ELSEVIER

Agricultural Economics 13 (1995) 89–99

AGRICULTURAL ECONOMICS

Poverty alleviation in Mozambique: a multi-market analysis of the role of food aid

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Accepted 22 July 1995

Abstract

The use of food aid in poverty alleviation programs has been hampered by two problems: the inability to target to households in need, and the disincentive effects on agriculture. In this paper, we present econometric estimates of an Almost Ideal Demand System (AIDS) for households in Maputo, Mozambique, and develop a multi-market model to show that in Maputo, imported yellow maize is not only self-targeting, but that owing to a combination of the low cross-price elasticity with locally produced staples (particularly, white maize) and cross-border trade in food products, the disincentive effects on domestic agriculture have been negligible.

1. Introduction

Food aid has played an instrumental role in providing for the welfare of the poor in war-torn Mozambique, one of the poorest countries in the world. This is especially the case in Maputo, the capital, where, because of civil conflict, the provision and subsequent sale of food aid became the city's lifeline. [1] Despite the apparent success of the donors in preventing widespread hunger through the provision of food aid, there are growing pressures to reduce the level of yellow maize food aid imports into Maputo and to ensure that whatever is marketed is sold at a price that reflects the world market price plus transport costs to Maputo. This derives from the perception that with peace, the need for food aid is diminishing, because of anticipated increases in production and reductions in marketing costs. Likewise, there is a concern that food aid distributed in the urban market is both a disincentive to rural producers and is not well-targeted to poor households. [2] Commercial distribution of yellow maize food aid

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[1] In addition to the commercial food aid program in Maputo and the other major urban commercial center, Beira, there was a free food aid emergency distribution program in rural areas that was operated as a separate effort, and will not be the subject of the discussion in this paper.

[2] Such concerns over food aid's potentially disincentive effects on domestic agriculture are discussed extensively in the development literature. See, for example, Isenman and Singer (1977), Schuh (1982), and Maxwell (1991).

SSDI 0169-5150(95)01156-0

at below import parity prices in the cities is thus seen as a blunt instrument for poverty alleviation, a threat to the resurgence of a healthy agriculture, and an impediment to raising incomes of the rural poor. [3]

In this paper, we address two questions: "are open market sales of yellow maize food aid an effective means of poverty alleviation in Maputo?" and "are there any deleterious effects on the rural poor arising from this policy?" Answers to these questions hinge on whether yellow maize has important substitution effects on either the demand or supply side of the local market for domestically produced commodities, particularly white maize. Our analysis is based on data and econometric estimates from a household survey in Maputo, which are incorporated into a multi-market model that is used to simulate the effect of changes in the level of yellow maize food aid in Maputo. We examine policy impacts on prices and household consumption, as well as the implications of income and price changes on various poverty measures.

The remainder of the paper is organized as follows. The analytical approach is outlined in Section 2. In addition to presenting the multi-market model itself, we briefly discuss the methodology for arriving at estimates of demand parameters and the poverty line. Results of simulations are given in Section 3, along with a cost benefit analysis of the subsidy arising from increased yellow maize imports. Finally, in Section 4 we discuss the implications of the results and present some concluding comments.

[3] The arguments against high levels of food aid sales in Maputo intensified in 1993, a year of unprecedented levels of emergency drought relief yellow maize food aid inflows into both urban and rural areas of Mozambique. The heightened concern over the possible disincentive effect on rural producers emanated from the emergency distribution of food aid in rural areas in response to the severe drought of 1992, as distinguished from the program of commercial sales of food aid in the cities. Although the emergency distribution effort was a huge success in the critical pre-harvest period (Green, 1992), food aid flows to rural areas continued even after the successful white maize harvest in early 1993.

2. The analytical approach

Analyzing the impact of changes in the level of yellow maize food aid imports into Maputo involves consideration of supply, demand, and prices of various commodities and household incomes. A multi-market approach that includes both production and consumption of major commodities is appropriate for two reasons. First, capturing potential effects of shifts in urban prices and incomes on rural markets, in particular the influence of urban yellow maize prices on white maize prices received by rural farmers, requires modeling of both demand and supply aspects of these markets. Second, even apart from concerns over rural incomes, substitution effects between yellow maize and non-traded goods on the demand side necessitate a framework that endogenizes urban prices of non-traded goods.

2.1. The multi-market model

The Mozambique multi-market model used in the analysis follows that of Braverman and Hammer (1986). The key modification is in capturing the Mozambique-specific price formation and distribution of rents for the yellow maize market. [4] Although yellow maize grain supplied by donors is supposed to be distributed through the government's food rationing system, [5] over 90% is leaked and finds its way to the parallel market at prices determined by supply and demand (Sahn and Desai, 1994). Since yellow maize supply in Maputo derives entirely from food aid imports, it behaves essentially as a non-traded commodity. In the short-term, where tastes and preferences are quite stable, the level of imports therefore determines the price of the product.

Thus, three mechanisms for price formation are modeled. For non-rationed traded goods (white maize, rice, wheat, and export crops), the domestic price level is determined by exogenous

[4] Further details concerning the model are found in Dorosh and Bernier (1994).

[5] For a description of the ration system, see Alderman et al. (1991).

world prices, the exchange rate, and fixed marketing margins. Net imports adjust so that total supply equals demand. For non-traded goods (vegetables and meat), [6] net imports are set to the (relatively small) base level of imports, and the model solves for the consumer price that clears the market, equating supply and demand. For yellow maize, which is imported in fixed amounts under foreign aid agreements, the quantity of net imports is fixed, the consumer price adjusts to equate supply and demand, and rents are earned by those able to buy at the official border price and sell at the market clearing price.

Using the poverty line computed elsewhere (Sahn and del Ninno, 1994), households in Maputo are divided into two groups: Maputo non-poor and Maputo poor. The rest of the population of the three southern provinces of Maputo, Inhambane, and Gaza, represent the third household group in the model. Consumption of both urban and rural households is a log linear function of household income and consumer prices. For rural households, the consumer price is equal to the producer price.

Domestic production of agricultural commodities is a log linear function of rural prices; non-agricultural production is fixed exogenously. Rural prices are linked to urban consumer prices by a fixed marketing margin. [7] Non-agricultural output is fixed and non-agricultural income varies with the price of non-agricultural goods in the model. Agricultural incomes are determined by quantities produced and their prices.

2.2. Model parameters

The major sets of parameters that influence the behavior of the model are supply elasticities and demand parameters. As a consequence of civil conflict, data from rural Mozambique is scarce. Supply parameters, therefore, derive mainly from estimates from other neighboring countries and theoretical restrictions on the matrix of parameters (symmetry of cross-price elasticities of supply and homogeneity of degree zero). Own-price elasticities of supply range from 0.1 to 0.4. The demand parameters were estimated econometrically following the Almost Ideal Demand System (AIDS), described by Deaton and Muellbauer (1990), using the data from the 1991–1992 Food Security Department/Cornell Food and Nutrition Policy Program integrated survey of Maputo households described below. The estimated demand equations take the following form:

$$W_i = \alpha_i + \Sigma_k \beta_{ik} \log P_k + \gamma_{ik} \log(X/P^*) \quad i = 1,2,...7 \tag{1}$$

where W_i is the budget share of the i^{th} good, and X is total expenditures on the group of goods, P^* is Stone's price index computed across all goods in the group, and P_k is the price index of the k^{th} composite good. The composite good price index is calculated for each household as: [8]

$$P_k = \sum_{j=1}^{Y} \left[(P_j/P_o) * W_{jk} \right] \tag{2}$$

where, W_{jk} is the expenditure share of commodity j in group k for each household; P_j is the price of commodity j paid by household; P_0 is the mean price of commodity j across all households; Y is the number of commodities in group k.

Three-stage least squares (3SLS) were employed in the estimation, enabling us to endogenize expenditures, with symmetry and homogeneity restrictions imposed. Furthermore, selectivity bias related to the consumption/non-consumption decision was addressed through the method suggested by Heien and Wessels (1990) that involves including a sample selectivity parameter (lambda) derived from dichotomous choice

[6] Vegetables include roots, tubers and fruit; meat includes fish and other foods not included elsewhere.

[7] The marketing margin is fixed as a constant percentage markup between rural and Maputo prices.

[8] For households that did not purchase a commodity, the average price paid in the month surveyed, in the household's district, was used. For non-food prices, the following goods were used in constructing the index: soap and cosmetics, wood, charcoal, cooking gas, tobacco, kerosene, and gasoline and diesel fuels.

Table 1
Mozambique: uncompensated demand elasticities for urban (Maputo) poor households

	Price							Income
	Yellow maize	White maize	Rice	Wheat	Vegetables	Meat	Non-agriculture	
Yellow maize	−0.552	0.013	0.080	0.014	0.213	0.034	0.026	0.172
White maize	0.004	−0.856	0.016	0.051	0.232	−0.102	0.145	0.510
Rice	0.019	−0.012	−0.668	0.143	−0.237	−0.276	−0.020	1.052
Wheat	−0.065	0.009	0.152	−1.077	−0.047	−0.097	0.228	0.897
Vegetables	0.054	0.031	−0.034	0.013	−0.617	−0.043	0.045	0.551
Meat	−0.166	−0.095	−0.321	−0.176	−0.491	−0.219	−0.514	1.980
Non-agriculture	−0.138	−0.018	−0.033	0.010	−0.189	−0.078	−0.977	1.423

Source: Authors' calculations.

(probit) models of whether or not to consume a product.

Using parameter estimates from Eqn. (1), we computed a matrix of price and income elasticities, which are used in the simulation model to examine the effect of price changes on consumption patterns and poverty, as discussed below. The formulas for the computation of the uncompensated Marshallian elasticities have been derived from Green and Alston (1990) where for a linear approximate AIDS:

$$\epsilon_{ij} = \beta_{ij}/w_i - \gamma_i w_j/w_i \;\forall\, i \neq j \qquad (3)$$

$$\epsilon_{ij} = -1 + \beta_{ij}/w_i - \gamma_i \;\forall\, i = j$$

$$a_i = 1 + \gamma_i/w_i$$

These elasticities, shown in Table 1, provide the reader with insights into the nature of consumer behavior that are not immediately apparent in examining parameter values generated by the demand estimation. [9] Perhaps the most important findings implied for the demand parameters is that for the non-poor, yellow maize is an inferior good, while for the poor, yellow maize is a normal good, with an expenditure elasticity of 0.172. In addition, the cross price effects between yellow and white maize grain are small.

2.3. Poverty line and base data

Maputo households are classified as poor or non-poor on the basis of a poverty line, which is defined as the minimum level of income needed to purchase 2500 calories per adult equivalent per day, given the structure of household demand estimated from the AIDS model described above. [10] In addition, we also define an ultra-poverty line, which will be used in the next section, with an intake of 2000 calories per adult equivalent as the minimum adequate caloric intake.

Defining the poverty line in this way implies that changes in relative prices facing consumers alter the composition of the consumption basket used to set the poverty line. For example, given the demand structure and parameters of the AIDS model, a policy that results in a decrease in the price of yellow maize leads to an increase in consumption of yellow maize and a decrease in consumption of substitutes that are more expensive calorie sources. In light of the price changes,

[9] Corresponding budget shares for the poor and non-poor households were used to calculate the different elasticities used in the model. Because of space limitations, only the results for the poor are shown in Table 1. The values of the compensated elasticities for poor households are given in Appendix 1.

[10] For a more detailed discussion of this approach, see Ravallion and Bidani (1994), Greer and Thorbecke (1986), and Paul (1989). A further description of the calculations for the Mozambican data is found in Sahn and del Ninno (1994).

the minimum income required to purchase an adequate caloric diet, given the structure of demand, is thus reduced. [11] This downward shift in the poverty line, combined with changes in household nominal incomes related to the new set of relative prices, results in changes in the number of people below the poverty line (the headcount index) and the average distance below the poverty line for poor households (the poverty gap index), which we report in Section 4. [12]

2.4. Data

The base data for the model consists of estimated levels of consumption expenditures by households, production, trade, and prices for the eight commodities included. Household expenditure estimates (e.g. volumes and quantities) in urban areas are derived from the 1991–1992 Food Security Department/Cornell Food and Nutrition Policy Program integrated survey of 1816 households in Maputo. Data on expenditures and incomes for rural households is considerably less certain and is derived from sectoral level data on production and producer prices, as well as the data on expenditure patterns of the urban poor. Results are given in Appendix 2.

The integrated household survey was conducted over a 7 month period, October 1991 to April 1992. The multipurpose survey was designed to collect detailed information on household structure, consumption, prices, incomes, labor market activities, morbidity, child nutrition and feeding practices, and housing characteristics. The sample was a self-weighted random sample of households in greater Maputo (including Maputo City, Matola, and Inhaca).

3. Policy simulations

3.1. Price and output effects of food aid sales

Table 2 presents the results of a simulation of a 15% increase in yellow maize food aid imports sold on the Maputo market, vis à vis the base 1991 level (Simulation 1). The increase in yellow maize sold supplied to the local market results in a sharp 37.1% fall in the price of yellow maize and a 28.7% increase in yellow maize consumption by the urban poor. [13] Because the price elasticity of demand for yellow maize by the urban non-poor households is low, their consumption of yellow maize increases by less than 1%.

Increasing imports of yellow maize not only lowers its price, but also affects markets for other commodities. Demand increases for wheat, meat, and non-agricultural goods, while demand falls for substitutes of yellow maize: white maize, rice, and vegetables. Prices of non-tradable vegetables tend to fall because of reduced demand, thus shifting production incentives away from these goods and toward tradable agricultural commodities and non-agricultural production. Production of white maize, rice, and export crops rises slightly (0.1 to 0.2%), while production of vegetables falls by 0.5%. [14]

The increase in yellow maize imports thus has little effect on the white maize market. The 37.1% decrease in the yellow maize price, in itself, leads to only a 0.9 percent decrease in demand for white maize by the urban poor (and a 1.5% increase in demand by the urban non-poor). White maize imports fall by only 0.9%.

The net effect of the changes in prices and agricultural production is to increase aggregate real incomes of the urban poor by 3.6%, mainly because of lower food prices. Aggregate real incomes of the urban non-poor increase only slightly

[11] See Ravallion (1994) for a discussion of the "equivalent income approach" employed here.

[12] In addition, we also report the impact of policy change on the Foster-Greer-Thorbecke P_2 measure, which is as follows:

$$P_2 = 1/n * \sum_{i=1}^{q} [(Z - Y_i)/Z)]^2 \quad (4)$$

where Y_i is the income of household i, Z is the poverty line, N is the total number of households, and q is the number of households below the poverty line.

[13] Total yellow maize consumption by all households rises by only 9%, despite a 15% increase in yellow maize food aid supply to urban areas, because the base level of urban consumption is only 60% of regional consumption.

[14] Production increases in spite of a small appreciation of the real exchange rate of 0.4%, arising from the incremental yellow maize imports, valued at 2.1 million dollars (11500 tons of yellow maize, valued at \$182.6 ton^{-1} c.i.f.).

since these households consume relatively little yellow maize. Because the terms of trade shift against rural households as the prices of vegetables and grains fall, real incomes of rural households fall very slightly (−0.1%).

3.2. Impacts on calorie intakes and poverty measures

The large fall in the price of yellow maize described above results in a simulated 12.38%

Table 2
Increased yellow maize imports: simulation results

Simulation	1	2	3	4	5
	(Percentage change)				
Production					
White maize	0.10	0.07	0.04	0.08	0.07
Rice	0.12	0.09	0.16	0.10	0.09
Export crops	0.23	0.17	0.26	0.18	0.17
Vegetables	−0.45	−0.36	−0.45	−0.37	−0.36
Meat	0.37	0.29	0.38	0.29	0.29
Consumption					
Yellow maize total	8.98	8.98	8.98	8.98	8.98
Urban non-poor	0.82	8.07	0.80	0.56	8.13
Urban poor	28.71	21.70	28.73	12.50	21.64
Rural	0.00	0.00	0.00	12.49	0.00
White maize total	−0.21	−0.13	0.03	−0.36	−2.37
Urban non-poor	1.46	1.17	1.72	0.51	−5.65
Urban pPoor	−0.92	−0.68	−0.66	−0.62	−7.38
Rural	−0.73	−0.54	−0.49	−0.64	−0.56
Rice	−1.77	−1.36	−1.77	−1.11	−1.36
Wheat	2.51	1.99	2.51	1.26	1.99
Nominal incomes					
Urban non-poor	−0.43	−0.36	−0.42	−0.34	−0.36
Urban poor	−0.43	−0.36	−0.42	−0.34	−0.36
Rural	−0.40	−0.36	−0.44	−0.38	−0.36
Prices					
Yellow maize	−37.07	−30.28	−37.10	−19.63	−30.22
White maize	−0.36	−0.36	−0.67	−0.36	−0.36
Rice	−0.36	−0.36	−0.36	−0.36	−0.36
Wheat	−0.36	−0.36	−0.36	−0.36	−0.36
Vegetables	−1.55	−1.23	−1.58	−1.30	−1.23
Meat	3.80	2.94	3.84	2.93	2.93
Non-agriculture	−0.43	−0.36	−0.42	−0.34	−0.36
Real incomes					
Urban non-poor	0.20	0.19	0.21	0.01	0.19
Urban poor	3.63	2.96	3.65	1.89	2.95
Rural	−0.07	−0.06	−0.08	2.53	−0.06
White maize imports	−0.86	−0.56	0.00	−1.27	−7.40

Source: Model Simulations. 1. Base simulation: 15% increase in imports sold on the Maputo market. (Econometric estimates for urban household demand parameters.) 2. Own-price elasticity of demand for yellow maize by urban non-poor households changed from 0.0 to −0.2. 3. Fixed white maize imports. 4. Increased rural consumption of yellow maize. 5. Greater cross-price elasticities of demand between yellow and white maize.

Table 3
Poverty level and depth after 15% increase in yellow maize imports

	Poverty line	Poverty indexes		
	Meticais per capita per month	Head count	Poverty gap	FGT P_2
At current prices				
Poverty line	32400	33.96	9.70	3.99
Ultra poverty line	21380	12.99	2.90	1.08
15% increase in yellow maize imports				
Poverty line	26944	22.82	5.87	2.29
Ultra poverty line	16610	5.46	1.22	0.45

Source: Model Simulations.

increase in calorie consumption for the urban poor. Much of this higher calorie consumption is due to the induced increase in consumption of yellow maize, for which the calorie share rises from 44.10% in the base case to 50.43%. Moreover, the shift in the composition of consumption together with the decline in yellow maize prices reduce the minimum level of income required to purchase 2500 calories per adult equivalent per day. Given the structure of household demand in Maputo, the poverty line falls from 32400 to 26944 meticais per capita per month. Similarly, the ultra-poverty line, (which uses a calorie standard of only 2000 calories per adult equivalent per day), falls from 21380 to 16610 meticais per capita per month.

This downward shift in the poverty lines, largely due to the changes in the vector of prices as yellow maize imports increase, implies a large reduction in urban poverty (Table 3). The number of households below the poverty line falls by 11%, from 34% in the base case to only 23% in Simulation 1 — while the poverty gap index falls from 9.7 to 5.9% of the poverty line income. Even larger declines in measures of severe poverty are observed. The percentage of households below the ultra poverty line falls from 13 to 5%, with similar large declines in the poverty gap and the FGT P_2 indexes.

3.3. Sensitivity analysis

The above results hold across a wide range of parameter values. [15] Raising the own-price elasticity of demand for yellow maize by the urban non-poor from 0.0 in Simulation 1 to −0.2 in Simulation 2, with the elasticity for the poor remaining at −0.55 as in Simulation 1, [16] reduces the effectiveness of the targeting since consumption of yellow maize by the non-poor now rises by 8.1%. Nonetheless, consumption of yellow maize by the poor still rises (by 21.7% instead of 28.7% as in Simulation 1) and their real incomes rise by 3.0% (compared with 3.6% in Simulation 1).

Similarly, assuming that white maize imports are fixed in the short run (due to problems in information flows or other market imperfections) has minimal effects on the urban market and results in only a small, 0.3% fall in white maize prices for farmers (Simulation 3).

Larger effects on rural households occur if yellow maize sold in Maputo leaks to the rural markets or if the food aid is distributed directly to rural households as well as in urban areas. Under the extreme assumption that yellow maize is supplied throughout the region (i.e. the rural areas in the three southern provinces of Mozambique that are near Maputo), so that the same price holds for all consumers, the consumption of yellow maize rises by 12.5% for both urban and rural households (Simulation 4). Real incomes increase by 2.5% for rural households, but the 1.9% gain for urban poor households is substantially less than in Simulation 1 (3.6%).

[15] The sensitivity analysis focuses on the multi-market simulation outcomes for sectoral and aggregate household variables. The implications for the poverty measures are not discussed here, since the results are not significantly different from those shown in Table 3.

[16] The income elasticity of demand for yellow maize is also adjusted upward to −1.345 so as to maintain homogeneity of degree 0 in prices and incomes. Engel's Law (the sum of the income elasticities weighted by the budget shares must equal unity) is satisfied by reducing the income elasticity of non-food from 1.338 to 1.321. Finally, zero homogeneity in prices and incomes for non-foods is satisfied by reducing the own-price elasticity from −0.975 to −0.950. With these adjustments, symmetry of the cross-price effects is no longer maintained, however.

Finally, assuming larger cross-price elasticities of demand between white and yellow maize [17] and the larger own-price elasticity of demand for yellow maize by the urban non-poor of Simulation 2, the decline in white maize demand is steeper (2.4%) and white maize imports fall by 7.4% as urban consumers substitute toward yellow maize (Simulation 5). The spillover effects of increased yellow maize imports on the white maize market are still small, however, mainly because Maputo accounts for only a small share (11%) of national consumption and 33% of regional consumption of white maize. [18] Moreover, because the white maize price remains tied to world prices, domestic production of white maize is almost unchanged. The change in consumption of yellow maize and real incomes of the urban poor is essentially identical to those in Simulation 2.

Thus, under a wide range of assumptions on model parameters and structure, a policy of open market sales of increased yellow maize imports is an effective self-targeting mechanism for increasing real incomes of the Maputo poor, without having any significant deleterious effects on rural producers. Several key parameters drive this result. First, the own-price elasticities of demand for yellow maize are larger in absolute magnitude for the poor than for the non-poor. Second, Maputo comprises a relatively small share of regional consumption of white maize. Third, cross-price effects of lowering the yellow maize price on the white maize market are small, even when we increase the substitution effects above those econometrically estimated and fix white maize imports. Fourth, white maize is a traded commodity, whose price is set internationally. And fifth, a large share of Maputo's white maize consumption is from commercial imports, which will bear the brunt of any decrease in demand for white maize.

3.4. *Countervalue funds and the cost of the subsidy*

As shown above, increasing yellow maize imports raises the incomes of the poor and reduces the number of people below the poverty line. The question arises, however, as to the costs of such a policy change, particularly to the treasury that receives the countervalue funds generated by the sale of food aid. [19] We measure costs to the government of increasing yellow maize imports in two ways. The first measure is simply the c.i.f. value of the yellow maize imports. The second measure is the net financial cost to the government of using yellow maize food aid to reduce urban poverty, equal to the difference between the c.i.f value of yellow maize imports (plus any government costs associated with the sale of the yellow maize to consignees) and the countervalue funds generated.

A 15% increase in yellow maize sold in Maputo (Simulation 1) reduces the market price by 18.5% to a level 47.7% below the border price. [20]

[17] The cross-price elasticities of white maize demand with respect to a change in yellow maize prices are changed from −0.046 to 0.150 for the urban non-poor and from 0.004 to 0.200 for the urban poor. Adjustments to other parameters are also made to maintain symmetry of the cross-price effects and to satisfy Engel's Law. See Dorosh and Bernier (1994).

[18] A 10% decrease in Maputo's demand for white maize would only represent a 3.3% decline in the region's demand for white maize.

[19] Until recently, the yellow maize food aid distributed in Maputo has been sold to consignees at below market clearing levels in a misguided attempt to subsidize consumers through commodity rationing. The government has sacrificed potential revenues from countervalue funds by selling to traders and parastatals at a low price in the expectation that such a subsidy would be passed onto consumers with ration cards. In practice, most yellow maize was diverted from the official market and purchased by consumers in the open (parallel) market at an average price of 414.2 meticais kg^{-1}, 50.6% above the official ration price of 275 meticais kg^{-1} (1991–1992 integrated household survey of Maputo). Selling yellow maize at a market clearing price would thus increase government revenues from countervalue funds, the cost being borne primarily by the traders and parastatals that captured the rents implied by the difference between the official and open market price.

[20] The border price calculation assumes a 30% marketing markup between c.i.f. and retail and a parallel market exchange rate of 2200 meticais per dollar. The actual (base level) market price of yellow maize (414.2 meticais kg^{-1}) was 16.9% below the border price of yellow maize at the retail level (498 meticais kg^{-1}).

Table 4
Benefits and costs of 15 percent increase in food aid to Maputo

CIF value of imports (bn meticais)	53.53
Countervalue funds (bn meticais)	34.1
(change)	−6.8
Price subsidy to consumers with respect to border price	47.7
Calorie consumption per capita (level)	1870
(change)	206
Change in real incomes of the urban poor	
(billion meticais)	5.90
(percent change)	3.6
Population below poverty line	
(thousands)	342.3
(percent of urban population)	22.8
Marginal cost	
(import cost, CIF, million dollars)	2.10
(import cost, CIF, billion meticais)	4.41
(financial cost, billion meticais)	6.75
Benefit/cost ratios	
Real incomes/import cost	1.34
Real incomes/financial cost	0.87
Reduction in poverty/import cost("000 people per million dollars)	79.6
Reduction in poverty/financial cost("000 people/billion meticais)	24.7

Source: Model simulations.

Countervalue funds are now 34.1 billion meticais, a decrease of 6.8 billion meticais from the base level countervalue funds (Table 4). The decrease in countervalue funds occurs despite an increase in maize sold because with a price-inelastic demand, the percentage fall in market price (−18.5%) is greater than the percentage increase in total sales in Maputo (15.0%). Nonetheless, the benefits of the increased inputs are large: increased yellow maize food imports reduce the number of people below the poverty line by 24.7 thousand per billion meticais of foregone countervalue funds.

4. Discussion and conclusions

In this paper we have shown the possibilities of using food aid as an effective means of poverty alleviation in Maputo. Specifically, the simulations, based on a multi-market model constructed using data on supply and demand levels in 1991/1992 and parameter estimates of a system of consumer demand from a survey during the same period, show that yellow maize is self-targeting and that poor consumers are responsive to changes in the price of yellow maize. The simulations based on these parameters indicate the importance and efficacy of continuing, and even marginally increasing, the quantity of food aid imports sold in the Maputo market above the levels of 1991/1992 as a means of raising calorie intake, reducing the number of poor, and narrowing the poverty gap.

Thus, strict adherence to import parity pricing for yellow maize food aid sales to Maputo may not be justified. The gains to the government from higher sales prices of yellow maize and the positive, but arguably small, gains to producers of white maize in southern regions supplying Maputo must be weighed against the effects of higher consumer prices of yellow maize in Maputo and substantial declines in real incomes of the Maputo poor.

The significant reductions in urban poverty and the minimal adverse effects on rural producers of yellow maize food aid shown here are not merely a consequence of the unusual war-time economy in Mozambique during the early 1990s. Rather, the results presented here derive from the observed demand characteristics of the food aid commodity (yellow maize) and the structure of production and trade of locally produced staples (most importantly, white maize). Low elasticities of substitution between yellow and white maize on the demand side minimize adverse effects on white maize demand, and because yellow maize is an "inferior good", open market sales of yellow maize are self-targeting to poor households. Cross-border trade with neighboring countries and limited marketable surplus of white maize in the southern region of Mozambique also tend to minimize the impact of any drop in demand for white maize products.

Of course, there is the prospect that, over time, changes in tastes and preferences will diminish these self-targeting attributes of yellow maize products. Moreover, the low elasticity of

substitution between yellow and white maize is itself likely to be a function of the relative price. Thus, the econometric estimates of demand parameters, and the multi-market analysis, apply to marginal changes in relative prices. A very large increase or decrease in relative prices of yellow to white maize would likely lead to significant changes in demand.

It is also essential to note that the above benefits of supplying yellow maize food aid to Maputo do not necessarily apply to other urban centers in Mozambique and almost certainly do not apply to rural areas in post-war Mozambique in years of normal harvest. Demand characteristics of non-Maputo households are not necessarily the same as those in Maputo. In isolated markets, impacts of substitution effects on prices may be larger as flows of white maize and other commodities from outside the region are limited. Addressing these issues fully would require data on rural household incomes and expenditure patterns, as well as information on market flows of commodities, a high priority for further data collection efforts. Nonetheless, the case of yellow maize food aid in Maputo illustrates that food aid flows can significantly contribute to urban poverty alleviation without major disincentive effects on rural households when food aid commodities are inferior goods and poor substitutes for domestic staples, and the structure of markets for domestic staples acts to limit adverse price movements of these goods.

Acknowledgements

Paul Dorosh is Associate Professor of Economics at the Cornell Food and Nutrition Policy Program; David E. Sahn is Associate Professor of Economics at and Director of the Cornell Food and Nutrition Policy Program (CFNPP); and Carlo del Ninno is an economist at the World Bank and performed this work while a Senior Research Associate at CFNPP. No priority of authorship is implied.

Appendix A

Mozambique: compensated demand elasticities for urban (Maputo) poor households

	Price						
	Yellow maize	White maize	Rice	Wheat	Vegetables	Meat	Non-agriculture
Yellow maize	−0.532	0.019	0.094	0.027	0.257	0.048	0.086
White maize	0.063	−0.838	0.056	0.091	0.362	−0.058	0.324
Rice	0.142	0.026	−0.587	0.227	0.030	−0.185	0.348
Wheat	0.040	0.041	0.221	−1.006	0.181	−0.020	0.543
Vegetables	0.118	0.051	0.009	0.057	−0.477	0.004	0.238
Meat	0.066	−0.024	−0.167	−0.018	0.012	−0.049	0.180
Non-agriculture	0.029	0.033	0.077	0.123	0.172	0.044	−0.478

Source: Authors' calculations.

Appendix B

Mozambique: base data table on supply and demand: 1991

	Domestic production [a]	Imports	Marketing	Total supply [b]	Consumption				
					Maputo poor	Maputo poor	Maputo total	Rural south	Total demand
Value(10^9 Mt)									
Yellow maize	0.00	49.12	3.94	53.06	15.62	16.15	31.77	21.29	53.06
White maize	15.07	16.97	7.67	39.70	18.29	6.35	24.64	15.07	39.70
Rice	3.72	42.31	26.22	72.25	54.80	14.54	69.34	2.91	72.25
Wheat	0.00	43.90	43.90	87.79	63.35	15.47	78.82	8.97	87.79
Vegetables	150.52	79.80	91.32	321.64	207.38	58.86	266.24	55.40	321.64
Meat	91.61	26.67	71.64	189.92	151.32	19.90	171.22	18.70	189.92
Export crops	4.80	−10.08	5.28	0.00	–	–	–	–	–
Non-food	46.50	1076.70	–	1123.20	277.70	32.60	310.30	38.70	1123.20 [c]
Total	312.22	1325.38	249.96	1887.56	788.45	163.88	952.33	161.04	1887.56 [c]
Quantity (1000 Mt)									
Yellow maize	0.0	128.1	–	128.1	37.7	39.0	76.7	51.4	128.1
White maize	79.3	38.4	–	117.7	28.5	9.9	38.4	79.3	117.7
Rice	10.1	57.4	–	67.5	47.1	12.5	59.6	7.9	67.5
Wheat	0.0	106.7	–	106.7	77.0	18.8	95.8	10.9	106.7

Source: FSC/CFNPP household survey, Mozambique unpublished national accounts table, International Monetary Fund (1992), and authors' calculations.

[a] Rural south production only.

[b] Includes marketing margins.

[c] Includes non-household demand.

References

Alderman, H., Sahn, D. and Arulpragasam, J., 1991. Food subsidies and exchange rate distortions in Mozambique. Food Policy, 16: 395–404.

Braverman, A. and Hammer, J., 1986. Multimarket analysis of agricultural pricing policies in Senegal. In: I. Singh, L. Squire and J. Strauss (Editors), Agricultural Household Models: Extensions, Applications, and Policy. Johns Hopkins University Press, Baltimore, MD.

Deaton, A. and Muellbauer, J., 1990. An almost ideal demand system. Am. Econ. Rev., 70: 312–326.

Dorosh, P. and Bernier, R., 1994. Agricultural and food policy issues in Mozambique: a multi- market analysis. Working Paper 63, Cornell Food and Nutrition Policy Program, Ithaca, NY, 81 pp.

Green, R.H., 1992. Southern Africa: that the people may be fed. Food Policy, 17: 455–464.

Green, R. and Alston, J., 1990. Elasticities in AIDS models. Am. J. Agric. Econ., 72: 442–445.

Greer, J. and Thorbecke, E., 1986. A methodology for measuring food poverty applied to Kenya. J. Dev. Econ., 24: 59–74.

Heien, D. and Wessels, D., 1990. Demand systems estimation with microdata: a censored regression approach. J. Bus. Econ. Stat., 8: 365–371.

International Monetary Fund, 1992. Republic of Mozambique — Statistical Annex. International Monetary Fund, Washington, DC.

Isenman, P.J. and Singer, H.W., 1977. Food aid: disincentive effects and their policy implications. Econ. Dev. Cult. Change, 25(2): 205–237.

Maxwell, S.J., 1991. The Disincentive Effect of Food Aid: A Pragmatic Approach. In E.J. Clay and O. Stokke (Editors), Food Aid Reconsidered. Frank Cass, London, 25 pp.

Paul, S., 1989. A Model of Constructing Poverty Lines. Journal of Development Economics, 30: 129–144.

Ravallion, M., 1994. Poverty comparisons. Fundamentals of Pure and Applied Economics, 56, Harwood Academic, Chur, 145 pp.

Ravallion, M. and Bidani, B., 1994. How robust is a poverty profile? World Bank Econ. Rev., 8(1): 75–102.

Sahn, D. and del Ninno, C., 1994. Living standards and the determinants of poverty and income distribution in Maputo, Mozambique. Working Paper 56, Cornell Food and Nutrition Policy Program, Ithaca, NY, 76 pp.

Schuh, A., 1982. Food aid as a component of general economic and development policy. The Developmental Effectiveness of Food Aid in Africa. New York: Agricultural Development Council.