4

Examining the Social Impact of the Indonesian Financial Crisis Using a Macro-Micro Model

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Determining the social cost of a macroeconomic crisis like the one that struck Indonesia in 1997 is not an easy task. One year after the crisis, the World Bank (1998) argued that if real gross domestic product (GDP) declined by 12 percent in 1998, then the incidence of poverty in Indonesia could affect up to 14.1 percent of the population in 1999—compared with a level of 10.1 percent in mid-1997. Other estimates released at about the same time were more pessimistic. Indonesia's Central Board of Statistics (CBS 1998) predicted a fourfold increase of the poverty headcount (rising from 11.3 percent in 1996 to 39.9 percent by mid-1999), whereas the International Labour Organization (ILO 1998) predicted a sixfold increase (of up to 66.3 percent) by the end of 1999.[1] Ex post estimates were much lower than these dramatic predictions. In a study based on data collected in Indonesia's National Labor Force Surveys (*Survei Angkatan Kerja Nasional,* or SAKERNAS) from August 1997 through 1998, Manning (2000) found that the "traditional" features of the Indonesian labor markets helped cushion the economic shock of the crisis. Finally, more recent estimates published by the World Bank (Suryahadi and others 2000), based on a comparison of the poverty level between two National Social Economics Surveys (*Survei Sosial Ekonomi Nasional,* or SUSENAS), show that the poverty headcount rose from 9.7 percent to 16.3 percent between 1996 and 1999.

These various estimates illustrate the basic methodological ambiguity in predicting either what will happen to the poor just after an economic crisis strikes or in deciphering what did happen ex post (after the fact, based on actual data). In both cases, an explicit counterfactual scenario is needed. In the first case, the scenario must show departures from the precrisis evolution of the economy. In the second case, it must permit assessing what would have happened without the crisis and help disentangle the effects of the crisis from other exogenous shocks that are present in the data—such as the climatic effects of the El Niño drought in the case of Indonesia. This counterfactual scenario may be simple. For instance, it is natural to assume that decreases in household income or consumption depend on the economic activity of the social groups being considered. A scenario would thus consist of a set of predictions about the rate of growth of either the various sectors of the economy or the aggregate income of the various factors of production. The early rough estimates of the effect of the Indonesian crisis on poverty were based on this type of approach. But the divergence between those estimates suggests that establishing even a simple counterfactual scenario of this type is not easy—and requires more than a rough model of the economy.

The use of more rigorous multisector models would probably yield more consensual predictions for the economy as a whole and for its various sectors and factors of production. It is not clear, however, that this would also result in satisfactory predictions for the distribution of income and poverty. Associating household incomes with sector activity or factor remuneration rates is, in effect, equivalent to defining representative household groups (RHGs) that derive income from a predetermined combination of factors. Models that incorporate several sectors and several RHGs with some exogenous distribution *within* those groups have been used for some time now—see, for example, Derviş, de Melo, and Robinson (1982) and the survey by Adelman and Robinson (1989). Whether these models are used to analyze either structural reforms like trade regimes or short-run macroeconomic issues—as in Bourguignon, Branson, and de Melo (1992)—this approach is problematic, as well. In particular, by ignoring changes in the distribution of income *within* RHGs, these models may ignore major sources of change in the distribution of economic welfare and poverty. In most studies of changes in inequality over time,[2] it is indeed shown that changes in the relative income and weight of a few groups of households with identical selected characteristics leave a sizable unexplained residual. Focusing on the inequality *between* representative groups (as multisector, multihousehold models presently do) may thus lead to a biased view of the impact of macro or structural policies on the distribution of income.

A simple example may explain the nature of the problem. A majority of households in Indonesia generate income from various sources: (1) salaried employment of some members in the formal sector, (2) wage work in the informal sector of others, and (3) self-employment of yet another group. If RHGs are defined, as is typically done, by the sector of activity and employment status of the household heads (small farmers, urban unskilled workers in the formal sector, and so forth), it may not be too much of a problem to account for this multiplicity of income sources. Thus, the change in the inequality *between* the groups of small farmers and urban unskilled workers in the formal sector may account for the fact that both groups have different secondary sources of income—because of differences in household composition, labor supply behavior, and the occupation of secondary members. Two difficulties arise, however. First, say that a macroeconomic crisis or a trade reform modifies the number of unskilled urban workers employed in the formal sector. What should be done with the number of households with households heads in that occupation? Should it be modified? If so, from which groups must new households in that RHG be taken, or to which groups should they be allocated? First, could this operation be completed based on the assumption that the distribution of income within all RHGs remains the same? Second, assuming that changes in occupation affect only secondary members and not household heads (so that RHGs are unchanged), is it reasonable to assume that all households in a group are affected in the same way by this change in the activity of some of their group members? A secondary member may move out of the formal sector and back into family self-employment, but this may happen only in a subgroup of households within a given representative group, which may seriously affect the distribution within this group. It is phenomena of this kind that may help explain changes in the "within" component of inequality decomposition exercises. But these changes are ignored in multisector, multihousehold group models.

This chapter presents a new approach that can be used to quantify the effects of macroeconomic shocks on poverty and inequality by overcoming difficulties such as these.[3] This new approach combines a micro simulation model with a standard multisector computable general equilibrium (CGE) model. The two models are used in a sequential fashion to simulate the full distributional impact of a financial crisis and generate meaningful counterfactual scenarios.[4] The CGE model is based on a standard social accounting matrix (SAM) and is intended to capture both the structural features of an economy and the general equilibrium effects of the macroeconomic constraints that arise from macro shocks. The micro simulation model is based on a subsample of the 1996 SUSENAS survey and simulates income generation mechanisms for approximately 10,000 Indonesian households. The two models are treated separately. The macro (or CGE) model communicates with the micro model by generating a vector of prices, wages, and aggregate employment variables that correspond to a given shock or policy. The micro model is then used to generate changes in individual wages, self-employment incomes, and employment status in a way that is consistent with the set of macro variables fed by the macro model. When this is done, the full distribution of real household income corresponding to the simulated shock or policy may be evaluated. This framework is designed to capture important channels through which a financial crisis of the type that struck Indonesia in 1997 may affect household incomes. Its main focus is the structure and functioning of labor markets, but this approach also captures part of the expenditure-side story by taking into account any increases in the relative price of food.

The following section shows the structure of the micro simulation module and explains how it is linked to the CGE part of the model. The general features of the CGE model are then discussed, followed by scenarios, simulation results, and conclusions.

The Micro Simulation Model

This section briefly describes the specification of the household income generation model used for micro simulation and then focuses on how consistency is achieved between micro simulation and the predictions of the CGE model. A more detailed discussion of the specification and econometric estimates of the various equations of the household income generation model and simulation methodology can be found in Alatas and Bourguignon (2005).[5]

In the notations used in the remainder of chapter 4, the household income generation model for household m with working-age members k_m consists of the following set of equations:

$$\text{Log } w_{mi} = \alpha_{g(mi)} + x_{mi}\beta_{g(mi)} + \nu_{mi} \qquad i = 1, \ldots k_m \tag{4.1}$$

$$\text{Log } y_m = \gamma_{f(m)} + Z_m \delta_{f(m)} + \lambda_{f(m)} N_m + \eta_m \tag{4.2}$$

$$(4.3) \qquad Y_m = \frac{1}{P_m}\left(\sum_{i=1}^{k_m} w_{mi} IW_{mi} + y_m \operatorname{Ind}(N_m > 0) + y_{0m}\right)$$

$$(4.4) \qquad P_m = \sum_{k=1}^{K} s_{mk} p_k$$

$$(4.5) \qquad IW_{mi} = \operatorname{Ind}\big[a^w_{h(mi)} + z_{mi} b^w_{h(mi)} + u^w_{mi} > \operatorname{Sup}\big(0, a^s_{h(mi)} + z_{mi} b^s_{h\,(mi)} + u^s_{mi}\big)\big]$$

$$(4.6) \qquad N_m = \sum_{i=1}^{k_m} \operatorname{Ind}\big[a^s_{h(mi)} + z_{mi} b^s_{h(mi)} + u^s_{mi} > \operatorname{Sup}\big(0, a^w_{h(mi)} + z_{mi} b^w_{h(mi)} + u^w_{mi}\big)\big].$$

Equation (4.1) expresses the (log) earnings of member i of household m as a function of that member's personal characteristics, x. The latter include age, education level, and geographic region. The residual term, v_{mi}, describes the effects of unobserved earning determinants. This earning function is defined separately on various "segments" of the labor market defined by gender, skill level (less than secondary or more than primary education), and area (urban/rural). Thus, $g(mi)$ is an index function that indicates the labor market segment to which member i in household m belongs.

Equation (4.2) is the (net) income function associated with self-employment, or small entrepreneurial activity, which includes the opportunity cost of household labor and profit. This function is defined at the household level and depends both on the number of household members actually involved in that activity, N_m, and on some household characteristics, Z_m. These characteristics include area of residence, the age and schooling of the household head, and land size for farmers. The residual term, η_m, summarizes the effects of unobserved determinants of self-employment income. A different function is used depending on whether the household is involved in farm or nonfarm activity. This is exogenous and is defined by whether or not the household has access to land, as represented by the index function $f(m)$.

Equation (4.3) is an accounting identity that defines total household real income, Y_m, as the sum of wage income of its members, profit from self-employment, and (exogenous) nonlabor income, y_{0m}. In this equation, the notation IW_{mi} stands for a dummy variable that is equal to unity if member i is a wage worker and zero otherwise. Thus wages are summed over only those household members actually engaged in wage work. Likewise, income from self-employment has to be taken into account only if at least one member of the household is engaged in self-employment activity ($N_m > 0$). Total income is then deflated by a household-specific consumer price index (CPI), P_m, which is derived from the observed budget shares, s_{mk}, of household m and the price, p_k, of the various consumption goods, k, in the model—equation (4.4).

Equations (4.5) and (4.6) represent the occupational choices made by household members. This choice is discrete. Each individual must choose from three alternatives: being inactive, a wage worker, or self-employed. This choice is represented within a discrete utility-maximizing framework. The utility associated with the first alternative (inactivity) is arbitrarily set to zero, whereas the utility of being a wage worker or self-employed is a linear function of a set of individual and household characteristics, z_{mi}. The intercept of these functions has a component, a^w or a^s, that is common to all individuals, and an idiosyncratic term, u_{mi}, which represents unobserved determinants of occupational choices. The coefficients of individual characteristics, z_{mi}, b^w, or b^s, are common to all individuals. However, they may differ across demographic groups indexed by *h(mi)*. For instance, occupational choice behavior, as described by coefficients a^w, a^s, b^w, and b^s, may be different for household heads, spouses, and male or female children. The constants may also be demography-specific.

Given this specification, an individual will prefer wage work if the utility associated with that activity is higher than that associated with the two other activities. This is the meaning of equation (4.5). Likewise, the number of self-employed workers in a household is the number of individuals for whom the utility of self-employment is higher than that of the two alternatives, as represented in equation (4.6).[6]

The model is now complete. Overall, it defines the total real income of a household as a nonlinear function of the observed characteristics of household members (x_{mi} and z_{mi}), some characteristics of the household (Z_m), its budget shares (s_m), and unobserved characteristics (ν_{mi}, η_m, u^w_{mi}, and u^s_{mi}). This function depends on five sets of parameters: (1) for the earning functions (α^g and β^g), for each labor market segment, *g;* (2) for the self-employment income functions (γ^f, δ^f, and λ^f); (3) for the farm or nonfarm sector, *f;* (4) for the utility of the alternative occupational choices (a^w_h, b^w_h, a^s_h, and b^s_h), for the various demographic groups, *h;* and (5) for the vector of prices, p. As is shown later, it is through several of these parameters that the results of the CGE part of the model may be transmitted to the micro module.

The micro simulation model gives a rather complete description of household income generation mechanisms by focusing on both earning and occupational choice determinants. However, a number of assumptions about the functioning of the labor market are incorporated in this specification. The fact that labor supply is considered to be a discrete choice between either inactivity or full-time work for wages (or for self-employment income) within the household calls for two sets of remarks. First, the assumption that individuals are inactive or work full time is essentially justified by the fact that no information on the number of hours worked is available in the micro data source used to estimate the benchmark set of the model's coefficients. As a practical matter, this implies that estimated individual earning functions—equation (4.1)—and profit functions—equation (4.2)—may incorporate some labor supply dimension. Second, distinguishing between wage work and self-employment is implicitly equivalent to assuming that the Indonesian labor market is imperfectly competitive. If this were not the case, then returns to labor would be the same in both types of occupation; and self-employment income would be different from wage income only because it would incorporate the returns to nonlabor assets being used. The specification that has been selected is justified, in part, by the fact that assets used in self-employment are not observed, so one cannot distinguish between self-employment income derived from labor and that derived from other assets. But it is also justified by the fact that the labor market may be segmented (in the sense that labor returns are not equalized across wage work and self-employment). There may be various reasons for this. On the one hand, there may be rationing in the wage labor market. People unable to find jobs as wage workers move into self-employment, which is a kind of shelter. On the other hand, there may be externalities that make working within and outside the household imperfect substitutes. These two interpretations are consistent with the way in which the labor market is represented in the CGE part of the model.[7]

It is now time to consider how the link is made between the CGE part and the micro part of the model—and how the effects of macroeconomic shocks and policies are simulated on each household represented in the database. The principle behind these simulations is quite simple. It associates macroeconomic shocks and policies simulated in the CGE part of the model with changes in the set of coefficients of the household income generation model—equations (4.1)–(4.6). With a new set of coefficients (α^g, β^g, γ^f, δ^f, λ^f, a_h^w, b_h^w, a_h^s, b_h^s) and the observed and unobserved individual and household characteristics (x_{mi}, z_{mi}, Z_m, s_m, ν_{mi}, η_m, u_{mi}^w, u_{mi}^s), these equations allow one to compute the occupational status of all household members, their earnings, their self-employment income, and finally, the total real income of their household. But this association must be done in a consistent way. Consistency with the equilibrium of aggregate markets in the CGE model requires that (1) changes in average earnings (with respect to the benchmark in the micro simulation) must be equal to changes in wage rates in the CGE model for each segment of the market for wage labor; (2) changes in self-employment income in the micro simulation must be equal to changes in informal sector income per worker in the CGE model; (3) changes in the number of wage workers and those self-employed by labor market segment in the micro simulation model must match those same changes in the CGE model; and (4) changes in the consumption price vector, p, must be consistent with the CGE model.

The link between the CGE part of the model and the micro part is obtained through the resolution of the following system of equations:

$$\sum_m \sum_{i,g(mi)=G} \text{Ind}\left[a^{w*}_{h(mi)} + z_{mi}\hat{b}^{w}_{h(mi)} + \hat{u}^{w}_{mi} > \text{Sup}\left(0, a^{s*}_{h(mi)} + z_{mi}\hat{b}^{s}_{h(mi)} + \hat{u}^{s}_{mi}\right)\right] = E^{*}_{G}$$

$$\sum_m \sum_{i,g(mi)=G} \text{Ind}\left[a^{s*}_{h(mi)} + z_{mi}\hat{b}^{s}_{h(mi)} + \hat{u}^{s}_{mi} > \text{Sup}(0, a^{w*}_{h(mi)} + z_{mi}\hat{b}^{w}_{h(mi)} + \hat{u}^{w}_{mi})\right] = S^{*}_{G}$$

$$\sum_m \sum_{i,g(mi)=G} \text{Exp}\left(\alpha^{*}_{G} + x_{mi}\hat{\beta}_{G} + \hat{v}_{mi}\right) \text{Ind}\left[a^{w*}_{h(mi)} + z_{mi}\hat{b}^{w}_{h(mi)} + \hat{u}^{w}_{mi} > \text{Sup}\left(0, a^{s*}_{h(mi)} + z_{mi}\hat{b}^{s}_{h(mi)} + \hat{u}^{s}_{mi}\right)\right] = w^{*}_{G}$$

$$\sum_m \sum_{i,f(m)=F} \text{Exp}\left(\gamma^{*}_{F} + Z_m\hat{\delta}_{F} + \hat{\lambda}_{F}\hat{N}_m + \hat{\eta}_m\right) \text{Ind}\left[N_m > 0\right] = I^{*}_{F},$$

$$\text{with} \quad \hat{N}_m = \sum_i \text{Ind}\left[a^{s*}_{h(mi)} + z_{mi}\hat{b}^{s}_{h(mi)} + \hat{u}^{s}_{mi} > \text{Sup}\left(0, a^{w*}_{h(mi)} + z_{mi}\hat{b}^{w}_{h(mi)} + \hat{u}^{w}_{mi}\right)\right],$$

where the unknowns are α^{g^*}, γ^{f^*}, a^{w*}_{h}, and a^{s*}_{h}. This system of equations has as many equations as unknowns and has a unique solution that can be obtained through standard Gauss-Newton techniques.[8] Once the solution is obtained, it is a simple matter to compute the new income of each household in the sample, according to the model in equations (4.1)–(4.6), with the new set of coefficients α^{g^*}, γ^{f^*}, a^{w*}_{h}, and a^{s*}_{h}, and then to analyze the modification that this implies for the overall distribution of income.

The justification for using the intercepts is that it implies a "neutrality" of the changes being made with respect to individual or household characteristics. For example, changing the intercepts of the log earning equations generates a proportional change of all earnings in a labor market segment, regardless of individual characteristics outside those that define the segments (skill, gender, and geographic area). The same is true of the change in the intercept of the log self-employment income functions. A similar argument applies to the criteria associated with the various occupational choices. Indeed, it is easily shown that changing the intercepts of the multilogit model implies the following neutrality property: the relative change in the ex ante probability that an individual has some occupation depends only on the initial ex ante probabilities of the various occupational choices, rather than on individual characteristics.

In the Indonesian case, the number of variables that allow the micro and the macro parts of the overall model to communicate, that is, the vector (E_G^*, S_G^*, w_G^*, I_F^*, q^*), is equal to 26 plus the number of consumption goods used in defining the household-specific CPI deflator. The labor market has eight segments. The employment requirements for each segment in the formal (wage work) and informal (self-employment) sectors (E_G^* and S_G^*) lead to 16 restrictions. In addition, there are eight wage rates in the formal sector (w_G^*) and two levels of self-employment income (I_F^*) in the formal and the informal sectors. Thus, simulated changes in the distribution of income implied by the CGE part of the model are obtained through a procedure that allows numerous degrees of freedom.

Two elements must be added to describe the full scope of the model. First, the household-specific price index, P_m, is based on the disaggregation of expenditure into only two goods, food and nonfood. This disaggregation is the most relevant one for the analysis of the consequences of the Indonesian financial crisis. Second, other incomes, y_{0m}, are considered as exogenous (in real terms) in all simulations. They include housing and land rents, dividends, royalties, imputed rents from self-occupied housing, and transfers from other households and institutions. It would have been possible to endogenize some of these items in the CGE model, but this was not done.

The CGE Model

The CGE model presented in this chapter is based on a 1995 SAM. The SAM has been disaggregated using cross-entropy estimation methods (Robinson, Cattaneo, and El-Said 2001) to include

38 sectors, 14 goods, 14 factors of production (8 labor categories and 6 types of capital), and 10 household types, as well as the usual accounts for aggregate agents (firms, government, rest of the world, savings-investment). The CGE model starts from the standard neoclassical specification in Derviş, de Melo, and Robinson (1982) but also incorporates the disaggregation of production sectors into formal and informal activities and associated labor market imperfections.

Markets for goods, factors, and foreign exchange are assumed to respond to changing demand and supply conditions, which are, in turn, affected by government policies, the external environment, and other exogenous influences. The model is Walrasian in that it determines only relative prices and other endogenous real variables in the economy. Financial mechanisms are modeled implicitly, and only their real effect is accounted for in a simplified way. Sectoral product prices, factor prices, and the real exchange rate are defined relative to the producer price index of goods for domestic use, which serves as the *numeraire*. The exchange rate represents the relative price of tradable goods with regard to nontraded goods (in units of domestic currency per unit of foreign currency).

Activities and Commodities

Indonesia's economy is dualistic, and the model captures this by distinguishing between formal and informal "activities" in each sector. Both subsectors differ in the type of factors they use—a distinction that allows for treating formal and informal factor markets differently. Informal and formal sectors are further differentiated by the fact that formal sectors are assumed to rely on foreign credit to operate, whereas informal sectors do not.

For all activities, the production technology is represented by a set of nested constant elasticity of substitution (CES) value added functions and fixed (Leontief) intermediate input coefficients. On the demand side, imperfect substitutability is assumed between formal and informal products. Thus, consumers demand an aggregate of the formal and informal products. Domestic prices of commodities are flexible, varying to clear markets in a competitive setting where individual suppliers and demanders are price-takers.

Following Armington (1969), the model assumes imperfect substitutability, for each good, between the domestic commodity (which itself results from a combination of formal and informal activities) and imports. What is demanded is a composite good, which is a CES aggregation of imports and domestically produced goods. For export commodities, the allocation of domestic output between exports and domestic sales is determined on the assumption that domestic producers maximize profits subject to imperfect transformability between these two alternatives. The composite production good is a constant elasticity of transformation (CET) aggregation of sectoral exports and domestically consumed products.

These assumptions of imperfect substitutability and transformability grant the domestic price system some degree of autonomy from international prices and serve to dampen export and import responses to changes in the producer environment. Such treatment of exports and imports provides a continuum of tradability and allows two-way trade at the sector level—which reflects what is observed empirically at the level of aggregation of the model.

Factors of Production

Eight labor categories are included in the Indonesia CGE model: urban male unskilled, urban male skilled, urban female unskilled, urban female skilled, rural male unskilled, rural male skilled, rural female unskilled, and rural female skilled. The designations male and female, as well as skilled and unskilled labor, are assumed to be imperfect substitutes in the production activity of urban or rural sectors.

In addition, labor markets are assumed to be segmented between formal and informal sectors. In the formal sector labor markets, imperfect competition mechanisms are assumed to result in some increasing wage-employment curve; and real wages are defined by the intersection of that curve and competitive labor demand. Informal sector labor is equivalent to self-employment, and wages in that sector are set to absorb any labor not employed in the formal sectors. Wages adjust to clear all labor markets in the informal sectors, whereas employment adjusts in the formal sectors.

Land appears as a factor of production in the agricultural sectors. Only one type of land is considered in the model. It is competitively allocated among the different crop sectors so that marginal value added is equalized across activities.

Capital markets are segmented into six categories: owner-occupied housing, other unincorporated rural capital, other unincorporated urban capital, domestic private incorporated capital, public capital, and foreign capital. Given the short-term perspective of the model, it is assumed that capital is fixed in each activity.

The model also incorporates working capital requirements by all sectors. Sectors demand domestic working capital in proportion to their demands for domestically produced intermediate inputs. They also demand working capital denominated in foreign exchange in proportion to their demands for imported intermediate inputs. Informal sectors are assumed not to require any imported intermediate inputs.

Working capital is treated as a factor input that is strictly complementary to physical capital. The model incorporates a nested production function in all sectors, with aggregate "capital" consisting of an aggregation of physical capital, domestic working capital, and foreign working capital (foreign exchange). Both types (domestic and foreign) of working capital are assumed to be required in fixed proportions to physical capital. When the supplies of aggregate domestic and foreign working capital are reduced (as an effect of the financial crisis), they are assumed to be competitively allocated across sectors, so that their marginal revenue product is the same. Because physical capital is fixed, this causes capacity underutilization in some sectors.

The effect of this treatment is to make aggregate output sensitive to any reduction in the supply of working capital. With cuts in working capital, the utilization of physical capital will also decline.[9] The sector impact depends on a sector's dependence on intermediate inputs, both domestic and imported.

Households

The disaggregation of households in the CGE model is not central to this discussion, because changes in factor prices are passed on directly to the micro simulation model without use of the RHGs used in the original SAM. Consumption demand by households at the CGE level is determined by the linear expenditure system (LES), in which the marginal budget share is fixed and each commodity has a minimum consumption (subsistence) level.

Macro Closure Rules

Equilibrium in a CGE model is defined by a set of constraints that need to be satisfied by the economic system but are not directly considered in the decisions of micro agents (Robinson 1989). Aside from the supply-demand balances in product and factor markets, three macroeconomic balances are specified in the Indonesia CGE model: (1) the fiscal balance, with government savings equal to the difference between government revenue and spending; (2) the external trade balance (in goods and nonfactor services), which implicitly equates the supply and demand for foreign exchange (flows, not stocks, because the model has no assets or asset markets); and (3) savings-investment balance. Practically, a balanced macro closure is used, in which aggregate investment and government spending are assumed to be in a fixed proportion to total absorption. Any shock affecting total absorption is thus assumed to be shared proportionately among government spending, aggregate investment, and aggregate private consumption. While simple, this closure effectively assumes a successful structural adjustment program in which a macro shock is assumed not to cause particular actors (government, consumers, and industry) to bear a disproportionate share of the adjustment burden.

Scenarios and Simulations

As mentioned earlier, both parts of the model are handled separately, with the macro level communicating with the micro part through a vector of "linking variables" (for prices, wages, and aggregate employment). The overall structure is top-down in that there is no feedback from the micro model back to the macro CGE model. This top-down sequential structure allows running various kinds of experiments. In the first set of experiments (labeled "historical simulation"), historical changes in the linking variables are derived from price statistics and labor market surveys taken during and after the crisis and fed directly into the micro model, without any use of the macro CGE model. Thus, this historical simulation is essentially meant to test the capacity of the micro model to generate income distribution predictions on the basis of a few observed macro indicators. In the second set of simulations (labeled "policy simulations"), the value of linking variables is taken from the results of the CGE model. These simulations are used to decompose the historical shock into various elementary components.

Time Horizon

The question of time horizon requires comment. The financial crisis that struck Indonesia during the summer of 1997, and the resulting turmoil, spanned approximately 20 months—extending until March 1999, when the first signs of output recovery were recorded.[10] Given the equilibrium nature of the macro framework and of the linking variables between the macro and micro models discussed in this chapter, the crisis is not tracked month by month. Instead, the impact of the shock is analyzed using comparative statics. The deviations from base values used as historical references are thus computed for a period extending from July–August 1997 to September–October 1998. The latest date corresponds to the peak of the crisis with respect to both macroeconomic indicators (Azis, Azis, and Thorbecke 2001) and poverty indicators (Suryahadi and others 2000).

The analysis of this short-term shock in a CGE framework is made possible by imposing a number of rigidities in the specification of factor markets, as shown earlier. The base year for the macro model is the 1995 SAM, with both the consumption structure and the factor disaggregation based on the 1996 SUSENAS. The sample used for the micro simulation is a subsample of the 1996 SUSENAS. Some inconsistency could arise between the macro and the micro parts of the model because they do not refer to the same year. In fact, due to the sequential nature of the framework used in this chapter, full consistency is not required between the macro and the micro sides of the model. Indeed, all of the analysis using this model may be performed in terms of deviations from benchmarks that may not fit perfectly together.[11]

Historical Changes in Poverty

As mentioned earlier, diverse estimates have been published on the before-and-after impact of the Indonesian financial crisis on poverty and income distribution. The results reported by Suryahadi and others (2000) are used as a reference to analyze the historical change in poverty and income distribution. These authors used various household surveys to compute changes in real income over the period from 1996 to 1999. Although poverty rates derived from SUSENAS data would be consistent with the household sample used in the model presented in this chapter, changes derived from the Indonesian Family Life Survey (IFLS), adjusted to achieve consistency with other estimates (Suryahadi and others 2000), were used as a general benchmark. This choice is justified, on the one hand, by the fact that the SUSENAS (conducted every three years) does not allow isolation of the crisis period and, on the other hand, by the fact that the second wave of the IFLS was specifically designed to help determine how the crisis affected welfare (Frankenberg, Thomas, and Beegle 1999). Based on IFLS estimates adjusted by Suryahadi and others (2000), poverty incidence is shown to have increased by 164 percent between September 1997 and October 1998.[12]

Because the IFLS results reported by Suryahadi and others (2000) do not distinguish between the urban and the rural sectors, the present authors report estimates based on both the 1996 and 1999 SUSENASs—to compare how urban and rural households

Table 4.1 Evolution of Poverty in Indonesia, 1996–99

Households/indicator	*1996*	*1999*	*Percentage change*
All			
Headcount index (P0)	9.75	16.27	66.8
Poverty gap index (P1)	1.55	2.79	80.2
Poverty severity index (P2)	0.39	0.75	91.9
Urban			
Headcount index (P0)	3.82	9.63	152.3
Poverty gap index (P1)	0.53	1.51	183.0
Poverty severity index (P2)	0.12	0.37	201.6
Rural			
Headcount index (P0)	13.10	20.56	56.9
Poverty gap index (P1)	2.12	3.61	70.5
Poverty severity index (P2)	0.54	0.99	83.6

Sources: SUSENAS 1996 and 1999, cited by Suryahadi and others (2000).

fared over the period (table 4.1). The overall increase in poverty appears to be much smaller than the one that Suryahadi and others (2000) obtained using IFLS data. This result is consistent with the difference in the time coverage of both sources, because poverty decreased with the recovery after October 1998. The data in table 4.1 show that poverty increased more in the urban sector than in the rural sector. Nevertheless, poverty remains higher in the rural sector because of the initial disadvantage of that sector. The strong increases in the poverty gap indicator (P1) and the poverty severity index (P2) also show that from 1996 to 1999, the situation deteriorated more for the poorest of the poor.

Historical Experiment

The first experiment, called "historical," uses historical vectors of the linking variables (prices, wages, and aggregate employment changes) to feed into the micro model. Changes in the last two sets of variables, shown in table 4.2, are derived from the comparison of two SAKERNASs (for 1997 and 1998). Consumer price changes (not reported) are taken from reports by Badan Pusat Statistik (BPS). SAKERNASs do not indicate changes in self-employment incomes. The authors assume that these are equal to changes in wages; but because of the effect of increases in relative output prices, this assumption is probably unsatisfactory in the case of rural self-employment incomes. A comparison of the 1997 and 1998 employment surveys shows a dramatic drop in real wages

Table 4.2 Evolution of Occupational Choices and Wages by Segment, 1997–98

Segment	*Inactive*	*Wage worker*	*Self-employed*	*Nominal wage*	*Real Wage*
Urban male unskilled	−0.9	−6.5	5.7	8.2	−40.8
Urban male skilled	11.9	−12.7	9.9	5.3	−42.3
Urban female unskilled	−2.6	5.1	5.9	21.8	−33.4
Urban female skilled	5.9	−15.5	2.3	10.3	−39.6
Rural male unskilled	−1.8	−13.6	5.1	27.9	−30.0
Rural male skilled	2.5	−13.3	9.3	16.8	−36.1
Rural female unskilled	−5.5	0.0	7.5	47.3	−19.4
Rural female skilled	2.7	−14.3	3.4	12.2	−38.6
All segments	−0.3	−10.2	5.8	11.7	−38.9

Sources: SAKERNAS 1997 and 1998; authors' calculations.

Note: Numbers in the first three columns are percentage changes in proportions. Real wage is equal to nominal wage deflated by consumer price index base year 1996 = 100.

and an important shift out of wage work and into self-employment over the period. It also suggests that overall inactivity did not increase significantly. The picture differs slightly, however, across labor types. The movement out of wage work and into self-employment activities is observed for all but two categories, urban and rural unskilled females. Concerning the employment rate, although stable overall, it decreases for all skilled categories but increases for all unskilled categories.[13]

Table 4.3 shows the results on poverty and inequality derived from the micro model (under the preceding assumptions). They show a 238.6 percent increase in poverty, higher than the historical change of 164 percent reported by Suryahadi and others (2000) based on the comparison of the 1997 and 1998 IFLS. This overestimation can be explained by the simulation, which ignores the fact that self-employment incomes decreased less than real wages. The poverty increase appears to be fueled by the dramatic income shock—a 40.4 percent drop in mean per capita income. Results also show an increase in inequality driven by the increase of *within-sector* inequality: although rural and urban mean per capita incomes converge (that is, the fall in per capita income in the urban sector is bigger than in the rural sector, −44.8 percent and −26.5 percent, respectively), the decrease in *between-sector* inequality does not compensate for the increases within the urban and rural sectors. In terms of the rural-urban divide, the results appear consistent with the historical record shown in table 4.1, although those data refer to a distinct time period.

Table 4.3 Historical Simulation Results

	All households		*Urban households*		*Rural households*	
Income and relative price changes	*Base*	*Percentage change*	*Base*	*Percentage change*	*Base*	*Percentage change*
Per capita income[a] (Rp, thousands[b])	121.1	−40.4	171.0	−44.3	90.6	−35.9
Entropy index 0 (×100)	35.5	2.7	38.7	10.2	25.6	9.0
Entropy index 1 (×100)	49.3	0.9	53.9	8.7	33.1	4.9
Gini index (%)	45.6	0.2	47.5	3.9	38.7	2.9
Headcount index (P0)	9.2	238.6	4.0	432.9	12.4	200.4
Poverty gap index (P1)	2.2	340.5	1.0	528.8	2.9	299.0
Poverty severity index (P2)	0.9	408.8	0.4	648.5	1.2	355.9

Source: Results from the authors' micro simulation module, using historical changes in prices, wages, and occupational choices by segment (see table 4.2). Self-employment income is assumed to drop by the same magnitude as male unskilled wage, that is, −40 percent in the urban sector and −30 percent in the rural sector.

Note: Base values are used for the Base column and percentage change for other simulations.

a. Per capita income is total monthly income.

b. Rp = rupiah, Indonesia's official currency.

The poverty increase in the urban sector is much higher than in the rural sector, but poverty remains higher in the rural sector.

These different results show the capacity of the micro simulation framework to generate plausible income distribution predictions on the basis of a few observed macro indicators.

CGE Experiments

In the following experiments, the vector of linking variables fed into the micro simulation is derived from the results of the CGE model. The set of experiments presented attempts to reproduce and decompose the effect of the crisis within the framework of the CGE model.

The base CGE scenario seeks to reproduce the evolution of the Indonesian economy between 1997 and 1998 in terms of changes in employment, wages, and macroeconomic aggregates. The most important external shocks during that period are the financial crisis and the extended drought caused by El Niño. The drought is simulated through a negative 5 percent shock on the total productivity factor in agricultural sectors. A 25 percent increase in the marketing cost of food is assumed. This increase reflects the fact that traders, more than producers, are expected to benefit from the food price increase. The financial crisis is simulated through a combination of different shocks. It is assumed that the need to adjust the current account led to a real devaluation that is simulated through a 30 percent decrease in the exogenous foreign saving flows to the economy (SIMDEV scenario). As a result of the devaluation, all sectors experienced a "credit crunch," simulated through a cut in the supply of working capital. As shown earlier, two types of working capital are considered. In a first stage, the impact of a 25 percent cut in the availability of foreign working capital is examined in combination with the real devaluation described above (the DEVCCF scenario). In a second stage, the impact of a 20 percent cut in the availability of domestic credit is considered (the FINCRI scenario). Because the domestic credit crunch shock is viewed as stemming from the foreign credit crunch, it is simulated in combination with the two previous components of the financial crisis. The resulting simulation can then be analyzed as mimicking a "pure" financial crisis shock, without any other historical shock. The effect of the El Niño drought is first simulated alone (SIMELN scenario) and then in combination with the financial crisis, thus yielding something that should be close to what actually happened in Indonesia between 1997 and 1998 (the SIMALL scenario).

Table 4.4 shows how different elements of the crisis contributed to the total negative real GDP shock. The historical simulation captures the main changes observed over the period: a 14.4 percent drop in GDP, a fall in imports and a surge of exports, an increase in the relative price of food commodities, and a drop in real wages. Combining the different shocks shows that the credit crunch is the major force explaining the collapse of GDP, while the drought combined with increases in the marketing cost of food appears to be the main driving force behind increases in the relative price of food commodities.

In terms of the impact of the macro shocks on poverty and income distribution, the results in table 4.5 show that the modeling exercise yields a 143.4 percent increase in the poverty headcount ratio when all components of the crisis are taken into account (SIMALL). This surge in poverty appears to be fueled by the drop in the average income per capita and by an important increase in inequality indicators. Both the financial crisis and the El Niño drought contribute to the negative income impact and the increase in inequality.

In terms of the rural-urban divide, the CGE experiments presented in this chapter capture (to some extent) the differences in per capita income changes shown in the historical simulation. This

Table 4.4 Simulation Results: Macro Aggregates

Indicator	*BASE*	*SIMELN*	*SIMDEV*	*DEVCCF*	*FINCRI*	*SIMALL*
GDP at factor costs (Rp, thousands of billions[a])	535.6	−0.5	−0.9	−10.7	−14.1	−14.4
Exports (Rp, thousands of billions)	122.7	−0.4	28.8	19.4	15.4	13.1
Imports (Rp, thousands of billions)	126.8	−0.3	−19.2	−28.4	−32.2	−34.4
Exchange rate	1.0	−5.1	31.8	27.3	27.2	24.3
Food/nonfood terms of trade	1.0	27.3	15.4	−4.2	−3.3	21.0
Incorporated capital income[b]	1.0	−13.2	7.8	43.0	32.2	19.7
Agricultural self-employment income[c]	1.6	−5.9	8.2	−8.0	−18.5	−23.4
Nonagricultural self-employment income	4.5	−19.9	−4.1	−16.1	−16.1	−30.7
Skilled labor wage[c]	4.9	−17.5	−12.8	−37.5	−42.2	−50.9
Unskilled labor wage[b]	2.7	−14.5	−12.6	−32.3	−35.5	−43.0

Source: Results from the authors' CGE module.

Note: Base values for BASE column and percentage change for other simulations; SIMELN = El Niño drought; SIMDEV = real devaluation; DEVCCF = real devaluation + foreign credit crunch; FINCRI = real devaluation + foreign credit crunch + domestic credit crunch; SIMALL = real devaluation + foreign credit crunch + domestic credit crunch + El Niño drought; GDP = gross domestic product.

a. Rp = rupiah, Indonesia's official currency.

b. Incorporated capital income includes private, public, and foreign capital income.

c. Self-employment and wage incomes are equal to value added divided by quantity of labor units in the social accounting matrix.

Table 4.5 Simulation Results: Per Capita Income, Inequality, and Poverty Indicators

Indicator	*BASE*	*SIMELN*	*SIMDEV*	*DEVCCF*	*FINCRI*	*SIMALL*
All areas						
Per capita income[a] (Rp, thousands[b])	121.1	−12.4	−5.1	−16.3	−19.5	−27.9
Entropy index 0 (×100)	35.5	2.9	1.4	−3.0	1.3	5.2
Entropy index 1 (×100)	49.2	4.5	1.7	−2.9	1.0	6.7
Gini index (%)	45.5	1.3	0.3	−1.8	0.2	2.2
Headcount index (P0)	9.2	49.7	17.1	51.6	80.2	143.4
Poverty gap index (P1)	2.2	54.6	25.2	61.9	101.0	182.0
Poverty severity index (P2)	0.9	54.1	31.3	68.2	111.6	197.5
Urban						
Per capita income[a] (Rp, thousands[b])	170.9	−14.0	−7.7	−23.8	−25.3	−33.5
Entropy index 0 (×100)	38.7	6.8	5.4	4.5	8.0	15.0
Entropy index 1 (×100)	53.9	7.9	5.3	4.5	6.8	15.1
Gini index (%)	47.5	3.3	2.4	2.1	3.5	6.9
Headcount index (P0)	4.0	70.4	44.1	130.8	167.1	301.4
Poverty gap index (P1)	1.1	70.6	55.4	135.1	186.6	324.8
Poverty severity index (P2)	0.4	72.0	67.3	146.9	216.6	353.4

Rural						
Per capita income[a] (Rp, thousands[b])	90.6	−10.5	−2.0	−7.7	−12.8	−21.5
Entropy index 0 (×100)	25.6	4.1	3.7	5.1	8.8	12.0
Entropy index 1 (×100)	33.1	5.2	3.6	5.5	9.8	14.6
Gini index (%)	38.7	1.8	1.3	1.9	3.7	5.1
Headcount index (P0)	12.4	45.6	11.8	36.0	63.1	112.2
Poverty gap index (P1)	2.9	51.0	18.6	45.7	82.1	150.5
Poverty severity index (P2)	1.2	50.1	23.4	50.8	88.5	163.1

Source: Results from the authors' micro simulation module using changes in prices, wages, and occupational choices by segment generated by the computable general equilibrium module.

Note: Base values for BASE column and percentage change for other simulations; SIMELN = El Niño drought; SIMDEV = real devaluation; DEVCCF = real devaluation + foreign credit crunch; FINCRI = real devaluation + foreign credit crunch + domestic credit crunch; SIMALL = real devaluation + foreign credit crunch + domestic credit crunch + El Niño drought.

a. Per capita income is total monthly income.

b. Rp = rupiah, Indonesia's official currency.

divide is apparent in terms of poverty changes, because urban poverty increases by 301.4 percent and rural poverty increases by only 112.2 percent. This can be explained by differential income shocks in the urban and rural sectors. Results also show that the inequality indicators increase in both sectors.

Conclusion

The income changes generated by the new macro-micro framework introduced in this chapter (drawn from a sample of households in an Indonesian household survey) are consistent, once they have been aggregated, with the predictions of a multisector CGE-like macro model. Chapter 4 shows that this framework captures important channels through which the 1997 financial crisis affected household incomes in Indonesia. This result is obtained through an explicit representation of the actual combination of different income sources within households and how this combination may change—through desired or undesired modifications in the occupational status of household members.

Compared with standard CGE, or before-and-after analysis, the framework developed in this chapter allows for an original analysis of the distributional effects of a financial crisis like the one that struck Indonesia in 1997. At the macro level, the analysis shows that the credit crunch was an important force behind the collapse of GDP in Indonesia, while the devaluation (combined with increases in the marketing cost of food) appears to be the primary driving force behind increases in the relative prices of food with respect to nonfood commodities. At the micro level, heterogeneity of households (with respect to factor endowments), consumption behavior, and occupational choices, whether free or forced, prove to be important in explaining the poverty and distribution effect of the crisis.

These are pure simulations intended to be consistent with what was observed in aggregate terms in Indonesia—and cannot be compared with actual data at the microeconomic level. Under these conditions, it is difficult to say that one simulation or methodology is better than another. The appeal of the framework developed in this chapter is that it accounts for realistic shocks on household economic conditions, especially with regard to the occupational status of household members. That it does so in a way that is selective, across household types, is also appealing—as suggested by the casual observation of household conditions during crisis periods. The main problem, however, is that this selectivity is essentially introduced by translating observed cross-sectional differences in household income generation behavior into the time dimension. In other words, the simulation methodology presented in chapter 4 relies on the standard assumption in economics that a household that faces specific conditions of crisis in a future labor market will behave like a household that is observed under those same current conditions. Determining whether this is justified could be accomplished only with panel data—and so is left for future work.

Notes

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1. Results from these International Labour Organization and Central Bureau of Statistics reports are taken from Booth (1998).

2. Starting with Mookherjee and Shorroks's (1982) study of the United Kingdom.

3. A detailed comparison of the approach used in this chapter with the representative household group approach is presented in a companion paper (see Bourguignon, Robilliard, and Robinson 2005).

4. A tighter integration of the micro and macro models has been attempted within a simpler framework by Cogneau (2001) and Cogneau and Robilliard (2001) and applied to Madagascar (as discussed in chapter 7 of this volume). For a general discussion of the link between CGE modeling and micro-unit household data, see Plumb (2001).

5. A more general discussion of the model can be found in Bourguignon, Ferreira, and Lustig (1998) and Bourguignon, Fournier, and Gurgand (2001).

6. The model also considers the possibility that a person may have concurrent income from both wage work and self-employment. This is taken as an additional alternative in the discrete choice model—equation (4.5). A dummy variable controls for this in the earning equation (4.1), and this person is assumed to count for half of a worker in the definition of N_m. To simplify presentation, the authors do not insist on this aspect of the data (or the model). See Alatas and Bourguignon (2005).

7. This rationing interpretation of the functioning of the labor market leads to reinterpreting the "utility" function—defined in equations (4.5) and (4.6)—as a combination of both utility aspects and the way in which the rationing scheme depends on individual characteristics.

8. For the Jacobian used in the Gauss-Newton method to make sense in the present framework, the number of households and the dispersion of their characteristics must be sufficiently high. If this were not the case, then the discontinuity implicit in the Ind( ) functions would create problems.

9. This representation of the output effect of the crisis fits the analysis made by Stiglitz. See, for example, Furman and Stiglitz (1998).

10. Azis, Iwan J., Erina E. Azis, and Erik Thorbecke. 2001. "Modeling the Socio-Economic Impact of the Financial Crisis: The Case of Indonesia." Ithaca, NY: Cornell University Press. (photocopy)

11. In particular, no attempt was made to reconcile the household survey data with the national accounts data.

12. To be consistent with the latest available estimates of the poverty headcount for 1996, the percentage changes reported by Suryahadi and others (2000) between 1996 and 1997 are applied to the base value computed by Pradhan and others (2000). This generates an estimate of the poverty headcount of 9.7 percent in 1997. The present authors then chose an income poverty line that would generate the same headcount for the sample and used that poverty line as the reference value.

13. Because the SAKERNAS does not permit deriving the evolution of self-employment income for agricultural and nonagricultural activities, in this historical simulation, self-employment incomes were assumed to decrease in real terms by the same magnitude as unskilled male wages in the urban and rural sectors.

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