size and in the direction of the effect. Discrepancies can be seen between the first iteration and the complete model that come essentially from the overestimation of the drop in real public spending in the former model. This bias generates negative biases in all sectors that provide inputs to the public sector (such as utilities, finance, and services).

Poverty figures show the same pattern. Aggregate results are comparable with the flexible wages specification, and they tend to overestimate the drop in poverty with the flexible wage specification. Poverty effects in the flexible wage case essentially are due to price changes that have been seen to be rather satisfactorily approximated by the first iteration. Results are more surprising in the rigid wage case. Because it tends to overestimate the drop in GDP and employment, one would have expected the initial negative impact on poverty to be smaller than at equilibrium. The explanation of that correction is to be related to sectoral biases for the pure TD rigid wage specification. This result is fully confirmed by the comparison of the growth incidence curves of the MSS and complete IMH rigid specifications (figure 6.3). The first iteration simply misses the increase in poverty because of job losses at the very bottom of the distribution. This does not mean that no job loss occurs in the first iteration, but rather that these losses do not take place in the same part of the distribution because they are not located in the same sectors.

It is thus at the micro level that the approximation of the sequential microsimulation approach appears to be the least satisfactory, whereas it would have seemed from the former IMH approach that it appeared at the aggregate level because of the imprecision of feedback effects. Results would have been quite different if the initial resolution of the CGE had been undertaken with a single household whose behavior had little to do with the aggregation of individual household behavior in the micro database. At the same time, this relative imprecision of the first-round micro effects points to the interest of resolving the whole model, or at least to iterate between the macro and the micro parts of the full micro-macro model.

Figure 6.3 Comparative Growth Incidence Curves for Total Population: IMH_FX_w^1 versus MSS_FX_w^1



Source: Authors' calculations.

Conclusion

This chapter tries to take into account the microeconomic consequences of a macro policy through the integration of a micro database of households within a conventional CGE framework. This was down in two ways: (1) through a conventional TD approach with an aggregate CGE model feeding a microsimulation module (the MSS model) without any kind of feedback at the macro level; and (2) through iterations between those two modules to obtain the solution of an IMH model.

In the simulation of trade liberalization policies undertaken in this chapter, differences between the two approaches were found to be important in the presence of rigidities in the labor market, which led to some rationing situations. In that case, the MSS approach tended to overestimate the negative impact of the reform on GDP and employment and, consequently, to underestimate its effect on reducing poverty. In comparison, differences between the two approaches appeared to be minor in the presence of flexible wages, as most micro effects were essentially channeled through price-induced changes in real income, rather than quantity adjustment at the micro level. It must be stressed, however, that this result was obtained because the CGE model included a rather satisfactory approximation of the aggregate consumption behavior of the population of households, which itself required several simulations at the micro level.

This experimentation with IMH models thus suggests that the standard TD microsimulation approach to the distributional impact of policies is satisfactory as long as no purely quantitative adjustment is assumed to take place at the micro level. This fits intuition. More work is needed to experiment and measure whether the difference in results is relatively robust to change in behavioral hypothesis, macro closure rules, or to different policy scenarios. Conversely, it is interesting to know that simple iterative techniques can be used to solve integrated models with more complete micro-based market adjustment mechanisms.

Annex 6A

Table 6A.1 Labor Supply Model Estimation Results

Regressor	*Coefficient*	*Standard error*	*t-statistic*	*Prob > |t|*
Probit				
Constant	1.61683	0.46963	3.44281	0.00029
Education	0.14937	0.00932	16.02265	0
Age	−0.10990	0.02984	−3.68280	0.00012
Age^2	0.00121	0.00030	3.99504	0.00003
Experience	0.02414	0.00976	2.47298	0.00671
Sex of head	−0.02718	0.05456	−0.49819	0.30918
Family size	0.06281	0.00779	8.06703	0
Two-stage Heckman selection model estimations—formal market				
Constant	4.15523	0.55819	7.44413	0
Education	0.22921	0.03320	6.90336	0
Age	0.06746	0.02143	3.14754	0.00084
Age^2	−0.00064	0.00025	−2.59636	0.00476
Experience	−0.01057	0.01798	−0.58781	0.27837
Sex of head	−0.26829	0.08243	−3.25484	0.00058
Family size	0.00591	0.04418	0.13380	0.44679
λ_1	−0.90843	0.25598	−3.54883	0.00020
Two-stage Heckman selection model estimations—informal market				
Constant	3.25639	0.48463	6.71934	0
Education	0.12500	0.03129	3.99533	0.00003
Age	0.05280	0.01901	2.77727	0.00275
Age^2	−0.00055	−0.00055	−2.52059	0.00588
Experience	−0.01826	0.01756	−1.03933	0.14935
Sex of head	0.11637	0.09675	1.20278	0.11456
Family size	0.04344	0.03247	1.33789	0.10650
λ_2	−1.65604	0.25121	−6.59213	0

Annex 6B

Table 6B.1 Education Code Definition

Education code	*Level of education*
1	Elementary undergraduate
2	Elementary graduate
3	One to three years of high school
4	High school graduate
5	College undergraduate
6	At least college graduate
0	Not reported or no grade

Annex 6C

Table 6C.1 Notations

Variable	*Description*
p_i	Market price in sector *i*
w_k	Wage rate by type of labor *k*
k_i	Capital of sector *i*
P_i	Profit of sector *i*
π_{hi}	Specific productivity endowment by household *h*
Y_i	Supply of sector *i*
y_h	Income of household *h*
C_{hi}	Consumption of good *j* by household *h*
L_i^d	Labor demand by sector *i*
$L_{h,k}$	Supply of labor *k* by household *h*
ε_h	Household *h* specific characteristics
α_{hi}	Household *h* endowment of capital of sector *i*

Notes

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1. It is known from the literature on aggregation that properties for aggregating labor supply are more demanding than those for aggregating consumption functions—see Deaton and Muellbauer (1980) and Muellbauer (1981). Note that introducing nonlinearity in labor supply through participation conditions is enough to make aggregation impossible.

2. The FP algorithm could be written in the space of goods and labor rather than in the space of prices.

3. This is the methodology proposed by Rutherford, Tarr, and Shepotylo (2005), but at every step of the algorithm rather than only at the first step.

4. The National Wage and Productivity Commission of the Department of Labour and Employment of the Philippines establishes a grid for minimum wages in formal sector activities. The wage grid is extremely complex because it is region specific, and each region has a multidimensional table specifying the size of the firms, sector of activity, location characteristics, among other factors. Complete tables can be found on the commission's Web page at http://www.nwpc.dole.gov.ph/.

5. Details of the procedure and a discussion of results can be found in Savard (2006, chapter 3). The simplification with respect to Magnac (1991) consisted of running a univariate probit on participation at the first step, with the identifying assumption that participation depended on the difference between an average of formal and informal earnings and the reservation wage. Then MCOs were run on the earnings within the two segments of the labor market with the standard Heckman correction for selectivity. Finally, arbitrary assumptions were made about the standard deviation of the cost of entry and the unobserved term in the reservation wage.

6. See note 5.

7. These conditions seem to make possible the perfect aggregation of individual demands. Yet full aggregation does not hold because of specific individual savings and tax rates. The authors could have chosen to use Frisch parameters and LES parameters differentiated across households could have been chosen. This choice was raising some calibration difficulties, however. Moreover, it seemed desirable for households to have the same nondiscretionary spending, so that poverty analysis could be based on that minimum basket of goods. The LES parameters in this application are drawn from Pollak and Wales (1969) after establishing some correspondence rule for the definition of goods.

8. In fact, the saving rate is based on disposable income minus the nondiscretionary income—that is, the cost of the minimum basket of consumption goods—assuming that the heterogeneous savings and tax rates are enough to rule out perfect aggregation of household consumption behavior.

9. The information on the type of work performed by the worker is detailed with decomposition into 200 types of work categories. Given the rich set of information, it was not too difficult to classify the workers as formal and informal workers.

10. The complete equation listing can be provided upon a request to the authors.

11. This approach is similar to what is proposed by Agénor, Izquierdo, and Fofack (2003) and Boccanfuso, Savard, and Cabral (2005).

12. For a discussion about the advantages and inconveniences of the two approaches, see Ravallion (1998).

13. It may be easily proven that $\varepsilon = \dfrac{z(\partial FGT_{\alpha}/\partial z)}{FGT_{\alpha}} = \alpha.\left[\dfrac{FGT_{\alpha-1}}{FGT_{\alpha}} - 1\right]$, where z is the poverty line and $\alpha > 0$. The initial poverty indexes suggest that ε is approximately the same for $\alpha = 1$ and $\alpha = 2$.

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