Simulating targeted policies with macro impacts: Poverty Alleviation Policies in Madagascar

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Abstract

This paper presents a modeling technique that integrates a static microsimulation module of labor supply/income and consumption demand, based on a cross sectional survey data with a static (CGE type) macro module. This simulation model is designed to study the short to medium term impact of policies that both select individuals within groups and have economywide implications. It is applied to the case of large size targeted poverty alleviation policies in Madagascar. We build upon a structural microeconometric model of occupational choices and labor income which is estimated on a standard cross sectional microeconomic dataset derived from a “multitopic household survey”. We present three alternative simulations with the objective of improving the incomes of the poor: a direct subsidy on agricultural prices, a workfare program, and an untargeted transfer program. These policies are compared both in terms of their macroeconomic impact and in terms of their impact on poverty and income distribution. The micro-macro model yields interesting results on the counterfactual impacts of each program on the overall distribution of income, taking into account both microeconomic targeting issues and macroeconomic general equilibrium effects.

1 Introduction

This paper presents a modeling technique that integrates a static microsimulation module of labor supply/income and consumption demand, based on a cross sectional survey data with a static (CGE type) macro module. This simulation model is designed to study the short to medium term impact of policies that both select individuals within groups and have economywide implications. It is applied to the case of large size targeted poverty alleviation policies in Madagascar. We build upon a structural microeconometric model of occupational choices and labor income which is estimated on a standard cross sectional microeconomic dataset derived from a “multitopic household survey” (see Scott 2003). Section 2 presents the motivation for building and using this kind of tool as well as its global structure. Section 3 presents the microsimulation module and its econometric estimation. Section 4 presents the
integration of the macro and micro modules. Simulations and results are presented in Section 5.

2 Motivation

This model is a member of the family of applied micro-macro tools that try 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, it places more weight on the microeconometric side of the model; as a consequence, its macroeconomic and multi-market framework is also less sophisticated.

2.1 A Structural Microeconometric Model of Income Generation…

The tool starts with 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, employment rationing -- that is, various kinds of “market imperfections.” For instance, Cogneau and Robilliard (2001) take into account the non recursive 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 also explicitly takes into account the market structure that constrains the agents’ decisions. For instance, Cogneau (1999 and 2001) estimates a labor income and occupational choice model for the city of Antananarivo under various assumptions on the segmentation (dualism) of the urban labor market. We provide here a kind of synthesis of those previous works.
2.2 … Augmented with a Simplified Macro-Module…

The structural nature of the microeconomic module paves the way for a consistent connection to a macromodule: Agents react to prices and other signals that are determined at the macro level. As even simple microeconomic models do not lead to perfect aggregation, outcomes from micro decisions must be summed up and confronted with each other and with other macro aggregates. In order to achieve a consistent micro-macro equilibrium, some macro variables, such as prices, vary until all aggregates coming from the households’ micro part, 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. We build here a very simple three-market CGE model.

2.3 … For the Study of Targeted Policies with Macro Impacts

Structural microeconometric modeling usually precludes a high level of disaggregation of market segments and/or sectors, because of both identification and algorithm limitations. As a result, it is less well suited for either the study of subtle intersectoral reallocations of supply and demand or fine modifications of the price and earnings schedule. Simulating short-term targeted policies with macro impacts might be the true comparative advantage of this type of models. This is the road that is explored in this paper. By targeted policies we mean policies whose aim is to reach specific categories of the population, most often among the poor, through various
targeting devices. These include labor market interventions like wage policies, workfare programs or job creation linked to foreign direct investment, but also land reforms and product markets interventions like marketing boards.

One first problem is to evaluate the efficiency of the targeting device. When the targeting is imperfect and depends on self-selection of individuals, a micro structural model may be most useful. For instance, 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, when their magnitude is big enough to have a macroeconomic impact. Here then, a macro closure may help.

For instance, how many people will benefit from an increase in the minimum wage, how will this increase be transmitted to other segments in the labor market through a raise in the informal labor earnings; or what are the respective impacts of a job creation policy and of a wage policy in a developing country urban labor market? 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 empirical illustrations presented in this paper try to address questions of this type.

3 The microeconometric model of income generation

We first present a canonical version of the model and discuss the basic identification and “microcalibration” issues. We then introduce some extensions.
3.1 The Main Labor Income Model

The labor income model presented here draws from the spirit of Roy’s model (1951), as formalized by Heckman and Sedlacek (1985), and characterized by Neal and Rosen (1998) as the most convincing model for explaining labor income distribution.

Each individual pertains to a given family or household whose composition and location is exogenously determined. Working-age individuals (15 years and older) have three kinds of work opportunities: family work, self-employed work, and wage work. Family work includes all kinds of activities under the supervision of the household head or the spouse, such as family help in agricultural activities, but also domestic work, non-market labor, and various forms of declared “inactivity”. Self-employed work corresponds to informal independent market activities. Wage work includes all other kinds of workers, mainly civil servants and large firm workers.

To self-employed work ($J=1$) and wage-work ($J=2$) we 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 which depends on observable characteristics $X_i$ (education, labor market experience, and geographical dummies) as well as on unobservable skills $t_{ji}$:

$$\ln w_{1i} = \ln \pi_1 + X_i \beta_1 + t_{1i}$$  \hspace{1cm} (1)

$$\ln w_{2i} = \ln \pi_2 + X_i \beta_2 + t_{2i}$$  \hspace{1cm} (2)

Returns to characteristics $\beta_j$ are differentiated by sector and by gender.

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

$$\ln \tilde{w}_{0i} = (X_{0i}, Z_{0h}) \beta_0 + t_{0i}$$  \hspace{1cm} (3)
may be seen as a reservation wage. Vector $X_{0i}$ contains the same variables as $X$, (education, labor market experience, and geographical dummies), plus a variable indicating the father’s occupation. Vector $Z_{0i}$ includes the demographic structure of the household and the household’s non-labor income. Given these elements, the choice of an occupation $J$ can be expressed as:

$$J = k \iff w_{ki} = \max\{\tilde{w}_{0i}, w_{1i}, w_{2i}\} \quad \text{for } k = 0,1,2 \quad (4)$$

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. In the presence of segmentation, selection condition (4) does not hold in many cases: Some individuals would prefer to work in a given segment but do not find any available job opportunity. Without any loss of generality, we may introduce one segmentation variable defined as the relative cost of entry between wage-work and self-employment:

$$\ln \tilde{w}_{2i} = \ln \tilde{x}_2 + X_{2i} \tilde{\beta}_2 + \tilde{\epsilon}_{2i} \quad (5)$$

Finally, comparing the respective values attributed to the three labor opportunities, workers allocate their labor force according to their individual comparative advantage. The selection rule (4) is replaced by:

- $i$ is observed in family work iff $\tilde{w}_{0i} > w_{1i}$ and $\tilde{w}_{0i} > \frac{w_{2i}}{\tilde{w}_{2i}}$
- $i$ is observed in self-employment iff $w_{1i} > \tilde{w}_{0i}$ and $w_{1i} > \frac{w_{2i}}{w_{2i}}$
- $i$ is observed in family work iff $\frac{w_{2i}}{\tilde{w}_{2i}} > \tilde{w}_{0i}$ and $\frac{w_{2i}}{\tilde{w}_{2i}} > w_{1i}$

### 3.2 Econometric Identification and “Micro-calibration”

The occupational choice / labor income may then be estimated by maximum likelihood. The segmented
model contains the simpler “competitive” Roy model as a particular constrained case (Magnac 1991).

For econometric identification, we must assume independence of the residuals \((t_0, t_1, t_2, \tilde{t}_2)\) between individuals. We also assume joint normality for the \((t_0, t_1, t_2, \tilde{t}_2)\) vector:

\[
(t_0, t_1, t_2, \tilde{t}_2) \sim N(0, \Sigma)
\]  

(7)

Under these assumptions, we estimate by maximum likelihood the occupational choice / labor income model represented by the (1)-(3) and equations and the series of selection conditions (6): We obtain 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 (see below).

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

\[
(t_0, t_1, t_2, \tilde{t}_2, \varepsilon_1, \varepsilon_2) \sim N(0, \Sigma^*)
\]  

(8)

Under these assumptions, nine variance or correlation parameters may be identified:

\[
\rho = \text{corr}(t_1 - t_0, \ t_2 - \tilde{t}_2 - t_0), \quad \sigma_j = \sqrt{\text{var}(t_j + \varepsilon_j)}, \quad k = \frac{\text{var}(t_1 - t_0)}{\text{var}(t_1 - t_2 - t_0)}, \quad \lambda_i = \text{corr}(t_i + \varepsilon_i, \ t_1 - t_0),
\]

\[
\lambda_2 = \text{corr}(t_2 + \varepsilon_2, \ t_2 - \tilde{t}_2 - t_0), \quad \mu_j = \text{corr}(t_j + \varepsilon_j, \ t_2 - \tilde{t}_2 - t_0) \text{ for } j = 1, 2.
\]

While all the parameters of potential earnings in self-employment and wage-work are identified, only the contrasts \(\frac{\beta_2 - \beta_0}{\sigma(t_1 - t_0)}\) and \(\frac{\beta_2 - \beta_1 - \beta_0}{\sigma(t_2 - \tilde{t}_2 - t_0)}\) are identified.
For purposes of simulation, we need to recover the parameters $\beta_0$ and $\beta_2$ for $\tilde{w}_0$ and $\tilde{w}_2$ respectively, and the whole covariance structure $\Sigma^*$. We therefore proceed to carry out a “micro-calibration”. We assume that measurement errors / transient components are white noises (uncorrelated with others). We “guesstimate” three kinds of parameters: (i) the variance of measurement errors, (ii) the correlation ($\rho_{12}$) between $t_1$ and $t_2$, and (iii) 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. We check that the resulting matrix $\Sigma^*$ is semi-definite positive.

We then draw for each individual a whole set of unobservables $(t_0, t_1, t_2, \tilde{t}_2, \varepsilon_1, \varepsilon_2)$, within the multidimensional normal distribution with the covariance structure $\Sigma^*$ and constrain the draws to respect the occupational selection rules (6). For instance, for an individual who is observed in the informal sector, we start from the observed $t_1 + \varepsilon_1$ and draw all other unobservable components conditionally on it, constraining the draws to respect $w_i > \tilde{w}_0$ and $w_i > \frac{w_2}{\tilde{w}_2}$. We finally obtain the set $(\tilde{w}_0, w_1, w_2, \tilde{w}_2)$ for each individual at base “prices” $(\pi_1, \pi_2, \tilde{\pi}_2) = (1,1,1)$.

### 3.3 A Non-head Members’ Extension

We assume a hierarchical decision making process within the household: The household head makes his/her decision first, without taking into account other members’ choices, then the head’s spouse decides and finally other working-age secondary members. The latter decisions are simultaneous: In making their decision, none of the non-head household members takes into account the consequences of the decision on other household members.
Accordingly, in the case of non-head 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 non-spouse secondary household members, it includes both the head’s and the spouse’s occupational choice and earnings.$^7$

### 3.4 Farm Income and Reservation Wage in Farm Households

Many household members are typically involved in farm activities.$^8$ To farming households we associate a reduced farm profit function derived from a Cobb-Douglas technology with homogenous labor:

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

(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, household head’s education and age, a dummy for the head being a woman, as well as geographical dummies.

We assume that the farm head always works on the farm (at least on a part-time basis; see the pluriactivity extension in Appendix 1). As a result, only non-head 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. We estimate this contribution $\Delta \Pi_{0h}$ holding fixed other members decisions and the farm global factor productivity $\bar{u}_0$:

$$\ln \Delta \Pi_{0h} = \ln p_0 + \ln (L_{h+i}^\alpha - L_{h-i}^\alpha) + Z_h \theta + u_{0h}$$  

(10)

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

Here again the labor decision model is hierarchical between the household head and non-head members,
and simultaneous among non-head members. We then write the family work value as follows:

\[ \ln \tilde{w}_{0i} = (X_{0i}, Z_{0i}) \beta_0 + \gamma \ln \Delta \Pi_{0i} + t_{0i} \]  

(11)

where \( \gamma \) stands for the (non-unitary) elasticity of the value of family work in agricultural households to the price of agricultural products.

For estimation, we assume that \( u_0 \), the idiosyncratic total factor productivity of the household, is independent from \( (t_0, t_1, t_2, \ldots) \) for all household members. This allows us to follow a limited information approach: In a first step, we estimate the reduced profit function (10), and then derive an estimate for the individual potential contribution to farm production (10); in a second step, we estimate the reservation wage equation (11) including this latter variable, and retaining the wage functions estimated for non-agricultural households. Again, we make separate estimations for each gender, excluding the farm heads whose occupational choice is not modeled.

### 3.5 Results of estimation and of micro-calibration

The microeconometric model is estimated on a household sample provided by the EPM (Enquête Permanente auprès des Ménages) survey for the year 1993-94, with approximately 4,500 households and 12,800 individuals aged 15 years and older. We estimate the pluriactivity extension presented in Appendix 1. Appendix 2 gives the results of the micro-calibration procedure for all the coefficients of the four basic variables of the structural microeconomic model: \( \tilde{w}_{0i}, w_{hi}, w_{zi}, \) and \( \tilde{w}_{2i} \).

Here we only comment the results that are of importance for the simulations carried out subsequently.

In the farm profit function, the number of family workers comes out with a coefficient that is consistent with usual orders of magnitude: A doubling of the work force 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 are, not surprisingly, 20 to 25 percent higher in the rural areas.

The reservation wage in non-farm 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. It is lower in both the rural area and the Antananarivo faritany (which translates into higher participation rates in those areas). Almost by definition, heads are less often inactive and non-labor 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 strictly prefer to work outside the farm, whether in self-employed or wage jobs (lower family-work value). When the farm head already works part of his time in nonagricultural activities, other 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 strongly constrains the short-run impact of agricultural price and workfare policies that are examined in the remainder of this paper. This feature also explains why we could not obtain an acceptable estimate for the elasticity ($\gamma$, see section 3.5) of the farm-work value with respect to the agricultural price $p_0$. In the remainder, we fix this elasticity to one, like in other sectors (see Appendix 2).

Before turning to the features of the macro-micro integration, it is worth pointing out that our structural microeconomic framework has welfare implications that are only partially taken into account in this paper. 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. Non-monetary arguments of utility are ignored in our analysis, which focuses on the distribution of household real income, i.e. the sum of $\Pi_0$, $w_1$, $w_2$ and other non-labor income deflated by a household-specific cost of living index (see Appendix 3). Those arguments are indeed reflected in the two variables $\tilde{w}_0$ and by $\tilde{w}_2$. $\tilde{w}_0$ stands for the utility of leisure or family-work (including the relative cost of entry in self-employment); recall that in the case of farm households, it includes the profit from farm activities. $\tilde{w}_2$ stands for the relative disutility of working in the wage-sector. Then a “full income” concept could be considered that would sum up $\tilde{w}_0$, $w_1$, and $\frac{w_2}{\tilde{w}_2}$ over individuals within each household. In a first step, we however prefer to use the microeconomic model only as a tool 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 which, at the end of our micro-calibration procedure, also come out with a very high variance (see Appendix 3). This is why we felt that the reliability of “full income” counterfactuals was still to be explored, and left it for further research.

4 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 economic shocks or policies under study is small enough, there is no necessity 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.\textsuperscript{12} Conversely, if the size of shocks or policies under study is large enough, micro-macro linkages 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). In order to achieve consistency between micro and micro data, household statistical weights of the EPM 1993-94 survey were recomputed to comply with the income structure of the 1995 SAM. The reweighing procedure relies on a cross-entropy estimation (Robilliard and Robinson 2003).

Figure 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 once taxes and savings have been subtracted. Consumption demands for the different goods are then derived based on household specific
budget shares (see Appendix 3). These household level consumption demands are added up and confronted to goods supply. Relevant prices are adjusted by “tatonnement” 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 the adjustment variable. More specifically, the three task prices \((\pi_1, \pi_2, \tilde{\pi}_2)\) as well as the agricultural price \(p_0\), introduced in section 3 are the variables that link the micro module to the macro module. \(p_0\) and \(\pi_1\) are endogenously determined on the goods market equilibrium for the agricultural and informal goods respectively. \(\pi_2\) is exogenous and may be used to simulate a uniform wage increase in the wage sector. \(\tilde{\pi}_2\) varies endogenously in order 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\(^{13}\); the informal sector produces a non tradable 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, while 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 CET (Constant Elasticity of Transformation) functions at the production level and through CES (Constant Elasticity of Substitution) functions at the consumption level.\(^{14}\)
At the macro level, closures rules for three constraints need to be specified in order 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:

\[ GS АV = GIN C - pq, QG \]  \hspace{1cm} (12)  

\[ FSA V = \left( \sum_h mps.Y_h + GS AV - \sum_c pq_c QINV_c \right) \times EXR. \]  \hspace{1cm} (13)  

\[ \sum_c pwm_c QM_c = \sum_c pwe_c QE_c + FSA V \]  \hspace{1cm} (14)  

where \( GS AV \) is government savings, \( GIN C \) is government income, \( QG \) is government consumption, \( FSA V \) 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 \( c \).

We assume that both government and foreign savings are flexible, and that government consumption, the exchange rate and total investment are fixed.\(^{15}\) By these closure rules, we assume that any large scale poverty reduction policy, such as those simulated thereafter, 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. Our 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.
5 Scenarios and Simulations

We present exploratory simulations with the objective of improving the incomes of the poor. In this paper we explore three alternative simulations to achieve this objective: a direct subsidy on agricultural prices, a workfare program, and an untargeted transfer program. These policies are compared both in terms of their macroeconomic impact and in terms of their impact on poverty and income distribution. All experiments are designed so that their ex post cost are equal (in real terms).

5.1 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 to producer and sell 10 percent lower to consumers.

In the second experiment, we simulate the implementation of a workfare scheme. Workfare programs, whereby participants must work to obtain benefits, have been widely used for fighting poverty, usually in times of crises due to macroeconomic or agro-climatic shocks (Ravallion, 1999). The workfare scheme we study is assumed to be highly labor intensive. The government buys at a fixed rate the services of labor in order to build or to rehabilitate roads and other infrastructures. Given the occupational choice model described in the previous section, the workfare scheme designed in our experiment can be summarized by two characteristics: the workfare wage level and the corresponding work load. We choose to design a part-time workfare scheme whereby participating individuals are allowed to remain 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 selection rule at the end of section 3.1.6). As mentioned earlier, 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, which translates into 515,250 Malagasy francs in full-time equivalent. Table 1 shows official minimum wages in different sectors from 1990 to 1996. Our database has been scaled to match structural and demographic features of the year 1995. Consequently, the meaningful figures are in the 1995 column. They show that our 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.

### Table 1: Minimum Yearly Wages, 1990-96 (in 1993 Malagasy francs)

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</thead>
<tbody>
<tr>
<td>Agricultural</td>
<td>576,015</td>
<td>614,821</td>
<td>543,323</td>
<td>494,400</td>
<td>554,188</td>
<td>603,866</td>
<td>557,053</td>
</tr>
<tr>
<td>Non agricultural</td>
<td>566,458</td>
<td>604,270</td>
<td>533,960</td>
<td>485,880</td>
<td>537,589</td>
<td>592,923</td>
<td>547,576</td>
</tr>
<tr>
<td>Public sector</td>
<td>774,965</td>
<td>811,706</td>
<td>716,329</td>
<td>651,828</td>
<td>665,334</td>
<td>719,102</td>
<td>653,844</td>
</tr>
</tbody>
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Source: Ministry of Finance and Ministry of Civil Service and Labor.

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 17,887 Malagasy francs per capita, which adds up with household non-labor income (and has the corresponding micro-economic effects of an increase in the value of inactivity in non-farm households).

All three programs share a high budgetary cost equivalent to almost 5 percent of GDP. They should therefore have large macroeconomic impacts as well as the intended distributional micro-impacts.
5.2 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. In order to explore this issue, table 2 presents the distribution of individuals in beneficiary households across quintiles of per capita income for these two simulations.

Table 2: Distribution of beneficiary households across quintiles

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<th>Agricultural Subsidy</th>
<th>Workfare Scheme</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Beneficiary households</td>
<td>Row %</td>
</tr>
<tr>
<td>1st quintile</td>
<td>2,184,281</td>
<td>83.9</td>
</tr>
<tr>
<td>2nd quintile</td>
<td>2,073,064</td>
<td>79.5</td>
</tr>
<tr>
<td>3rd quintile</td>
<td>2,073,970</td>
<td>79.4</td>
</tr>
<tr>
<td>4th quintile</td>
<td>1,752,415</td>
<td>67.2</td>
</tr>
<tr>
<td>5th quintile</td>
<td>1,036,771</td>
<td>39.7</td>
</tr>
<tr>
<td>Total</td>
<td>9,120,501</td>
<td>69.9</td>
</tr>
</tbody>
</table>

Notes: 1. Quintiles are computed using per capita income in the base year.
2. Row percent figures are shares of beneficiary population by quintile.

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 subsidy, only 7.2 percent of the total program cost accrues to these, and the largest share (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, regressive in terms of program cost allocation.
When compared to the agricultural subsidy, the workfare scheme appears to be less progressive in terms of the distribution of individuals in beneficiary households, since they are distributed evenly across quintiles. But since the benefits accruing to households are not proportional to their incomes, 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, and also more 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, since the workfare scheme fails to take these costs into account, it is implicitly targeted towards urban areas. As a result, it has a large impact on urban poverty (see next section).

### 5.3 Simulation Results

Table 3 shows various price and macro aggregate changes as a result of the three programs. Macro aggregate changes are presented in real terms.

| Table 3: Macroeconomic impact of alternative policies |
|----------------------------------------|--------|------------------|-----------------|------------------|
| Base values                           | Agricultural subsidy | Part time workfare program | Untargeted uniform per capita transfer |
| Agricultural price                    | 1.0    | 4.7              | 8.2             | 5.6              |
One common point across all three experiments is the increase in the relative price of the agricultural good. In particular, even the subsidy simulation leads to a 4.7 percent increase in the consumers’ price of the agricultural good (relative to the consumer price index). This result stems from large income effects which 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), as it also leads to a decrease in the labor available for agriculture (see table 4).

Results also show that the macroeconomic impact of all three policies is small and positive in terms of GDP. As mentioned earlier, all experiments were designed in order to equalize their ex post cost. Since 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 4. The top part of the table shows numbers of workers in terms of their occupational choices, 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 under-employment with the number of inactive workers decreasing by almost 18 percent. It also leads to important reallocations of labor out of 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 4: Employment impact of alternative policies

<table>
<thead>
<tr>
<th></th>
<th>Base values</th>
<th>Agricultural subsidy</th>
<th>Part time workfare program</th>
<th>Untargeted uniform per capita transfer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full time agricultural workers</td>
<td>4 248.9</td>
<td>2.8</td>
<td>-5.3</td>
<td>1.6</td>
</tr>
<tr>
<td>Full time informal workers</td>
<td>324.6</td>
<td>4.4</td>
<td>-42.2</td>
<td>3.2</td>
</tr>
<tr>
<td>Full time formal workers</td>
<td>527.0</td>
<td>0.4</td>
<td>-2.9</td>
<td>0.4</td>
</tr>
<tr>
<td>Part time workers</td>
<td>874.9</td>
<td>-12.7</td>
<td>67.9</td>
<td>-7.0</td>
</tr>
<tr>
<td>Full time inactive workers</td>
<td>1 144.3</td>
<td>-2.1</td>
<td>-17.7</td>
<td>-1.5</td>
</tr>
<tr>
<td>Agricultural labor</td>
<td>4 536.3</td>
<td>1.5</td>
<td>-3.9</td>
<td>0.8</td>
</tr>
<tr>
<td>Informal labor</td>
<td>687.0</td>
<td>-5.9</td>
<td>-12.6</td>
<td>-2.9</td>
</tr>
<tr>
<td>Formal labor (incl. workfare)</td>
<td>602.1</td>
<td>0.2</td>
<td>76.1</td>
<td>0.3</td>
</tr>
<tr>
<td>Total active workers</td>
<td>5 825.4</td>
<td>0.5</td>
<td>3.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Total labor force</td>
<td>7 119.7</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Notes: 1. Base values for BASE column and percent changes for the simulations.
2. Part time workers category include 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.
3. 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 5 shows results in terms of poverty and income distribution for all households, and in both urban and rural areas. Changes in three indicators of inequality are presented: the Gini index as well as two entropy indices.

Table 5: Social impact of alternative policies – General Equilibrium results

<table>
<thead>
<tr>
<th></th>
<th>ALL HOUSEHOLDS</th>
<th>Agricultural subsidy</th>
<th>Part time workfare program</th>
<th>Untargeted uniform per capita transfer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per Capita Income</td>
<td>352.7</td>
<td>4.4</td>
<td>4.6</td>
<td>5.0</td>
</tr>
<tr>
<td>General Entropy Index 0</td>
<td>45.2</td>
<td>-2.5</td>
<td>-7.6</td>
<td>-11.2</td>
</tr>
<tr>
<td>General Entropy Index 1</td>
<td>59.0</td>
<td>-3.0</td>
<td>-6.8</td>
<td>-8.2</td>
</tr>
<tr>
<td>Gini Index</td>
<td>51.1</td>
<td>-1.3</td>
<td>-3.6</td>
<td>-4.8</td>
</tr>
<tr>
<td>Poverty Incidence</td>
<td>59.0</td>
<td>-5.0</td>
<td>-6.6</td>
<td>-6.2</td>
</tr>
<tr>
<td>Poverty Gap</td>
<td>24.9</td>
<td>-8.2</td>
<td>-13.5</td>
<td>-16.3</td>
</tr>
<tr>
<td>Poverty Severity</td>
<td>13.4</td>
<td>-10.0</td>
<td>-17.4</td>
<td>-24.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>URBAN HOUSEHOLDS</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Per Capita Income</td>
<td>631.1</td>
<td>0.8</td>
<td>3.1</td>
<td>2.7</td>
</tr>
<tr>
<td>General Entropy Index 0</td>
<td>48.1</td>
<td>-1.1</td>
<td>-7.2</td>
<td>-6.2</td>
</tr>
<tr>
<td>General Entropy Index 1</td>
<td>62.8</td>
<td>-0.9</td>
<td>-5.5</td>
<td>-4.5</td>
</tr>
<tr>
<td>Gini Index</td>
<td>52.7</td>
<td>-0.5</td>
<td>-3.3</td>
<td>-2.6</td>
</tr>
<tr>
<td>Poverty Incidence</td>
<td>30.5</td>
<td>-1.0</td>
<td>-11.1</td>
<td>-7.0</td>
</tr>
<tr>
<td>Poverty Gap</td>
<td>10.3</td>
<td>-3.2</td>
<td>-24.0</td>
<td>-19.7</td>
</tr>
<tr>
<td>Poverty Severity</td>
<td>4.5</td>
<td>-5.1</td>
<td>-29.5</td>
<td>-28.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>RURAL HOUSEHOLDS</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Per Capita Income</td>
<td>260.7</td>
<td>7.3</td>
<td>5.7</td>
<td>6.8</td>
</tr>
<tr>
<td>General Entropy Index 0</td>
<td>33.2</td>
<td>0.8</td>
<td>-8.4</td>
<td>-14.3</td>
</tr>
<tr>
<td>General Entropy Index 1</td>
<td>39.7</td>
<td>0.6</td>
<td>-8.2</td>
<td>-11.3</td>
</tr>
<tr>
<td>Gini Index</td>
<td>44.0</td>
<td>0.3</td>
<td>-4.1</td>
<td>-6.4</td>
</tr>
<tr>
<td>Poverty Incidence</td>
<td>68.4</td>
<td>-5.6</td>
<td>-5.9</td>
<td>-6.1</td>
</tr>
<tr>
<td>Poverty Gap</td>
<td>29.7</td>
<td>-8.8</td>
<td>-12.3</td>
<td>-16.0</td>
</tr>
<tr>
<td>Poverty Severity</td>
<td>16.4</td>
<td>-10.4</td>
<td>-16.3</td>
<td>-23.8</td>
</tr>
</tbody>
</table>

Note: Base values for BASE column and percent changes for the simulations.

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
erural 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.

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 5.0 percent. It also
has a stronger effect on income distribution, with a 3.6 percent decrease in the Gini index (compared to a
1.3 percent decrease with the subsidy program), and a 17.4 percent decrease in the poverty severity
indicator (compared to a 10.0 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, while it decreases only slightly in the case of the
agricultural subsidy and is reduced by 7.0 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 (see above).

In sum, the two targeted programs which 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, the simulations reveal however that there is room for improvement in the quality of targeting. Indeed, a general subsidy to agricultural producers does not appear to be an adequate scheme for reaching the poorest farmers, as it fails in doing 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 around the minimum wage also reaches somewhat disappointing results, especially in rural areas. Costs of access to the labor market prevent individuals living in remote areas and/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 under-employment, but 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. It should, however, be kept in mind that they all 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 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, we have seen that part of these additional costs are internalized by individuals who give up the workfare job offers when they are located too far from them. Finally, even the untargeted transfer scheme would entail an additional cost of bringing the cash to the households, even in very remote areas.

5.4 Comparing « Micro-Accounting », Ex Ante and Ex Post Results
We now turn to a more methodological question and compare the simulation results of three specifications of the model. The first version corresponds to the results of a “micro-accounting” exercise where neither behavior nor general equilibrium effects would be taken into account. The second version still does not take into account general equilibrium effects but allows individuals and households to respond to the shock. The last version takes into account 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% agricultural price subsidy analyzed previously and a 20% Total Factor Productivity shock in the agricultural sector. The results of both simulations are presented in Figures 1 and 2. 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 2, the micro-accounting and ex ante curves are very close. Both indicate that the incidence of the subsidy program is progressive. The ex post curve does not reverse that conclusion but appears closer to the 45° line, indicating that the program is more progressive than ex ante simulations would predict. This is reversed in the second simulation where results indicate that taking into account general equilibrium actually leads to conclude that the shock is less progressive than micro-accounting or ex ante simulations would predict.18

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 towards 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 towards urban households thus making it more progressive ex post than ex ante.

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

**Conclusion**

This paper has presented the basic motivations for the construction of an integrated static micro-macro model for a low-income economy. It has outlined the main features of such a model in terms of micro-econometric 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: (i) a price subsidy to agricultural producers, (ii) a general workfare program proposing part-time job opportunities paid around the minimum wage, and (iii) a uniform unconditional and untargeted transfer provided to each individual regardless of her age and job situation. The micro-macro model yields interesting results on the counterfactual impacts of each program on the overall distribution of income, 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 in order 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 micro-macro approach. In the first section of this paper we advocated the use of integrated micro-macro models on the basis of three main arguments. We first argued that the approach was well
suited to incorporating current advances in the microeconometrics of households behaviors and markets 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 agricultural households behavior whose collective production in family farms does not fit as well as our “individualistic” framework (see Cogneau and Robilliard, 2001, for an alternative). 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. It would greatly benefit from the availability of dynamic panel data and/or from experimental knowledge on poor households’ responses to programs (Duflo, 2004). Second, we argued that integrated tools might be desired for the sake of micro-macro consistency, as far as “aggregation issues” and “interlinked welfare issues” are concerned. It should, however, be stressed that such a consistency in the modeling of household welfare (labor supply, earnings, consumption) is obtained at the expense of sectoral disaggregation and of 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.” We 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 we implemented, we hope to have shown that integrated micro-macro 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.
Appendix 1: A Pluri-Activity Extension

We wish to allow individuals to pursue outside part-time activities when they work for the family. We first have to introduce a “part-time” variable in the wages and benefits equations to take into account the variability of hours worked:

\[
\ln w_{i1} = \ln \pi_1 + X_{i1}x_1 + \delta_1 T_{1i} + t_{1i}
\]

\[
\ln w_{i2} = \ln \pi_2 + X_{i2}x_2 + \delta_2 T_{2i} + t_{2i}
\]

with \( \delta_1 < 0 \), and \( \delta_2 < 0 \) and where \( T_{1i} \) (resp. \( T_{2i} \)) is a dummy variable indicating whether the individual works part-time. We may then redefine “full-time” incomes:

\[
\ln \tilde{w}_{i1} = \ln w_{i1} - \delta_1 T_{1i} \quad (1)
\]

\[
\ln \tilde{w}_{i2} = \ln w_{i2} - \delta_2 T_{2i} \quad (2)
\]

We finally simply 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 \( \tilde{w}_{0i} > (1+a)\tilde{w}_{i1} \) and \( \tilde{w}_{0i} > (1+a)\tilde{w}_{2i} \)

- \( i \) chooses family work and self-employment iff \( (1+a)\tilde{w}_{i1} > \tilde{w}_{0i} > (1-a)\tilde{w}_{i1} \) and \( \tilde{w}_{0i} > \frac{\tilde{w}_{2i}}{\tilde{w}_{2i}} \)

- \( i \) chooses family work and wage work iff \( (1+a)\tilde{w}_{2i} > \tilde{w}_{0i} > (1-a)\tilde{w}_{2i} \) and \( \frac{\tilde{w}_{2i}}{\tilde{w}_{2i}} > \tilde{w}_{i1} \)

- \( i \) chooses full time self-employment iff \( (1-a)\tilde{w}_{i1} > \tilde{w}_{0i} \) and \( \tilde{w}_{i1} > \frac{\tilde{w}_{2i}}{\tilde{w}_{2i}} \)
\( i \) chooses full time wage work iff \((1-a)\frac{\bar{w}_{2i}}{\bar{w}_{2j}} > \bar{w}_{0i}\) and \(\frac{\bar{w}_{2i}}{\bar{w}_{2j}} > \bar{w}_{1i}\)

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

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

if \(i\) had chosen full time family work, \(i\) takes the workfare offer iff \(2w_3(1-a) > \bar{w}_{0i}\)

if \(i\) had chosen self-employment, \(i\) takes the workfare offer iff \(w_3 > \bar{w}_{1i}[1 - \exp(\delta_i)]\)

if \(i\) had chosen wage work, \(i\) takes the job offer iff \(w_3 > \bar{w}_{2i}[1 - \exp(\delta_2)]\)

The two last conditions apply whether \(i\) had chosen a full time or part time option. In the case she had chosen part time, and if the relevant condition holds, she then gives up part time family work in favor of workfare. In any case, she ends up working part time in self-employment or wage work, and the rest of her time in the workfare program. If the first condition holds, she ends up working part time in the family and the rest of her time in the workfare program.
### Appendix 2: Results from estimation and micro-calibration

#### Men - In Non Farm Households

<table>
<thead>
<tr>
<th></th>
<th>$\beta_1$</th>
<th>$\beta_2$</th>
<th>$-\beta_2$</th>
<th>$\beta_0$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of years of education (/10)</td>
<td>0.9841</td>
<td>0.8995</td>
<td>-1.3384</td>
<td>0.9429</td>
</tr>
<tr>
<td>Number of years of experience (/10)</td>
<td>0.3232</td>
<td>0.5100</td>
<td>-0.7785</td>
<td>0.1533</td>
</tr>
<tr>
<td>Number of years of experience squared (/1000)</td>
<td>-0.3879</td>
<td>-0.6276</td>
<td>1.1335</td>
<td>0.0315</td>
</tr>
<tr>
<td>Region of Antananarivo (=1)</td>
<td>-0.0561</td>
<td>-0.0689</td>
<td>0.1520</td>
<td>-0.2380</td>
</tr>
<tr>
<td>Rural area (=1)</td>
<td>-0.2504</td>
<td>-0.0891</td>
<td>0.4053</td>
<td>-0.0039</td>
</tr>
<tr>
<td>Father in the informal sector (=1)</td>
<td>0.0</td>
<td>0.0</td>
<td>-0.0695</td>
<td>0.0485</td>
</tr>
<tr>
<td>Father in the formal sector (=1)</td>
<td>0.0</td>
<td>0.0</td>
<td>-0.4124</td>
<td>0.2920</td>
</tr>
<tr>
<td>Household head in the informal sector (=1)</td>
<td>0.0</td>
<td>0.0</td>
<td>0.4913</td>
<td>-0.0505</td>
</tr>
<tr>
<td>Household head in the formal sector (=1)</td>
<td>0.0</td>
<td>0.0</td>
<td>-0.2107</td>
<td>0.1436</td>
</tr>
<tr>
<td>Spouse in the informal sector (=1)</td>
<td>0.0</td>
<td>0.0</td>
<td>0.7386</td>
<td>-0.0473</td>
</tr>
<tr>
<td>Spouse in the formal sector (=1)</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Number of children aged 0 to 9 years old</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>-0.0641</td>
</tr>
<tr>
<td>Number of males aged 10 to 14 years old</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>-0.0160</td>
</tr>
<tr>
<td>Number of males aged 15 to 69 years old</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0261</td>
</tr>
<tr>
<td>Number of females aged 10 to 14 years old</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0150</td>
</tr>
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#### Standard errors (diagonal) and correlation of unobservables

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Note: Coefficients in regular characters are econometrically estimated. In contrast, the three coefficients with a star (*) are pure guesses. Other guessed coefficients not shown in the table include the two measurement errors variances (which are assumed null) and the $\left(t_2 - t_2 - t_1\right)$ standard error (respectively at 2 and 1.5 in non farm and farm households). Coefficients in
italics result from a “micro-calibration” using both econometric estimates and guessed coefficients. See sections 3.2 and 3.6 for more precisions. For the definition of part-time corrections and threshold (a), see Appendix 1.
### Women - In Non Farm Households

<table>
<thead>
<tr>
<th></th>
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<td>2.0197</td>
<td>4.7003</td>
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Note: Coefficients in regular characters are econometrically estimated. In contrast, the three coefficients with a star (*) are pure guesses. Other guessed coefficients not shown in the table include the two measurement errors variances (which are assumed null) and the \((\tilde{t}_2 - \tilde{t}_2 - \tilde{t}_1)\) standard error (respectively at 2 and 1.5 in non farm and farm households). Coefficients in italics result from a “micro-calibration” using both econometric estimates and guessed coefficients. See sections 3.2 and 3.6 for more precisions. For the definition of part-time corrections and threshold (a), see Appendix 1.

### Women - In Farm Households

<table>
<thead>
<tr>
<th></th>
<th>( \beta_1 )</th>
<th>( \beta_2 )</th>
<th>(-\beta_2 )</th>
<th>( \beta_0 )</th>
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Standard errors (diagonal) and correlation of unobservables

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</table>

Note: Coefficients in regular characters are econometrically estimated. In contrast, the three coefficients with a star (*) are pure guesses. Other guessed coefficients not shown in the table include the two measurement errors variances (which are assumed null) and the \((\tilde{t}_2 - \tilde{t}_2 - \tilde{t}_1)\) standard error (respectively at 2 and 1.5 in non farm and farm households). Coefficients in italics result from a “micro-calibration” using both econometric estimates and guessed coefficients. See sections 3.2 and 3.6 for more precisions. For the definition of part-time corrections and threshold (a), see Appendix 1.
Appendix 3: A very simple expenditure system with heterogeneous preferences

The micro-macro model tries to make use of the wealth of the data, not only in the labor supply and income generation dimension, but also in the consumption dimension. Data limitations however prevent going too far in that direction. In order to avoid microeconometric complications, savings and consumption choices are first assumed 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:

\[ C_h = (1-s) Y_h \]

Household disposable income \( Y_h \) is equal to the sum of agricultural benefits (including auto-consumption of goods produced by the household), self-employment benefits and wage earnings, non-labor 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, formal) through idiosyncratic budget shares \( \omega_{j,h} \) here taken from the data:

\[ C_{j,h} = \omega_{j,h} C_h \quad \text{with } j=0,1,2 \quad \text{and} \quad \sum_{j=0,1,2} \omega_{j,h} = 1 \]

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


Modeling 27(2): 231-247.


Figure 1: Fully integrated macro-micro model structure

Macro Module (CGE type model)

Equations
- Macro closures
  * Savings-Investment balance
  * Government budget balance
  * Current account balance
- Factor demand
- Goods supply

Output
- Macro aggregates
- Production and prices

Micro Module (household survey)

Equations
- Structural wage & labor supply model
- Consumption demand system
- Income generation equation

Output
- Full Income Distribution
Figure 2: Benefit incidence of an agricultural subsidy under various specifications

Figure 3: Benefit incidence of a Total Factor Productivity shock in the agricultural sector
We thank the National Institute of Statistics of Madagascar for providing the data. Special thanks go to Mireille Razafindrakoto, François Roubaud, and members of the MADIO project in Antananarivo for fruitful discussions about our research and the Malagasy economy. We also thank François Bourguignon, Jesko Hentschel, Phillippe Leite, Dominique van der Mensbrugghe, Luiz Pereira da Silva, and Abdelkhalek Touhami for discussions about previous versions of the present work. The usual disclaimer applies.

When supplemented with a dynamic demographic module, it can be relatively suited to exploring demo-economic issues like the distributive impact of the AIDS epidemics (Cogneau and Grimm, 2002) or general poverty reduction strategies like the long-term impact of education policies (Grimm 2004 and 2005).

Cogneau (1999 and 2001) shows that a micro-macro model of the distribution of income is able to 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.

It moreover assumes that individuals compare self-employment and wage-work opportunities only in terms of earnings, in other words they do not bring differential non-pecuniary benefits. See Cogneau (2001).

The reservation value \( \tilde{w}_0 \) then includes the cost of entry into the informal activities. See later about the simulation of the access to workfare programs job opportunities.

In econometric estimation, the X vectors include a constant.

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

It might be also the case for some non-agricultural occupations. In light of the Malagasy case and data, we however choose to treat non-agricultural self-employment as a purely individual occupation since our data suggests that the great majority of self-employed working in non-agricultural sectors are running very small size, most often individual, businesses.

This latter assumption should allow for a direct identification of the \( \Delta \Pi_0 \) effect in \( \tilde{w}_0 \), through the effect of \( u_{00} \). However, as \( \Delta \Pi_0 \) is presumably affected by large measurement errors, we exclude ‘available land’ from the variables in \( \tilde{w}_0 \), taking it as an instrument for the identification of the effect of \( \Delta \Pi_0 \).

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.

More detailed econometric results are available from the authors upon request.
Even with small size policies, this assumption of no price variation may be violated if there is a strong spatial segmentation of markets. In this latter case, local prices variation may matter.

Production functions parameters are estimated (see Section 3) 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.

The parameters of the agricultural CET function are calibrated on aggregate data but the share of exports on total production is idiosyncratic and taken from survey data.

By Walras’ law, one of the system constraints is redundant. System constraints include markets as well as macro balances. In our model, the redundant equation is the external balance equation (13).

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

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

Under the current version of our algorithm, we 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”.

We thank François Bourguignon for a fruitful discussion about this extension.