Representative versus real households in the macro-economic modeling of inequality

François Bourguignon
DELTA and the World Bank, Paris

Anne-Sophie Robilliard
DIAL, Paris

Sherman Robinson
IFPRI, Washington D.C.

Revised, October 2002

Abstract

To analyze issues of income distribution, most disaggregated macroeconomic models of the Computable General Equilibrium (CGE) type specify a few representative household groups (RHG) differentiated by their endowments of factors of production. To capture "within-group" inequality, it is often assumed, in addition, that each RHG represents an aggregation of households in which the distribution of relative income within each group follows an exogenously fixed statistical law. Analysis of changes in economic inequality in these models focuses on changes in inequality between RHGs. Empirically, however, analysis of household surveys indicates that changes in overall inequality are usually due at least as much to changes in within-group inequality as to changes in the between-group component.

One way to overcome this weakness in the RHG specification is to use real households, as they are observed in standard household surveys, in CGE models designed to analyze distributional issues. In this integrated approach, the full heterogeneity of households, reflecting differences in factor endowments, labor supply, and consumption behavior, can be taken into account. In such a model, one can explore how household heterogeneity combines with market equilibrium mechanisms to produce more or less inequality in economic welfare as a consequence of shocks or policy changes.

An integrated microsimulation-CGE model must be quite large and raises many issues of model specification and data reconciliation. This paper presents an alternative, top-down method for integrating micro-economic data on real households into modeling. It relies on a set of assumptions that yield a degree of separability between the macro, or CGE, part of the model and the micro-econometric modeling of income generation at the household level. This method is used to analyze the impact of a change in the foreign trade balance, and the resulting change in the equilibrium real exchange rate, in Indonesia (before the Asian financial crisis) and a comparison with the standard RHG approach is provided.

1. Introduction

There are various ways distributional issues might be analyzed within the framework of economy-wide models. The most common method relies on defining representative household groups (RHG) characterized by different combinations of factor endowments and possibly different labor supply, saving, and consumption behavior. The heterogeneity of the population of households is integrated into economy-wide or macro modeling through a two-way channel. In one direction, heterogeneity affects aggregate demand and labor supply and their structure in terms of goods and labor types. In the other direction, household income heterogeneity depends on the remuneration rates of the various factors of production, which are determined at the aggregate level.

The amount of heterogeneity that can be accounted for with this approach depends on the number of RHGs specified in the model. It is easier to work with a small number of groups because they can be more easily differentiated and the number of equations to deal with is smaller. To get closer to observed heterogeneity, it is then often assumed that each group results from the aggregation of households which are heterogeneous with respect to their preferences or the productivity of the factors they own. Practically, however, it is assumed that the distribution of relative income within a RHG follows some law that is completely exogenous. In general, this law is estimated on the basis of household surveys where the same groups as in the macro model may be identified.[1] This specification permits making the distribution of income "predicted" or simulated with the model closer to actual distribution data. It remains true, however, that the inequality being modeled in counterfactual analyses essentially is the inequality "between" representative groups.

From a conceptual point of view, the difficulty with this approach is that the assumption of exogenous within group income heterogeneity is essentially ad hoc. If households within a group are different, why would their differences be independent of macroeconomic events? From an empirical point of view, the problem is that observed changes in income distribution are such that

[1] For early applications of this type of model, see Adelman and Robinson (1978) and Dervis, de Melo and Robinson (1982), who specified lognormal within-group distributions. The tradition is now well established—as may be seen in the surveys of CGE models for developing countries by Decaluwe and Martens (1987) and Robinson (1989). Another approach is to focus on disaggregating a specific sector of the economy such as agriculture—see the Indian model AGRIM by Narayana et al. (1991).

changes in within-group inequality generally are at least as important as changes in between-group inequality.[2]

An example may help understand the nature of the difficulty. Suppose that a sizable proportion of households in a country obtain income from various sources—wage work in the formal or informal sector, farm income, other self-employment income—as is common in many developing countries, especially in Asia. If RHGs are defined, as is usually done, by the sector of activity and the employment status of the head (small farmers, urban unskilled workers in the formal sector, etc.), it does not seem difficult to take into account this multiplicity of income sources. When generating counterfactuals, however, two difficulties arise. First, imagine that the counterfactual drastically modifies the number of unskilled urban workers employed in the formal sector. What should be done with the number of households whose head is 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? Would it then be reasonable to assume that the distribution of income within each of these RHGs remains the same despite movements from one to the other? Second, assume that changes in occupation affect only secondary members and not household heads, so that weights of RHGs within the population are unchanged. Is it reasonable then to assume that all households in a group are affected in the same way by this change in the activity of some of their members? That a secondary member moves out of the formal sector back into family self-employment may happen only in a sub-group of households belonging to a given representative group. Yet, it may seriously affect the distribution within this group. While this kind of phenomenon may be behind the change in the within-group component in inequality decomposition exercises, they are practically ignored in multi-sector, multi-household RHG models.

What may be wrong in the preceding example is that RHGs are defined too precisely. Why look at urban unskilled workers in the formal sector, and not at urban unskilled workers in general? But if one looks at a broader group, despite the fact that wage differentials are observed between the formal and informal urban sectors, then the assumption of constant within-group distributions becomes untenable for any counterfactual that modifies the relative weights of the two sectors.

---

[2] Starting with Mookherjee and Shorroks' (1982) study of UK. There are now numerous examples of "within/between" decomposition analysis of changes in inequality leading to the same conclusion. Ahuja et al. (1998) illustrate this point very well for several Asian countries in the 1980s and 1990s.

An obvious alternative approach, and a more direct way of dealing with distributional issues in macro modeling, would be to specify as many representative household groups as there are households in the population or in any available representative sample from the population. Computable general equilibrium (CGE) models based on observed rather than representative households do exist. But they usually concern a specific sector, a specific market, or a community—for example, CGE models of village economies.[3] Dealing with the whole economy and a representative sample of the whole population raises more difficulties.[4] The issue is not so much computational—computing simultaneous equilibrium in markets with thousands of independent agents is no longer very difficult. The real problem is that of identifying the heterogeneity of factor endowments or preferences at the level of a single household or individual.

Calibrating the consumption and labor supply behavior of a representative household is generally done by assuming some functional form for preferences and ignoring the underlying individual heterogeneity. Operating at the individual level requires dealing explicitly with that heterogeneity and introducing "fixed effects" to represent it. This is generally done by estimating a structural model on the observed cross-section of households and interpreting residuals as fixed individual effects. This estimation work usually involves identification assumptions which may be debatable, though. For instance, the estimation of the price elasticity of labor supply often calls for exclusion restrictions, and fixed effects behind the residuals of wage or labor supply equations are likely to reflect a very specific kind of preference or labor skill heterogeneity, together with measurement errors and other disturbances. Another difficulty is the complexity of structural models meant to represent satisfactorily household income generation behavior. This is true in particular when the modeling of the labor market requires accounting explicitly, as in the example above, for the joint labor supply behavior of individual household members. These two difficulties explain why micro-data-based applied general equilibrium models often rely on relatively simple structural models focusing on only one or two dimensions of household or individual behavior—see for instance Browning et al. (1999), Townsend and Ueda (2001), or Heckman (2001). Yet, it is not clear that this type of model may be convincingly used to describe the full complexity of household income inequality and the way it may be affected by macro-economic policies.

[3] See for instance Taylor and Adelman (1996) for village models and Heckman (2001) for labor market applications.
[4] For attempts at the full integration of micro data and household income generation modeling within multi-sectoral general frameworks, see Cogneau (2001) and Cogneau and Robilliard (2001). A general discussion of the link between CGE modeling and micro-unit household data is provided by Plumb (2001).

In this paper, we propose an alternative approach to quantify the effects of macro-economic shocks on poverty and inequality which tries to bypass the preceding difficulties. It combines a standard multi-sector CGE model with a micro-simulation model that describes real income generation behavior among a representative sample of households. This micro-simulation model is based on econometric reduced form equations for individual earnings, household income from self-employment, and the occupational choice of all household members of working age. Such an integrated set of equations has proved useful in analyzing observed changes in the distribution of income over some period of time in various countries—see Bourguignon et al. (2001) and the various papers in the MIDD project run by Bourguignon, Ferreira and Lustig.[5] It is used here to study changes between two hypothetical states of the economy as described by an economy-wide CGE model.

What makes the method proposed in this paper simpler than a fully integrated model with as many RHGs as actual households in a representative sample is that the two parts of the modeling structure are treated separately, in a top-down fashion. The macro or CGE model is solved first and communicates with the micro-simulation model through a vector of prices, wages, and aggregate employment variables. Then the micro-simulation model is 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 generated by the macro model. When this is done, the full distribution of real household income corresponding to the shock or policy change initially simulated in the macro model may be evaluated.

For illustrative purposes, this framework is used to estimate the effects on the distribution of household income of various scenarios of real devaluation in Indonesia. The CGE part of this framework is fairly standard and could be replaced by any other macro model that could provide satisfactory counterfactuals for the variables that ensure the link with the micro-simulation model. For this reason, the presentation focuses more on the micro-simulation model than on the CGE model or the nature of the macro shock driving the simulations.

The paper is organized as follows. Section 2 shows the structure of the micro-simulation model and how it is linked to the CGE model. Section 3 describes the general features of the CGE model.

---

[5] These papers are presently being edited into a volume. They may be obtained at http://www.iadb.org/sds/pov/publication/gen_21_2349_e.htm.

The devaluation scenario and its implications for the distribution of household income are presented in Section 4. Finally, section 5 discusses the differences between the micro/macro framework proposed in this paper and the standard representative household group (RHG) approach.

2. The Micro-simulation Model

This section describes the specification of the household income model used for micro-simulation and then focuses on the way consistency between the micro-simulation model and the predictions of the CGE model is achieved. A detailed discussion of the specification and econometric estimates of the various equations of the household income generation model and simulation methodology may be found in Alatas and Bourguignon (2000).[6]

- The household income generation model

With the notation used in the rest of this paper, the household income generation model for household *m* and working age household members i = $1, .., k_m$ consists of the following set of equations:

$$Log\ w_{mi} = \alpha_{g(mi)} + x_{mi}\beta_{g(mi)} + v_{mi} \qquad i=1,..k_m \tag{1}$$

$$Log\ y_m = \gamma_{f(m)} + Z_m\delta_{f(m)} + \lambda_{f(m)}N_m + \eta_m \tag{2}$$

$$Y_m = \frac{1}{P_m}\left(\sum_{i=1}^{k_m} w_{mi}IW_{mi} + y_m\ Ind(N_m > 0) + y_{0m}\right) \tag{3}$$

$$P_m = \sum_{k=1}^{K} s_{mk}\,p_k \tag{4}$$

$$IW_{mi} = Ind[a^w_{h(mi)} + z_{mi}b^w_{h(mi)} + u^w_{mi} > Sup(0, a^s_{h(mi)} + z_{mi}b^s_{h(mi)} + u^s_{mi})] \tag{5}$$

$$N_m = \sum_{i=1}^{k_m} Ind[a^s_{h(mi)} + z_{mi}b^s_{h(mi)} + u^s_{mi} > Sup(0, a^w_{h(mi)} + z_{mi}b^w_{h(mi)} + u^w_{mi})] \tag{6}$$

The first equation expresses the logarithm of the (full-time) wage of member *i* of household *m* as a function of his/her personal characteristics, *x*. The latter essentially include age, schooling level, and region. The residual term, v_{mi}, describes the effects of unobserved earning determinants. This earning function is defined independently on various "segments" of the labor market defined by gender, skill (less than secondary or more than primary), 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.

The second equation is the (net) income function associated with self-employment, or small entrepreneurial activity, which includes both the opportunity cost of household labor and profit. This function is defined at the household level. It depends on the number N_m of household members actually involved in that activity and on some household characteristics, Z_m. The latter 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 non-farm activity. This is exogenous and defined by whether the household has access to land or not, as represented by the index function *f(m).*

The third equation is an accounting identity that defines total household real income, Y_m, as the sum of the wage income of its members, profit from self-employment, and (exogenous) non-labor 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 members actually engaged in wage work. Note that it is implicitly assumed here that all wage workers are employed full-time. This assumption will be weakened later. Income from self-employment has to be taken into account only if there is at least one member of the household engaged in self-employment activity, that is if the indicator function, *Ind*, defined on the logical expression ($N_m>0$) is equal to unity. Total income is then deflated by a household specific consumer price index, 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).

The last two equations represent the occupational choice made by household members. This choice is discrete. Each individual has to choose from three alternatives: being inactive, being a

[6] A more general discussion of the model may be found in Bourguignon, Ferreira and Lustig (1998) and Bourguignon, Fournier and Gurgand (2001).

wage worker, or being self-employed. A fourth alternative consisting of being both self-employed and a wage worker is also taken into account but, for the sake of simplicity, it is ignored in what follows. Individuals chose among alternatives according to some criterion the value of which is specific to the alternative. The alternative with the highest criterion value is selected.

The criterion value associated with the first alternative is arbitrarily set to zero, whereas the value of being a wage worker or self-employed are linear functions 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 stands for 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 and the variables in z_{mi} may be different for household heads, spouses, male or female children. The constants may also be demography specific.

Given this specification, an individual will prefer wage work if the value of the criterion associated with that activity is higher than that associated with the two other activities. This is the meaning of equation (5). Likewise, the number of self-employed workers in a household is the number of individuals for whom self-employment yields a criterion value higher than that of the two alternatives, as represented in (6).[7]

The model is now complete. Overall, it defines the total real income of a household as a non-linear 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 of the household (η_m) or household members (v_{mi}, $u^w{}_{mi}$, and $u^s{}_{mi}$). This function depends on five sets of parameters : the parameters in the earning functions (α_g and β_g), for each labor market segment, g; the parameters of the self-employment income functions (γ_f, δ_f, and λ_f) for the farm or non-farm sector, f; the parameters of the occupational choice model ($a^w{}_h$, $b^w{}_h$, $a^s{}_h$ and $b^s{}_h$), for the various demographic groups h, and the vector of prices (p). It will be seen below that it is through a subset of these

[7] As mentioned above, the possibility that a person be involved simultaneously in wage work and self-employment is also considered. This is taken as an additional alternative in the discrete choice model (5). A dummy variable controls for this in the earning equation (1) and this person is assumed to count for half a worker in the definition of N_m. See details in Alatas and Bourguignon (2000).

parameters that the results of the CGE part of the model may be transmitted to the micro-simulation module.

The micro-simulation model gives a 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 as a discrete choice between inactivity and full time work for wages or for self-employment income within the household calls for two sets of remarks. First, the assumption that individuals either are inactive or work full time is justified essentially by the fact that no information on working time is available in the micro data source used to estimate the model coefficients. Practically, this implies that estimated individual earning functions (1) and profit functions (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 occupations and self-employment income would be different from outside wage income only because it would incorporate the returns to non-labor assets being used. The specification that has been selected is partly justified by the fact that assets used in self-employment are not observed, so that one cannot distinguish between self-employment income due to labor and that due to 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 segmentation. On the one hand, there may be rationing in the wage labor market. People unable to find a job as a wage worker move into self-employment, which thus appears as a kind of shelter. On the other hand, there may be externalities that make working within and outside the household imperfect substitutes. All these interpretations are fully consistent with the way in which the labor-market is represented in the CGE part of the model—see below.[8]

[8] This “rationing” view at the labor market explains why we refrain from calling “utility” the criteria that describe occupational choices, as is usually done. Actually, the functions defined in (5)-(6) combine both utility aspects and the way in which the rationing scheme may depend on individual characteristics.

- Estimation of the model for the benchmark simulation

The benchmark simulation of the model requires previous econometric estimation work. This is necessary to have an initial set of coefficients (α_g, β_g, γ_f, δ_f, λ_f, $a^w{}_h$, $b^w{}_h$, $a^s{}_h$, $b^s{}_h$) as well as an estimate of the unobserved characteristics, or fixed effects, that enter the earning and profit functions, or the utility of the various occupational alternatives, through the residual terms (v_{mi}, η_m, $u^w{}_{mi}$, $u^s{}_{mi}$).

The data base consists of the sample of 9,800 households surveyed in the “income and saving” module of Indonesia's 1996 SUSENAS household survey. This sample is itself a sub-sample of the original 1996 SUSENAS. The coefficients of earning and self-employment income functions and the corresponding residual terms are obtained by ordinary least square estimation on wage earners and households with some self-employment activity.[9] This estimation also yields estimates of the residual terms, v_{mi} and η_m. For individuals at working age (i.e. 15 years and older) who are not observed as wage earners in the survey, unobserved characteristics, v_{mi}, are generated by drawing random numbers from the distribution that is observed for actual wage earners. The same is done with η_m for those households who are not observed as self-employed in the survey but might get involved in that activity in a subsequent simulation.[10]

Parameters of the occupational choice model were obtained through the estimation of a multi-logit model, thus assuming that the residual terms ($u^w{}_{mi}$, $u^s{}_{mi}$) are distributed according to the double exponential law. The estimation was conducted on all individuals of working age, but separately for three demographic groups (h): household heads, spouses, and other family members. The set of explanatory variables, z_{mi}, includes not only the socio-demographic characteristics of the individual, but also the average characteristics of the other members in the household and the size and composition of the household. In addition, it includes the occupational status of the head, and possibly his/her individual earning, for spouses and other household members. For all individuals, values of the residual terms ($u^w{}_{mi}$, $u^s{}_{mi}$) were drawn randomly in a way consistent with observed occupational choices. For instance, residual terms for a wage earner should be such that:

$$\hat{a}^w_{h(mi)} + z_{mi}\hat{b}^w_{h(mi)} + u^w_{mi} > Sup(0, \hat{a}^s_{h(mi)} + z_{mi}\hat{b}^s_{h(mi)} + u^s_{mi})$$

---

[9] Correction for selection biases did not lead to significant changes in the coefficients of these equations and was thus dropped.

where the ^ notation corresponds to multi-logit coefficient estimates.[11]

To save space, the results of this estimation work are not reported in this paper. Interested readers may find a presentation and a discussion of a similar household income model in Alatas and Bourguignon (2000). Note that the CPI equation (4) does not call for any estimation since it is directly defined on observed household budget shares.

- *Link with the CGE model*

In principle, the link between the micro-simulation model that has just been described and the CGE model is extremely simple. It consists of associating macro-economic shocks and changes in policies simulated in the CGE model to changes in the set of coefficients of the household income generation model (1)-(6). With a new set of coefficients (α_g, β_g, γ_f, δ_f, λ_f, $a^w{}_h$, $b^w{}_h$, $a^s{}_h$, $b^s{}_h$) and the observed and unobserved individual and household characteristics (x_{mi}, z_{mi}, Z_m, s_m, v_{mi}, η_m, $u^w{}_{mi}$, $u^s{}_{mi}$), these equations permit computing the occupational status of all household members, their earnings, self-employment income, and finally total real income of the household. But this association has to 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 obtained in the CGE model for each segment of the wage labor market; (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 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 calibration of the CGE model, or of the Social Accounting Matrix behind it, is done in such a way that the preceding four sets of consistency requirements are satisfied in the benchmark simulation. Let E_G be the employment level in the G segment of the wage labor market, w_G the corresponding wage rate, S_G the number of self-employed in the same segment and I_F the total self-employment household income in informal sector F (farm and non-farm). Finally, let q be the

[10] Actually, homoskedastic normal distributions were assumed in both cases. No attempt has been made to incorporate heteroskedasticity.

vector of prices for consumption goods in the CGE model. Consistency between the micro data base and the benchmark run of the CGE model is described by the following set of constraints:

$$\sum_m \sum_{i,g(mi)=G} Ind[\hat{a}^w_{h(mi)} + z_{mi}.\hat{b}^w_{h(mi)} + \hat{u}^w_{mi} > Sup(0,\ \hat{a}^s_{h(mi)} + z_{mi}.\hat{b}^s_{h(mi)} + \hat{u}^s_{mi})\ ] = E_G$$

$$\sum_m \sum_{i,g(mi)=G} Ind[\hat{a}^S_{h(mi)} + z_{mi}.\hat{b}^S_{h(mi)} + \hat{u}^S_{mi} > Sup(0,\ \hat{a}^w_{h(mi)} + z_{mi}.\hat{b}^w_{h(mi)} + \hat{u}^w_{mi})\ ] = S_G$$

$$\sum_m \sum_{i,g(mi)=G} Exp(\hat{\alpha}_G + x_{mi}.\hat{\beta}_G + \hat{v}_{mi}).Ind[\hat{a}^w_{h(mi)} + z_{mi}.\hat{b}^w_{h(mi)} + \hat{u}^w_{mi} > Sup(0,\ \hat{a}^s_{h(mi)} + z_{mi}.\hat{b}^s_{h(mi)} + \hat{u}^s_{mi})\ ] = w_G$$

$$\sum_{m,f(m)=F} Exp(\hat{\gamma}_F + Z_m.\hat{\delta}_F + \hat{\lambda}_F.\hat{N}_m + \hat{\eta}_m).Ind(N_m > 0) = I_F$$

$$with \quad \hat{N}_m = \sum_i Ind[\hat{a}^S_{h(mi)} + z_{mi}.\hat{b}^S_{h(mi)} + \hat{u}^S_{mi} > Sup(0,\ \hat{a}^w_{h(mi)} + z_{mi}.\hat{b}^w_{h(mi)} + \hat{u}^w_{mi})\ ]$$

for all labor-market segments, G, and both self-employment sectors, F.

In these equations, the ^ notation refers to the results of the estimation procedure described above. Given the way in which the unobserved characteristics or fixed effects (v_{mi}, η_m, $u^w{}_{mi}$, $u^s{}_{mi}$) have been generated, predicted occupational choices, earnings, and self-employment income that appear in these equations are identical to those actually observed in the micro data base for all households and individuals.

Consider now a shock or a policy measure in the CGE model which changes the vector (E_G, S_G, w_G, I_F, q) into ($E^*{}_G$, $S^*{}_G$, $w^*{}_G$, $I^*{}_F$, q*). The consistency problem is to find a new set of parameters $C = (\alpha_g, \beta^g, \gamma_f, \delta_f, \lambda_f, a^w{}_h, b^w{}_h, a^s{}_h, b^s{}_h, p)$ of the micro-simulation model such that the preceding set of constraints will continue to hold for the new set of right hand macro variables ($E^*{}_G$, $S^*{}_G$, $w^*{}_G$, $I^*{}_F$, q*). This is trivial for consumption prices, p, which must be equal to their CGE counterpart. For the other parameters, there are many such sets of coefficients so that additional restrictions are necessary. The choice made in this paper is to restrict the changes in *C* to changes in the *intercepts* of all earning, self-employment income, and occupational criterion functions—that is changes in α^g, γ^f, $a^w{}_h$ and $a^s{}_h$.

The justification for that choice 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

[11] This may be done by drawing ($u^w{}_{mi}$, $u^s{}_{mi}$) independently in double exponential laws until they satisfy the preceding condition. A more direct technique is given in Bourguignon et al. (2001).

earning equations generates a proportional change of all earnings in a labor-market segment, irrespectively of individual characteristics—outside those that defined labor-market segments, that is skill, gender, and area. The same is true of the change in the intercept of the log self-employment income functions. It turns out that a similar argument applies to the criteria associated with the various occupational choices. Indeed, it is easily shown that changing the intercepts of the multi-logit 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, and not on individual characteristics. More precisely, let P_{mi}^{w}, P_{mi}^{s} and P_{mi}^{0} be the a priori probabilities of wage work, self-employment and no employment for individual *mi*. According to the multi-logit model, these probabilities have the following expression: [12]

$$P_{mi}^{w} = \frac{Exp(a^{w} + z_{mi}b^{w})}{1 + Exp(a^{w} + z_{mi}b^{w}) + Exp(a^{s} + z_{mi}b^{s})}, P_{mi}^{s} = \frac{Exp(a^{w} + z_{mi}b^{w})}{1 + Exp(a^{w} + z_{mi}b^{w}) + Exp(a^{s} + z_{mi}b^{s})} \quad (7)$$

and $P_{mi}^{0} = 1 - P_{mi}^{w} - P_{mi}^{s}$. Then, differentiating with respect to the intercepts yields the preceding property, namely:

$$\frac{dP_{mi}^{w}}{P_{mi}^{w}.da^{w}} = (1 - P_{mi}^{w}), \frac{dP_{mi}^{s}}{P_{mi}^{s}.da^{w}} = \frac{dP_{mi}^{0}}{P_{mi}^{0}.da^{w}} = -P_{mi}^{w} \quad (8)$$

and symmetrically for a^{s}.

There are as many intercepts as there are constraints in the preceding system. Thus, the linkage between the CGE part of the model and the micro-simulation part is obtained through the resolution of the following system of equations:

---

[12] The following argument is cast in terms of ex-ante probabilities of the various occupation rather than the actual occupational choice that appear in the preceding system of equation. This is for the sake of simplicity. Note that ex-ante probabilities given by the multi-logit model correspond to the observed frequency of occupation among individuals with the same observed characteristics. Also note that, for simplicity, we ignore demographic group heterogeneity *h(mi)* in what follows.

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

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

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

$$\sum_{m,f(m)=F} Exp(\gamma^*_F + Z_m\hat{\delta}_F + \hat{\lambda}_F\hat{N}_m + \hat{\eta}_m) Ind(N_m > 0) = I^*_F$$

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

for all labor-market segments, G, and both self-employment sectors, F. The unknowns of this system are ${\alpha_g}^*$, ${\gamma_f}^*$, ${a^{w*}}_h$ and ${a^{s*}}_h$. There are as many equations as unknowns.[13] No formal proof of existence or uniqueness has yet been established. But there is a strong presumption that these properties hold. Indeed, the last two sets of equations in ${\alpha_g}^*$, ${\gamma_f}^*$ are independent of the first two sets and clearly have a unique solution for given values of ${a^{w*}}_h$ and ${a^{s*}}_h$ since left hand sides are monotone functions that vary between zero and infinity. Things are more difficult for the first two sets of equations, in particular because of the discreteness of the *Ind( )* functions. If there are enough observations, these functions may be replaced by the probability to be in wage work or self-employed as given by the well-known multi-logit model. This would make the problem continuous. It can then be checked that local concavity properties make standard Gauss-Newton techniques convergent. However, the minimum number of observations necessary for the multi-logit probability approximation to be satisfactory is not clear.[14]

Once the solution is obtained, it is a simple matter to compute the new income of each household in the sample, according to model (1)-(6), with the new set of coefficients ${\alpha_g}^*$, ${\gamma_f}^*$, ${a^{w*}}_h$ and ${a^{s*}}_h$ and then to analyze the modification that this implies for the overall distribution of income.

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. There are 8 segments in the labor market. The employment requirements for each segment in the formal (wage

[13] Of course, this requires some particular relationship between the number of demographic groups, h, and the number of labor-market segments, G.

[14] In the event, we were able to solve the model using a standard Newton method (programmed in STATA).

work) and the informal (self-employment) sectors (E^*_G and S^*_G) lead to 16 restrictions. In addition there are 8 wage rates in the formal sector (w^*_G) and 2 levels of self-employment income (I^*_F) in the farm and non-farm sectors. Thus, simulated changes in the distribution of income implied by the CGE part of the model are obtained through a procedure that comprises a rather sizable number of degrees of freedom.

- Interpretation of the consistency system of equations

The micro-macro linkage described by the preceding system of equations may be seen as a generalization of familiar grossing up operations aimed at correcting a household survey to make it consistent with other data sources—e.g. another survey or a census or national accounts. The first type of operation consists of simply rescaling the various household income sources, with a scaling factor that varies across the income sources and labor-market segments. This corresponds to the last two set of equations in the consistency system (S). However, because households may derive income from many different sources, this operation is more complex and has more subtle effects on the overall distribution than simply multiplying the total income of households whose head belongs to different groups by different proportionality factors, as is often done.

The second operation would consist of reweighing households depending on the occupation of their members.[15] This approach loosely corresponds to the first two sets of restrictions in system (S). Here again, however, this procedure is considerably different from reweighing households on the basis of a simple criterion like the occupation of the household head, his/her education, or area of residence. There are two reasons for this. First, reweighing takes place on individuals rather than households, so that the composition of households and the occupation of their members matter. Second, the reweighing being implemented is highly selective. For instance, if the CGE model results require that many individuals move from wage work to self-employment and inactivity, individuals whose occupational status will change in the micro-simulation model will not be drawn randomly from the initial population of individuals in the formal sector. On the contrary, they will be drawn in a selective way, essentially based on cross-sectional estimates of their a priori probability of being a formal wage worker or self-employed. Standard reweighing would consist of modifying these ex-ante probabilities of being a formal wage worker, P_{mi}^{w} in the same proportion. The selective reweighing used here is such that this proportion depends itself on the ex-ante probabilities of being a wage worker, as shown by equations (8). For instance, the youngest employees with self-employed parents might be more likely to move than an older person in a small household. As the earnings or the income of the former may be different from that of the latter, this selectivity of the reweighing procedure has a direct effect on the distribution of earnings *within* the group of formal wage workers.

- Interpreting the intercepts of occupational choice criteria

There is another way of interpreting this reweighing procedure, or the changes in the multi-logit intercepts which it relies on, that can be made consistent with standard utility maximizing behavior, and with the CGE part of the whole model. Consider that each occupation yields some utility that can be measured by the log of the money it yields, net of working disutility. To simplify, ignore momentarily the difference between individuals and households and write the utility of the three occupations as:

$$\begin{aligned} U_i^w &= Log\, w_i - (\theta_w . x_i + \phi_w z_i + \mu_i^w) \\ U_i^s &= Log\, y_i - (\theta_s . x_i + \phi_s z_i + \mu_i^s) \qquad (9) \\ U_i^0 &= Log\, Y_i - (\theta_0 . x_i + \phi_0 z_i + \mu_i^0) \end{aligned}$$

where Y_i is the monetary equivalent of domestic production in case of no employment. In all these cases, the first term on the RHS corresponds to the (log) of the monetary (or monetary equivalent) return to each occupation, and the second term to the disutility of that occupation. This disutility is itself expressed as a function of individual or household characteristics, x_i and z_i, and a random term, μ_i. This specification permits putting more economic structure into the initial specification of the multi-logit model for occupational choices. In particular, it is possible to replace $Log(w_i)$ and $Log(y_i)$ by their expression in (1) and (2). In addition, we know that the intercept of the earning function depends on the earning of the labor-market segment an individual belongs to, as given by the CGE model. Likewise, the intercept of the self-employment income function depends on the value-added price of the output of the self-employment activity, and therefore on the whole price

[15] For simulation techniques of income or earnings distribution based on straight reweighing of a benchmark sample see diNardo, Fortin, Lemieux (1996).

vector as given by the CGE model. Of course, the same can be said of the unobserved domestic output, Y_i, in case of inactivity. Thus the income terms in (9) may be rewritten as:

$$
\begin{aligned}
Log\, w_i &= \alpha(w_{G(i)}) + z_i.\beta_{G(i)} + v_i \\
Log\, y_i &= \gamma_{f(i)}(p) + z_i.\delta_{f(i)} + \eta_i \\
Log\, Y_i &= \chi(p) + x_i.\psi + z_i.\lambda + \zeta_i
\end{aligned}
\qquad (10)
$$

where w_G and p are earnings and prices given by the CGE model. Combining (9) and (10) into a utility maximizing choice model finally leads to the equivalent of the multi-logit formulation (5)-(6). Using inactivity as the default choice, the preferred occupational choice of individual i, C_i, belonging to labor market segment G, is wage work, W, self-employment, S, or inactivity I, according to:

$$
\begin{aligned}
C_i &= W \text{ if } A_w(w_{G(i)}, p) + z_i.B_w^{G(i)} + \omega_i^w \geq Sup\left[0, A_s(p) + z_i.B_s^{G(i)} + \omega_i^s\right] \\
C_i &= S \text{ if } A_s(p) + z_i.B_s + \omega_i^s \geq Sup\left[0, A_w(w_{G(i)}, p) + z_i.B_w^{G(i)} + \omega_i^w\right] \\
C_i &= S \text{ if } Sup\left[A_s(p) + z_i.B_s + \omega_i^s, A_w(w_{G(i)}, p) + z_i.B_w^{G(i)} + \omega_i^w\right] < 0
\end{aligned}
$$

If the functions $A_w(w_{G(i)}, p)$ and $A_s(p)$ were known, we would have a complete micro-economic structural labor supply model that could nicely feed into the CGE model. Given a wage-price vector *(w,p)*, this model would give the occupational choice of every individual in the household sample and therefore labor supply in the CGE. It would then be possible to have the whole micro-simulation structure integrated within the CGE model. The fundamental point, however, is that *there is no way we can get an estimate of these functions on a micro-economic cross-sectional basis*, for there is no variation of the price vector, *p,* in the data. If we do not want to import the functions $A_w(w_{G(i)}, p)$ and $A_s(p)$ arbitrarily from outside the micro-simulation framework and household survey data, the only way to achieve consistency with the CGE part of the model is to assume that these functions are such that the equilibrium values of wages and prices coming from the CGE model ensure the equilibrium of markets for both goods and labor. This is equivalent to looking for the *intercepts* that ensure equilibrium the supply demand equilibrium of the labor markets behind the last two sets of equations of system (S).

Solving for those intercepts thus is not necessarily inconsistent with the full general equilibrium of the economy and full utility-maximizing behavior at the micro-level. It is a solution that permits avoiding arbitrary assumptions necessary to get a structural representation of individual labor choices that can be made consistent with the CGE model. Of course, this solution implicitly assumes some specific property of the labor choice model does hold for the influence of prices and wages to go only through the intercepts. It was seen above that this solution had interesting neutrality properties. On the other hand, failure to identify precisely this property is the cost to be paid for maintaining the maximum dichotomy between the macro and the micro part of the model.

Of course, the preceding discussion is based on a purely competitive view of the labor market . The occupational model represented by equation (5)-(6) does not necessarily reflect utility maximizing behavior, and it might be possible to justify that representations of individual employment status determination by other arguments, for instance by the existence of selective rationing. This would seem natural in view of the imperfection assumed for the labor markets in the CGE—see below. Most of the preceding conclusions would still hold, however. Maintaining the maximum dichotomy between the micro and the macro part of the model requires avoiding the import of structural assumptions from outside the micro-economic model. At the same time, insuring consistency through the intercepts simplifies things but also imposes implicit assumptions that one would like to identify more precisely.

The lack of communication between the macro and the micro part of the model is also concerned with the non-labor income variable, y_{0m}. It is taken as exogenous (in nominal terms) in all simulations. Yet, it includes housing and land rents, dividends, royalties, imputed rents from self-occupied housing, and transfers from other households and institutions. It could have been possible to endogenize some of these items in the CGE model, but this was not done.

3. The CGE Model

The macro model used in this paper is a conventional, trade-focused CGE model.[16] It is based on a Social Accounting Matrix (SAM) for the year 1995. The SAM has been disaggregated using cross-entropy estimation methods (Robinson, Cattaneo, and El-Said, 2001) and includes 38 sectors ("activities"), 14 goods ("commodities"), 14 factors of production (8 labor categories and 6 types of capital), and 10 households types, as well as the usual accounts for aggregate agents (firms, government, rest of the world, and savings-investment). The CGE model starts from the standard neoclassical specification in Dervis et al. (1982), but it also incorporates disaggregation of production sectors into formal and informal activities and associated labor-market imperfections, as well as working capital. The SAM, including the sector and agent breakdown, is given in Appendix A.

The model is Walrasian in the sense that it determines only relative prices, and other endogenous real variables in the economy. Financial mechanisms are modeled implicitly and only their real effects are taken into account in a simplified way. Sectoral product prices and factor prices are defined relatively to the producer price index of goods for domestic use, which serves as the numeraire.

In common with many trade-focused CGE models, the model includes an explicit exchange-rate variable. Since world prices are measured in U.S. dollars and domestic prices in Indonesian currency, the exchange-rate variable has units of domestic currency per unit of foreign exchange—it is used to convert world prices of imports and exports to prices in domestic currency units, and also to convert foreign-exchange flows measured in dollars (e.g., foreign savings). Given the choice of numeraire, the exchange rate variable can be interpreted as the real price-level-deflated (PLD) exchange rate, deflating by the domestic (producer) price of non-traded goods.[17] Since world prices are assumed fixed, the exchange rate variable corresponds to the real exchange rate, measuring the relative price of traded goods (both exports and imports) and nontraded goods.

Following Armington (1969), the model assumes imperfect substitutability for each good between the domestic commodity—which results itself 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 CET (constant-elasticity-of-transformation) aggregation of sectoral exports and domestically consumed products. [18]

[16] For a detailed exposition of this type of model, and for the implementation of the "standard" model in the GAMS modeling language, see Lofgren et al. (2001).
[17] This terminology was standardized in a series of NBER studies in the 1970s in a project led by Jagdish Bhagwati and Anne Krueger.
[18] The appropriate definition of the real exchange rate in this class of model, with a continuum of substitutability between domestically produced and foreign goods, is discussed in Devarajan, Lewis and Robinson (1993).

Indonesia's economy is dualistic, which the model captures by distinguishing between formal and informal "activities" in each sector. Both sub-sectors produce the same "commodity" but differ in the type of factors they use.[19] This distinction allows treating formal and informal factor markets differently. On the demand side, imperfect substitutability is assumed between formal and informal products of the same commodity classification.

For all activities, the production technology is represented by a set of nested CES (constant-elasticity-of-substitution) value-added functions and fixed (Leontief) intermediate input coefficients. Domestic prices of commodities are flexible, varying to clear markets in a competitive setting where individual suppliers and demanders are price-takers.

Factors of Production

There are eight labor categories: 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. Male and female, as well as skilled and unskilled labor are assumed to be imperfect substitutes in the production activities.

In addition, labor markets are assumed to be segmented between formal and informal sectors. In the formal sectors, a degree of imperfect competition is assumed to result in there being an increasing wage-employment curve, and real wages are defined by the intersection of that curve with competitive labor demand. Informal sector labor is equivalent to self-employment. Wages in that sector are set so as to absorb all the labor not employed in the formal sectors. Non-wage income results from the other factors operated by self-employed.

Land appears as a factor of production in all agricultural sectors. Only one type of land is considered in the model. It is competitively allocated among the different crops and sectors so that its marginal revenue product is equated across all uses. Capital is broken down into six categories, but, given the short-run nature of the model, it is assumed to be fixed in each activity.

---

[19] Typically, CGE models assume a one-to-one correspondance between activities and commodities. This model allows many activities producing the same commodity or one activity producing many commodities. See Lofgren et al. (2001).

Households

The disaggregation of households in the CGE model is not central for our purpose since changes in factor prices are passed on directly to the micro-simulation model, without use of the representative household groups (RHG) used in the original SAM and in the CGE model. Yet, this feature will later permit comparing the methodology developed in this paper with the standard CGE/RHG approach. Thus RHGs are endowed with some specific combination of factors (labor and capital) and derive income from the remuneration of these factors, which they supply in fixed quantity to the rest of the economy. Consumption demand by households is specified as a linear expenditure system (LES), with fixed marginal budget shares and minimum consumption (subsistence) level for each commodity.

Macro Closure Rules

Aside from the supply-demand balances in product and factor markets, three macroeconomic balances must hold in the model: (i) the external trade balance (in goods and non-factor services), which implicitly equates the supply and demand for foreign exchange flows; (ii) savings-investment balance; and (iii) the fiscal balance, with government savings equal to the difference between government revenue and spending. As far as foreign exchange is concerned, foreign savings are taken as exogenous and the exchange rate is assumed to clear the market—the model solves for an equilibrium real exchange rate given the fixed trade balance. Concerning the last two constraints, three alternative closures will be considered in what follows. The objective behind these three macro-economic closures is to see whether they may affect the nature of the results obtained with the micro-simulation model and how they compare with those obtained with the RHG method.

The first macro closure assumes that aggregate investment and government spending are in fixed proportions to total absorption. Any shock affecting total absorption is thus assumed to be shared evenly among government spending, aggregate investment, and aggregate private consumption. While simple, this "balanced" closure effectively assumes a "successful" structural adjustment program whereby a macro shock is assumed not to cause particular actors—government, consumers, and industry—to bear a disproportionate share of the adjustment burden. This closure implies that the fiscal balance is endogenous.

In the second macro closure, investment is savings-driven and government spending adjusts to maintain the fiscal balance at the same level as in the benchmark simulation, which fits the economic situation observed in 1997. Note, however, that government employment remains constant. The third macro closure achieves the same fiscal balance through a uniform increase in indirect (VAT) tax rates.[20]

4. Scenarios and simulation results

As the purpose of this section is essentially to illustrate empirically the way the micro-simulation model is linked with the CGE model, the nature of the shock being simulated does not matter very much. A companion paper uses an extended version of the model to describe the dramatic crisis that hit Indonesia in 1998.[21] Two simpler scenarios are considered here—see table 1. They allow some foreign sector parameters to vary under the three alternative macro-economic closures listed above.

The first scenario consists of a major terms of trade shock that reduces the foreign price of both crude oil and exports of processed oil products—amounting altogether to approximately 40 per cent of total Indonesian exports—by 50 percent. The corresponding drop in foreign exchange receipts results in a devaluation of the equilibrium exchange rate (in order to increase exports and reduce imports) to maintain the fixed trade balance, under the three macro-economic adjustment scenarios described above. The corresponding simulations appear respectively under the headings SIMTOT1 to SIMTOT3 in the tables below.

The second scenario consists of a 30 percent drop in exogenous foreign savings. This shock also results in a devaluation, under the same three macro-economic adjustment scenarios as above. The corresponding simulations are referred to as SIMDEV1 to SIMDEV3. The main difference with the first set of simulations is that there is no change in relative prices before the devaluation,

[20] The Indonesian CGE model includes other features, including demand for working capital in all sectors. These features have not been discussed here because no use is made of them in the experiments we report. See Robilliard et al. (2001) for a discussion of how the model was extended to capture the impact of the Asian financial crisis.
[21] See Robilliard et al. (2001).

whereas the terms of trade shock in SIMTOT first reduces the relative prices of oil and oil products, both on the export and import sides, with spillover on the structure of domestic prices.

Table 2 shows the effects of these shocks on some macro-economic indicators. Results are unsurprising. GDP is little affected since both capital and the various types of labor are assumed to be fully employed. The small drop that is observed corresponds to sectoral shifts and price index effects. The effect of SIMTOT on the exchange rate and the volume of foreign trade is much less pronounced than that of SIMDEV. This result reflects the relative sizes of both shocks. In both cases, the resulting change in relative prices leads to an increase in the relative price of food products, which are largely non-traded. In turn, this causes an absolute increase in the real income of farmers that contrasts with the drop in the real income of self-employed in the urban sector and of all workers. With no change in the wage curve and a drop in labor demand coming from traded good sectors, which are the main employers of wage labor, wages fall. The drop is more pronounced for unskilled workers, reflecting more exposure to foreign competition by the sectors employing them. All these effects depend on the size of the devaluation, and are bigger in SIMDEV.

As far as the three macro-economic closures are concerned, it may be seen in table 2 that they make a difference only in the case of the foreign saving shock, SIMDEV. The last two closures lead to more intense sectoral reallocations due to the change in the structure of absorption and the composition of aggregate demand. This effect is slightly bigger with the last closure where the fiscal balance is re-established through a uniform change in VAT rates. Because the VAT affects the various sectors in different proportions, with exemptions for informal sectors, the sectoral shift in aggregate demand is more important. Changes in the relative remuneration of the various types of labor are also more pronounced under the last two closures in the pure devaluation scenario. These effects are practically absent in the terms-of-trade scenario because all sectoral shifts are dominated by the initial change in foreign prices.

Table 3 shows the effect of the simulated shocks on the distribution of income after feeding the micro-simulation model with values for the linkage variables provided by the CGE counterfactuals. Overall, the distributional effects of the terms-of-trade shock as reflected in standard summary inequality and poverty measures are limited. Inequality tends to go down, but the change in inequality measures shown in the table barely exceeds one percent. The change is slightly more pronounced for poverty, reflecting the general drop in per capita income. It remains small, though. The only substantial effect occurs for SIMTOT3, when the poverty gap (P1) or the mean poverty gap squared (P2) is used, suggesting a worsening of the distribution at the very bottom.

As could be expected from the discussion above, distribution effects are more pronounced with the pure devaluation simulation, SIMDEV, and still more so with the last two macro-economic closures. The two entropy inequality measures increase by approximately 5 percent and the Gini coefficient gains 2 percent. As the drop in per capita income is bigger in this scenario, so is the increase in poverty. The same worsening at the very bottom of the income distribution as in SIMTOT3 is reflected in the larger increase of the P1 and P2 poverty measures.

The last two panels of table 3 reflect the asymmetry stressed above between the urban and the rural sectors. With the terms-of-trade scenario, inequality increases in the urban sector, but falls in the rural sector, the same being true with poverty in the first two macro-economic closures. With the pure devaluation scenario, the distribution worsens quite substantially—i.e. practically 2 percentage points of the Gini—in both sectors, and poverty increases. The reason why these changes are larger than observed for the overall distribution is that per capita income falls less in the countryside. Thus, the increase in inequality within both sectors is compensated by a fall in the inequality existing between sectors. Relative changes in poverty measures in both sectors match that evolution. They are smaller in the rural sector.

Micro-simulation techniques allow for a much more detailed description of distribution effects than may be seen from looking at a few summary inequality and poverty measures. For the terms-of-trade shock, the solid curves in graphs 1 and 2 show the full change in the distribution of income by picturing the percentage change in the mean income of each percentile of the population—using smoothed curves (cubic splines). These curves will be referred to as “income change curves” below.

Percentiles on the horizontal axis in graph 1 correspond to the initial ranking of households in the benchmark simulation. In that graph, the terms-of-trade shock appears to be equalizing. The income change curve decreases with the household rank, except for the highest ranks, where lower food budget shares dampen the negative effect of increasing relative food prices on real income. This result corresponds to what might be expected from the macro results in table 2. Rural agricultural self-employment incomes, which go to households who are located at the bottom of the distribution, decline less (in effect they increase) than the wage of skilled workers, who tend to be in the upper part. In turn, those households tend to lose less than households depending on self-employment non-agricultural income, many of whom are located at the top of the distribution. On the other hand, it is striking that the three macro-economic closures lead to practically the same curve.

Percentiles on the horizontal axis in graph 2 are obtained after re-ranking households by increasing per capita income in the counterfactual, as for standard inequality measurement. Again, the solid line represents changes in mean incomes. The difference with graph 1 is that households on which these mean changes are computed are not the same. Re-ranking may imply, for instance, that a household who was in the 15th percentile in the benchmark distribution ends up in the first percentile after the terms-of-trade shock because somebody in the household lost his/her job. Indeed, such an event would produce a relatively large relative loss in the income of the household. Yet, this kind of phenomenon would not show up in graph 1 unless households facing this situation are concentrated in some specific percentiles. If this is not the case, income changes due to occupational switches caused by the shock are simply averaged out. They appear more clearly in graph 2 after re-ranking. In particular, they are responsible for the fact that the poorest percentiles, which do not necessarily comprise only those households who were initially the poorest, are more affected by the crisis than percentiles in the lower middle income range in SIMTOT1. The comparison with the other macro-economic closures shows that the preceding effect may be more or less accentuated. The income change curve is increasing rather steeply over the first quartile of the distribution for SIMTOT1, but it is much flatter for SIMTOT2. That the curve is the steepest at the very bottom for SIMTOT3 is due to the bigger increase in extreme poverty shown by P1 and P2 in table 3 for that closure.

The upper part of the income change curves remains decreasing, except at the very top. The shape is much closer to what was obtained in graph 1 with no re-ranking. That part of the curve is responsible for the drop in summary inequality measures shown in table 3. Yet, it is clear from graph 2 that this drop in inequality is ambiguous. An inequality measure with enough weight on the bottom of the distribution would show an unequalizing, rather than equalizing, effect of the terms-of-trade shock.

The difference between income change curves without and with re-ranking is still more striking with the scenario of a devaluation caused by a drop in foreign savings (SIMDEV in graphs 3 and 4). Without re-ranking, the same downward sloping shape as with SIMTOT is obtained for the first 3 quartiles. In the upper quartile, income losses tend to decrease as one moves further up in the distribution. With SIMTOT, this effect was limited to the top decile. The explanation of that difference comes from the fact that the change in the relative price of food products is much bigger with SIMDEV. Thus the dampening effect of decreasing food shares starts at a level of income lower than for SIMTOT.

Re-ranking in graph 4 modifies the shape of the income change curves more radically than in the previous scenario. First, the same steeply increasing segment appears at the bottom of the distribution, which may be interpreted in the same way as for SIMTOT. Differences in steepness are also noticeable when comparing the first macro-economic closure and the others. Second, the middle of the curve becomes flat, whereas it was decreasing before re-ranking. As a result, the whole income change curve now looks upward sloping everywhere, and is so under all three macro-economic closures. The explanation for this flattening of the income change curve after re-ranking is the same as that for the change of slope at the bottom. It is essentially due to changes in occupations producing bigger changes in household income than changes in wage rates or self-employment incomes. Because the shock is bigger in SIMDEV, this phenomenon is stronger than with SIMTOT. Closer scrutiny also shows that it is more frequent in the third quartile, where most workers in the formal sector are located. Re-ranking sends these households further down in the distribution and moves up those households in the second quartile who had the least negative income change. This switch contributes to flattening the income change curve.

5. Micro-simulation versus representative household groups (RHG)

A key question is whether this micro-simulation approach adds very much to the standard RHG approach to modeling distribution issues within a macroeconomic framework. To answer this question, this section compares the preceding results obtained with the help of the micro-simulation model with results that would have been obtained using RHGs and assuming that the within-group distributions do not change. This comparison suggests that the differences may be quite substantial, in one case even reversing the sign of the effect of the shock on inequality.

Rather than using the prediction of the CGE model for the mean income of the RHGs incorporated in it, and combining accordingly the income distribution observed within those groups, a shortcut was used. We classified households in the original micro-simulation sample into groups corresponding to the RHGs in the CGE model—see appendix A—and then multiplied their incomes by the average income change predicted for that group in the simulation under study. The average income change found in the micro-simulation, rather than the change found in the CGE model, was used. Thus, the result does not really correspond to what would have been obtained directly with a CGE/RHG approach. The bias implied by this simplification is to make the two approaches more similar. Simulated changes in summary inequality and poverty measures obtained with the RHG approach appear in table 4. Dotted curves in graphs 1-4 show the mean income change by percentile of the distribution simulated with the RHG approach before and after re-ranking—note that the re-ranking generally is not the same with the micro-simulation and the RHG approaches.

Differences in summary inequality and poverty measures between micro-simulation (FULL) in table 3 and the RHG approach in table 4 are readily apparent. Because the overall effect of the terms-of-trade shock on summary aggregate inequality measures is low, the comparison of these aggregate measures is not meaningful. For the urban sector, however, the difference is substantial. The micro-simulation model results show an increase in inequality, whereas the RHG approach shows practically no change. Likewise, the increase in all poverty measures is much bigger with the micro-simulation model.

Because distribution effects are bigger, the SIMDEV simulation leads to much larger differences between the two approaches. Some results are even contradictory. Thus, the micro-simulation shows a clear increase in inequality for the whole distribution as well as for both its urban and rural components, whereas the RHG approach shows a drop in inequality for the whole distribution and practically no change in the urban and rural distributions. Likewise, the micro-simulation model leads to much bigger estimates of the effect of the shock on poverty.

The comparison of the dotted and solid curves in graphs 1 to 4 leads to a simple interpretation of the preceding differences. As all effects are more prominent with the SIMDEV simulation, it is convenient to focus on this scenario first. Three observations come immediately to mind when examining graphs 3 and 4: (a) The dotted and solid income change curves are very close to each other when no re-ranking of households takes place. Both sets of curves are downward sloping overall, although the micro-simulation (solid) curves change slope at the very top of the distribution. (b) The dotted curves are very similar across macro-economic closures, whereas this is much less the case for the solid curves. (c) Re-ranking modifies drastically the income change curves for the micro-simulation approach, which then slope upward. In contrast, minor changes take place for the dotted RHG curves. Overall, the difference between the income change curves associated with the two approaches in graph 4 is striking: a slight equalizing of real incomes for the RHG approach and an unambiguous worsening of the distribution for the micro-simulation approach.

Two features of the micro-simulation approach are responsible for these three differences. The first has to do with the role of occupational changes in the micro-simulation approach. As long as there is no re-ranking, these occupational changes are interpreted in the same way as changes in earnings or self-employed incomes, and the two approaches yield similar income change curves. On closer scrutiny, however, it is found that these occupational changes tend to concentrate in those percentiles where the distance between the two curves in graph 3 is the largest. This result is to be expected. If occupational changes leading to big changes in household income were uniformly distributed within each representative group, there would be no difference between the two approaches from that point of view. The same argument also explains why re-ranking modifies substantially the income change curve with the micro-simulation approach, but has limited effects in the case of the RHG approach.

The second feature responsible for the differences outlined above is the heterogeneity of consumption behavior—i.e. budget shares—in the micro-simulation approach. The distribution of real income within each household group in the RHG approach is assumed to be constant and could not be affected by a change in relative consumer prices. Things are different in the micro-simulation approach. Even though the relative nominal incomes within each group might not be affected by the shock being simulated, a change in relative consumption prices would be responsible for changes in the distribution of real income. As noted above, this phenomenon is responsible for the upward sloping of the income change curve at the right end of the distribution even before re-ranking. It is not present in the dotted curves of graph 3.

Conclusion

The top-down, micro-macro framework discussed in this paper generates income changes in a sample of actual households drawn from a household survey that are consistent, once they have been aggregated, with the predictions of a multi-sector CGE macro model. At the micro level, income changes are obtained through an explicit representation of the actual combination of different income sources within households, the way in which these income sources are affected by macro phenomena, and the way their combination may change through desired or undesired modifications in the occupational status of household members. This method for estimating the distributional impact of macro shocks and policies contrasts with the usual approach, which consists of modeling the behavior of various representative household groups at the macro-level and then assuming that the distribution of income within those groups is exogenous and independent of the macro phenomena being studied.

The results from the experiments reported in this paper suggests that the micro-simulation and RHG approaches may lead to quite different estimates of the distributional effects of macro-economic shocks and policy changes. In some cases, the results have different signs—the micro-simulation approach points to a strongly unequalizing effect of a devaluation due to a reduction in foreign savings, whereas the RHG approach predicts a slight improvement in the distribution of real household income. There are two main reasons for this difference. First, the fact that the micro-simulation approach takes into account changes in occupations allows for an important source of actual changes in the distribution of income that is absent from the RHG approach. Second, the micro-simulation approach explicitly accounts for heterogeneous consumption behavior.

The fact that the micro-simulation approach proves to be more sensitive than the RHG approach in terms of income distribution is not necessarily a test of whether it is superior. Ultimately, its superiority lies in the fact that it accounts for phenomena that are known to be important in explaining distributional changes—that is, changes in types of occupation or combination of income sources and heterogeneous consumption behavior. But, then the problem is to know whether the representation of these phenomena is satisfactory. The ad hoc nature of some of the assumptions that permit linking in a simple top-down way a macro model and a household income model based on a full sample of households has been explicitly stressed. The same is true for the fact that the representation of the income generation behavior of households is based on reduced form rather than structural econometric modeling. More work is needed in order to integrate satisfactorily micro and macro approaches to distributional issues. The method proposed in this paper may be a useful practical step in that direction.

References

Adelman, I. and S. Robinson (1978), *Income distribution policy in developing countries: a case study of Korea*, New York: Oxford University Press.

Ahuja, V. et al. (1997), *Everyone's miracle? Revisiting poverty and inequality in East Asia*, Washington, D.C.: World Bank.

Alatas, V. and F. Bourguignon (2000) "The evolution of the distribution of income during Indonesian fast growth: 1980-1996". Mimeo. Princeton University.

Armington (1969), "The Geographic Pattern of Trade and the Effects of Price Changes." *International Monetary Fund Staff Papers* Vol. 16, No. 2, 179-201

Azis, I. and E. Thorbecke. 2001. "Modeling the Socio-Economic Impact of the Financial Crisis: The Case of Indonesia." Mimeo. Cornell University.

Bourguignon, F., F. Ferreira, and N. Lustig (1998), The microeconomics of income distribution dynamics, a research proposal, The Inter-American Development Bank and the World Bank, Washington

Bourguignon F., M. Fournier, and M. Gurgand (2001), "Fast Development with a Stable Income Distribution: Taiwan, 1979-1994." *Review of Income and Wealth*, 47(2), 139-163.

Browning, M. , L. Hansen, J. Heckman (1999), "Microdata and General Equilibrium models," in and Woodford (eds.), *Handbook of Macroeconomics*, Vol. 1A, North-Holland

Central Bureau of Statistics (CBS). 1998. "Perhitungan Jumlah Penduduk Miskin dengan GNP Per Kapita Riil". Mimeo. Jakarta.

Cogneau, D. 2001. "Formation du revenu, segmentation et discrimination sur le marché du travail d'une ville en développement : Antananarivo fin de siècle." DIAL DT/2001/18.

Cogneau, D. and A.S. Robilliard. 2001. "Growth, Distribution and Poverty in Madagascar: Learning from a Microsimulation Model in a General Equilibrium Framework." IFPRI TMD Discussion Paper No. 61 and DIAL DT/2001/19.

Decaluwe, B. and A. Martens (1988), "CGE Modeling and Developing Economies: A Concise Empirical Survey of 73 Applications to 26 Countries." *Journal of Policy Modeling,* v10, n4, pp. 529-68.

Dervis, K., J. de Melo and S. Robinson (1982), *General equilibrium models for development policy.* New York: Cambridge University Press.

Devarajan, Shantayanan, Jeffrey D. Lewis, and Sherman Robinson. 1993. "External Shocks, Purchasing Power Parity, and the Equilibrium Real Exchange Rate." *World Bank Economic Review*. Vol. 7, No. 1, pp. 45-63.

DiNardo J., N. Fortin and T. Lemieux (1996), "Labor Market Institutions and the Distribution of Wages, 1973-1992: A Semiparametric Approach." *Econometrica,* v64, n5 , 1001-44

Heckman, J. (2001), "Accounting for heterogeneity, diversity and general equilibrium in evaluating social programmes." *Economic Journal*, v111, n475, 654-99

Lofgren, Hans, Rebecca Lee Harris, and Sherman Robinson. (2001) "A Standard Computable General Equilibrium (CGE) Model in GAMS." IFPRI, Trade and Macroeconomics Division, Discussion Paper No. 75

Mookherjee, D. and A. Shorrocks (1982), "A Decomposition Analysis of the Trend in UK Income Inequality." *Economic Journal,* v92, n368, 886-902

Narayana N.S.S., K. S. Parikh and T. N. Srinivasan (1991), *Agriculture, growth and redistribution of income: Policy analysis with a general equilibrium model of India*, Contributions to Economic Analysis, no. 190. Amsterdam; Oxford and Tokyo: North-Holland; distributed in the U.S. and Canada by Elsevier Science, New York; New Delhi: Allied

Plumb, M. (2001), *Empirical tax modeling: an applied general equilibrium model for the UK incorporating micro-unit household data and imperfect competition*, Dphil Thesis, Nuffield College, University of Oxford.

Robilliard, Anne-Sophie, Francois Bourguignon and Sherman Robinson (2001), "Crisis and Income Distribution: A Micro-Macro Model for Indonesia," Mimeo.

Robinson, S., A. Cattaneo, and M. El-Said. (2001) "Updating and Estimating a Social Accounting Matrix Using Cross Entropy Methods." *Economic Systems Research*. Vol. 13, No. 1, pp. 47-64.

Robinson, Sherman. 1989. "Multisectoral Models." Chapter 18, in *Handbook of Development Economics*. H. Chenery and T.N. Srinivasan (eds.). Amsterdam: North-Holland Publishing Co.

Taylor, E. and I. Adelman (1996), *Village economies: the design, estimation and use of villagewide economic models.* Cambridge: Cambridge University Press

Townsend, R.M., and K. Ueda (2001), "Transitional Growth and Increasing Inequality with Financial Deepening." Paper presented at IMF conference on "Macro economics and poverty reduction," April 2001

Table 1: Simulations

*Terms of Trade shock (50% decrease in price of petroleum & chemicals)	
SIMTOT1	BALANCED CLOSURE (all elements of absorption adjust)
SIMTOT2	SAVING-DRIVEN INVESTMENT & FLEXIBLE GOVERNMENT SPENDING
SIMTOT3	SAVING-DRIVEN INVESTMENT & FLEXIBLE VAT RATE

*Devaluation (30% decrease in foreign savings)	
SIMDEV1	BALANCED CLOSURE (all elements of absorption adjust)
SIMDEV2	SAVING-DRIVEN INVESTMENT & FLEXIBLE GOVERNMENT SPENDING
SIMDEV3	SAVING-DRIVEN INVESTMENT & FLEXIBLE VAT RATE

Table 2: Macroeconomic simulation results

	BASE	**SIMTOT1**	**SIMTOT2**	**SIMTOT3**	**SIMDEV1**	**SIMDEV2**	**SIMDEV3**
GDP at Factor Costs (Rp thousands of billions)	535,6	-0,4	-0,5	-0,4	-0,9	-1,6	-1,6
Exports (Rp thousands of billions)	122,7	4,4	3,5	4,2	28,5	25,2	25,5
Imports (Rp thousands of billions)	126,8	-10,0	-10,9	-10,3	-19,5	-22,7	-22,5
Exchange Rate	1,0	15,0	14,5	15,1	31,6	25,7	25,8
Food/Non Food Terms of Trade	1,0	7,1	9,0	7,6	15,2	16,8	16,2
Incorporated Capital Income	1,0	-13,1	-15,1	-18,0	6,5	0,2	-0,6
Agricultural Self Employment Income	1,6	7,3	9,3	6,1	8,0	9,0	8,0
Non Agricultural Self Employment Income	4,5	-6,0	-7,0	-6,5	-4,9	-7,4	-7,2
Skilled Labor Wage	4,9	-5,4	-4,8	-8,2	-8,4	-11,0	-12,0
Unskilled Labor Wage	2,7	-6,6	-6,0	-9,8	-12,6	-25,0	-26,1

Source: CGE model simulation results.

Notes: 1. Incorporated Capital Income includes private, public, and foreign capital income.
2. Self employment incomes are equal to value-added divided by the number of labor units.
3. Wage incomes are equal to value-added divided by the number of labor units.

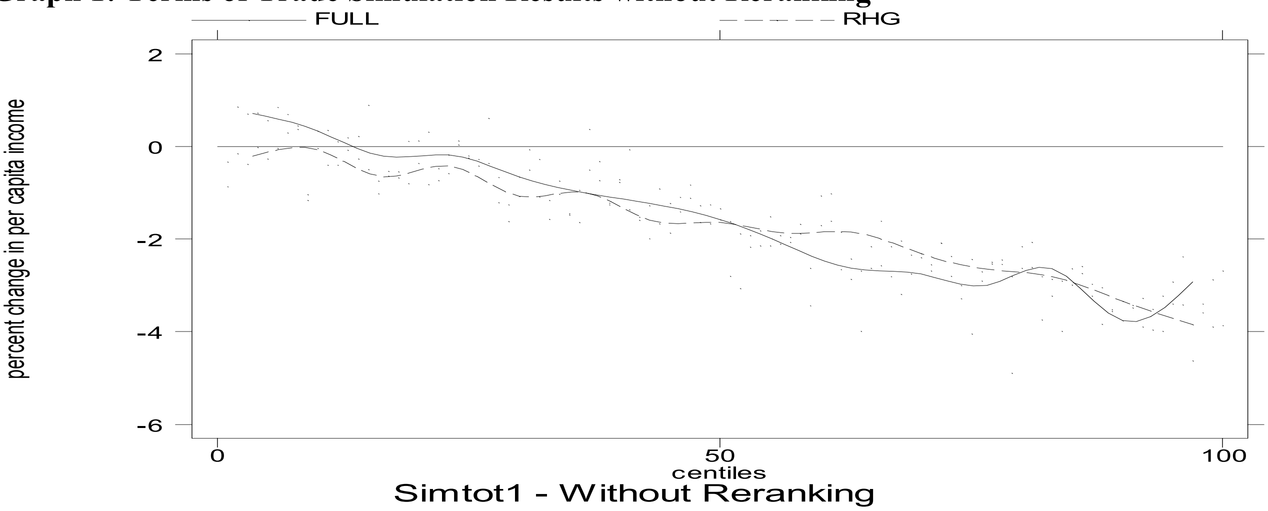
Table 3: Microeconomic simulation results with full microsimulation model (FULL)

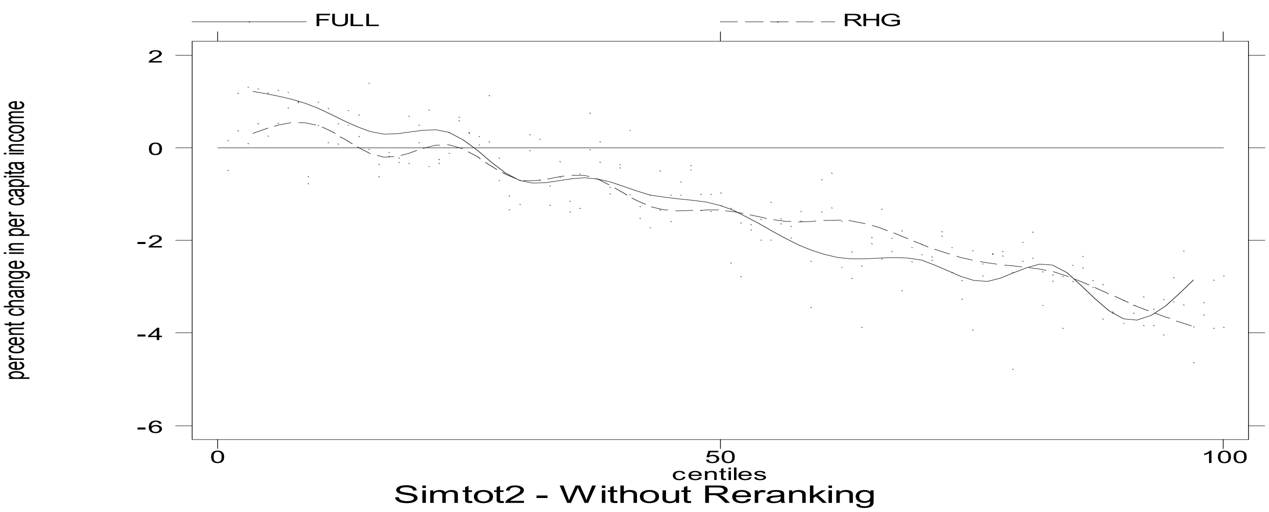
ALL	**BASE**	**SIMTOT1**	**SIMTOT2**	**SIMTOT3**	**SIMDEV1**	**SIMDEV2**	**SIMDEV3**
Per Capita Income	121,1	-2,6	-2,4	-3,8	-4,3	-6,4	-6,8
Entropy Index (0)	35,5	-1,4	-1,5	-0,6	1,7	4,9	5,2
Entropy Index (1)	49,3	-0,8	-1,0	-0,1	2,2	4,4	4,7
Gini Index	45,6	-0,8	-0,9	-0,4	0,6	2,0	2,1
Head-Count Index (P0)	9,2	5,3	4,4	9,8	15,5	36,9	39,6
Poverty Gap Index (P1)	2,2	4,1	3,1	11,8	22,6	49,9	53,1
Poverty Severity Index (P2)	0,9	5,4	3,9	14,2	27,9	60,6	63,8
URBAN	**BASE**	**SIMTOT1**	**SIMTOT2**	**SIMTOT3**	**SIMDEV1**	**SIMDEV2**	**SIMDEV3**
Per Capita Income	170,9	-5,1	-5,3	-6,5	-6,8	-9,7	-10,0
Entropy Index (0)	38,7	2,6	3,0	3,6	6,0	9,2	9,5
Entropy Index (1)	53,9	2,7	3,0	3,5	5,8	8,5	8,6
Gini Index	47,5	1,2	1,3	1,6	2,7	4,1	4,2
Head-Count Index (P0)	4,0	29,1	31,1	37,8	40,8	74,9	77,5
Poverty Gap Index (P1)	1,1	29,8	34,3	41,7	50,8	90,5	94,0
Poverty Severity Index (P2)	0,4	37,3	42,8	51,0	60,8	111,3	115,3
RURAL	**BASE**	**SIMTOT1**	**SIMTOT2**	**SIMTOT3**	**SIMDEV1**	**SIMDEV2**	**SIMDEV3**
Per Capita Income	90,6	0,3	1,0	-0,7	-1,5	-2,6	-3,1
Entropy Index (0)	25,5	-0,4	-0,1	1,1	3,4	9,4	9,8
Entropy Index (1)	33,1	0,0	-0,2	1,2	3,4	8,2	8,7
Gini Index	38,7	-0,3	-0,3	0,3	1,3	4,0	4,2
Head-Count Index (P0)	12,4	0,6	-0,9	4,3	10,5	29,4	32,2
Poverty Gap Index (P1)	2,9	-1,6	-3,8	5,3	16,4	40,9	44,1
Poverty Severity Index (P2)	1,2	-1,5	-4,6	6,2	20,7	49,5	52,6

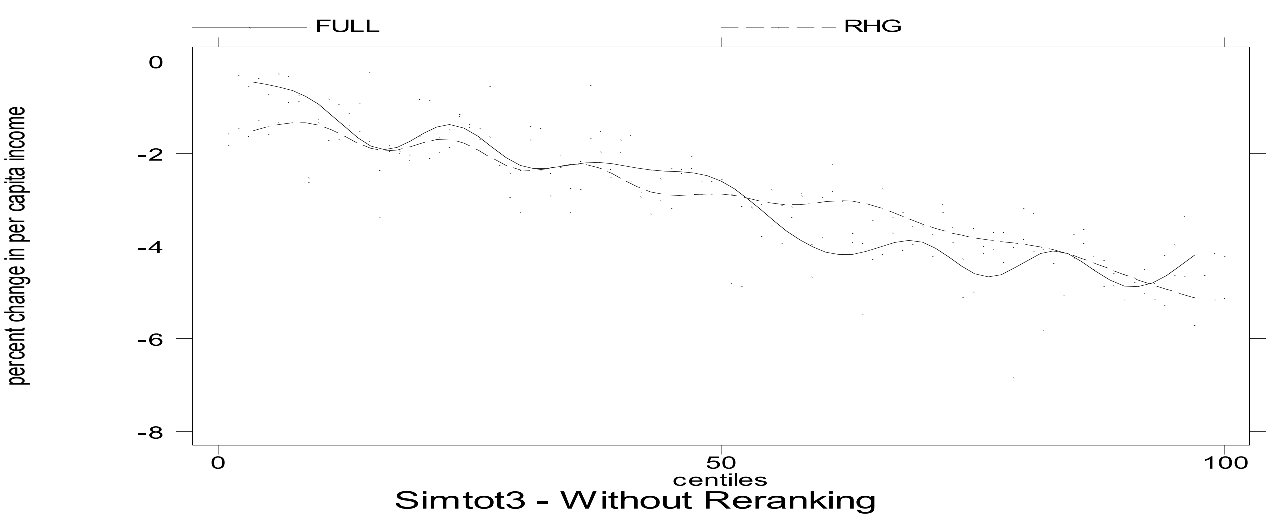
Table 4: Microeconomic simulation results with Representative Household Groups (RHG)

ALL	**BASE**	**SIMTOT1**	**SIMTOT2**	**SIMTOT3**	**SIMDEV1**	**SIMDEV2**	**SIMDEV3**
Per Capita Income	121,1	-2,5	-2,3	-3,8	-4,3	-6,4	-6,8
Entropy Index (0)	35,5	-2,6	-3	-2,6	-2,1	-2,1	-2
Entropy Index (1)	49,3	-2,5	-2,9	-2,6	-2,1	-2,3	-2,2
Gini Index	45,6	-1,3	-1,5	-1,3	-1,1	-1,1	-1
Head-Count Index (P0)	9,2	0,8	-0,8	4	8,1	16,2	17,2
Poverty Gap Index (P1)	2,2	0,8	-0,8	5,1	8,4	17,5	19,5
Poverty Severity Index (P2)	0,9	0,9	-0,5	4,9	8,1	16,8	18,6
URBAN	**BASE**	**SIMTOT1**	**SIMTOT2**	**SIMTOT3**	**SIMDEV1**	**SIMDEV2**	**SIMDEV3**
Per Capita Income	170,9	-4,9	-5,1	-6,4	-6,6	-9,5	-9,8
Entropy Index (0)	38,7	-0,4	-0,4	-0,3	0,3	1	1,1
Entropy Index (1)	53,9	-0,4	-0,5	-0,4	0	0,2	0,3
Gini Index	47,5	-0,2	-0,2	-0,1	0,2	0,4	0,5
Head-Count Index (P0)	4	17,7	18,3	22,5	26,6	39,1	39,3
Poverty Gap Index (P1)	1,1	14,6	15,1	20,2	25,5	43,2	45,3
Poverty Severity Index (P2)	0,4	13,4	13,8	19,1	24,4	42,6	44,9
RURAL	**BASE**	**SIMTOT1**	**SIMTOT2**	**SIMTOT3**	**SIMDEV1**	**SIMDEV2**	**SIMDEV3**
Per Capita Income	90,6	0,2	0,9	-0,8	-1,7	-2,8	-3,3
Entropy Index (0)	25,5	-0,5	-0,6	-0,2	-0,2	0,9	1
Entropy Index (1)	33,1	-0,3	-0,3	0	0,1	1,3	1,3
Gini Index	38,7	-0,3	-0,3	-0,1	-0,1	0,4	0,4
Head-Count Index (P0)	12,4	-2,5	-4,6	0,4	4,4	11,7	12,8
Poverty Gap Index (P1)	2,9	-2,2	-4,3	1,7	4,6	11,8	13,8
Poverty Severity Index (P2)	1,2	-1,8	-3,6	1,8	4,5	11,1	12,9

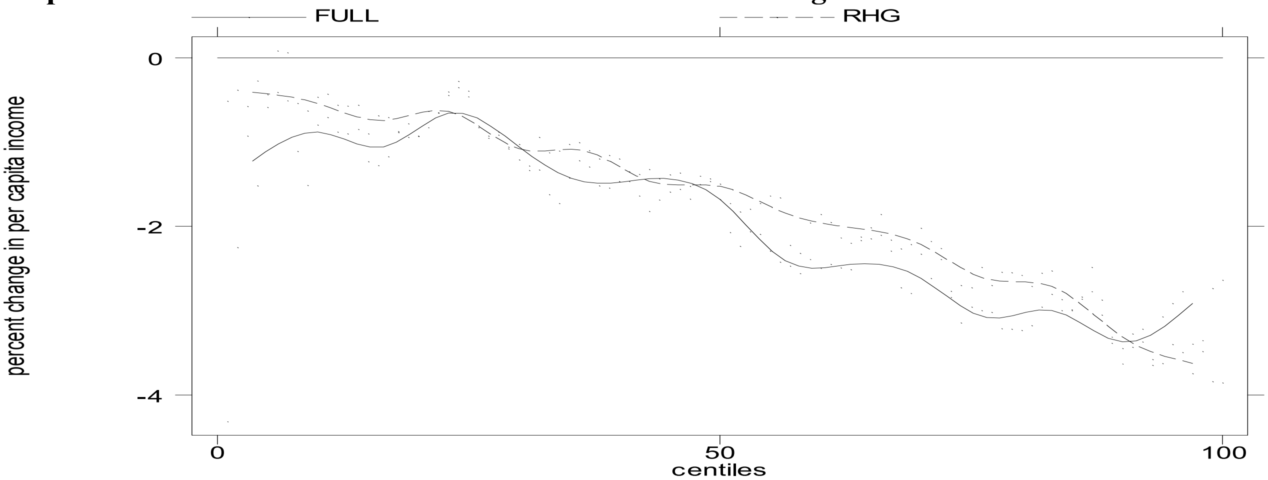
Graph 1: Terms of Trade Simulation Results without Reranking



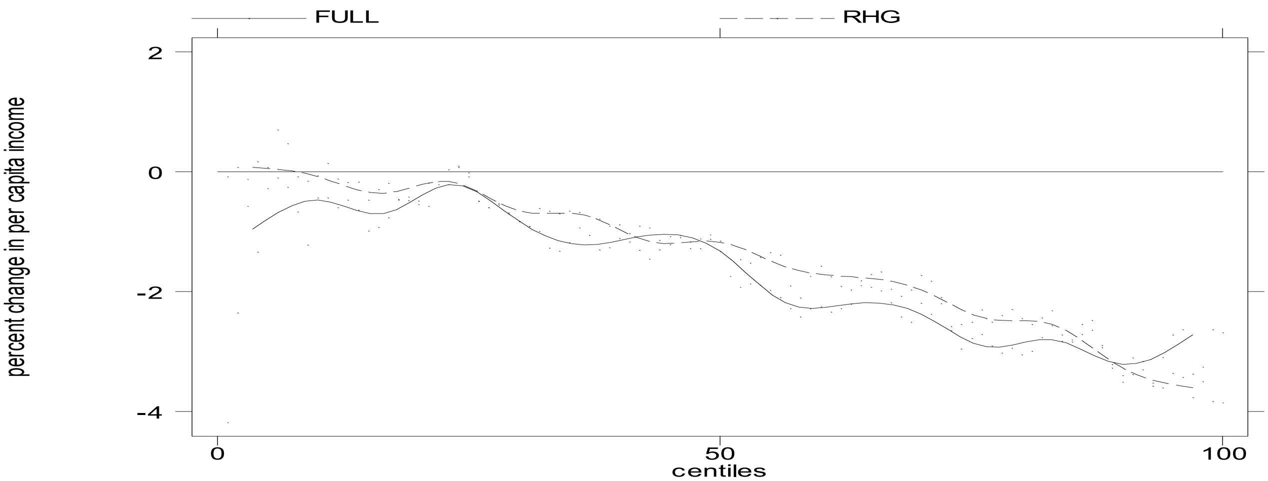




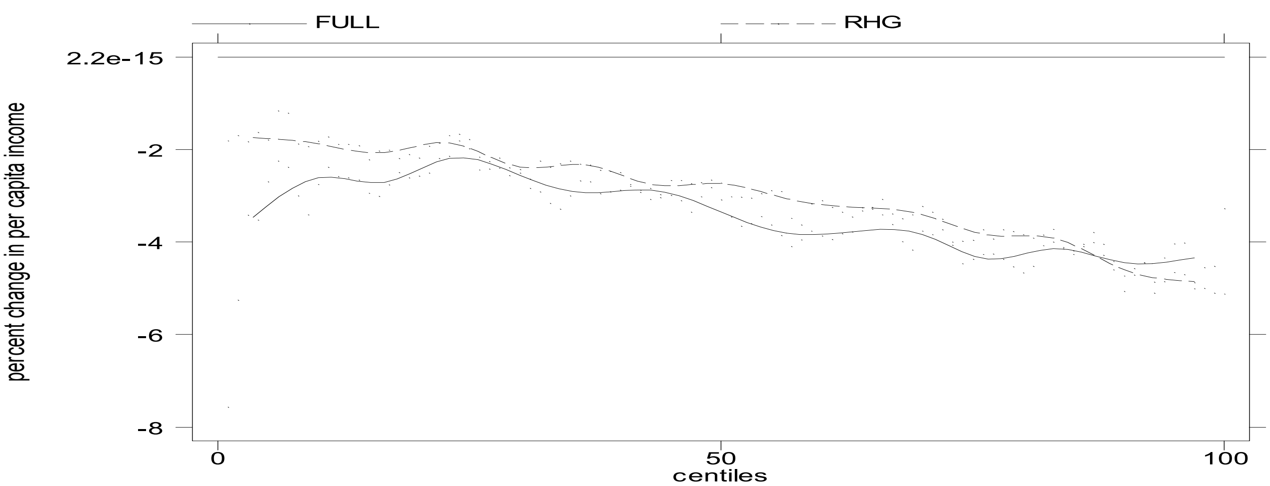
Graph 2: Terms of Trade Simulation Results with Reranking



Simtot1 - With Reranking

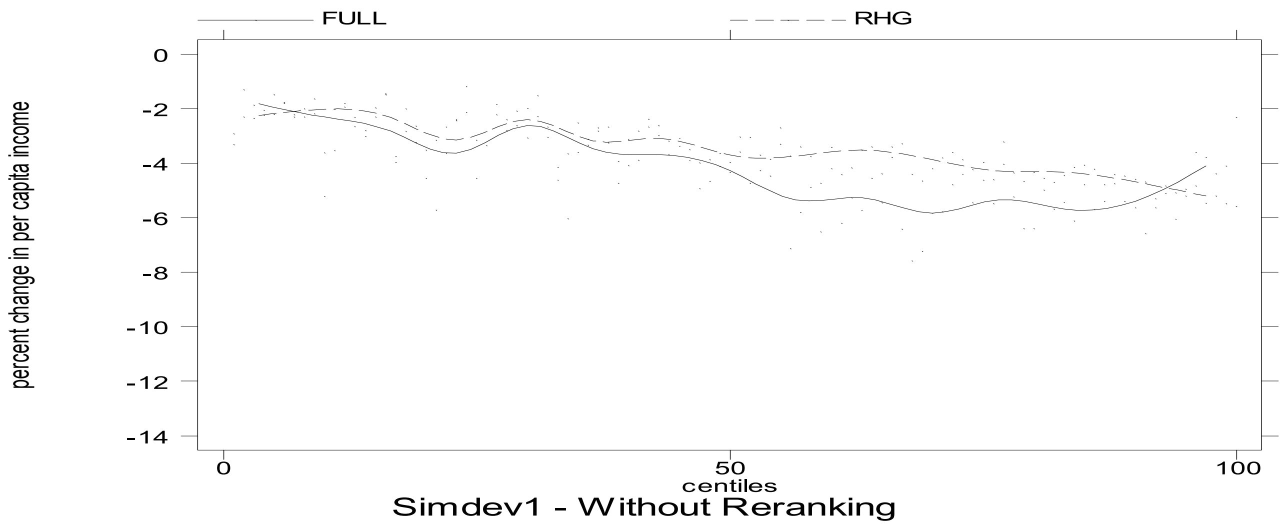


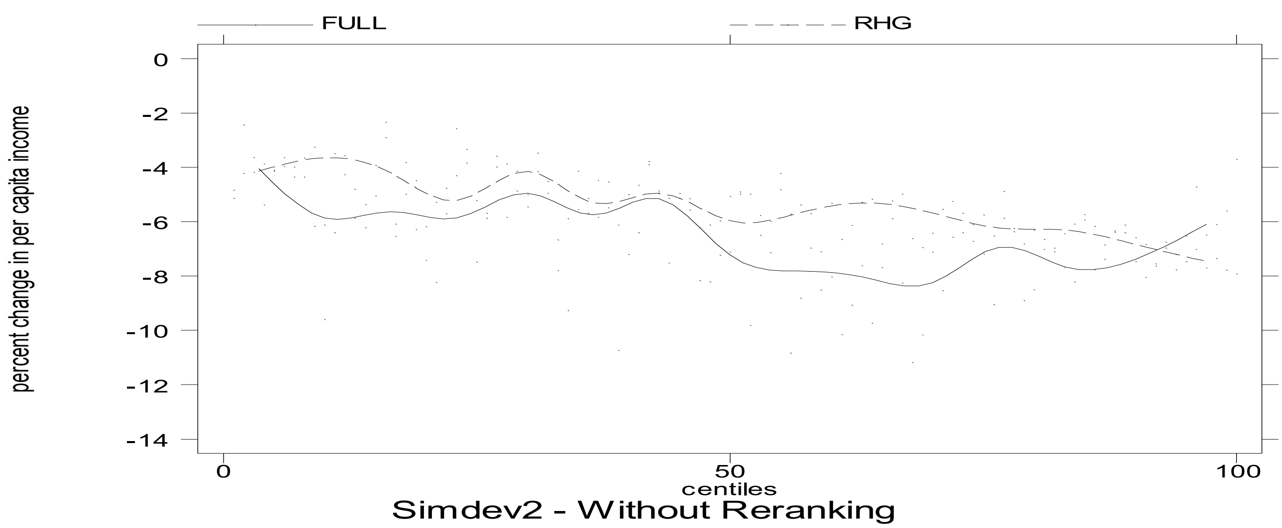
Simtot2 - With Reranking

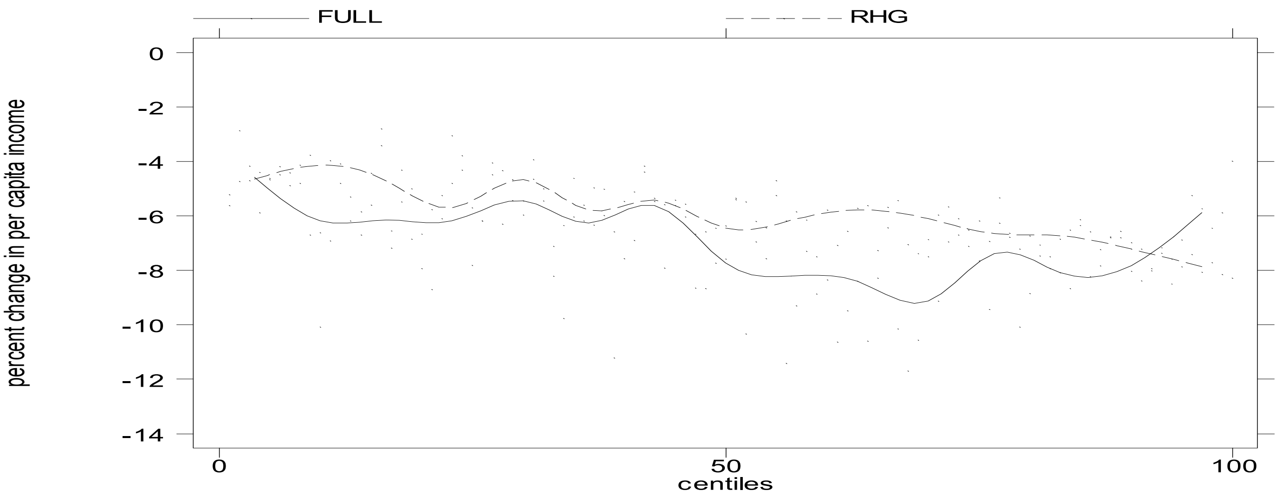


Simtot3 - With Reranking

Graph 3: Devaluation Simulation Results without Reranking

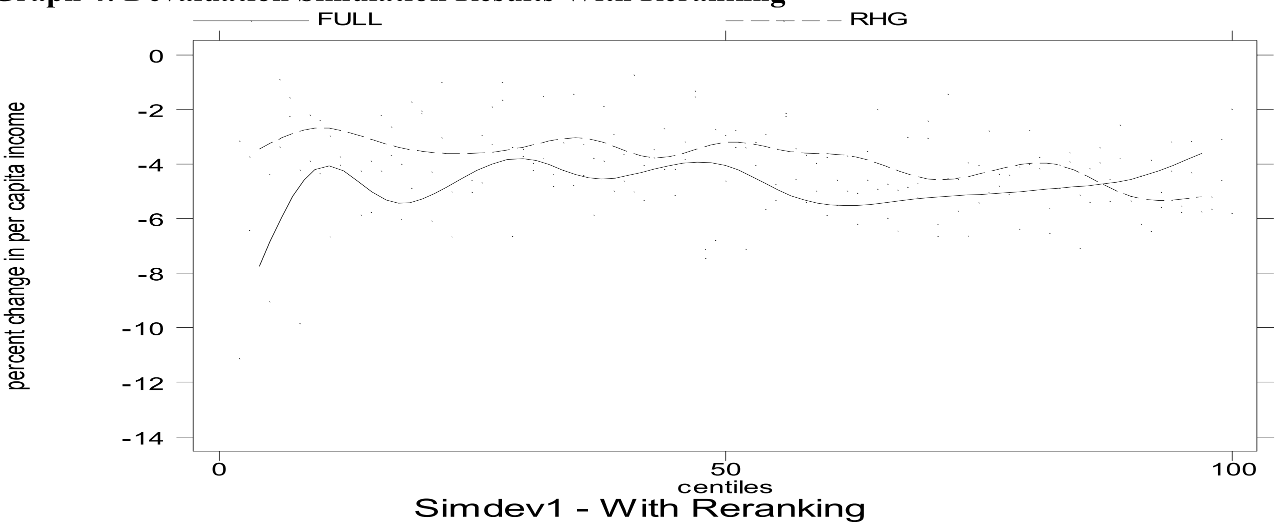


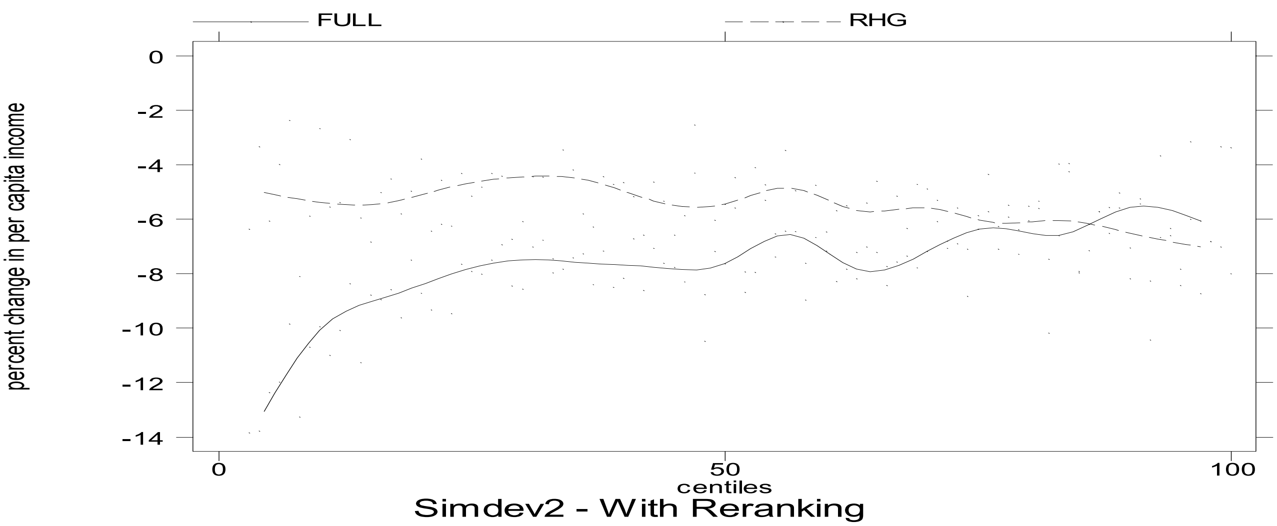


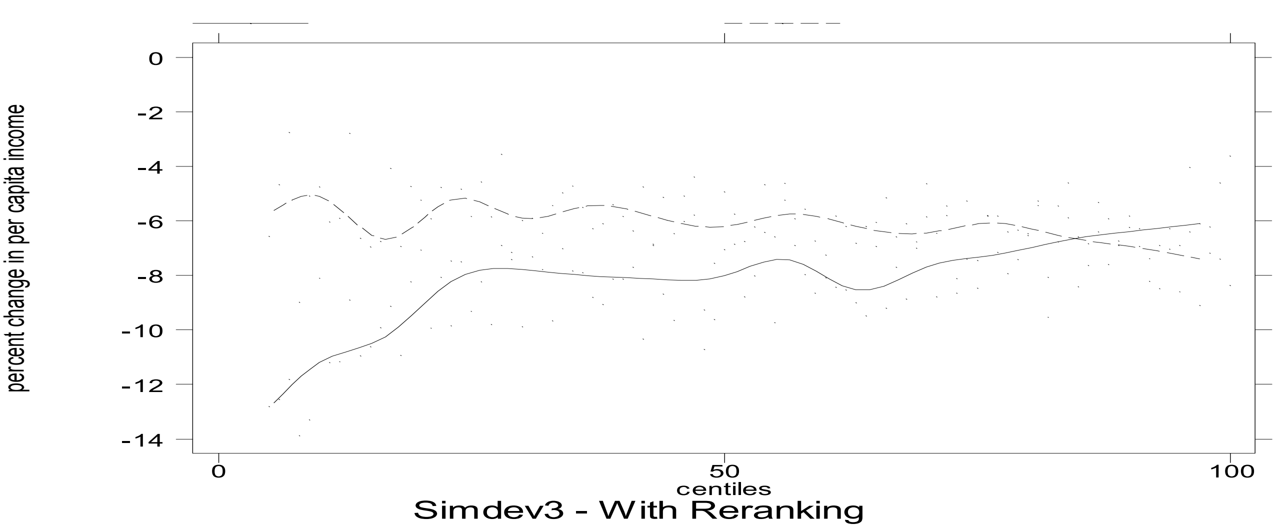


Simdev3 - Without Reranking

Graph 4: Devaluation Simulation Results With Reranking







Appendix A: Structure of the Social Accounting Matrix

Activities

AA-AGFOO	Farm Food Crops
AA-AGCAS	Farm Non Food Crops
AA-AGLIV	Livestock Products
AA-AGFOR	Forestry & Hunting
AA-AGFIS	Fishery & Drying & Salting of Fish
AF-COGAP	Coal & Metal Ore & Petroleum & Natural Gas
AI-OTHMI	Other Mining & Quarrying - Informal
AF-OTHMI	Other Mining & Quarrying - Formal
AI-FOODB	Food, Beverages & Tobacco Manufacturing - Informal
AF-FOODB	Food, Beverages & Tobacco Manufacturing - Formal
AI-TEXTI	Spinning & Textile & Leather & Wearing Apparel Manufacturing Industry - Informal
AF-TEXTI	Spinning & Textile & Leather & Wearing Apparel Manufacturing Industry - Formal
AI-WOODI	Wood & Wood Products Industries - Informal
AF-WOODI	Wood & Wood Products Industries - Formal
AI-PAPER	Paper Printing, Transport Equipment, Metal Products & Other Manufacturing Industries - Informal
AF-PAPER	Paper Printing, Transport Equipment, Metal Products & Other Manufacturing Industries - Formal
AI-CHEMF	Chemical Fertilization & Clay Products & Cement & Basic Metal Manufacturing Industries - Informal
AF-CHEMF	Chemical Fertilization & Clay Products & Cement & Basic Metal Manufacturing Industries - Formal
AF-ELECW	Electricity & Gas & Water Supply
AI-CONST	Construction Sector - Informal
AF-CONST	Construction Sector - Formal
AI-TRADE	Whole Sale & Retail Trade & Transport - Storage - Warehousing - Informal
AF-TRADE	Whole Sale & Retail Trade & Transport - Storage - Warehousing - Formal
AI-RESTA	Restaurants - Informal
AF-RESTA	Restaurants - Formal
AI-HOTEL	Hotel and Lodging Places - Informal
AF-HOTEL	Hotel and Lodging Places - Formal
AI-TRANS	Road Transport and Railways - Informal
AF-TRANS	Road Transport and Railways - Formal
AI-AIRTR	Air & Water Transport & Communications - Informal
AF-AIRTR	Air & Water Transport & Communications - Formal
AI-BANKI	Banking and Insurance - Informal
AF-BANKI	Banking and Insurance
AI-REALE	Real Estate and Business Services - Informal
AF-REALE	Real Estate and Business Services - Formal
AF-PUBLI	Public Administration, Defense, Social, Recreational & Cultural Services
AI-OTHSE	Personal Household & Other Services - Informal
AF-OTHSE	Personal Household & Other Services - Formal

Commodities

C-AGFOOD	Farm Food Crops
C-AGCASH	Farm Non Food Crops
C-AGLIVE	Livestock & Products
C-AGFORE	Forestry & Hunting
C-AGFISH	Fishery & Drying & Salting of Fish
C-COGAPE	Coal & Metal Ore & Petroleum & Natural Gas
C-OTHMIN	Other Mining & Quarrying
C-FOODBE	Food & Beverages & Tobacco Manufacturing
C-TEXTIL	Spinning & Textile & Leather and Wearing Apparel Manufacturing Products

C-WOODIN	Wood & Wood Products
C-PAPERP	Paper Printing, Transport Equipment, Metal Products & Other Manufacturing Products
C-CHEMFE	Chemical Fertilization & Clay Products & Cement & Basic Metal Manufacturing Products
C-ELECWA	Electricity & Gas & Water Supply
C-CONSTR	Construction Sector
C-TRADES	Whole Sale & Retail Trade & Transport - Storage – Warehousing
C-RESTAU	Restaurants
C-HOTELS	Hotel and Lodging Places
C-TRANSP	Road Transport and Railways
C-AIRTRN	Air & Water Transport & Communications
C-BANKIN	Banking and Insurance
C-REALES	Real Estate and Business Services
C-PUBLIC	Public Administration, Defense, Social, Recreational & Cultural Services
C-OTHSER	Personal Household & Other Services
Labor	
LAB-UMU	Urban Male Unskilled Labor
LAB-UMS	Urban Male Skilled Labor
LAB-UFU	Urban Female Unskilled Labor
LAB-UFS	Urban Female Skilled Labor
LAB-RMU	Rural Male Unskilled Labor
LAB-RMS	Rural Male Skilled Labor
LAB-RFU	Rural Female Unskilled Labor
LAB-RFS	Rural Female Skilled Labor
Capital	
CAP-LAND	Land
CAP-HOUS	Owner Occupied Housing
CAP-ORUR	Unincorporated Rural Capital
CAP-OURB	Unincorporated Urban Capital
CAP-PRIV	Incorporated Domestic Private Capital
CAP-PUBL	Incorporated Domestic Public Capital
CAP-FORE	Incorporated Foreign Capital
Institutions	
HH-AGEMP	Agricultural Households – Employees
HH-AGL05	Agricultural Households - Operators 0.0 to 0.5 ha
HH-AGL10	Agricultural Households - Operators 0.5 to 1.0 ha
HH-AGLBG	Agricultural Households - Operators more than 1.0 ha
HH-LORUR	Non Agricultural Households - Lower Level Rural
HH-NLRUR	Non Agricultural Households - Non Labor Force Rural
HH-HIRUR	Non Agricultural Households - Higher Level Rural
HH-LOURB	Non Agricultural Households - Lower Level Urban
HH-NLURB	Non Agricultural Households - Non Labor Force Urban
HH-HIURB	Non Agricultural Households - Higher Level Urban
ENT	Companies
GOV	Government
VATAX	Value Added Tax
STAX	Sales Tax
IMPTAX	Import Tax
DIRTAX	Direct Tax
ROW	Rest of the World
SAVINV	Savings-Investment Account