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Simulating Targeted Policies with Macro Impacts: Poverty Alleviation Policies in Madagascar

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The modeling technique presented in this chapter integrates a static micro simulation module of labor supply or income and consumption demand, which is based on cross-sectional survey data with a static (computable general equilibrium [CGE]–type) macro module. This simulation model is designed to study the short- to medium-term impact of policies that select individuals within groups and have economywide implications. The model is applied to the case of large targeted poverty alleviation policies in Madagascar. The model builds on a structural microeconometric model of occupational choices and labor income that is estimated on a standard cross-sectional microeconomic data set derived from a "multitopic household survey" (see Scott 2003). The motivation for building and using this kind of tool is discussed in the first section. This discussion is followed by the micro simulation module and its econometric estimation and presentation of the integration of the macro and micro modules. The chapter concludes with simulations and results.

A Structural Microeconometric Model of Income Generation

This model is a member of the family of applied macro-micro tools that attempt to account for within-group heterogeneity when simulating the counterfactual distributive effect of a given policy or economic shock. In contrast with other approaches of the same family, this tool places greater weight on the microeconometric side of the model; as a consequence, its macroeconomic and multimarket framework is less sophisticated.

The tool employs a structural microeconometric modeling of occupational choices and labor income formation. Advances in microeconometrics allow the consideration of complex production, labor supply, and consumption behaviors of heterogeneous households and individuals confronted with transaction costs, information asymmetries, and employment rationing—that is, various kinds of "market imperfections." Cogneau and Robilliard (2007) consider the nonrecursive behavior of Malagasy agricultural households in the absence of a market for agricultural labor, which prevents the equalization of the productivity of agricultural labor between households. Structural microeconometric estimation may also explicitly consider the market structure that constrains the decisions of various agents. For example, Cogneau (1999, 2001) estimates a labor income and occupational choice model for Madagascar's capital city of Antananarivo under various assumptions on the segmentation (dualism) of the urban labor market. A synthesis of that earlier work follows.

A Simplified Macro Module Augmentation

The structural nature of the microeconomic module paves the way for a consistent connection to a macro module: agents react to prices and other signals that are determined at the macro level. Because even simple microeconomic models do not lead to perfect aggregation, outcomes from micro decisions must be summed up and measured against each other and against other macro aggregates. To achieve a consistent macro-micro equilibrium, some macro variables (such as prices) vary—until all aggregates arising from the micro components (such as the supply of categories of labor, the consumption demand, or total wage earnings) are equal to the corresponding macro aggregates (such as the demand for categories of labor, the domestic supply of consumption goods, and the wage bill). The macro module includes the determination of these latter macro aggregates and the specification of macro closures for each macro-accounting identity. The module built here is a simple three-market CGE model.

Study of Targeted Policies with Macro Impacts

Because of identification and algorithm limitations, structural microeconometric modeling usually precludes a high level of disaggregation of market segments or sectors. As a result, this approach is less suited for either the study of subtle intersectoral reallocations of supply and demand or fine modifications of the price and earnings schedule.[1]

Simulating short-term targeted policies with macro impacts might be the true comparative advantage of this type of model. This notion is explored in this chapter. In this context, "targeted policies" refers to policies that aim to reach specific categories of the population, most often among the poor, through various targeting devices. These devices include not only labor market interventions like wage policies and workfare programs or job creation linked to foreign direct investment, but also land reforms and product market interventions like marketing boards.

The first problem is to evaluate the efficiency of the targeting device. When the targeting is imperfect and depends on self-selection of individuals, a structural microeconometric model may be most useful. For instance, this model can be used to determine how many people will choose the new wage offer from a workfare program or from an export processing zone. Another problem is to assess the overall distributional impact of such policies within and outside the target population, particularly when its magnitude is big enough to have a macroeconomic impact. Under such circumstances, it may be helpful to apply a general equilibrium model with a clearly defined macro closure.

For instance, the integrated macro-micro modeling framework described in this chapter can be used to answer the following questions:

- How many people will benefit from an increase in the minimum wage, and how will this increase be transmitted to other segments in the labor market through a raise in the informal labor earnings?
- What are the respective impacts of a job-creation policy and of a wage policy in a developing country urban labor market?[2]
- How much will a food price subsidy that is operated through a marketing board benefit small farmers, and how much will it benefit the urban poor through a relative food price reduction?

- How much of the workforce will a workfare program attract, and what will be the consequences on the production and prices of other sectors and, hence, on the overall income distribution?

The Microeconometric Model of Income Generation

This section first presents a canonical version of the model and then discusses the basic identification and micro calibration issues. These are followed by some extensions.

The Labor Income Model

The labor income model presented here follows Roy's model (1951), as formalized by Heckman and Sedlacek (1985), and is characterized by Neal and Rosen (1998) as the most convincing model to explain labor income distribution.

In this model, each "individual" pertains to a given family or household whose composition and location are exogenously determined. Working-age individuals (those 15 years and older) have three types of work opportunities: family work, self-employed work, and wage work. Family work includes all kinds of activities supervised by the household head or the spouse, such as family help in agricultural activities, as well as domestic work, nonmarket labor, and various forms of declared "inactivity." Self-employed work corresponds to informal independent market activities. Wage work includes all other kinds of work performed by (mainly) civil servants and large-firm workers.

To self-employed work ($J = 1$) and wage work ($J = 2$), first assign two potential earnings functions. Individual potential earnings, w_{ji}, are the product of a task price, $\pi_j (J = 1, 2)$, and of a fixed idiosyncratic amount of efficient labor that depends on observable characteristics, X_i (education, labor market experience, and geographic dummies), as well as unobservable skills, t_{ji}:

$$\ln w_{1i} = \ln \pi_1 + X_i\beta_1 + t_{1i} \tag{7.1}$$

$$\ln w_{2i} = \ln \pi_2 + X_i\beta_2 + t_{2i}\,. \tag{7.2}$$

Returns to characteristics β_j are differentiated by sector and by gender.

To family work, associate an unobserved individual value that depends on both individual and household characteristics:

$$\ln \tilde{w}_{0i} = (X_{0i}, Z_{0h})\beta_0 + t_{0i}\,, \tag{7.3}$$

where $\tilde{w}_0$ may be seen as a reservation wage. Vector X_{0i} contains the same variables as X_i (education, labor market experience, and geographic dummies) plus a variable indicating the father's occupation. Vector Z_{0h} includes the demographic structure of the household and the household's nonlabor income.

Given these elements, the choice of an occupation J can be expressed as follows:

$$(7.4) \quad J = k \quad \text{iff } w_{ki} = \max(\tilde{w}_{0i}, w_{1i}, w_{2i}) \quad \text{for } k = 0, 1, 2 .$$

This simple form of the Roy occupational model assumes that the labor market is not imperfect or segmented; in other words, there is no job rationing.[3] In the presence of segmentation, the selection condition in equation (7.4) does not hold in many cases. Some individuals would prefer to work in a given segment but cannot find an available job. Without any loss of generality,[4] one may introduce one segmentation variable defined as the relative cost of entry between wage work and self-employment:

$$(7.5) \qquad \ln \tilde{w}_{2i} = \ln \tilde{\pi}_2 + X_{2i}\tilde{\beta}_2 + \tilde{t}_{2i} .$$

Finally, comparing the respective values attributed to the three labor opportunities, workers allocate their labor according to their individual comparative advantage. The selection condition in equation (7.4) is replaced by the following:

$$(7.6) \quad \begin{aligned} &i \text{ is observed in family work iff } \tilde{w}_{0i} > w_{1i} \text{ and } \tilde{w}_{0i} > \frac{w_{2i}}{\tilde{w}_{2i}} \\ &i \text{ is observed in self-employment iff } w_{1i} > \tilde{w}_{0i} \text{ and } w_{1i} > \frac{w_{2i}}{\tilde{w}_{2i}} \\ &i \text{ is observed in wage work iff } \frac{w_{2i}}{\tilde{w}_{2i}} > \tilde{w}_{0i} \text{ and } \frac{w_{2i}}{\tilde{w}_{2i}} > w_{1i} . \end{aligned}$$

Econometric Identification and Micro Calibration

The segmented model contains the simpler "competitive" Roy model as a particular constrained case (Magnac 1991).

For econometric identification, one must assume independence of the residuals $(t_0, t_1, t_2, \tilde{t}_2)$ between individuals—as well as joint normality for the $(t_0, t_1, t_2, \tilde{t}_2)$ vector:

$$(7.7) \qquad (t_0, t_1, t_2, \tilde{t}_2) \rightarrow N(0, \Sigma) .$$

Under these assumptions, the occupational choice and labor income model represented by the expressions in equations (7.1)−(7.3) and the series of selection conditions in equation (7.6) may then be estimated by maximum likelihood; one obtains a bivariate tobit, as in Magnac (1991). The coefficients of self-employment benefits and wages are exactly identified, but only some parameters of the family work value (or reservation wage) and of the relative cost of entry are identified, as shown later.

Likewise, only some elements of the underlying covariance structure between unobservables can be identified. Moreover, observed earnings are measured with errors or include a transient component $\varepsilon_j (j = 1, 2)$ that must be taken into account. These unobservable components of earnings do not enter into labor supply decisions of (risk-neutral) individuals. One may then assume for estimation:

$$(t_0, t_1, t_2, \tilde{t}_2, \varepsilon_1, \varepsilon_2) \rightarrow N(0, \Sigma^*). \tag{7.8}$$

Under these assumptions, eight variance or correlation parameters may be identified: $\rho = \text{corr}\ (t_1 - t_0, t_2 - \tilde{t}_2 - t_0)$, $\sigma_j = \sqrt{\text{var}(t_j + \varepsilon_j)}$, $k = \dfrac{\sqrt{\text{var}(t_1 - \tilde{t}_0)}}{\sqrt{\text{var}(t_2 - \tilde{t}_2 - \tilde{t}_0)}}$, $\lambda_1 = \text{corr}\ (t_1 + \varepsilon_1, t_1 - t_0)$, $\lambda_2 = \text{corr}\ (t_2 + \varepsilon_2, t_2 - \tilde{t}_2 - t_0)$, and $\mu_j = \text{corr}\ (t_j + \varepsilon_j, t_2 - \tilde{t}_2 - t_1)$ for $j = 1, 2$. While all the parameters of potential earnings in self-employment and wage work are identified, only the contrasts $\dfrac{\beta_1 - \beta_0}{\sigma(t_1 - t_0)}$ and $\dfrac{\beta_2 - \tilde{\beta}_2 - \beta_0}{\sigma(t_1 - \hat{t}_2 - t_0)}$ are identified.

For purposes of simulation, one needs to recover the parameters β_0 and $\tilde{\beta}_2$ for $\tilde{w}_0$ and $\tilde{w}_2$, respectively, and the whole covariance structure, Σ^*. Therefore, proceed to a micro calibration, assuming that measurement errors and transient components are white noises (uncorrelated with others). One might then "guesstimate" three kinds of parameters: (1) the variance of measurement errors, (2) the correlation (ρ_{12}) between t_1 and t_2, and (3) the standard error of $(t_2 - \tilde{t}_2 - t_1)$. A linear system of equations is then solved, with the econometrically estimated parameters and the guesstimated parameters as givens and remaining structural parameters as unknowns. Check that the resulting matrix Σ^* is semi-definite positive.

Then draw for each individual a whole set of unobservables (t_0, t_1, t_2, $\tilde{t}_2$, ε_1, ε_2) within the multidimensional normal distribution with the covariance structure Σ^* and constrain the draws to respect the occupational selection conditions in equation (7.6). For instance, for an individual who is observed in the informal sector, start from the observed $t_1 + \varepsilon_1$ and draw all other unobservable components conditionally on it, constraining the draws to respect $w_1 > \tilde{w}_0$ and $w_1 > \dfrac{w_2}{\tilde{w}_2}$. One finally obtains the set $(\tilde{w}_0, w_1, w_2, \tilde{w}_2)$ for each individual at base "prices" $(\pi_1, \pi_2, \tilde{\pi}_2) = (1, 1, 1)$.[5]

An Extension for Nonhead Household Members

Here assume a hierarchical decision-making process within the household. The household head makes his or her decision first, without taking into account the choices of other household members; the household head's spouse then makes his or her decision; and finally, the other working-age, secondary members make their decisions. The latter decisions are simultaneous. In making their choices, the other nonhead members do not consider the consequences of the decision on other household members.

Accordingly, in the case of nonhead members, a variable indicating the link to the household head (spouse/child/other) is added to the Z_0 vector. In the case of spouses, Z_0 also includes the head's occupational choices and earnings. In the case of nonspouse secondary household members, it includes both the head's and the spouse's occupational choice and earnings.[6]

Farm Income and Reservation Wage in Farm Households

Many household members are typically involved in farm activities.[7] To farming households, associate a reduced farm profit function derived from a Cobb-Douglas technology with homogeneous labor:

$$\ln \Pi_{0h} = \ln p_0 + \alpha \ln L_h + Z_h\theta + u_{0h} \,. \tag{7.9}$$

The variable L_h stands for the number of members working on the farm, while the vector Z_h includes the amount of land and capital, the household head's education and age, a dummy variable in the case of a female head, and geographic dummies.

Assume that the farm head always works on the farm (at least on a part-time basis; see the part-time extension in annex 7A). As a result, only nonhead members may choose whether or not to participate in farm work. Moreover, $\tilde{w}_0$ is assumed to depend on the individual's contribution to farm profits. Estimate this contribution as $\Delta\Pi_{0h}$, holding fixed the decisions of other household members and the farm global factor productivity u_0:

$$\ln \Delta\Pi_{0h} = \ln p_0 + \ln(L^{\alpha}_{h+i} - L^{\alpha}_{h-i}) + Z_h\theta + u_{0h} \,, \tag{7.10}$$

where $L_{h+1} = L_h$ and $L_{h-1} = L_h - 1$ if i is actually working on the farm in h, and $L_{h+1} = L_h + 1$ and $L_{h-1} = L_h$, alternatively.

Here again, the labor decision model is hierarchical between the head of the household and nonhead members, and simultaneous among nonhead members. Then write the value of family work as follows:

$$\ln \tilde{w}_{0i} = (X_{0i}, Z_{0h})\beta_0 + \gamma \ln \Delta\Pi_{0i} + t_{0i} \,, \tag{7.11}$$

where γ stands for the (nonunitary) elasticity of the value of family work in agricultural households to the price of agricultural products.

For estimation, assume that u_0, the idiosyncratic total factor productivity of the household, is independent from (t_0, t_1, t_2, $\tilde{t}_2$) for all household members.[8] This allows one to follow a limited information approach. In a first step, estimate the reduced profit function (7.10) and then derive an estimate for the individual potential contribution to farm production (7.10); in a second step, estimate the reservation wage equation (7.11), including this latter variable and retaining the wage functions estimated for nonagricultural households.[9] Again, make separate estimations for each gender, excluding the farm heads whose occupational choice is not modeled.

Results of Estimation and of Micro Calibration

The microeconometric model is estimated on a household sample provided by the Enquête Permanente auprès des Ménages (EPM) survey for 1993–94, with approximately 4,500 households and 12,800 individuals ages 15 years and older. The part-time extension presented in annex 7A is estimated. Annex 7B gives the results of the micro calibration procedure for all the coefficients of the four basic variables of the structural microeconomic model: $\tilde{w}_{0i}$, w_{1i}, w_{2i}, and $\tilde{w}_{2i}$.[10] Here the authors comment only on the results that are of importance for the subsequent simulations.

In the farm profit function estimates (not shown), the number of family workers comes out with a coefficient that is consistent with usual orders of magnitude: a doubling of the workforce leads to an increase of about 20 percent in agricultural profits. The amounts of arable land and of capital also come out with a decreasing marginal productivity and a similar impact on profits. Age and education of the farm head also come out with a positive and significant coefficient.

The returns to education are rather close in the self-employment and wage sectors. Returns to labor market experience (or to job tenure) are higher in the wage sector. Self-employment benefits are 25 percent lower in the rural areas. Costs of entry in the wage sector vary negatively with education and experience and, not surprisingly, are 20 to 25 percent higher in the rural areas.

The reservation wage in nonfarm households is positively related to education, the effect of which lies in between the returns to education in the informal sector and the "discounted" returns (monetary returns less cost of entry) in the wage sector. This wage is lower in both the rural area and the Antananarivo *faritany* (region), which translates into higher participation rates in those areas. Almost by definition, household heads are less often inactive and nonlabor income increases the propensity to stay inactive. The demographic structure of the household and the hierarchical decisions of other members play only a minor role in the decision to participate in the labor market.

In farm households, educated people prefer to work outside the farm, whether in self-employment or wage jobs (lower family-work value). When the farm head already works part time in nonagricultural activities, other household members have a higher propensity to do the same. Activity is more diversified out of agriculture in the Antananarivo *faritany*. The estimate of the effect of the marginal productivity of labor has a negative effect on the farm-work value. This effect could stem from the fact that resource-endowed agricultural households, with more land or more capital and hence a higher labor productivity, are more prone (or have more opportunities) to diversify their activities. It should, however, be stressed that this diversification of activity is not frequent among agricultural households. Only 13 percent of the total agricultural households' labor force works outside the farm at least part time, the bulk of which (10 percent) work in part-time informal activities. Diversification is higher for household heads (20 percent work outside of the farm) than for other members (only 10 percent work outside). This absence of real opportunities for diversification of activities among agricultural households, especially the poorest, is one of the most important features of the distribution of income in Madagascar, and it strongly constrains the short-run impact of agricultural price and workfare policies that are examined in the remainder of this chapter. This feature also explains why the authors could not obtain an acceptable estimate for the elasticity (γ, see the previous section) of the farm-work value with respect to the agricultural price, p_0. The remainder of this chapter fixes this elasticity to one, as in other sectors (see annex 7B).

Before turning to the features of the macro-micro integration, it is worth pointing out that this structural microeconomic framework has welfare implications that are only partially taken into account in this chapter. As far as occupational choices are concerned, agents are indeed assumed to derive utility not only from monetary income (whether it comes from labor or other sources), but also from job-specific attributes and from leisure. Nonmonetary arguments of utility are ignored in this analysis, which focuses on the distribution of household real income, that is, the sum of Π_0, w_1, w_2, and other nonlabor income deflated by a household-specific cost of living index (see annex 7C). These arguments are indeed reflected in the two variables $\tilde{w}_0$ and $\tilde{w}_2$, where $\tilde{w}_0$ stands for the utility of leisure or family work (including the relative cost of entry in self-employment)—recalling that in the case of farm households, it includes the profit from farm activities—and $\tilde{w}_2$ stands for the relative disutility of working in the wage sector. A "full-income" concept would sum up $\tilde{w}_0$, w_1, and $\frac{w_2}{\tilde{w}_2}$ over individuals within each household. In a first step, however, the authors prefer to use the microeconomic model as a tool only for generating counterfactual income distributions, even at the expense of theoretical consistency from the standpoint of welfare. This choice is led by the fact that $\tilde{w}_0$ and $\tilde{w}_2$ are purely unobserved variables that at the end of this micro calibration procedure, also come out with a high variance (see annex 7C). This variance is why the authors felt that the reliability of full-income counterfactuals was still to be explored, and thus left it for further research.

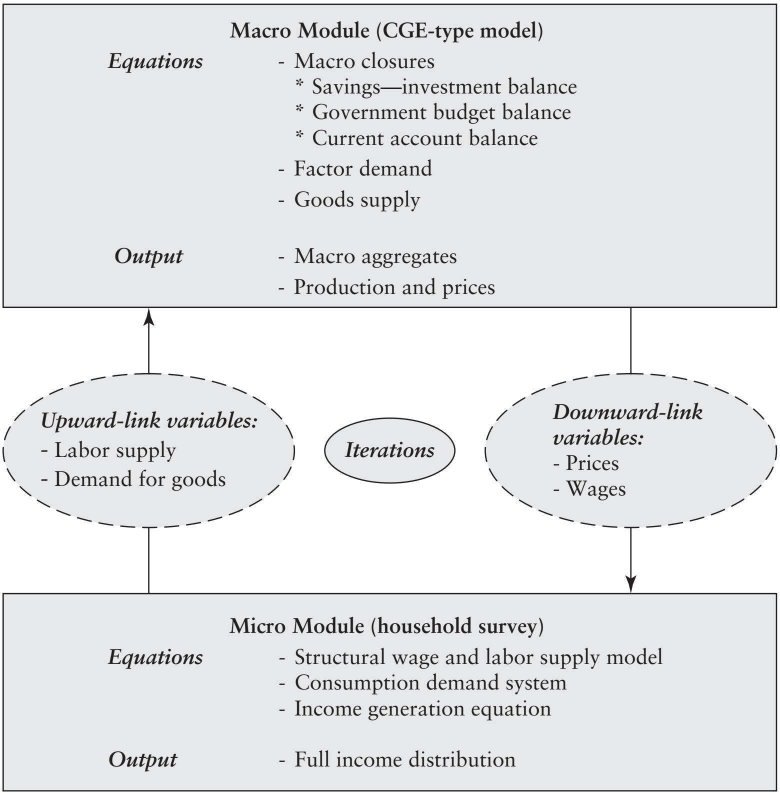
Macro-Micro Integration

Once micro calibration has been achieved, the segmented occupational choice and labor income model is ready for simulation. If the size of the economic shocks or policies under study is small enough, there is no need to consider macro-level interactions. The microeconometric model can be simulated alone, under the assumption that the variation of goods prices and of factor returns is negligible.[11] Conversely, if the size of the shocks or policies under study is large enough, macro-micro links must be considered.

The database for the macro module comes from a social accounting matrix (SAM) built for the year 1995 (Razafindrakoto and Roubaud 1997). To achieve consistency between micro and macro data, household statistical weights of the 1993–94 EPM were recomputed to comply with the income structure of the 1995 SAM. The reweighting procedure relies on a cross-entropy estimation (Robilliard and Robinson 2003).

Figure 7.1 presents the global structure of the macro-micro integration. Equations in the micro module describe the behavior of individuals and households in terms of their labor supply and consumption demand. At the micro level, all income sources, stemming from individual occupational choices and household-level endowments in capital, are added up in a household income generation equation. Household expenditure is computed as the disposable income after taxes and savings have been subtracted. Consumption demands for the different goods are then derived based on household-specific budget shares (see annex 7C). These household-level consumption

Figure 7.1 Fully Integrated Macro-Micro Model Structure



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

demands are added up and confronted to goods supply. Relevant prices are adjusted by a *tâtonnement* process so that market equilibrium is achieved. The same applies to labor market equilibrium, with labor supply defined as the sum of the individual occupational choices and wages defined as the adjustment variable. More specifically, the three task prices (π_1, π_2, $\tilde{\pi}_2$) and the agricultural price p_0, introduced above, are the variables that link the micro module to the macro module. The variables p_0 and π_1 are endogenously determined on the goods market equilibrium for agricultural and informal goods, respectively. The variable π_2 is exogenous and may be used to simulate a uniform wage increase in the wage sector, and $\tilde{\pi}_2$ varies endogenously to match labor supply with labor demand in the wage sector.

Only three sectors are considered in this model. The agricultural sector produces a tradable good and is a family-based sector, with total production equal to the sum of household-level productions.[12] The informal sector produces a nontradable good and is an individual-based sector, with total production equal to the sum of individual-level value added augmented by intermediate consumption. Finally, the formal sector produces a tradable good, and total domestic formal production is fixed. Both agricultural and formal goods are imperfect substitutes for exports, the formal good is a *perfect* substitute for imports, and the agricultural good is an *imperfect* substitute for imports. Following common specifications for this class of models, imperfect substitution is captured through constant elasticity of transformation (CET) functions at the production level and through constant elasticity of substitution (CES) functions at the consumption level.[13]

At the macro level, closure rules for three constraints need to be specified for the model to be "closed." They are the (current) government balance, the savings-investment balance, and the external balance (the current account of the balance of payments, which includes the trade balance). These three constraints may be expressed as follows:

$$GSAV = GINC - pq_f \cdot QG \tag{7.12}$$

$$FSAV = \left(\sum_h mps \cdot Y_h + GSAV - \sum_c pq_c QINV_c\right) / EXR \tag{7.13}$$

$$\sum_c pwm_c QM_c = \sum_c pwe_c QE_c + FSAV\,, \tag{7.14}$$

where *GSAV* is government savings; *GINC* is government income; *QG* is government consumption; *FSAV* is foreign savings; *mps* is marginal propensity to save; Y_h is household h net income; $QINV_c$ is investment demand for good c; *EXR* is the exchange rate; QM_c and QE_c are, respectively, import and export quantities of good c; pq_c is the consumption price of good c; and pwm_c and pwe_c are, respectively, import and export world prices of good c.

Assume that both government and foreign savings are flexible, and that government consumption, the exchange rate, and total investment are fixed.[14] By these closure rules, assume that any large poverty reduction policy, such as those simulated later, will actually be financed by an increase in foreign savings (or, equivalently, by a reduction in current debt service). Whether this assumption is sustainable in the long term remains an open question. This choice of closure was mainly led by the desire to compare the direct and general equilibrium impact of policies without clouding this impact with those stemming from various government revenue-increasing mechanisms, such as flexible direct or indirect tax rates.

Scenarios and Simulations

This chapter explores three simulations with the objective of improving the situation of the poor: a direct subsidy on agricultural prices, a workfare program, and an untargeted transfer program.[15] These policies are compared in terms of both macroeconomic impact and their impact on poverty and income distribution. All experiments are designed so that their ex post costs are equal (in real terms).

Description of the Scenarios

The first simulation looks at the impact of a direct subsidy on agricultural production prices. The subsidy is set at 10 percent and is introduced as a negative tax on producer prices, thus creating a 10 percent gap between producer and consumer prices. Such a policy could be achieved by the intervention of a marketing board on agricultural goods markets, which would buy at high prices (from producers) and sell at 10 percent less (to consumers).

The second experiment simulates the implementation of a workfare scheme. Workfare programs, whereby participants must work to obtain benefits, have been used widely to fight poverty, usually in times of crises caused by macroeconomic or agroclimatic shocks (Ravallion 1999). The workfare scheme studied is assumed to be highly labor intensive. The government buys at a fixed rate the services of labor to build or rehabilitate roads and other infrastructures. Given the occupational choice model described in the previous section, the workfare scheme designed in this experiment can be summarized by two characteristics: the workfare wage level and the corresponding workload. A part-time workfare scheme was designed whereby participating individuals are allowed to continue working (in part) in their original occupation. Whether individuals choose to participate in the workfare program depends on the level of the workfare wage and on their formal, informal, and reservation wages (see the selection rule presented in annex 7A). As discussed, the level of the workfare wage is fixed ex ante so that the ex post cost of the scheme matches the cost of the agricultural price subsidy. The resulting yearly wage is 257,625 Malagasy francs (FMG), which translates into FMG 515,250 in full-time equivalent. Table 7.1 shows official minimum wages in different sectors from 1990 to 1996. This

Table 7.1 Minimum Yearly Wages, 1990–96
(1993 Malagasy francs)

Sector	*1990*	*1991*	*1992*	*1993*	*1994*	***1995***	*1996*
Agriculture	576,015	614,821	543,323	494,400	554,188	**603,866**	557,053
Nonagriculture	566,458	604,270	533,960	485,880	537,589	**592,923**	547,576
Public	774,965	811,706	716,329	651,828	665,334	**719,102**	653,844

Source: Ministry of Finance and Ministry of Civil Service and Labor, Antananarivo, Madagascar, www.mefb.gov.mg.

database has been scaled to match structural and demographic features of the year 1995. Consequently, the meaningful figures are in the 1995 column (shown in bold in table 7.1). They show that this simulation workfare wage is relatively close to official minimum wages and represents 87 percent of the minimum wage in nonagricultural sectors. Given this workfare wage level, a total of 908,470 workers—corresponding to 12.7 percent of the labor force—choose to participate in the workfare scheme.

The third and last simulation is a uniform, untargeted, per capita transfer program. Again, the amount paid is computed so that the aggregate ex post cost of the program matches the cost of the previous programs. The resulting amount is FMG 17,887 per capita, which will be added to household nonlabor income (and has the corresponding microeconomic effects of an increase in the value of inactivity in nonfarm households).

All three programs share a high budgetary cost equivalent of almost 5 percent of gross domestic product (GDP). They should therefore have large macroeconomic impacts as well as the intended distributional micro impacts.

Targeting Issues

A central issue related to the poverty and income distribution impacts of all three simulations is the targeting properties of each scheme. Obviously, the uniform, untargeted transfer per capita is distributed evenly across quintiles of income, but this is not the case for the agricultural subsidy and workfare simulations. To explore this issue, table 7.2 presents the distribution of individuals in beneficiary households across quintiles of per capita income for these two simulations.

Not surprisingly, the agricultural subsidy appears to have good targeting properties in terms of the distribution of beneficiary households. But this result does not hold when one considers the distribution of the program cost: while 83.9 percent of individuals in the first quintile are in a household that benefits from the agricultural

Table 7.2 Distribution of Beneficiary Households across Quintiles

	Agricultural subsidy			Workfare scheme		
Quintile	*Beneficiary households*	*Row (percent)*	*Share of program cost (percent)*	*Beneficiary households*	*Row (percent)*	*Share of program cost (percent)*
1st	2,184,281	83.9	7.2	821,244	31.5	16.4
2nd	2,073,064	79.5	12.6	842,288	32.3	17.1
3rd	2,073,970	79.4	18.5	919,525	35.2	23.9
4th	1,752,415	67.2	24.0	829,048	31.8	22.0
5th	1,036,771	39.7	37.7	715,063	27.4	20.6
Total or average	9,120,501	69.9	100.0	4,127,168	31.6	100.0

Source: Authors' estimations.

Note: Quintiles are computed using per capita income in the base year. Row percentage figures are shares of beneficiary population by quintile.

subsidy, only 7.2 percent of the total program cost accrues to these households, and the largest share of the cost (37.7 percent) accrues to the last quintile. This result is related to the fact that the price subsidy is proportional to agricultural output and thus, by construction, is regressive in terms of program cost allocation.

When compared with the agricultural subsidy, the workfare scheme appears to be less progressive in terms of the distribution of individuals in beneficiary households, because they are distributed evenly across quintiles. Because the benefits accruing to households are not proportional to their incomes, however, the distribution of the program cost is actually less regressive than in the agricultural subsidy experiment. The targeting performance of the workfare scheme is nevertheless disappointing as it fails to reach a large number of workers in poor households. This is explained by the fact that the reservation value ($\tilde{w}_0$) estimated and calibrated from actual data not only reflects preferences for family work but also includes a cost-of-entry component in outside informal activities. Estimated parameters indicate, for instance, that activity is more diversified out of agriculture in households living in the Antananarivo *faritany* or in urban areas, as well as more diversified in land-rich households. As a result, individuals from poor agricultural households dwelling in remote areas are given large reservation values, which reflect large costs of access to all markets, including the labor market. This cost of access prevents some agricultural workers from seizing the workfare job opportunities. In other words, because the workfare scheme fails to take these costs into account, it is implicitly targeted toward urban areas. As a result, it has a large impact on urban poverty (see the following section, "Simulation Results").

Simulation Results

Table 7.3 shows various price and macro aggregate changes as a result of the three programs. Macro aggregate changes are presented in real terms.

One common point across all three experiments is the increase in the relative price of the agricultural goods. In particular, even the subsidy simulation leads to a 4.7 percent increase in the price of agricultural goods for consumers (relative to the consumer price index). This result stems from large income effects that raise the demand for agricultural products. The workfare program has the strongest impact of all on the agricultural prices (8.2 percent increase against 4.7 and 5.6 percent in the other simulations), because it also leads to a decrease in the labor available for agriculture (see table 7.4).

Results also show that the macroeconomic impact of all three policies is small and positive in terms of GDP.[16] As mentioned earlier, all experiments were designed to equalize their ex post cost. Because

Table 7.3 Macroeconomic Impact of Alternative Policies

Indicator	*BASE*	*Agricultural subsidy*	*Part-time workfare program*	*Untargeted uniform per capita transfer*
Agricultural price	1.0	4.7	8.2	5.6
Informal price	1.0	1.8	3.5	1.7
Formal price	1.0	−3.0	−5.3	−3.5
Consumption price index	1.0	0	0	0
GDP at market prices	4,713.5	1.0	1.6	1.0
Absorption	4,975.2	4.4	5.0	4.4
Private consumption	4,274.5	5.2	5.9	5.2
Investment	467.2	−0.7	−1.2	−0.7
Government consumption	233.6	0	0	0
Exports	1,144.3	−0.5	1.3	−0.2
Imports	1,406.0	12.0	13.2	12.0
GDP at factor cost	4,424.0	0.3	1.0	0.3
Agricultural value added	1,429.1	0.4	−1.1	0.3
Informal value added	413.6	1.2	1.0	1.7
Formal value added	2,581.2	0.2	2.2	0.1
Cost (FMG, billion)		227.5	228.4	226.8
Cost (percentage of base GDP)		4.8	4.8	4.8

Source: Authors' estimations.

Note: FMG = Malagasy francs; GDP = gross domestic product. Base values are reported in the first column, and percentage changes are reported in the following columns. Cost figures are ex post.

program costs are entirely distributed to the households, all three simulations have the same impact on private consumption.

The employment impact is presented in table 7.4. The top part of the table shows the number of workers by occupational choice, while the lower part presents aggregate values of the sectoral allocation of labor. Results show that the subsidy simulation leads to a mild increase in total employment. In terms of sectoral employment, labor appears to be reallocated from the informal (−5.9 percent) to the agricultural sector (+1.5 percent). As expected, the workfare scheme has a strong impact on urban underemployment, with the number of inactive workers decreasing by almost 18 percent. It also leads to important reallocations of labor out of the agricultural (−3.9 percent) and informal sectors (−12.6 percent) into workfare. As a result, the total active population increases by 3.3 percent. Given its design, the workfare program obviously drives transitions out of full-time work and into part-time work. The uniform transfer scheme has a milder impact on the structure of employment.

Table 7.4 Employment Impact of Alternative Policies

Indicator	*BASE*	*Agricultural subsidy*	*Part-time workfare program*	*Untargeted uniform per capita transfer*
Full-time agricultural workers	4,248.9	2.8	−5.3	1.6
Full-time informal workers	324.6	4.4	−42.2	3.2
Full-time formal workers	527.0	0.4	−2.9	0.4
Part-time workers	874.9	−12.7	67.9	−7.0
Full-time inactive workers	1,144.3	−2.1	−17.7	−1.5
Agricultural labor	4,536.3	1.5	−3.9	0.8
Informal labor	687.0	−5.9	−12.6	−2.9
Formal labor (including workfare)	602.1	0.2	76.1	0.3
Total active workers	5,825.4	0.5	3.3	0.3
Total labor force	7,119.7	0	0	0

Source: Authors' estimations.

Note: Base values are reported in the first column, and percentage changes are reported in the following columns. Part-time workers category includes either part-time formal or informal work with inactivity, part-time formal or informal work with agricultural activity, as well as part-time inactivity, agricultural activity, formal or informal work with workfare in the case of the workfare scheme simulation. Total active workers and sectoral labor are in full-time equivalent, with full-time workers counting for 1.0 and part-time workers counting for 0.5.

Table 7.5 shows results in terms of poverty and income distribution for all households, in both urban and rural areas. Changes in three indicators of inequality are presented: the Gini index and two entropy indexes.

All indicators show that the agricultural price subsidy simulation leads to an improvement in the distribution of income at the national level. A closer look into each area suggests that the decrease in overall inequality is driven both by the convergence in urban and rural per capita incomes and by the decrease in inequality in the urban area. The introduction of a subsidy on agricultural production leaves the inequality within the rural area almost unchanged (the Gini index slightly increases by 0.3 percent), while inequality in the urban area only slightly decreases. As mentioned earlier, the small increase in rural inequality stems from the targeting property of the subsidy, whereby agricultural households with higher incomes benefit more (in absolute terms) than do smaller agricultural households. As a result, changes in poverty indicators are mainly driven by changes in per capita income.

Table 7.5 Social Impact of Alternative Policies, General Equilibrium Results

All households	*BASE*	*Agricultural subsidy*	*Part-time workfare program*	*Untargeted uniform per capita transfer*
Per capita income	352.7	4.4	4.6	5.0
General entropy index 0	45.2	−2.5	−7.6	−11.2
General entropy index 1	59.0	−3.0	−6.8	−8.2
Gini index	51.1	−1.3	−3.6	−4.8
Poverty incidence	59.0	−5.0	−6.6	−6.2
Poverty gap	24.9	−8.2	−13.5	−16.3
Poverty severity	13.4	−10.0	−17.4	−24.2
Urban households				
Per capita income	631.1	0.8	3.1	2.7
General entropy index 0	48.1	−1.1	−7.2	−6.2
General entropy index 1	62.8	−0.9	−5.5	−4.5
Gini index	52.7	−0.5	−3.3	−2.6
Poverty incidence	30.5	−1.0	−11.1	−7.0
Poverty gap	10.3	−3.2	−24.0	−19.7
Poverty severity	4.5	−5.1	−29.5	−28.2
Rural households				
Per capita income	260.7	7.3	5.7	6.8
General entropy index 0	33.2	0.8	−8.4	−14.3
General entropy index 1	39.7	0.6	−8.2	−11.3
Gini index	44.0	0.3	−4.1	−6.4
Poverty incidence	68.4	−5.6	−5.9	−6.1
Poverty gap	29.7	−8.8	−12.3	−16.0
Poverty severity	16.4	−10.4	−16.3	−23.8

Source: Authors' estimations.

Note: Base values are reported for the first column, and percentage changes are reported in the following columns.

In terms of poverty reduction, the workfare scheme has a stronger impact than the subsidy program: the poverty headcount is reduced by 6.6 percent, while the subsidy program reduces it by 5 percent. Workfare also has a stronger effect on income distribution, with a 3.6 percent decrease in the Gini index (compared with a 1.3 percent decrease with the subsidy program) and a 17.4 percent decrease in the poverty severity indicator (compared with a 10 percent decrease with the subsidy program). This strong decrease in inequality is explained both by the convergence of average per capita incomes between urban and rural areas and by the decrease of inequality within both areas. The workfare scheme has by far the strongest impact on inequality and poverty in urban areas. Thanks to the workfare scheme, poverty incidence in urban areas decreases by more than 11 percent, whereas it decreases only slightly in the case of the agricultural subsidy and is reduced by 7 percent with the uniform transfer. Although the GDP impact of the untargeted transfer program is mild, both the poverty and income distribution impacts are significant: the program reduces the poverty headcount by 6.2 percent and the Gini index by 4.8 percent, and its impact on poverty severity is the highest among the three experiments. These results again show that the workfare scheme does not achieve much better targeting than the untargeted transfer program and does not satisfactorily reach the poorest of the poor.

In sum, the two targeted programs that have been examined here indeed have large impacts on monetary poverty alleviation, even once general equilibrium effects are taken into account. Given the large budgetary amounts that are transferred to households, this does not come as a surprise. Apart from scaling and financing issues, however, the simulations reveal that there is room to improve the quality of targeting. Indeed, a general subsidy to agricultural producers does not appear to be an adequate scheme for reaching the poorest farmers, because it fails to do better than a uniform per capita transfer or even a workfare scheme—even in rural areas. A general workfare program offering part-time job opportunities paid at about the minimum wage reaches somewhat disappointing results, especially in rural areas. Costs of access to the labor market prevent individuals living in remote areas or in poor autarkic agricultural households from seizing the workfare opportunities. The workfare scheme performance is relatively good in urban areas, where it draws a lot of people out of inactivity or out of informal underemployment, but it falls short in rural areas, where it is outperformed by the untargeted transfer.

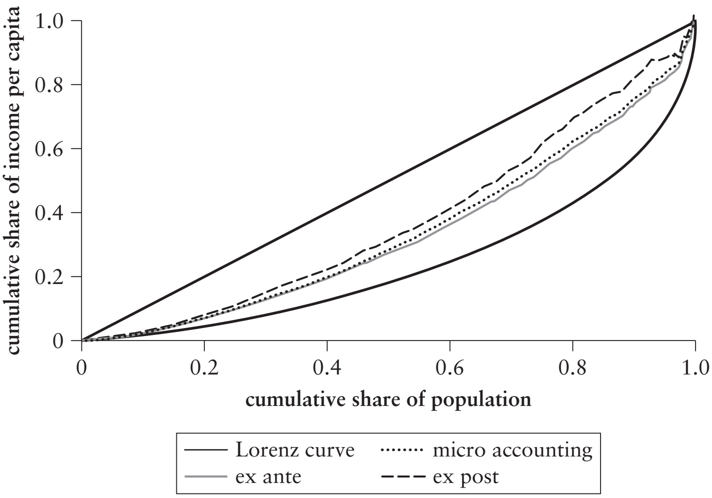
All three schemes have been designed to have the same ex post budgetary cost in terms of the total amount of transfer received by households. They all, however, have specific implementation costs that should be taken into account when comparing their relative efficiency. For instance, the implementation of an agricultural subsidy would call for the reconstruction of a marketing board, which raises many institutional issues and might imply high administrative costs. Likewise, the implementation of a workfare scheme has more costs than pure wage costs, no matter how labor intensive it is: organizational and administrative costs, advertisement costs, and input costs (see Ravallion 1999). In this case, however, some of these additional costs are internalized by individuals who give up the workfare job offers when these are located too far from their household. Finally, even the untargeted transfer scheme would entail an additional cost of bringing the cash to the households, even in remote areas.

Comparing Micro Accounting Ex Ante and Ex Post Results

This section turns to a more methodological question and compares the simulation results of three specifications of the model. The first version corresponds to the results of a micro accounting exercise in which neither behavior nor general equilibrium effects would be taken into account. The second version still does not account for general equilibrium effects but allows individuals and households to respond to the shock. The final version accounts for both micro behaviors and general equilibrium effects. It corresponds to the version used above for the analysis of poverty reduction policies. Two types of shocks are examined: the 10 percent agricultural price subsidy analyzed previously and a 20 percent total factor productivity shock in the agricultural sector. The results of both simulations are presented in figures 7.2 and 7.3. These figures show the Lorenz curve (built on income per capita) together with the concentration curves of the benefits of the two shocks under the three specifications of the model.

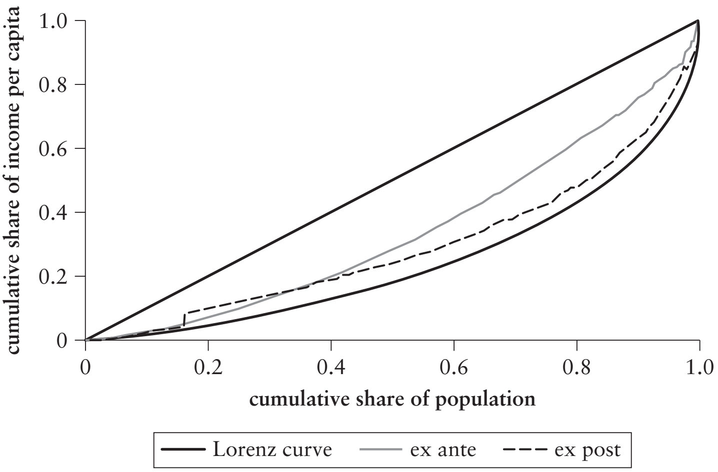
In figure 7.2, the micro accounting and ex ante curves track closely. Both indicate that the incidence of the subsidy program is progressive. The ex post curve does not reverse that conclusion

Figure 7.2 Benefit Incidence of an Agricultural Subsidy under Various Specifications



Source: Authors' estimations.

Figure 7.3 Benefit Incidence of a Total Factor Productivity Shock in the Agricultural Sector



Source: Authors' estimations.

but appears closer to the 45-degree line, indicating that the program is more progressive than ex ante simulations would predict. This is reversed in the second simulation (figure 7.3), where results indicate that taking into account general equilibrium actually leads to the conclusion that the shock is less progressive than micro accounting or ex ante simulations would predict.[17]

In the case of Madagascar and of shocks that affect the relative price of the agricultural good, general equilibrium effects will mainly change the distribution of the benefits between rural and urban households. Given the big difference in mean incomes between urban and rural households, it does not come as a surprise than any shock that leads to an increase in the relative price of the agricultural good will "redistribute" the benefits of the program toward rural households, thus making it more progressive ex post than ex ante. Symmetrically, any shock that leads to a decrease in the relative price of the agricultural good (such as a productivity shock), will "redistribute" the benefits of the program toward urban households, thus making it more progressive ex post than ex ante.

The two experiments presented here show that it is not possible to reach a conclusion on a systematic bias in terms of poverty or inequality changes when ignoring general equilibrium effects.

Conclusion

This chapter has presented the basic motivations for the construction of an integrated static macro-micro model for a low-income economy. It has outlined the main features of such a model in terms of microeconometric specifications and macro closures. Finally, it has explored the use of this kind of model for the simulation of targeted transfer schemes dedicated to poverty alleviation. These types of transfer schemes might be implemented either following a macroeconomic shock or as permanent safety nets. For purposes of illustration, three large-scale transfer schemes have been simulated and compared: (1) a price subsidy to agricultural producers, (2) a general workfare program proposing part-time job opportunities paid at about the minimum wage, and (3) a uniform unconditional and untargeted transfer provided to each individual regardless of their age and job situation. The macro-micro model yields interesting results on the counterfactual impacts of each program on the overall distribution of income, by taking into account both microeconomic targeting issues and macroeconomic general equilibrium effects. Considerations about the financing of the programs and about their technical implementation costs could supplement the simulations to build realistic, efficient, and sustainable poverty alleviation schemes.

To conclude, it may be useful to review briefly the comparative advantages and disadvantages of the integrated macro-micro approach. The authors first argued that the approach is well suited to incorporating current advances in the microeconometrics of household behaviors and market structures in developing countries. The illustrations presented show the usefulness of a thorough modeling of labor supply behavior in the context of highly segmented markets. However, much remains to be done to improve the modeling of behavior in agricultural households where collective production in family farms does not fit this "individualistic" framework as well. (For an alternative, see Cogneau and Robilliard 2007.) Moreover, it should be emphasized that structural estimation based on cross-sectional data may either overstate or understate the true reaction of poor households with respect to labor incentives. This type of estimation would benefit from the availability of dynamic panel data or from experimental knowledge on the response of poor households to various programs (Duflo 2004).

Second, the authors argued that integrated tools might be desired for the sake of macro-micro consistency, as far as "aggregation issues" and "interlinked welfare issues" are concerned. It should, however, be stressed that such consistency in the modeling of household welfare (labor supply, earnings, consumption) is obtained at the expense of sectoral disaggregation and dynamic considerations. Depending on the policy problem at stake, trade-offs must be solved inside a triangle made of "household heterogeneity," "sectoral detail," and "intertemporal issues." The authors therefore argued that the static integrated tool might be better suited for analyzing the distributional aspects of general development strategies, on the one hand, and for evaluating the impact of short- to medium-term targeted programs with macro impacts, on the other.

Through the applications implemented in this chapter, the authors hope to have shown that integrated macro-micro modeling could be useful in the design of these latter programs. The design of other structural policies, such as minimum-wage increases or foreign-investment-led jobs creation, could also benefit from this type of approach.

Annex 7A: A Part-Time Extension

To account for individuals who wish to pursue outside part-time activities when they also work for the family, one must introduce a "part-time" variable in the wages and benefits equations that accounts for the variability of hours worked:

$$\ln w_{1i} = \ln \pi_1 + X_{1i}\beta_1 + \delta_1 T_{1i} + t_{1i}$$

$$\ln w_{2i} = \ln \pi_2 + X_{2i}\beta_2 + \delta_2 T_{2i} + t_{2i} \, ,$$

with $\delta_1 < 0$, and $\delta_2 < 0$ and where T_{1i} (and T_{2i}) is a dummy variable indicating whether the individual works part-time.[18] One may then redefine full-time incomes as follows:

$$\ln \widehat{w}_{1i} = \ln w_{1i} - \delta_1 T_{1i} \tag{A7.1}$$

$$\ln \widehat{w}_{2i} = \ln w_{2i} - \delta_2 T_{2i} \, . \tag{A7.2}$$

Finally, assume that when reservation value is close enough to either full-time wage or self-employment benefits, individuals choose to work (simultaneously or successively) inside and outside the family. The listing of selection rules then becomes

i chooses full-time family work iff

$$\tilde{w}_{0i} > (1 + a)\widehat{w}_{1i} \quad \text{and} \quad \tilde{w}_{0i} > (1 + a)\frac{\widehat{w}_{2i}}{\tilde{w}_{2i}}$$

i chooses family work and self-employment iff

$$(1 + a)\widehat{w}_{1i} > \tilde{w}_{0i} > (1 - a)\widehat{w}_{1i} \quad \text{and} \quad \widehat{w}_{1i} > \frac{\widehat{w}_{2i}}{\tilde{w}_{2i}}$$

i chooses family work and wage work iff

$$(1 + a)\frac{\widehat{w}_{2i}}{\tilde{w}_{2i}} > \tilde{w}_{0i} > (1 - a)\frac{\widehat{w}_{2i}}{\tilde{w}_{2i}} \quad \text{and} \quad \frac{\widehat{w}_{2i}}{\tilde{w}_{2i}} > \widehat{w}_{1i}$$

i chooses full-time self-employment iff

$$(1 - a)\widehat{w}_{1i} > \tilde{w}_{0i} \quad \text{and} \quad \widehat{w}_{1i} > \frac{\widehat{w}_{2i}}{\tilde{w}_{2i}}$$

i chooses full-time wage work iff

$$(1 - a)\frac{\widehat{w}_{2i}}{\tilde{w}_{2i}} > \tilde{w}_{0i} \quad \text{and} \quad \frac{\widehat{w}_{2i}}{\tilde{w}_{2i}} > \widehat{w}_{1i} \, .$$

For econometric estimation, the likelihood of the model is rewritten according to this new selection rule.

The workfare program that is subsequently simulated introduces a new kind of part-time job offer that is paid at a rate w_3. In this case, once the former selection rule has been run, add the following rules:

if i had chosen full-time family work, i takes the workfare offer iff

$$2w_3(1 - a) > \tilde{w}_{0i}$$

if i had chosen self-employment, i takes the workfare offer iff

$$w_3 > \widehat{w}_{1i}[1 - \exp(\delta_1)]$$

if i had chosen wage work, i takes the job offer iff

$$w_3 > \widehat{w}_{2i}[1 - \exp(\delta_2)] \, .$$

The two last conditions apply whether i chooses a full-time or part-time option. In the case of a part-time choice, and if the relevant condition holds, this worker relinquishes part-time family work in favor of workfare. In any case, this worker ends up working part-time in self-employment or wage work, and the balance of time in the workfare program. If the first condition holds, the work is then part time in the family, with the remaining time spent in the workfare program.

Annex 7B: Estimation and Micro Calibration

Table 7B.1 Results from Estimation and Micro Calibration

Variable	β_1	β_2	$\tilde{\beta}_2$	β_0
Men				
Nonfarm households				
Number of years of education (/10)	0.9841	0.8995	*−1.3384*	*0.9429*
Number of years of experience (/10)	0.3232	0.5100	*−0.7785*	*0.1533*
Number of years of experience squared (/1,000)	−0.3879	−0.6276	*1.1335*	*0.0315*
Region of Antananarivo (=1)	−0.0561	−0.0689	*0.1520*	*−0.2380*
Rural area (=1)	−0.2504	−0.0891	*0.4053*	*−0.0039*
Father in the informal sector (=1)	0	0	*0.1901*	*−0.1696*
Father in the formal sector (=1)	0	0	*−0.0695*	*0.0485*
Household head in the informal sector (=1)	0	0	*0.4913*	*−0.0505*
Household head in the formal sector (=1)	0	0	*−0.4124*	*0.2920*
Spouse in the informal sector (=1)	0	0	*−0.2107*	*0.1436*
Spouse in the formal sector (=1)	0	0	*0.7386*	*−0.0473*
Number of children ages 0 to 9 years old	0	0	*0*	*−0.0641*
Number of males ages 10 to 14 years old	0	0	*0*	*−0.0160*
Number of males ages 15 to 69 years old	0	0	*0*	*0.0261*
Number of females ages 10 to 14 years old	0	0	*0*	*0.0150*
Number of females ages 15 to 69 years old	0	0	*0*	*−0.0134*
Number of adults ages 70 years and older	0	0	*0*	*0.1188*
Household head (=1)	0	0	*0*	*−0.7030*
Spouse of the head (=1)	0	0	*0*	*−0.5665*
Child of the head (=1)	0	0	*0*	*0.1395*
Nonlabor income	0	0	*0*	*0.6465*
Household head wage income	0	0	*0*	*0.7335*
Spouse wage income	0	0	*0*	*0.2203*
Part-time correction	−0.80	−0.43	*0*	*0*
Constant	3.8386	3.3470	*1.6192*	*4.8406*
Part-time threshold[a]	0.28			
Standard errors (diagonal) and correlation of unobservables				
	t_1	t_2	$\tilde{t}_2$	t_0
t_1	0.9740	0.5000*	*−0.5020*	*0.8580*
t_2		0.5940	*0.0180*	*0.5110*
$\tilde{t}_2$			*1.8330*	*−0.6220*
t_0				*1.4780*

Variable	β_1	β_2	$\tilde{\beta}_2$	β_0
Men				
Farm households				
Number of years of education (/10)	0.9841	0.8995	*−1.8892*	*0.8106*
Number of years of experience (/10)	0.3232	0.5100	*−1.4856*	*−0.1862*
Number of years of experience squared (/1,000)	−0.3879	−0.6276	*3.8351*	*0.6089*
Region of Antananarivo (=1)	−0.0561	−0.0689	*−0.5764*	*−0.8237*
Rural area (=1)	−0.2504	−0.0891	*0.8868*	*0.3592*
Household head in the informal sector (=1)	0	0	*6.6620*	*−0.6282*
Household head in the formal sector (=1)	0	0	*−1.5937*	*0.0513*
Number of children ages 0 to 9 years old	0	0	*0*	*−0.0611*
Number of males ages 10 to 14 years old	0	0	*0*	*0.0738*
Number of males ages 15 to 69 years old	0	0	*0*	*0.0598*
Number of females ages 10 to 14 years old	0	0	*0*	*0.0824*
Number of females ages 15 to 69 years old	0	0	*0*	*0.0252*
Number of adults ages 70 years and older	0	0	*0*	*0.1822*
Spouse of the head (=1)	0	0	*0*	*−0.1442*
Child of the head (=1)	0	0	*0*	*0.1180*
Nonlabor income	0	0	*0*	*−0.3589*
Marginal productivity of agricultural labor	0	0	*0*	1*
Part-time correction	−0.81	−0.44	*0*	*0*
Constant	3.8386	3.3470	*4.1720*	*6.1760*
Part-time threshold[a]	0.45			

Standard errors (diagonal) and correlation of unobservables

	t_1	t_2	$\tilde{t}_2$	t_0
t_1	0.9740	0.3000*	*0.0280*	*0.8930*
t_2		0.5940	*0.1040*	*0.5940*
$\tilde{t}_2$			*2.0450*	*−0.4120*
t_0				*1.7070*

(*Continued on next page*)

Table 7B.1 (Continued)

Variable	β_1	β_2	$\tilde{\beta}_2$	β_0
Women				
Nonfarm households				
Number of years of education (/10)	1.0697	1.3439	*−1.6047*	*0.8535*
Number of years of experience (/10)	0.2387	0.5243	*−0.4425*	*−0.1333*
Number of years of experience squared (/1,000)	−0.2571	−0.6476	*0.7708*	*0.3569*
Region of Antananarivo (=1)	−0.2530	0.0541	*0.2790*	*−0.3937*
Rural area (=1)	−0.2494	−0.0135	*0.3500*	*−0.1241*
Father in the informal sector (=1)	0	0	*−0.2720*	*0.1344*
Father in the formal sector (=1)	0	0	*−0.2139*	*0.2915*
Household head in the informal sector (=1)	0	0	*0.3239*	*0.1247*
Household head in the formal sector (=1)	0	0	*−0.1145*	*0.2320*
Spouse in the informal sector (=1)	0	0	*−0.3565*	*0.2135*
Spouse in the formal sector (=1)	0	0	*−0.4257*	*0.1466*
Number of children ages 0 to 9 years old	0	0	*0*	*0.0038*
Number of males ages 10 to 14 years old	0	0	*0*	*−0.0675*
Number of males ages 15 to 69 years old	0	0	*0*	*0.0046*
Number of females ages 10 to 14 years old	0	0	*0*	*−0.0187*
Number of females ages 15 to 69 years old	0	0	*0*	*−0.0124*
Number of adults ages 70 years and older	0	0	*0*	*0.1094*
Household head (=1)	0	0	*0*	*−0.3917*
Spouse of the head (=1)	0	0	*0*	*0.0583*
Child of the head (=1)	0	0	*0*	*0.2056*
Nonlabor income	0	0	*0*	*1.1474*
Household head wage income	0	0	*0*	*0.0574*
Spouse wage income	0	0	*0*	*−0.7528*
Part-time correction	−0.83	−0.20	*0*	*0*
Constant	3.5774	2.4824	*2.0197*	*4.7003*
Part-time threshold[a]	0.29			
Standard errors (diagonal) and correlation of unobservables				
	t_1	t_2	$\tilde{t}_2$	t_0
t_1	0.9750	0.5000*	*−0.4960*	*0.8760*
t_2		0.5590	*0.0890*	*0.3300*
$\tilde{t}_2$			*1.8810*	*−0.6530*
t_0				*1.4520*

Variable	β_1	β_2	$\tilde{\beta}_2$	β_0
Women				
Farm households				
Number of years of education (/10)	1.0697	1.3439	*−2.3181*	*0.7551*
Number of years of experience (/10)	0.2387	0.5243	*−0.5943*	*−0.2368*
Number of years of experience squared (/1,000)	−0.2571	−0.6476	*0.4778*	*0.5286*
Region of Antananarivo (=1)	−0.2530	0.0541	*−0.1836*	*−0.5821*
Rural area (=1)	−0.2494	−0.0135	*0.5646*	*0.3172*
Household head in the informal sector (=1)	0	0	*0.1660*	*−0.6827*
Household head in the formal sector (=1)	0	0	*−0.8654*	*−0.1080*
Number of children ages 0 to 9 years old	0	0	*0*	*0.0074*
Number of males ages 10 to 14 years old	0	0	*0*	*0.1417*
Number of males ages 15 to 69 years old	0	0	*0*	*−0.0070*
Number of females ages 10 to 14 years old	0	0	*0*	*0.0670*
Number of females ages 15 to 69 years old	0	0	*0*	*−0.0311*
Number of adults ages 70 years and older	0	0	*0*	*−0.1026*
Spouse of the head (=1)	0	0	*0*	*0.0994*
Child of the head (=1)	0	0	*0*	*−0.1417*
Nonlabor income	0	0	*0*	*0.2221*
Marginal productivity of agricultural labor	0	0	*0*	1*
Part-time correction	−0.84	−0.21	*0*	*0*
Constant	3.5774	2.4824	*3.9111*	*6.3980*
Part-time threshold[a]	0.55			

Standard errors (diagonal) and correlation of unobservables

	t_1	t_2	$\tilde{t}_2$	t_0
t_1	0.9750	0.3000*	*0.0900*	*0.8340*
t_2		0.5590	*0.5100*	*0.0950*
$\tilde{t}_2$			*1.9590*	*−0.4470*
t_0				*1.7470*

Sources: Enguête Permanente auprès des Ménages 1993 survey and authors' calculations.

Note: Coefficients in roman type (first two columns) are econometrically estimated. In contrast, the three coefficients with an asterisk (*) are pure guesses. Other guessed coefficients not shown in the table include the two measurement errors variances (which are assumed null) and the $(t_2 - \tilde{t}_2 - t_1)$ standard error (at 2 and 1.5 in nonfarm and farm households, respectively). Coefficients in italics (last two columns) result from a "micro calibration" using both econometric estimates and guessed coefficients. See section titled "Econometric Identification and Micro Calibration" for more details.

a. For the definition of part-time corrections and threshold, see annex 7A.

Annex 7C: A Simple Expenditure System with Heterogeneous Preferences

The macro-micro model tries to make use of the wealth of data available—not only for labor supply and income generation but also for consumption. However, data limitations prevent going too far in that direction. To avoid microeconometric complications, savings and consumption choices are first assumed as separable from labor supply decisions. Second, saving rates derived from the data come out as unreliable; therefore, a fixed saving rate common to all households (and equal to 0.052 in the application) is assumed:

$$C_h = (1 - s)Y_h \, . \tag{C7.1}$$

Household disposable income Y_h is equal to the sum of agricultural benefits (including autoconsumption of goods produced by the household), self-employment benefits and wage earnings, nonlabor income stemming from capital income, and transfers. C_h stands for household h total consumption expenditures.

Third, total consumption is then split between the three composite goods of the model (agricultural, informal, and formal) through idiosyncratic budget shares $\omega_{j,h}$ derived from the data:

$$C_{j,h} = \omega_{j,h} C_h \quad \text{with } j = 0, 1, 2 \quad \text{and} \sum_{j=0,1,2} \omega_{j,h} = 1 \, . \tag{C7.2}$$

This specification corresponds to the simplest Cobb-Douglas homothetic utility function for consumption.

Notes

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1. When supplemented with a dynamic demographic module, this approach can be relatively well suited to exploring demo-economic issues like the distributive impact of the HIV/AIDS epidemics (Cogneau and Grimm forthcoming) or general poverty reduction strategies like the long-term impact of education policies (Grimm 2004, 2005).

2. Cogneau (1999, 2001) shows that a macro-micro model of the distribution of income can simulate the historical decrease in poverty observed in the city of Antananarivo during the 1995–99 period, thanks to job creation and minimum-wage increases in the formal sector.

3. Moreover, this simple form assumes that individuals compare self-employment and wage-work opportunities only in terms of earnings; in other words, they do not bring differential nonpecuniary benefits. See Cogneau (2001).

4. The reservation value $\tilde{w}_0$ includes the cost of entry into the informal activities.

5. In econometric estimation, the X vectors include a constant.

6. For estimation, the authors still assume independence for $(t_1, t_2, \tilde{t}_2, t_0)$ between individuals, even among members of the same household.

7. It also might be the case for some nonagricultural occupations. In light of the Malagasy case and data, however, the authors choose to treat nonagricultural self-employment as a purely individual occupation. These data suggest that the great majority of self-employed workers in nonagricultural sectors are running very small, most often individual, businesses.

8. This latter assumption should allow for a direct identification of the $\Delta\Pi_0$ effect in $\widetilde{w}_0$, through the effect of u_{0h}. However, as $\Delta\Pi_0$ is presumably affected by large measurement errors, the authors exclude "available land" from the variables in $\widehat{w}_0$, taking it as an instrument for the identification of the effect of $\Delta\Pi_0$.

9. This latter option is rather innocuous for potential earnings outside the farm, as only a small number of individuals declare out-of-farm earnings in agricultural households.

10. More detailed econometric results are available from the authors upon request.

11. Even with small policies, this assumption of no price variation may be violated if there is a strong spatial segmentation of markets. In this latter case, local price variations may matter.

12. Production functions parameters are estimated (see section "Econometric Identification and Micro Calibration") and technical coefficients are taken from the survey. Although all technical coefficients are scaled up so that the sum of intermediate consumption equals national accounts aggregate, they remain household specific for the agricultural production.

13. For the calibration of the agricultural CET function, the share of exports on total production is idiosyncratic and taken from survey data.

14. By Walras's law, one of the system constraints is redundant. System constraints include markets as well as macro balances. In this model, the redundant equation is the external balance equation (7.13).

15. Previously, the authors showed that neither a devaluation of 20 percent nor a fourfold increase in agricultural tariffs could achieve a significant reduction in poverty and inequality indicators (Cogneau, Grimm, and Robilliard 2003).

16. The GDP aggregate does not include the value of goods, services, or infrastructure produced by the workfare program.

17. Under the current version of this algorithm, the authors are not able to distinguish micro accounting from ex ante results in the case of the productivity shock because the shock amounts to changing a technical parameter that does not affect household behaviors in the first round.

18. The authors thank François Bourguignon for a fruitful discussion about this extension.

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