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## **Evaluating Alternative Policy Responses to Higher World Food Prices**

The Case of Increasing Rice Prices in Madagascar

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## ABSTRACT

Higher world food prices have led many governments in developing countries to adopt policy measures to mitigate the adverse impact on low-income households. This paper sets out a partial equilibrium framework to evaluate the relative efficiency, distributional, and revenue implications of alternative policy responses. The model is applied to Madagascar data to evaluate the net welfare impact of reductions in rice tariffs and to compare this to the alternative policy of targeted transfers. Lowering tariffs is not a cost-effective approach to protecting low-income households due to substantial leakage of benefits to higher income households and an adverse impact on poor net rice producers even when the substantial efficiency gains from such tariff reductions are incorporated into the analysis. Developing a system of well-designed and -implemented targeted direct transfers to poor households is thus likely to be a substantially more cost-effective approach to poverty alleviation, especially if these can be linked to productivity-enhancing investments. Such an approach should be financed by switching revenue raising from rice tariffs to more efficient tax instruments. These policy conclusions are likely to be robust to the incorporation of general equilibrium considerations.

**Keywords:** Madagascar, rice, import tariffs, targeted transfers, welfare impacts

# 1. INTRODUCTION

Recent large increases in cereal and other food prices have led many governments to adopt policies intended to mitigate the adverse impact on households, especially low-income households that allocate a substantial proportion of their total budget to food. Since 2000, the nominal price of wheat has increased about threefold and the prices of corn and rice have doubled. Both exporting and importing countries have responded with policies aimed at reducing domestic food prices. Exporting countries have increased export taxes or imposed quotas on food exports. Importing countries have reduced import tariffs and other food taxes or introduced price controls.

When evaluating the welfare impact of such policy responses, it is important to incorporate not only their distributional effectiveness but also their implications for efficiency and government revenues. In addition, this net welfare impact should be compared to alternative policy responses. In this paper we set out a simple partial equilibrium framework that facilitates such an evaluation. This model is then used to evaluate two policy options considered in Madagascar to mitigate the adverse impact of higher rice prices on low-income households, namely, lowering rice tariffs or introducing targeted transfers.

In early 2004, the Malagasy economy suffered a series of shocks resulting in pressure on the government to introduce measures to counteract the negative effects on the *real incomes* of poor households. Madagascar's rice harvest typically occurs from March through June, and in February and March 2004, there was severe cyclone damage to the rice harvest and also to crucial market infrastructure. In addition, the world price of rice increased substantially with a 43 percent increase in the Bangkok dollar price of rice. During the same period, the Malagasy franc (FMG) also experienced rapid depreciation of 58 percent relative to the dollar. The import parity price of rice thus increased by 113 percent between January and August 2004 (Minten and Dorosh, 2006). Such price increases can be expected to have a substantial welfare impact on households, as rice is a staple in Madagascar.

These events led to an active policy debate regarding the appropriate policy instrument to use to mitigate their poverty impact, in particular whether the government should decrease the import tax on rice to bring about a decrease in the domestic price of rice or instead rely on direct transfers to poor households. At the time, rice imports were subject both to an import tax of 20 percent and a value-added tax (VAT) of 21 percent (levied on the import tax-inclusive price), which together yield a net tax rate of 45 percent. Those in favor of reducing the rice tariff argued that this would lower the domestic price and quickly benefit the poor. Those against argued that lower tariffs would have adverse effects on tax revenues and the balance of payments and could generate political pressure for wider tariff reductions. It was argued that the government should rely more on direct transfers, although it was recognized that developing a well-designed and well-implemented safety net would take some time.

The structure of the paper is as follows. Section 2 sets out a simple partial equilibrium model that provides a framework for integrating the distributional, efficiency, and revenue influences of both policies into an evaluation of the net welfare effect of the two policy alternatives. Section 3 uses this framework to evaluate each of the policies in turn and to compare across both. Section 4 discusses some caveats related to the use of a partial equilibrium model, identifying potential implications for our policy conclusions. Section 5 provides a brief summary of the results and their policy implications.

## 2. A PARTIAL EQUILIBRIUM MODEL

In this section, we present a partial equilibrium model that provides a useful framework to guide our evaluation of the relative welfare effects of tariff reductions and transfers. Although the model has a clear general equilibrium counterpart, the assumptions we make transform it into a partial equilibrium model.<sup>1</sup>

### 2.1. The Model

The model has two agents: households and the government. Rural agricultural households are incorporated into the household sector so that formally there is no need to distinguish between agricultural producers and nonproducers. All other producers in the economy are implicitly assumed to produce using constant returns to scale technology, with fixed producer and factor prices.

*Household welfare* is captured by a standard indirect utility function  $V(\mathbf{p}, y)$ , where  $\mathbf{p}$  is a vector of prices facing the household sector (factor prices are included as negative entries) and  $y$  is lump-sum income; later, superscript  $h$  will be added to denote specific households. Household lump-sum income is given by

$$y = \pi(\mathbf{p}, A) + m \quad (1)$$

where  $\pi(\mathbf{p}, A)$  is a (restricted) profit function that gives the imputed rent obtained from land area  $A$  given  $\mathbf{p}$ , and  $m$  is lump-sum transfers to or from the government. The profit function in turn is given by

$$\pi(\mathbf{p}, A) = \mathbf{p} \cdot \mathbf{q} - \mathbf{c} \cdot \mathbf{f} \quad (2)$$

where  $\mathbf{q}$  is a vector of agricultural output,  $\mathbf{c}$  is a vector of input prices, and  $\mathbf{f}$  is a vector of input quantities.

The government derives revenue from both rice import tariffs and lump-sum taxation of households; so revenue  $R$  is given by

$$R = t_i s_i + T = t_i (x_i - \mathbf{q}_i) - \sum_h m^h \quad (3)$$

where subscript  $i$  denotes rice,  $x_i = \sum_h x_i^h$  is the aggregate household demand for rice,  $q_i = \sum_h q_i^h$  is the aggregate household production of rice,  $s_i = x_i - q_i$  is the imports of rice calculated as the difference between aggregate consumption and production of rice in the economy, and  $m^h$  is the lump-sum transfer to each household (if positive) or lump-sum tax from each household (if negative) so that  $T = -\sum_h m^h$  is the net lump-sum taxes and transfers between the government and households. The import tax per unit of rice is denoted by  $t_i = p_i - p_i^*$ , where the asterisk superscript denotes border import prices. We abstract from trade and transport margins for convenience. Note that, under this specification, a unit increase in the rice tariff leads to a unit increase in the domestic price.

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<sup>1</sup> See Drèze and Stern (1987) and Newbery and Stern (1987) for more detailed discussions of the general model and Coady and Drèze (2002) for the implications of alternative distributional assumptions for tax rules. See also Braverman, Hammer, and Ahn (1987) and Newbery (1987) for early empirical evaluations of agricultural price reforms for Korea and Coady (1997) for an application of the model within the context of an evaluation of agricultural pricing policies for Pakistan.

*Social welfare* in the economy is defined, over  $H$  households, by a standard Bergson-Samuelson social welfare function:

$$W = W[V^1(\mathbf{p}, y^1), \dots, V^h(\mathbf{p}, y^h), \dots, V^H(\mathbf{p}, y^H)]. \quad (4)$$

The effect on social welfare of a (marginal) *reform* of each policy instrument (i.e., tariff  $t_i$  or transfers  $m^h$ ) is derived by differentiating the social welfare function with respect to that instrument. Each of these reforms will also have revenue implications that need to be incorporated into the overall welfare analysis. To avoid having to explicitly identify the social cost of raising an extra unit of government revenue to finance the resulting expenditures, the approach taken here is to focus on *equal-revenue* expenditure reforms. Specifically, we identify the welfare effect of a tariff reduction that results in a unit decrease in government revenue and compare it to the welfare effect of allocating an extra unit of revenue to a transfer program that delivers transfers to households identified as poor. Under such revenue-neutral comparisons, the social cost of raising an extra unit of revenue to finance these unit expenditures can be assumed common across the alternative policy instruments and thus cancels out in any comparison across reforms.<sup>2</sup>

## 2.2. Rice Tariff Reform

Differentiating the social welfare function (4) with respect to  $t_i$  and applying Roy's identity to the indirect utility function and Shepard's lemma to the profit function (2) gives the effect on social welfare of a marginal change,  $dt_i$ , in the rice tariff as

$$\frac{\partial W}{\partial t_i} dt_i = -\sum_h \frac{\partial W}{\partial V^h} \frac{\partial V^h}{\partial y^h} x_i^h dt_i + \sum_h \frac{\partial W}{\partial V^h} \frac{\partial V^h}{\partial y^h} \mathbf{q}_i^h dt_i = -\sum_h \beta^h (x_i^h - \mathbf{q}_i^h) dt_i = -\sum_h \beta^h s_i^h dt_i,$$

where  $\beta^h$  is the social valuation of an extra unit of income to household  $h$ , typically referred to as the *welfare weight*. The revenue effect of this reform is given by differentiating the revenue equation (3) with respect to  $t_i$ , which gives

$$\frac{\partial R}{\partial t_i} dt_i = t_i \left( \frac{\partial x_i}{\partial p_i} - \frac{\partial q_i}{\partial p_i} \right) dt_i + s_i dt_i = \tau_i s_i (\eta_i^x \frac{x_i}{s_i} - \eta_i^q \frac{\mathbf{q}_i}{s_i}) dt_i + s_i dt_i = s_i (1 + \tau_i \eta_i^s) dt_i,$$

where  $\tau_i$  is the tariff rate (i.e., the share of the tariff in the market price),  $\eta_i^x, \eta_i^q, \eta_i^s$  are the price elasticities of aggregate rice demand, aggregate rice production, and rice imports, respectively, and  $\frac{x_i}{s_i}, \frac{\mathbf{q}_i}{s_i}$  are the ratios of aggregate demand and production to imports, respectively. The term  $\tau_i \eta_i^s$  can be interpreted as the marginal deadweight loss associated with a unit increase in the tariff level: the effect on social welfare (ignoring equity concerns so that welfare weights are implicitly unity) is  $-s_i$ ; and the effect on revenue is  $s_i (1 + \tau_i \eta_i^s)$ , so the net effect on the economy is  $s_i \tau_i \eta_i^s < 0$  because  $s_i > 0$ ,  $\eta_i^s < 0$ , and  $\tau_i > 0$ .

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<sup>2</sup> Coady and Harris (2004) present more detailed discussion and examples of the calculation of the MCFs under alternative tax transfer schemes within a general equilibrium version of the model.

Dividing the social welfare effect by the revenue effect gives the social welfare cost of an increase in the tariff sufficient to increase revenue by one unit. This can be derived as

$$\lambda_t = \frac{\sum_h \beta^h \theta^h}{(1 + \tau_i \eta_i^s)} = \sum_h \beta^h \theta^h \text{inv}(\eta_R) \equiv \lambda_t^D \lambda_t^E \quad (5)$$

where  $\theta^h = \sum_h \beta^h \frac{s_i^h}{s_i}$  is the share of the burden borne by household  $h$  and  $(1 + \tau_i \eta_i^s) = \eta_R$  is the elasticity of revenue with respect to the tariff, so its inverse is the price (or tariff) increase required to increase revenue by one unit. If demand and production do not respond to prices, then  $\eta_i^s = 0$  and the welfare effect arises solely from a redistributive effect. Every unit increase in revenue results in a unit decrease in aggregate household income, and the numerator captures how this burden is distributed across households. The greater the positive correlation between the burden share and household income (or, equivalently, between  $\beta^h$  and  $\theta^h$ ), the higher the share of the burden borne by low-income households and, thus, the greater the decrease in social welfare.

With  $\eta_i^s = 0$ , the revenue elasticity is unity, implying that a 10 percent increase in the tax will result in a 10 percent increase in revenue. However, if  $\eta_i^s < 0$ , then the revenue elasticity is less than unity and the tax needs to increase by more than 10 percent to raise an extra 10 percent in revenue. Therefore, the welfare effect of raising a unit of revenue is greater when  $\eta_i^s < 0$ , that is, when the revenue base is elastic. This, of course, is the source of the marginal deadweight loss associated with tariff increases; by fixing the revenue requirement, we are simply returning this extra deadweight loss to households via higher tariffs.

### 2.3. Targeted Transfers

The social welfare impact of a transfer program is derived by differentiating the social welfare function with respect to lump-sum transfers from the government, that is,  $m^h$ . A transfer program can thus be thought of as a vector,  $d\mathbf{m}$ , of transfers to households. This gives

$$\frac{\partial W}{\partial \mathbf{m}} d\mathbf{m} = \sum_h \frac{\partial W}{\partial V^h} \frac{\partial V^h}{\partial y^h} d\mathbf{m}^h = \sum_h \beta^h d\mathbf{m}^h$$

where  $d\mathbf{m}^h$  is the lump-sum transfer to the household and different transfer programs can be thought of as different vectors of such transfers to households.

The revenue effect of the transfer program is made up of the sum of transfers plus an adjustment for the second-round revenue effects from the resulting increase in rice consumption:

$$\frac{\partial R}{\partial \mathbf{m}} d\mathbf{m} = \frac{t_i}{\mathbf{p}_i} \sum_h \frac{\partial(\mathbf{p}_i x_i^h)}{\partial \mathbf{m}^h} d\mathbf{m}^h - \sum_h d\mathbf{m}^h$$

where  $\frac{\partial(\mathbf{p}_i x_i^h)}{\partial \mathbf{m}^h}$  is the amount of each extra unit of income to a household that is allocated to rice consumption, that is, the *marginal budget share* (MBS) of rice. If we assume that the MBS is constant across households, this can be rewritten as:

$$\frac{\partial R}{\partial \mathbf{m}} d\mathbf{m} = \left[ \tau_i \frac{\partial(\mathbf{p}_i x_i)}{\partial \mathbf{m}} - 1 \right] \sum_h d\mathbf{m}^h .$$

The first term in brackets is the *marginal tax propensity* for rice, that is, the impact on rice tariff revenue of a unit income transfer to households.<sup>3</sup> If the tax rate is positive and rice is a normal good, then the marginal tax propensity is positive so that the full term in brackets is less than unity in absolute terms. This captures the fact that each unit of transfer to households generates tax revenues from higher rice consumption so that the net revenue cost of the unit transfer is less than unity.<sup>4</sup>

Dividing the social welfare effect by the revenue effect gives the social welfare benefit of a program that transfers one unit of revenue across various households, that is,

$$\lambda_m = \frac{\sum_h \beta^h d\mathbf{m}^h}{\left[1 - \tau_i \frac{\partial(\mathbf{p}_i x_i)}{\partial \mathbf{m}}\right] \sum_h d\mathbf{m}^h} = \gamma \sum_h \beta^h \phi^h,$$

where  $\phi^h$  is the share of each household in total transfers and  $\gamma$  is the inverse of  $\left[1 - \tau_i \frac{\partial(\mathbf{p}_i x_i)}{\partial \mathbf{m}}\right]$ . The

social welfare impact of the transfer program then depends on how well it is targeted at low-income households with relatively high welfare weights—the greater the leakage of benefits to high-income households with relatively low welfare weights, the lower the redistributive power of the program and the lower the social welfare impact.<sup>5</sup>

In practice, a major concern often expressed regarding safety net programs is that too many program resources are absorbed by operating costs and thus never reach the intended beneficiaries.<sup>6</sup> This feature of programs can be incorporated into the above model by making the revenue impact also depend on these costs, say, as a fixed proportion of the total program budget. It is then straightforward to show that the social welfare impact of a unit of revenue allocated to the program is simply

$$\lambda_m = \gamma \frac{\sum_h \beta^h d\mathbf{m}^h}{\sum_h d\mathbf{m}^h} \frac{\sum_h d\mathbf{m}^h}{B} = \gamma \sum_h \beta^h \phi^h \rho \equiv \lambda_m^D \gamma \rho, \quad (6)$$

where  $\rho$  is the share of transfers in total program costs. The inverse of the term  $\rho$  can be interpreted as an efficiency cost of transfers, that is, the budget cost of transferring one unit of revenue to beneficiary households.

## 2.4 Welfare Weights

The calculation of  $\lambda_t$  and  $\lambda_m$  above requires one to specify a set of welfare weights, which capture the relative social valuation of a unit of income to each household. A very useful and common approach to specifying these weights derives from Atkinson's (1970) constant elasticity of social welfare function where the welfare weight of household  $h$  is calculated as:

$$\beta^h \equiv (y^k / y^h)^\varepsilon$$

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3 See Coady and Drèze (2002) for a more detailed discussion of the role of the tax propensity in tax reform and optimum tax rules.

4 Note that the assumption that the MBSs for rice are constant across households biases the welfare impact of transfers downward for progressive transfers because, in reality, one expects MBSs to be negatively correlated with income.

5 See Coady and Skoufias (2004) for a more detailed discussion of this statistic.

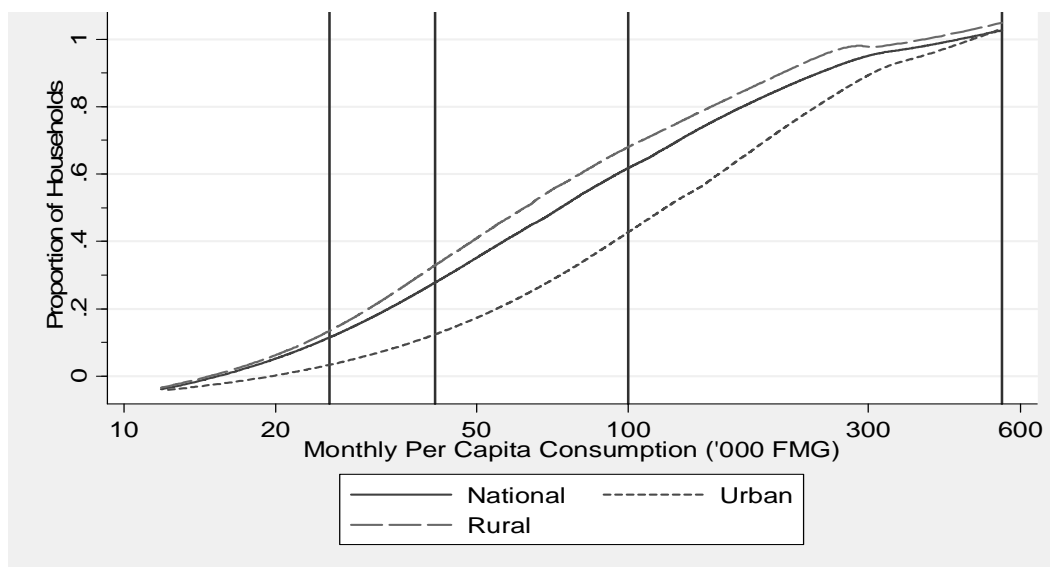
6 See Grosh (1994) and Caldés, Coady, and Maluccio (2006) for more detailed discussions on the operating costs of transfer programs.

where  $k$  is a reference household (for which  $\beta^k = 1$ ) and  $\varepsilon$  captures one's *aversion to inequality*, with this aversion increasing in  $\varepsilon$ . For example, a value of  $\varepsilon = 0$  implies no aversion to inequality (i.e., a franc is a franc no matter to whom it accrues) so that all welfare weights take on the value unity. A value of  $\varepsilon = 1$  implies that if household  $h$  has twice (half) the income of household  $k$ , then its welfare weight is 0.5 (2.0) as opposed to unity for  $k$ . A value of  $\varepsilon = 2$  similarly implies a welfare weight of 0.25 (4.0) for  $h$ .

As  $\varepsilon$  approaches infinity, the welfare impact on the poorest household dominates the evaluation, consistent with a Rawlsian maxi-min social welfare perspective where one only cares about the welfare of the poorest household or welfare group. For example, if we divide households into welfare quintiles, assign each household the mean income of its quintile group, and set the welfare weight of the lowest quintile equal to unity, then as  $\varepsilon$  approaches infinity the terms  $\lambda_m^D \equiv \sum_h \beta^h \phi^h$  and  $\lambda_i^D \equiv \sum_h \beta^h \theta^h$  above converge to the share of the total change in household incomes that accrues to the poorest quintile. More generally, one can interpret these terms as the share of total benefits accruing to the *target population* as defined by the set of welfare weights.

In our empirical analysis below, we evaluate the welfare impact of policy reforms for values  $\varepsilon = 1$  to  $\varepsilon = 5$ . Consistent with the literature, we use household per capita consumption as our measure of household welfare. Figure 1 presents nonparametric cumulative densities of welfare in urban and rural areas separately. The welfare weights used in our analysis are presented in Table 1 of the appendix. Note that if we classify the poorest 30 percent of households as poor, the welfare weights for  $\varepsilon \geq 3$  mimic very closely the pattern of welfare weights implicit in a *severity of poverty* index, with the welfare weights for households at or above the poverty line being near zero. Throughout the paper we use the terms *extreme poor* to refer to households in the bottom welfare decile, *moderate poor* to refer to households in deciles 2 and 3, *poor* to refer to households in the bottom three welfare deciles, *middle income* to refer to households in deciles 4–7, and *high income* to refer to households in the top 3 deciles. We also use the terms welfare and income interchangeably. In all figures using nonparametric regressions, we superimpose vertical lines indicating the 10th, 30th, 70th, and 90th percentiles to facilitate interpretation of patterns across the welfare distribution.

**Figure 1. Cumulative densities of per capita consumption**



Source: Authors' calculations based on EPM2001.

### 3. THE WELFARE IMPACT OF TARIFFS AND TRANSFERS

In this section, we evaluate, in turn, the welfare impact of distributing a unit of revenue to households using rice tariffs and targeted transfers. For each policy instrument, we look separately at the distributional and efficiency implications. We then combine both these dimensions to compare their net welfare impact. For the purposes of analyzing the distributional dimensions, we use data available in the 2001 national household survey (Enquête permanente auprès des ménages, EPM2001). A brief description of these data is presented in the appendix.

#### 3.1. Lowering Rice Tariffs

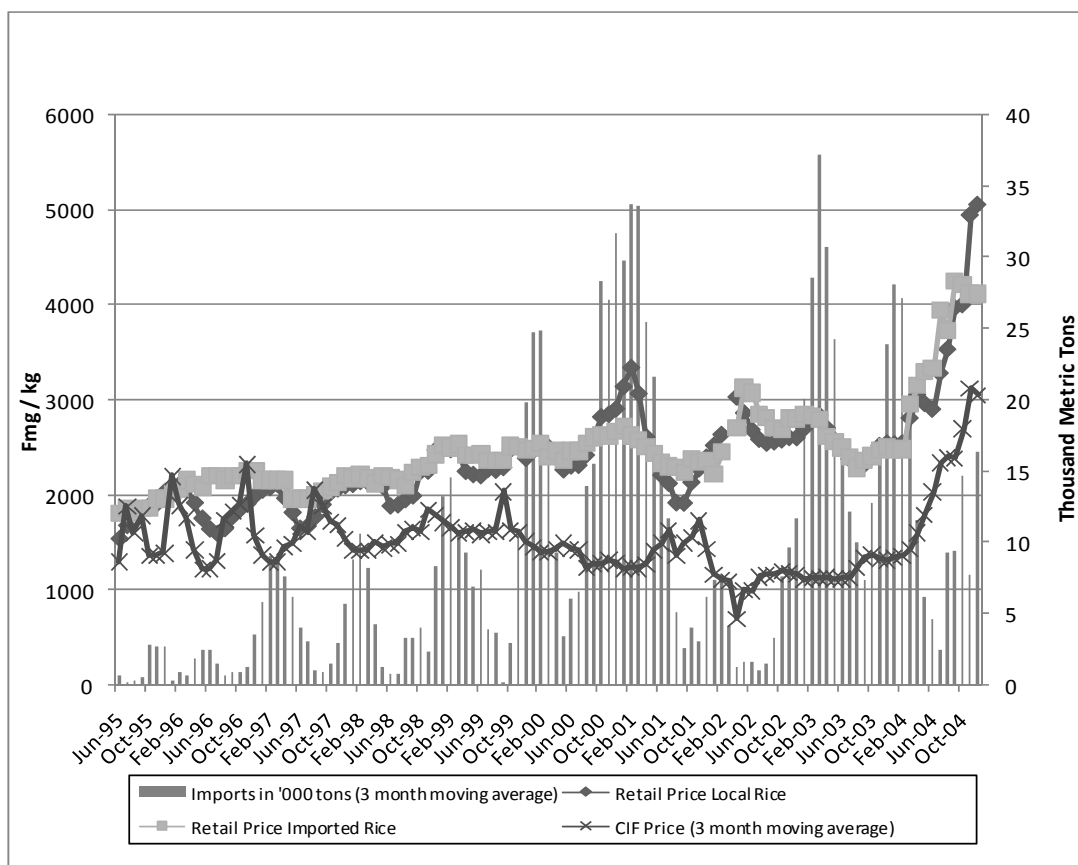
A tariff on rice imports increases the domestic price of rice above world prices and is essentially a subsidy to rice net producers financed by a tax on rice net consumers. The effect on government is similar to that of a net supplier to the market, with imported rice being sold at a higher domestic price and the government claiming the difference between domestic and world prices as revenue. In the absence of any demand and supply responses, the government share of the benefit will equal the share of imports in total consumption—the rest goes to net producers. *Decreasing* the tariff therefore results in a decrease in the domestic price, a redistribution of income from net producers to net consumers, and a decrease in revenue. At the start of 2004, the net tax on rice imports was 45 percent, so that, ignoring trade and transport margins, the domestic price faced by producers and consumers was 1.45 times the world price. This net tax reflected a combination of two separate taxes: an import tariff of 20 percent and a VAT of 21 percent, with the latter levied on the import tax-inclusive price.

Figure 2 presents times series on international and domestic rice prices as well as import volumes. Private sector rice imports, which averaged 170,000 tons per year between 2000 and 2004 (equivalent to about 10 percent of net supply), follow a distinct seasonal pattern, typically peaking 6–11 months after the main harvest (i.e., from October to March). Domestic prices of locally produced and imported rice in the capital, Antananarivo, track each other very closely, reflecting the fact that these are very close substitutes.<sup>7</sup> However, there has been a substantial gap between the cost, insurance, and freight (c.i.f.) import price and the domestic prices of imported rice because of substantial VATs and import tariffs (in addition to domestic marketing margins), which increase from mid-1999 as the c.i.f. price falls. The sharp rise in the domestic prices of local and imported rice that began at the end of 2003 mirrors the rise in c.i.f. rice prices. The price of local rice rose substantially above the (official) price of imported rice at the end of 2004, however, because policy uncertainty resulted in a shortfall of total (public and private) rice imports (Minten and Dorosh, 2006).

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<sup>7</sup> Moser, Barrett, and Minten (2006) show that rice markets in 2000 were fairly well integrated at the subregional level although high transfer costs and lack of competition limited integration at the national level. Thus, changes in the costs of imported rice are not necessarily directly transmitted to markets throughout rural Madagascar.

**Figure 2. Import and domestic rice prices, 1995–2005**



Source: Minten and Dorosh (2006).

### *Rice Consumption and Production Patterns*

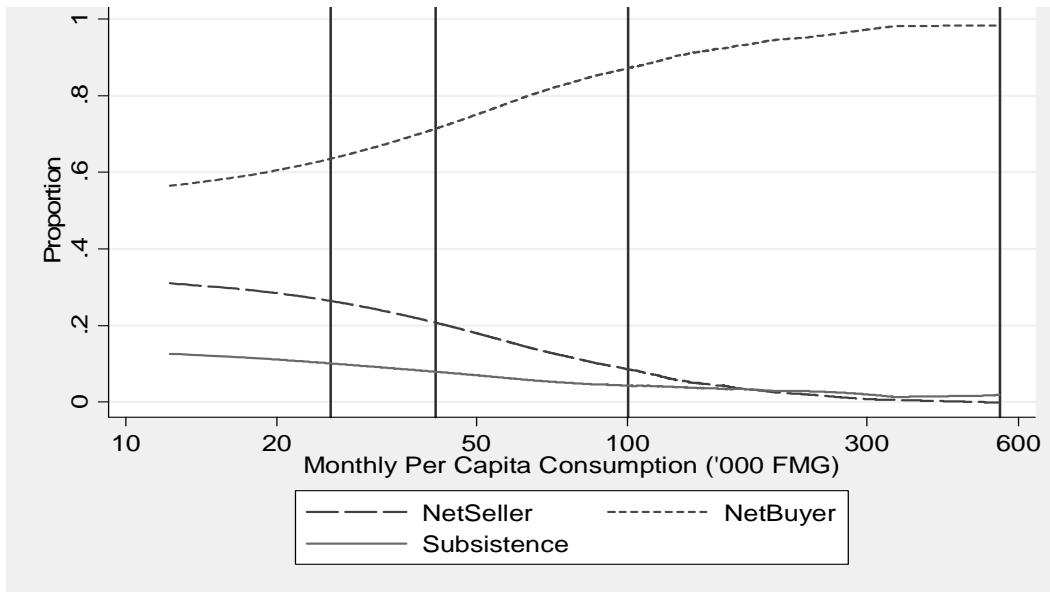
Based on EPM2001, approximately 76 percent of households are classified as rural. Rural households are disproportionately represented among the poor with, for example, around 90 percent of poor households being rural. As expected, the direction of rice trade differs markedly between urban and rural areas. Whereas in urban areas 87 percent of households are net purchasers of rice, in rural areas 66 percent are net purchasers.

Patterns of trade also vary substantially across welfare groups within both urban and rural areas. Figures 3a and 3b present the classification of urban and rural households according to whether they are net sellers or net buyers or neither (i.e., rice subsistence households). In urban areas, whereas around 65 percent of poor households are net purchasers of rice, over 90 percent of high-income households are net purchasers. Similarly, in rural areas, whereas around 64 percent of poor households are net purchasers, around 70 percent of high-income households are net purchasers.

Of course, the welfare impact of a change in the price of rice will depend not only on the direction of rice trade but also on the magnitude of the rice flows involved. For the purposes of capturing the diversity of flows, households are classified according to whether they are urban or rural, are small or big rice cultivators (using 0.25 hectare of rice land as the cutoff), own land but do not cultivate rice, or are landless. Figures 4a and 4b present the magnitude of rice flows for each of these

household classifications and across welfare groups.<sup>8</sup> In urban areas, only big rice cultivators, constituting around 3.6 percent of all households, are net sellers of rice across all deciles. All other urban groups are net purchasers across all deciles, with the higher welfare groups tending to have substantially larger net purchases. In rural areas, again only big rice cultivators, constituting around 35 percent of the total population, are net sellers, with net sales being substantially higher for the highest welfare groups. All other household groups are net purchasers of rice, with magnitudes increasing with welfare levels.

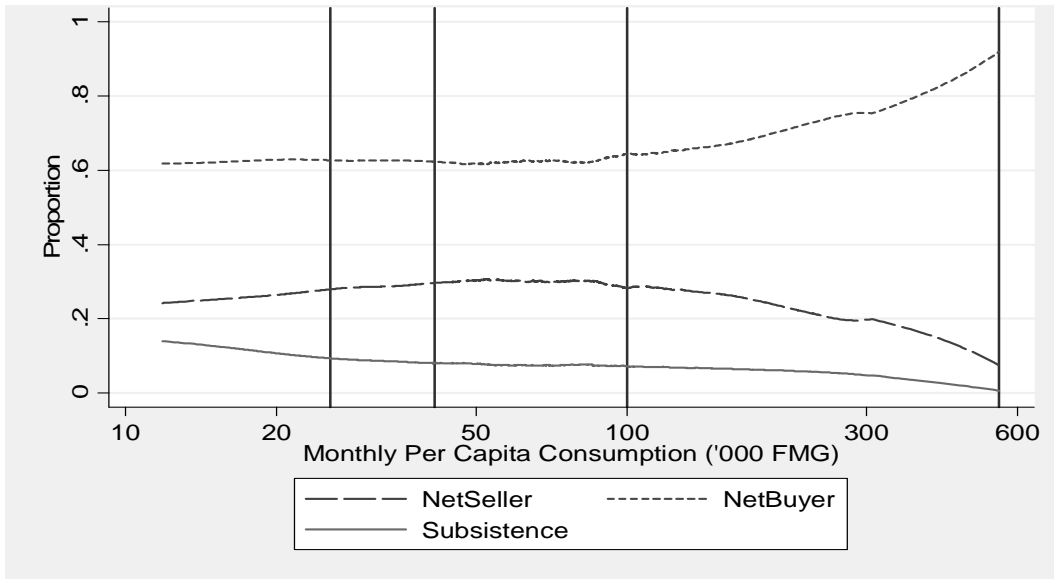
**Figure 3a. Net sellers/buyers by welfare group, urban**



Source: Authors' calculations based on EPM2001.

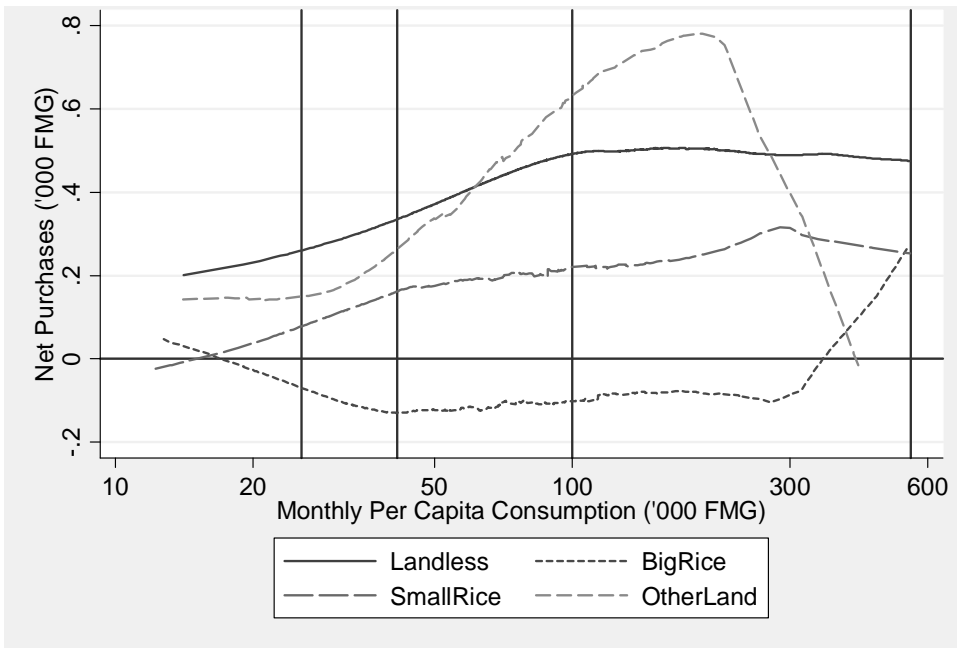
<sup>8</sup> Nonparametric analysis of data from a 1990 survey of rice farmers by Barrett and Dorosh (1996) showed similar patterns of net rice sales by landholdings and by income.

**Figure 3b. Net sellers/buyers by welfare group, rural**



Source: Authors' calculations based on EPM2001.

**Figure 4a. Net purchases by welfare group, urban**



Source: Authors' calculations based on EPM2001.

**Figure 4b. Net purchases by welfare group, rural**



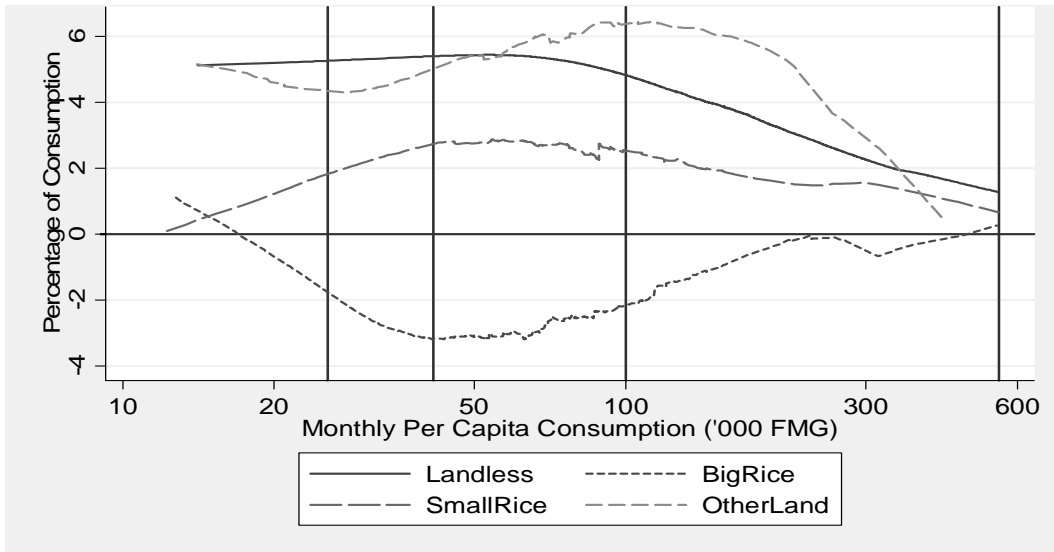
Source: Authors' calculations based on EPM2001.

The percentage welfare (or real income) impact of a unit *decrease* in the price of rice (i.e., a price decrease of one FMG per kilogram of rice) on each household can be calculated by dividing the quantity (in kilograms) of each household's market purchases or sales by total household income, that is,  $s_i / y$  for each household. Figures 5a and 5b present such a welfare impact for a 33 percent decrease in price, which at 2005 prices of about 1,500 FMG per kilogram is equivalent to a 500 FMG price decrease. The welfare impact of a price decrease of this magnitude is clearly sizeable. In urban areas, the welfare impact is equivalent to an increase in welfare of between 4 and 6 percent for most net rice purchasers, although this falls to between 2 and 4 percent for high-income households.<sup>9</sup> For net sellers (i.e., big rice producers), the impact is a decrease in welfare of greater than 2 percent for moderately poor and middle-income households, but this falls toward zero for both extreme poor and high welfare households. For rural households, the impact on net purchasers is clearly progressive, with welfare increases between 2.5 and 7 percent for poor households but falling to less than 3 percent for high-income households. For net sellers, the decrease in welfare is also progressive, with poor households experiencing decreases of between 1 and 3 percent and high-income households experiencing decreases of between 5 and 15 percent.

<sup>9</sup> The bottom 10 percent of households have a monthly per capita consumption of less than 25,000 FMG, the bottom 30 percent have a consumption of less than around 40,000 FMG, and the top 30 percent have a consumption of greater than 135,000 FMG.

**Figure 5a. Welfare impact of rice price decrease, urban**

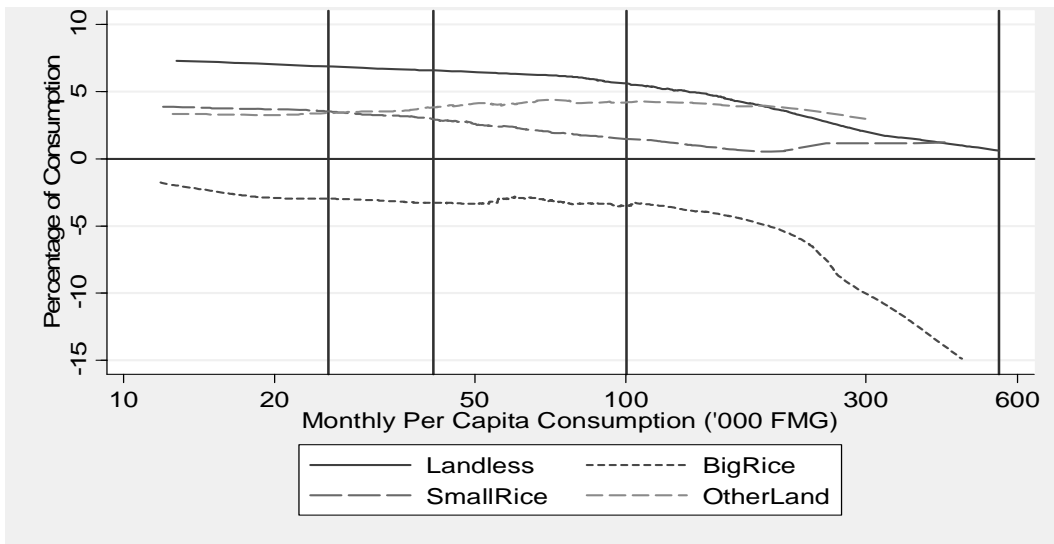
**(33% price decrease from 1,500 FMG per kg)**



Source: Authors' calculations based on EPM2001.

**Figure 5b. Welfare impact of rice price decrease, rural**

**(33% price decrease from 1,500 FMG per kg)**



Source: Authors' calculations based on EPM2001.

### *Distributional Impact*

The distributional effect of lower rice prices will depend on the relationship between  $\theta^h = \frac{S_i^h}{S_i}$  and

household welfare. Table 1 presents the sum of  $\theta^h$  for each welfare decile and also for each household classification. This shows how the benefit from each unit of revenue lost due to a price (and tariff) decrease is distributed across households. The first column shows the distribution of welfare changes across each welfare decile. The top five deciles all gain from the price decrease. Out of every 100 FMG lost from tariff revenue, these households together gain 97.8 FMG. The gains from tariff reduction are thus very badly targeted.

But the aggregate gains and losses across deciles hide substantial variation across households within deciles and across household classifications. Whereas landless households in both urban and rural areas together gain 128 FMG, big rice cultivators lose 81 FMG. Nonrice farmers and small rice cultivators also gain 53 FMG. For both gainers and losers, the aggregate impacts on the lower welfare deciles are substantially smaller than those on the higher deciles. Therefore, lower rice tariffs essentially involve a redistribution of welfare from higher income net producers to higher income net consumers with little absolute impact on lower income groups, reflecting the low absolute rice trading levels of the latter.

**Table 1. Distribution of welfare impact from tariff increase across households (shares)**

	Urban Households					Rural Households			
	All Households	Landless	Big Rice Cultivators	Small Rice Cultivators	Nonrice Farmers	Landless	Big Rice Cultivators	Small Rice Cultivators	Nonrice Farmers
Bottom	0.018	0.000	-0.000	0.001	0.001	0.008	-0.028	0.025	0.010
2nd decile	-0.002	0.004	-0.005	0.001	0.002	0.006	-0.060	0.039	0.012
3rd decile	0.029	0.007	-0.001	0.005	0.001	0.017	-0.049	0.029	0.020
4th decile	0.001	0.022	-0.004	0.002	0.003	0.015	-0.100	0.045	0.018
5th decile	-0.024	0.039	-0.003	0.003	0.005	0.027	-0.156	0.032	0.029
6th decile	0.119	0.061	-0.009	0.007	0.008	0.061	-0.068	0.024	0.036
7th decile	0.116	0.081	-0.000	0.005	0.004	0.086	-0.085	0.002	0.024
8th decile	0.228	0.162	-0.004	0.002	0.008	0.082	-0.065	0.030	0.012
9th decile	0.301	0.175	-0.003	0.007	0.009	0.090	-0.016	0.010	0.030
Top	0.214	0.197	-0.002	0.003	0.003	0.137	-0.148	0.018	0.007
Total	1.000	0.748	-0.031	0.036	0.044	0.529	-0.775	0.254	0.198
Share of Total Households	1.000	0.165	0.036	0.024	0.012	0.141	0.350	0.186	0.086

Source: Authors' calculations based on EPM2001.

### *Efficiency Impact*

As well as having a redistributive effect, tariffs have an efficiency effect, which must be incorporated into any analysis. The marginal social cost of raising one unit of revenue by increasing tariffs (or marginal cost of funds, MCF) is calculated as the inverse of the revenue elasticity; see (5). For example, if production is 80 percent of total consumption (imports accounting for the remaining 20 percent), the elasticity of production is 0.2, and the elasticity of consumption is  $-0.3$ , then the elasticity of imports is approximately  $-2.3$ . This very high elasticity reflects the fact that even small responses in consumption and production translate into very large proportional changes in imports, because imports are only a small share of consumption. The tax base is thus extremely elastic. Because the initial tax rate (defined, somewhat differently than earlier, as the share of tax in the domestic price) is 30 percent, the MCF is 3.23 (the inverse of  $1 + 0.3 * -2.3$ ). The deadweight loss associated with an increase in the tariff that raises this one unit of revenue is thus 2.23. The converse of this is that a reduction in the tariff generates an equally large efficiency gain. The marginal efficiency gain from decreasing tariffs can also be expected to decrease as the tariff approaches zero because imports (the tax base) will increase as a proportion of total supply when production falls and consumption increases, and the elasticity of imports will also decrease.

Table 2 presents the MCFs for alternative assumptions about the demand and supply elasticities, as well as about the share of imports in total supply. Notice that the MCF is negative for higher elasticities of production and consumption when the import share is 10 percent. This indicates that the tariff is on the wrong side of the Laffer curve; so a decrease in the tariff is associated with an increase in revenue, reflecting a substantial increase in imports. Therefore, in an aggregate sense, a potential Pareto improvement exists because decreasing the tariff will increase both revenue and the aggregate welfare of households as the latter are, in aggregate, net purchasers. Ignoring such Pareto-improving possibilities, the range for the MCF is 1.20–6.25. When combining the, distributional and efficiency impacts below, we therefore consider MCF values of 1.20 (low), 3.70 (medium), and 6.25 (high).

### *Distribution and Efficiency*

We now combine the distributional and efficiency implications of tariff decreases using equation (5). Table 3 presents the marginal social benefit from a tariff decrease under alternative assumptions for both the MCF and the level of inequality aversion. The first column presents the pure distributional impact,  $\lambda_t^D$ , for alternative levels of inequality aversion, which can be interpreted as the increase in welfare of our target population as defined by the underlying welfare weights. This suggests that the benefits from a tariff reduction are not well targeted because  $\lambda_t^D$  decreases rapidly with  $\varepsilon$ . Only 0.019 units of each revenue unit forgone accrue to the lowest parts of the welfare distribution.

**Table 2. Marginal cost of public funds for different import elasticities**

Demand and Production Elasticities	Marginal Cost of Funds ( $\tau = 0.3$ )		
	Import Share=10% x/s=100/10=10.0 q/s=90/10=9.0	Import Share=20% x/s=100/20=5.0 q/s=80/20=4.0	Import Share=30% x/s=100/30=3.33 q/s=70/30=2.33
$\eta^x = -0.1; \eta^q = 0.1$	2.33 ( $\eta^s = -1.90$ )	1.37 ( $\eta^s = -0.90$ )	1.20 ( $\eta^s = -0.57$ )
$\eta^x = -0.1; \eta^q = 0.2$	6.25 ( $\eta^s = -2.80$ )	1.64 ( $\eta^s = -1.30$ )	1.32 ( $\eta^s = -0.80$ )
$\eta^x = -0.2; \eta^q = 0.1$	-7.14 ( $\eta^s = -3.80$ )	2.17 ( $\eta^s = -1.80$ )	1.51 ( $\eta^s = -1.13$ )
$\eta^x = -0.3; \eta^q = 0.2$	-2.27 ( $\eta^s = -4.80$ )	3.23 ( $\eta^s = -2.30$ )	1.78 ( $\eta^s = -1.47$ )
$\eta^x = -0.3; \eta^q = 0.3$	-1.41 ( $\eta^s = -5.70$ )	5.26 ( $\eta^s = -2.70$ )	2.04 ( $\eta^s = -1.70$ )

Source: Authors' calculations based on EPM2001.

**Table 3. Welfare impact of lower rice tariff**

	$\lambda_t^D$	$\lambda_{tL}$	$\lambda_{tM}$	$\lambda_{tH}$
Inequality Aversion				
$\varepsilon = 0$	1.000	1.200	3.700	6.250
$\varepsilon = 1$	0.172	0.207	0.637	1.077
$\varepsilon = 2$	0.050	0.059	0.183	0.310
$\varepsilon = 5$	0.019	0.023	0.071	0.191

Source: Authors' calculations based on EPM2001.

The final three columns adjust for the efficiency gains from tariff reductions. The first row shows the aggregate welfare benefits for all households for alternative MCFs: the aggregate benefit to households from each unit of revenue forgone from tariff reductions ranges from 1.20 to 6.25 for low- to high-efficiency gains. For each value of MCF, the column gives the product of the MCF and  $\lambda_t^D$ . Looking across the final row, the benefit to the poorest households from a unit of revenue forgone from a tariff reduction ranges from 0.023 to 0.191.

### 3.2. Targeted Transfers

The effectiveness of targeted transfers as a poverty alleviation instrument will depend on how effective the program is at both identifying poor households and ensuring that transfers are delivered to them at low administrative cost. In practice, even the best targeted transfer programs are imperfectly targeted, with some of the transfers *leaking* to the nonpoor and incomplete *coverage* of the poor. In addition, designing and implementing a transfer program requires that some budget resources be devoted to these activities, reducing the amount of the budget available for transfers to program beneficiaries. Of course, these two dimensions are interdependent—the more resources allocated to improving the design and implementation of a program, the higher the percentage of the transfer budget that will reach poor households.

Existing empirical evidence shows that the performance of transfer programs varies substantially in both dimensions across and within countries and across targeting methods used and program types. A recent review of the targeting performance of transfer programs found that under the

median program, the poor received only 25 percent more than their population share (Coady, Grosh, and Hoddinott, 2004). If 30 percent of the population is classified as poor, this implies that only 37.5 percent of transfers go to the poor. However, many programs do substantially better than the median. For example, the median targeting performance for programs using some form of means testing was such that the poor received a share of transfers that was 1.5 times their population share. Using a 30 percent poverty rate, this implies the poor receive 45 percent of total transfers. Even within means-tested programs, there was substantial variation in performance. The median performance for the top 10 performing programs was such that the poor received approximately twice their population share of transfers, that is, the poorest 30 percent would receive 60 percent of transfers.

High administrative costs further decrease the effectiveness of transfer programs (conditional on targeting performance). Unfortunately, there is very little evidence on the cost level or structure of transfer programs. But what little evidence exists suggests that there may be great variability, with the share of administrative costs in the total program budget ranging from 10 percent to 40 percent (Caldés, Coady, and Maluccio, 2006; Grosh, 1994). In other words, the fiscal cost of distributing one unit of welfare to all beneficiary households ranges from 1.11 to 1.67 units.

To address the issue of the potential effectiveness of targeted transfers in the context of Madagascar, we use information from ECM2001 on the socioeconomic characteristics of households to simulate the targeting performance of a program that employs proxy-means targeting. We start by identifying a range of household characteristics that are typically highly correlated with household welfare.<sup>10</sup> Household welfare is then regressed on these characteristics. The estimated coefficients are taken as weights that are applied to household characteristics to get a household score, in this case predicted household consumption per capita. Households with a score below a certain *threshold* are identified as program beneficiaries.

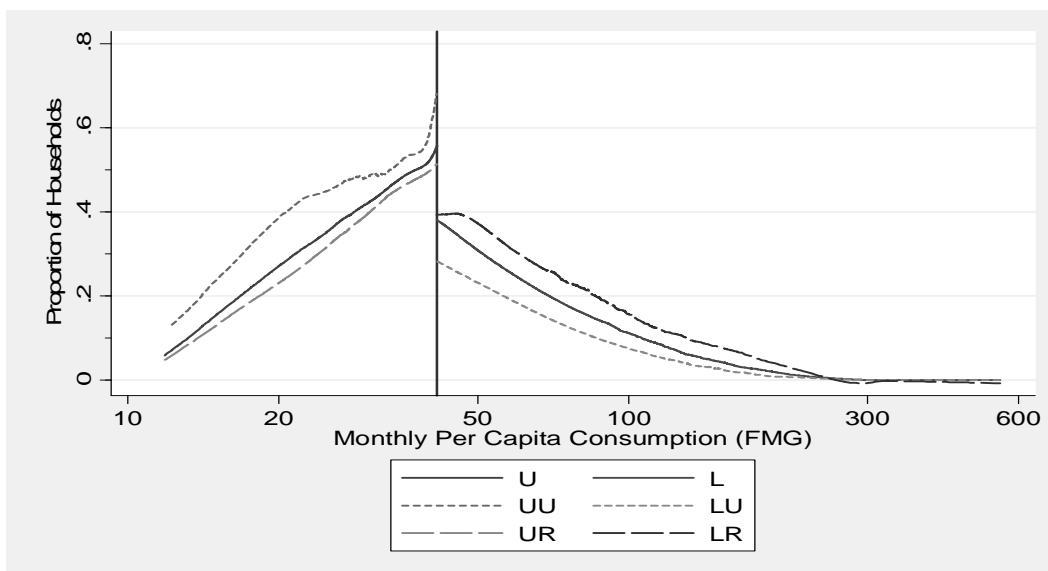
Basing program eligibility on the predicted score will of course result in the standard targeting errors. For example, if the poorest 30 percent of households according to the score are deemed poor and thus eligible for program benefits, then some households that would be classified as poor based on per capita consumption will be wrongly excluded (*errors of mission*) and some nonpoor households will be wrongly included (*errors of inclusion*). Figure 5 presents the distribution of targeting errors for the simulated transfer program.<sup>11</sup>

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10 In practice, these characteristics should be easily verified by program officials and not easily manipulated by households in an attempt to gain access to the program. Typically, households will be informed about the existence of such a program and asked to apply at a program office, thus introducing an element of self-selection into the targeting process. At the office, households report these characteristics and are informed if they are potentially eligible. Eligible households will then be visited to verify the reported information.

11 The underlying regression used per capita household consumption as the dependent variable. Independent variables included information on geographic location; gender, age, education, and sectoral employment of the head of household; household size and composition; types of housing and materials for walls, floors, and ceilings; housing area; source of water and lighting; and possession of various consumer durables. The r-squared for the regression was 0.69 based on 4,857 household observations. More details are available from the authors upon request.

**Figure 6. Undercoverage and leakage, urban and rural**



Source: Authors' calculations based on EPM2001.

The vertical line in Figure 6 is the poverty line, so the curves to the left of it indicate undercoverage of the poor (U) and those to the right of it indicate leakage to nonpoor (L) households. Undercoverage and leakage are highest close to the poverty line, undercoverage is highest in urban areas, and leakage is highest in rural areas. So, on average, the rural nonpoor are included at the expense of the urban poor. This, of course, could be partly addressed by developing a different proxy-means scoring system for urban and rural areas and allocating program places across urban and rural areas in proportion to those areas' share of the poor population.

Table 4 presents the welfare impact of transfers based on equation (6). The first column presents the share of transfers accruing to the various target populations as specified by the underlying welfare weights. Nearly 30 percent of transfers accrue to the poorest households: Every one unit of revenue transferred through the program results in 0.3 going to the bottom decile of the welfare distribution. The first column essentially abstracts from administrative costs (an efficiency cost) as well as the efficiency benefit associated with the extra rice tariff revenue due to higher rice consumption; these welfare impacts are captured in the final three columns. The first row of these columns gives the share of the budget allocated to transfers (i.e., one minus the share of administrative costs in the budget), reflecting the administrative efficiency of the program times an adjustment for second-round revenue benefits. This share of the budget allocated to transfers is taken to range from 0.6 for the low-efficiency program (L), to 0.75 for medium-efficiency programs (M), to 0.9 for the high-efficiency program (H). These are multiplied by 1.057 to capture second-round revenue effects, derived using 0.18 as the MBS for rice, which in turn is based on available empirical estimates.<sup>12</sup> Incorporating these into the analysis, the final row shows that the benefit accruing to the lowest welfare households from every one unit of revenue allocated to the program ranges from 0.19 to 0.28.

<sup>12</sup> For a discussion of rice demand patterns in Madagascar, see Lundberg and Rich (2002); Minten, Randrianarisoa, and Zeller (1998); Ravelosoa, Haggblade, and Rejemison (1999); and Stifel and Randrianarisoa (2004).

**Table 4. Welfare impact of proxy-means-targeted transfers**

	$\lambda_m^D$	$\lambda_{mL}$	$\lambda_{mM}$	$\lambda_{mH}$
$\varepsilon = 0$	1.000	0.634	0.793	0.951
$\varepsilon = 1$	0.608	0.386	0.482	0.579
$\varepsilon = 2$	0.442	0.280	0.350	0.420
$\varepsilon = 5$	0.297	0.189	0.236	0.283

Source: Authors' calculations based on EPM2001.

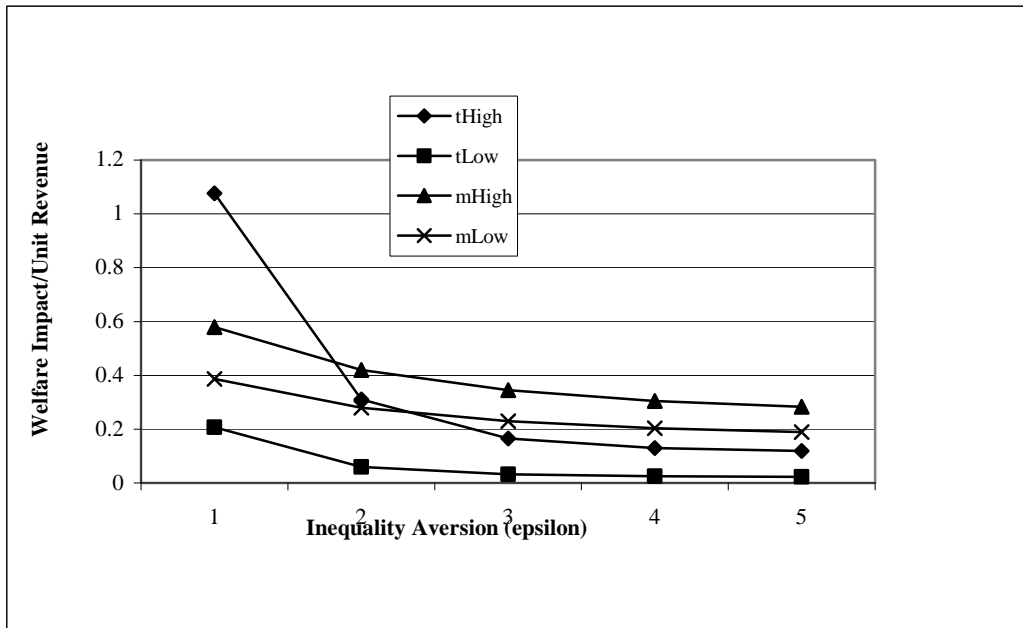
### 3.3. Tariffs, Transfers, or Both?

In this section, we compare the net social welfare impact of tariffs and transfers by comparing the welfare impact per unit of revenue absorbed by each policy instrument. As above, for each instrument we consider three scenarios representing high (H), medium (M), and low (L) efficiency levels. With tariffs, these relate to different assumptions about demand and supply responses, which affect the revenue elasticity and thus the magnitude of the efficiency gain from reducing tariffs. We consider revenue elasticities of 6.25 (tHigh), 3.70 (tMedium), and 1.20 (tLow). With direct transfers, the scenarios relate to the administrative effectiveness in terms of the share of the program budget absorbed by administrative costs: We consider administrative cost shares of 10 percent (mHigh), 25 percent (mMedium), and 40 percent (mLow).

Figure 7 presents the high- and low-efficiency welfare impacts for each policy instrument for  $1 \geq \varepsilon \leq 5$ . If the efficiency gains from reducing rice tariffs are on the lower side, then tariff reduction is dominated by even the low-efficiency direct transfer programs. Tariff reductions are only superior if the efficiency gains are on the higher side and at lower values of  $\varepsilon$ , where sufficient weight is given to welfare gains accruing to higher income groups. With high-efficiency gains, tariff reductions clearly dominate at  $\varepsilon = 1$ , where the weight given to welfare gains to higher income households is relatively large. At higher values of  $\varepsilon$ , the attraction of tariffs as a poverty alleviation mechanism diminishes rapidly, reflecting the almost exclusive focus on gains at the bottom of the welfare distribution. Therefore, a focus on poor households (e.g., taking  $\varepsilon > 2$ ) would clearly rank direct targeted transfers above tariff reductions as a poverty alleviation measure. Reasonably effective transfer programs are clearly a more cost-effective approach to poverty alleviation. This is reinforced when one takes into account that the efficiency gains from tariff reductions are upper bounds, because they refer to marginal changes and thus can be expected to decrease nonlinearly with the tariff rate.

It is tempting to interpret the above results as an argument for increasing the rice tariff to finance transfers to the poor. The welfare increase from such a reform package can be calculated as  $(\lambda_m - \lambda_t)$ , which is clearly positive for higher levels of aversion to inequality. However, this ignores the fact that the MCF associated with raising revenue using other tax instruments is probably much lower. In this case, it is clearly preferable to switch from rice tariffs to other taxes and to use any revenue increases to finance a transfer program. In addition, initial tariff reductions will also have a substantial impact on poverty reduction because the efficiency gains are likely to be substantially higher when tariffs are reduced from a high level.

**Figure 7. Welfare impact of tariff reductions and targeted transfers**



Source: Authors' calculations based on EPM2001.

The results can also be interpreted as an argument for sequencing policy reforms by initially reducing tariffs, gradually replacing them with other tax revenues (possibly as part of a broader tax reform that improves the efficiency of the tax system), and using some of the extra revenues to develop an effectively targeted transfer program. However, to the extent that it takes time to develop a comprehensive and cost-effective safety net, some ad hoc measures aimed at mitigating the adverse impacts on poor net sellers of rice are warranted. Such measures could take many forms, including measures aimed at increasing land productivity through increasing yields and diversifying into alternative crops. These targeted measures should eventually be integrated into the overall safety net framework.

#### 4. FROM PARTIAL TO GENERAL EQUILIBRIUM ANALYSIS

An obvious shortcoming of the above discussion is that it is partial equilibrium. A general equilibrium approach that addresses both the indirect revenue effects through changing demand and supply for other taxed or subsidized goods and services, as well as the welfare effects generated through factor markets, might change some of the numbers above or even the qualitative nature of the results. For example, in principle, if goods that are very strong substitutes or complements to rice in production or consumption are relatively highly taxed or subsidized, then indirect revenue effects may be substantial. However, in practice, because the other main crops grown in Madagascar (maize and cassava) are not traded internationally and not subject to taxes or subsidies, these indirect revenue effects are not likely to be important.

Alternatively, if rice production is relatively unskilled labor intensive, then lower rice prices may result in lower unskilled wages. If the poorest households rely very heavily on such sources of income and if they cannot find alternative employment—for example, in the production of other crops—then, in principle, this wage effect may be strong enough to switch these households from being net gainers to net losers. Note that this unskilled wage effect would simply make tariff reductions even less attractive from a distributional perspective and reinforce the dominance of transfers from a poverty alleviation perspective. In this instance, it is still the case that a reform package of lower tariffs combined with increases in other taxes and direct interventions through safety nets is the most effective policy response, because the tax reform should generate substantial efficiency gains that can then be used to finance a transfer program that benefits the poorest households.

## 5. SUMMARY AND CONCLUSIONS

This paper is concerned with the relative efficiency, distributional, and revenue implications of tariffs and transfers, especially in the context of identifying their respective roles for poverty alleviation. The results indicate that although there are likely to be substantial efficiency gains from tariff reductions, these accrue mainly to higher income households. In addition, poor net rice sellers lose from price decreases. Developing a system of well-designed and well-implemented targeted direct transfers to poor households is thus likely to be a substantially more cost-effective approach to poverty alleviation. Such an approach can be financed by switching the source of revenue from rice tariffs to alternative, more efficient tax instruments. In the short term, the development of a system of direct transfers could focus on poor net rice sellers (i.e., smallholder rice producers) because these households lose from tariff reductions; these transfers could also be conditioned on participation in extension services to promote higher agricultural productivity. Over the longer term, such a program should be integrated into a more comprehensive targeted safety net mechanism that has high coverage of poor households.

## APPENDIX THE MADAGASCAR EPM HOUSEHOLD SURVEY

The analysis in the paper uses information from the 2001 Madagascar household survey, Enquête permanente auprès des ménages (EPM2001), organized by the National Statistical Institute (INSTAT) at the end of 2001. The survey was nationwide and comprehensive and included information on household socioeconomic characteristics, consumption, health, education, income sources, time allocation, occupation, and agricultural production. The sample was set up in a stratified manner to produce representative statistics at the national and provincial level as well as along the urban-rural divide. The total sample consists of 5,080 households. About 2,500 households have land in cultivation. Households in rural areas accounted for 2,040 household in the sample.

The consumption aggregate was calculated for the year prior to the survey and incorporates food autoconsumption (from agricultural production, livestock production, and enterprise income), purchased food, food gifts and payments in-kind, education and health-care expenditures, imputed and actual housing costs, expenditures on consumer durables, and other nonfood expenses. The consumption aggregate is deflated to account for regional price differences using price information available in the survey and the Paasche index method.

The definition of poverty used by INSTAT is based on these consumption data. A poor person, as identified by INSTAT, is a person who cannot afford to consume the bundle of food and nonfood goods deemed essential to lead an active and social life. The poverty line was evaluated in 2001 at approximately 988.6 FMG per person per year (corresponding to US\$0.42 per day). With this benchmark, it was estimated that almost 70 percent of the Malagasy population was poor. The poverty rate in rural areas was estimated at 77 percent and in urban areas at 44 percent.

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