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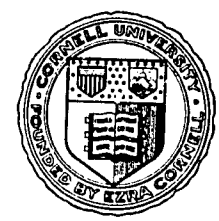
The Adverse Nutrition Effects of Taxing Export Crops in Malawi

David E. Sahn
Yves Van Frausum
Gerald Shively

CORNELL FOOD AND NUTRITION POLICY PROGRAM



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David E. Sahn
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ABBREVIATIONS

GDP	Gross Domestic Product
MAPE	Mean Absolute Percentage Error
2SLS	Two-Stage Least Square

FOREWORD

Economic reform programs have often included the basic principle of border pricing to reduce distortions and improve resource allocation. One component of this strategy has involved reducing taxation of agricultural exports in order to raise foreign exchange earnings and increase output. However, some skeptics have argued that this strategy will not raise the incomes of the poor, but, by encouraging the production of export crops instead of food for home consumption, it will increase their nutritional risk.

In order to address this issue for Malawi, this paper builds upon the macroeconomic model presented in Working Paper 13, and adds a household model that allows the authors to address explicitly the nutritional effects of reducing taxation on tobacco. The results indicate that an export-oriented agricultural strategy would increase income and improve nutrition of smallholders. This corresponds to similar findings from Côte d'Ivoire, reported in Working Paper 2. Both papers were prepared under CFNPP's Cooperative Agreement with the Africa Bureau of the Agency for International Development and were designed to determine the effect of economic reforms on poverty and living standards in Africa.

Ithaca, New York
May 1992

David E. Sahn
Deputy Director, CFNPP

1. INTRODUCTION

Although smallholders in Malawi are largely engaged in producing maize for subsistence, export-crop production on customary land contributes significantly both to household incomes and to the country's total foreign exchange earnings. Malawi's export-oriented agricultural policy, however, from independence through the 1980s, was predicated on the growth and development of a leasehold estate sector, instead of giving smallholders incentives, through prices and market structures, to produce lucrative export crops and be the primary beneficiaries of their sale. The estate sector value added has thus grown at a much faster rate than that of the smallholder sector and has become an increasingly large share of agricultural GDP, benefiting from favorable marketing arrangements and state-imposed restrictions on the crops which smallholders can legally grow. Those export crops that smallholders have been permitted to produce have also been heavily taxed, in contrast to the treatment of estate producers, who have received export parity prices for their product (Sahn and Arulpragasam 1991; Kydd and Christiansen 1982). Thus, as the estate sector has expanded, Malawi's heavily cultivated, customary land in the densely populated southern region has become increasingly characterized by smallholdings, contributing to high levels of poverty and malnutrition (World Bank 1990b; UNICEF 1986).

Poverty among smallholders and its manifestation in extraordinarily high levels of malnutrition among preschool-aged children have been argued to result largely from the size of landholdings' being inadequate to produce sufficient food for the nutritional needs of the household (Centre for Social Research 1988; UNICEF 1986). It has virtually become a convention in Malawi to define poverty by landholding size.[1] As a consequence, a key element of the strategy to alleviate poverty and ensure food security in rural Malawi has become promoting at least a subsistence level of maize production by smallholders through increasing, or at minimum maintaining, the size of smallholder farms, coupled with efforts to intensify smallholder maize production (Government of Malawi 1989).

There is little question that increasing fertilizer application and introducing improved varieties represent important components of any food security strategy. A complementary strategy, however, one heretofore not implemented, emphasizes export-crop promotion in the smallholder sector by offering farmers remunerative border prices for their export crops, instead of

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[1] For example, a recent World Bank publication defines the "core poor" as those farming less than 0.5 hectare, and the "other poor" as those farming between 0.5 and 1.0 hectare, plus half of those farming between 1.0 and 1.5 hectares of land. All other households are classified as nonpoor (World Bank 1990a).

heavily taxing such crops (Sahn and Arulpragasam 1991). This approach is often viewed skeptically by those most concerned with food security. In Malawi as well as other countries, the assertion has been made that devoting scarce land resources to the production of export crops — in the case of Malawi, most notably tobacco — represents a food-security and nutritional risk, and this may be the case even if there is an increase in household incomes.[2] That perspective on the effects of cash cropping in Malawi is perhaps best captured by the following quotation:

> ... money earned from tobacco is said to be like that earned from labor migration to South Africa: it comes in a single large amount and burns holes in people's pockets. The part deprecating, part envious jokes made about this money and the tendency for it to be spent carelessly, appear to say that while tobacco income may be used for the family's needs, it is often used for items that, in the eyes of local people, are non-necessities (drink, radios, fancy clothes) (Peters and Herrera 1989).

The underlying assumption is that producing tobacco will reduce food availability at the household level and increase malnutrition. This, of course, assumes that cash cropping does not raise incomes, or at least not sufficiently to compensate for the nutritional risks that are commonly asserted to arise with cash cropping. These risks are, first, that the marginal propensity to consume food out of income from sales of cash crops will differ from that for other forms of income, particularly home production,[3] and second, that cash-crop production will put a greater share of income under the control of men, who may place a lower priority on nutrition than their female spouses.[4]

This paper, then, addresses two complementary issues: the effect on smallholder real incomes of moving to a regime of parity pricing for smallholder export crops, and how such a change in the level and composition of income affects nutrition.[5] In particular, while higher prices for export crops will

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[2] For a general review of the issues that have led to a concern over cash cropping, see von Braun and Kennedy (1986) and Pinstrup-Andersen (1985). Also, for recent empirical studies of this issue from Africa, see Sahn (1990), Kennedy and Cogill (1987), and von Braun et al. (1989).

[3] See, for example, Massel (1969) and Kumar (1979) for a discussion of marginal propensities to consume from different income sources.

[4] This is discussed, for example, in Gittinger (1990), von Braun et al. (1989), Kennedy and Cogill (1987), and Tinker (1979).

[5] Altering state policy that has attempted to delineate clearly between the leasehold estate sector and the customary smallholder sector by differentiating legal and institutional rules regarding crop choice and land tenure is certainly

(continued...)

result in a shift in the structure of land use and output, away from subsistence maize production and toward tobacco, the extent to which such a policy will contribute to higher incomes for the poor is not obvious. A large number of factors, including the elasticity of substitution between maize and export crops, will determine whether and to what extent it will do so. Such a major policy change has repercussions throughout the economy, affecting government revenue and expenditure, the price of labor to other key sectors, the level of gross fixed capital formation, the level of inflation, output in other sectors, and so forth. These less-obvious and more indirect effects, and how in combination they determine real GDP, sectoral value added, income distribution, and thus smallholder incomes, need to be taken into account in determining the impact of reformulating policy away from taxing smallholders to a pricing regime based on export parity.

The second underlying issue that will determine the extent to which removing export taxes will affect nutrition is also more complex than it appears at first glance. It is important to go beyond the necessary, first analytical step of determining the effect of incomes on nutrition and address the issue of whether income derived from export crops instead of subsistence maize production will have deleterious effects on nutrition.

In order to incorporate these concerns into the analysis, an econometric model of the Malawian economy is first employed to determine how a border pricing regime for smallholder export crops affects GDP and the functional distribution of income. This allows us to arrive at a figure for the percentage change in the incomes of poor smallholders from adopting such a policy. The results derived from the policy simulations with the econometric model are then linked with a conditional, reduced-form household model of the determinants of nutrition. This household model is used to derive parameters that show the degree to which the changes in smallholder incomes determined from the econometric model will subsequently affect nutrition. But in addition, the household model is designed to explore the extent to which an increase in the share of income derived from export crops will have deleterious nutritional consequences.

The remainder of the paper is organized as follows. Section 2 provides a brief description of the econometric model used to generate household incomes. The results of the simulation that involves adopting an export-oriented policy that raises export-crop prices relative to maize will also be presented. Section 3 then presents the results of the household model showing how the changes in income level and source derived from the econometric model affect the level of malnutrition. Section 4 presents some conclusions, focusing on the implications of the findings for alleviating poverty and malnutrition in Malawi.

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[5](...continued)
an issue that merits close scrutiny (see, for example, Sahn and Arulpragasam 1991). A more immediate issue, and a policy that is more amenable to change given Malawi's political economy, is the removal of high taxes on the export crops that smallholders are permitted to produce and market, which is the subject of this paper.

2. THE ECONOMETRIC MODEL

As indicated above, the major component of a strategy to raise smallholder production of export crops would be eliminating taxation of export crops. In this section, therefore, we briefly discuss the model that will enable us to determine how such a policy will affect output of food relative to export crops and, more important, incomes of poor smallholders.

The prototype econometric model is detailed in Van Frausum and Sahn (1991). It is basically composed of five blocks that include a combination of 60 stochastic equations and identities, as shown in Appendix Table A.1. The most important stochastic equations, those that predict output in agriculture, are in the production block. A separate equation is included for estate agriculture, as well as smallholder export crops and cash crops. In keeping with the above discussion, the smallholder and estate sectors compete for factors of production and agricultural inputs. Other key equations in the block include one for industry as well as construction value added.

The other four blocks included in the model are as follows: the balance-of-payment block, government finance block, prices block, and monetary sector block. While space does not allow a full treatment of the equations in these blocks, a few points are worth emphasizing. First, in the balance-of-payment block, among the key equations are a foreign-exchange-constrained import function and a series of export functions. Furthermore, the block effectively shows how the current account balance is ultimately transformed into external debt.

The government finance block is composed of nonstochastic equations. Among the important features of the model is that expenditures are determined by the level of financing. As for the price block, the essential variables generated include the retail price index, gross domestic product (GDP) deflator, and the real wage rate. Key variables used to explain the former two include import prices, import duties, indirect tax rates, and government-set procurement rates for smallholder agricultural products. Finally, the monetary block is kept to a minimum by simply modeling total advances from commercial banks as a function of foreign exchange availability and the real interest rate. Advances received by the private sector from commercial banks are then derived by netting out commercial bank advances to government parastatals.

The distribution of value added across functional groups is achieved by taking endogenized production of smallholder maize and cash crops, estate crops, industrial output, and value added in construction, all derived from the model in constant prices, and converting them into current prices value added. This is accomplished using price indices from the model. The sectoral value added

derived from this procedure was then distributed over labor remuneration and capital (i.e., gross profit), including depreciation.

The average factor shares over the 1980s are reported in Table 1. They are derived from a combination of existing economic surveys for Malawi, although in the model the shares are endogenized and vary from one year to the next.[6] In terms of the choice of functional income groups and how they are incorporated in the model, the lack of a recent and reliable national household income and expenditure survey constrained what we could accomplish. Nonetheless, a key decision in terms of defining the functional groups to be included in the model was the delineation between large (i.e., better-off) and small (poor) smallholder households. We obviously did not wish to treat smallholders as a homogenous group, owing to the variability in landholding size and the assertion that the size of landholding is a primary determinant of incomes. However, distinctions among smallholder households are best based on an empirical question: how does the size of holding influence incomes? To make this determination, we employed the same regional household survey (to be discussed in greater detail below) to examine the relationship between landholding size and income. The results, found in Table 2, suggest that over the bottom four landholding quintiles, there is no trend in per capita expenditures, although household expenditures increase noticeably over the first three deciles, reflecting the smaller household size for those households in the bottom landholding quintiles. In contrast, for the largest landholding households, with an average farm size of 2.7 hectares, the expenditure figures jump noticeably. Based on this descriptive data, coupled with a simple, double log-quadratic function wherein landholdings are used to predict expenditures, we chose 1.5 hectares as a cutoff point to distinguish functional groups of poor and better-off smallholders to be incorporated in the model.

Ideally, we would have broken down labor remuneration further, between skilled and unskilled, in those categories other than smallholders. This, however, was not feasible and is particularly problematic for the estate sector, where great income disparities exist. Thus, we are unable to say anything directly about how poverty among estate workers per se would be affected by alternative policy scenarios. However, given that estimates suggest that only 10.7 percent of Malawi's poor are in the estate sector, as contrasted with 87.5

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[6] In particular, as discussed in greater detail in Van Frausum and Sahn (1991), three real-wage rate equations were estimated: one for private sector workers, which included industry and other workers, one for estate workers, and one for construction workers. Four employment equations are estimated: for estate workers, construction workers, workers in industry, and workers in other productive services. Since virtually all of the smallholder and government shares of value added accrues to labor, estimating functions for these groups was not necessary as depreciation is assumed to stay constant. This in turn allowed us to compute sectoral labor income and labor income shares, since sectoral value added is known. This implicit labor income share was then calibrated to match the period averages shown in Table 1.

Table 1 — Malawi: Mean Share of Value Added by Sector

	Labor	Gross Profit
	Percentage	
Value added, smallholders of which:	95.9	4.1
<1.5 hectares	52.5	
>1.5 hectares	47.5	
Value added, estates	62.3	37.7
Value added, industry	39.3	60.7
Value added, construction	74.4	25.6
Value added, government	93.5	6.5
Value added, other services	46.5	53.5

Sources: National Statistical Office (1989); Ministry of Agriculture (1980).

Table 2 — Expenditures by Household Landholding Quintile

Quintile	Hectares Cultivated	Per Capita Hectares Cultivated	Monthly Household Expenditures	Monthly Per Capita Expenditures
All	**1.5**	**0.23**	**56.5**	**9.0**
1	0.6	0.13	38.6	8.1
2	1.0	0.19	46.7	8.3
3	1.3	0.22	54.9	9.0
4	1.7	0.26	52.5	7.9
5	2.7	0.36	91.0	11.9

percent in the smallholder sector,[7] the implications of this shortcoming are limited.

In considering the predictive capability of the model, the major outcomes of interest are the levels of smallholder cash-crop and maize production, as well as GDP, which in combination determine the level and functional distribution of income, and the contributions of cash- versus food-crop production in generating smallholder income. To determine how well the model tracks reality, Appendix Figures A.1 through A.3 compare the values actually observed with the base run of the model over the course of the 1980s. In addition, Table 3 summarizes the tracking capability of the model for a number of other key endogenous variables, presenting the Theil and Mean Absolute Percentage Error (MAPE) indexes. Overall, the model appears to behave well in the base-run simulation. Thus, we will present the results of the simulations run using the model in terms of deviations from the base case scenario. Since the dynamic (base-case) simulation generates results that are close to the variables observed during the 1980s, percentage deviations from the base-case values from eliminating crop taxes can be meaningfully interpreted as what would have actually happened if the government had adopted such an alternative policy.

EFFECTS OF ELIMINATING TAXATION ON SMALLHOLDER INCOMES

The model described above is next employed to examine how smallholder incomes are affected by changing the incentive structure to encourage the production of export crops, particularly tobacco, instead of maize. Throughout the 1980s, maize prices were near export parity, in contrast to those of export crops. This is illustrated in Figure 1, which shows the nominal protection coefficients for tobacco during the 1980s. The result was that the structure of relative prices (along with other factors, such as risk aversion, inadequate financial markets, and information asymmetries) discouraged production of potentially lucrative smallholder export crops, especially tobacco. Despite the fact that a key component of Malawi's structural adjustment program was supposedly to encourage production of export crops, the price of maize relative to that of smallholder tobacco indicates no improvement in the structure of incentives (Figure 2). Furthermore, real tobacco prices actually fell. This contributed to the fact that yields of smallholder export crops and the level of production were stagnant (Sahn and Arulpragasam 1991).

The question of what would have happened to smallholder incomes (as well as output) if export parity pricing principles were adhered to was therefore next examined using the model described above. Specifically, the counterfactual

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[7] The remaining 1.8 percent of the poor are urban, a small share in comparison with other developing countries, reflecting in part the low level of urbanization and the terms of trade that have favored the urban producers. See World Bank (1991).

Table 3 — Coefficient of Theil and MAPE (Dynamic Simulation)

Variable	Theil	MAPE
	Percentage	
Maize	0.56	4.0
Cash	0.21	6.4
Estate	0.52	3.6
Value added, construction sector	0.89	10.7
Constant prices exports	0.37	5.2
Total factor payments (BOP)	0.23	3.5
External debt (in Kwacha)	0.19	3.0
Creditworthiness	0.47	5.4
Imports at current prices (goods and services)	0.51	8.9
Government expenditure on goods, services, wages, and capital formation (current prices)	0.32	3.9
Retail price index	0.18	2.2
Deflator, GDP	0.14	1.5
Real wage rate	0.31	2.7
Index of industrial production	0.77	3.5
Government expenditure on goods, services, wages (constant prices)	0.55	3.9
GDP at factor cost, constant prices	0.99	2.6
GDP at market prices, current prices	0.47	5.3
Debt service ratio	0.39	6.5

Figure 1 — Malawi: Nominal Protection Coefficients, Tobacco

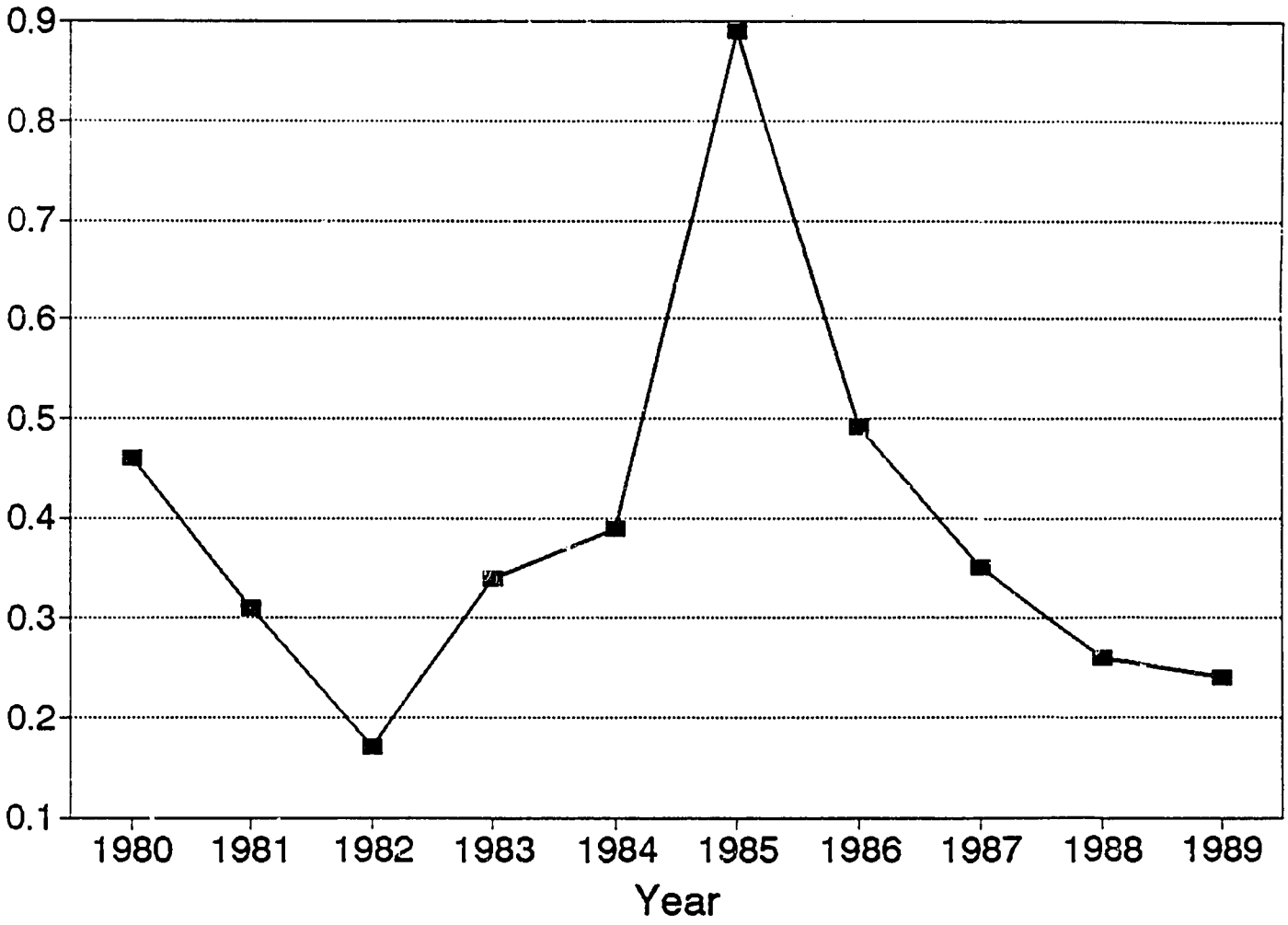
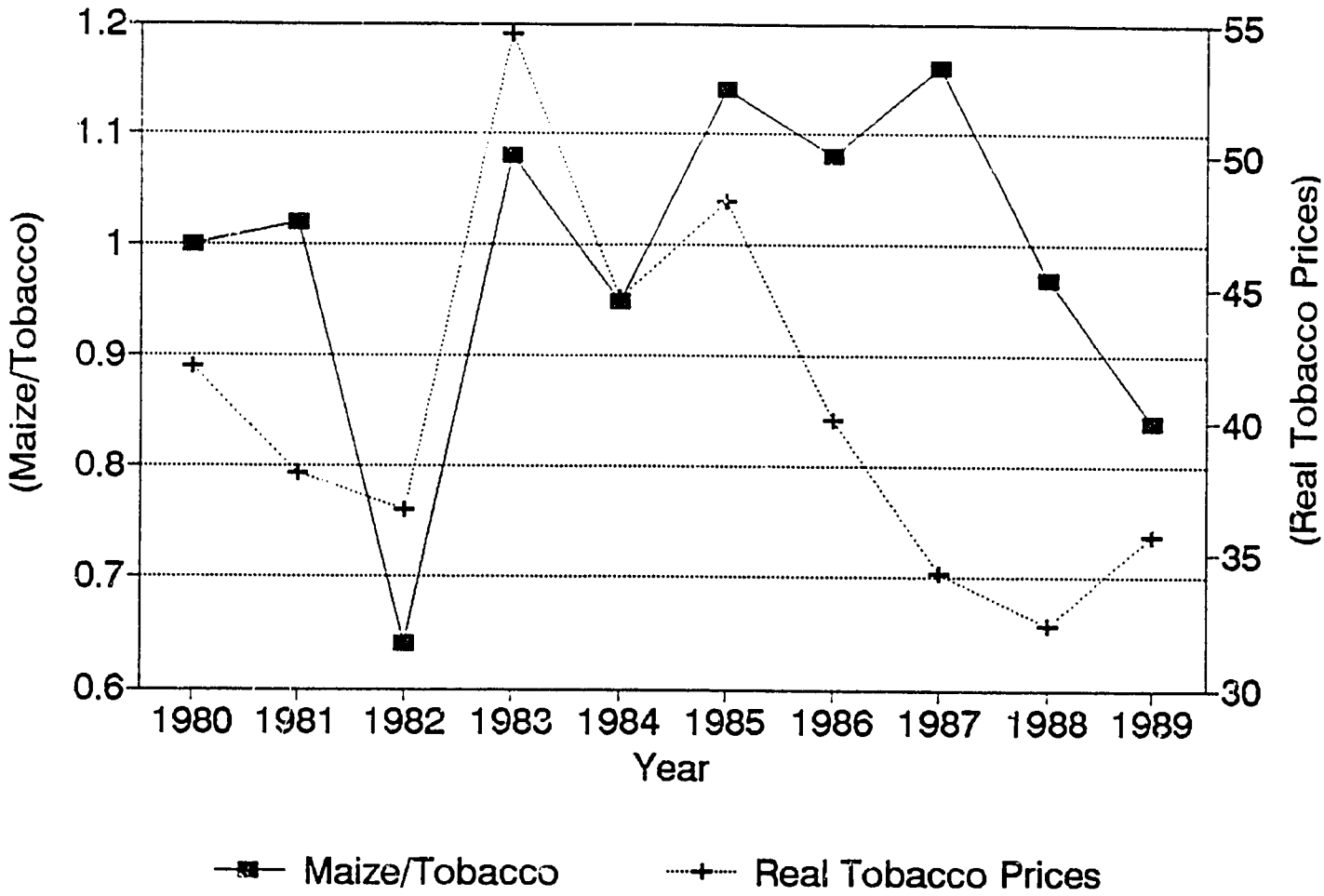


Figure 2 — Malawi: Indices of Maize to Smallholder Tobacco and Real Tobacco Prices (1980=100)



scenario eliminates the taxation of export crops. The model then generates the level of GDP and the distribution of value added.[8]

Results indicate that in the absence of the heavy taxation of smallholder export crops, GDP in Malawi would have been on average 4.4 percent higher during the 1980s (Figure 3). This improved economic performance would have been mediated by a large increase in cash-crop production of nearly 65.8 percent, which would have also contributed to more exports and greater government revenues and expenditures. This in turn would have contributed to increased construction activity and more industrial output. At the same time, maize production would have been, on average, 4.9 percent lower. While this jump in cash crop production may, at first glance, seem extremely high, one should recognize that export crops represent only around 2 percent of total smallholder land use. Thus, a large increase in export crop production will still leave cash crops a relatively small share of the smallholder farmer's output.

In terms of the functional distribution of income, the results indicate that the share accruing to smallholders with less than 1.5 hectares of land will increase by 9.3 percent (Figure 4). The biggest winners of this policy change are smallholders with holdings greater than 1.5 hectares. Once again, it comes as no surprise that the larger smallholders are the prime beneficiaries of the elimination of taxes on export crops. Simply, larger smallholders plant a greater share of their land in cash crops and gain disproportionately from any policy that increases the returns to such an activity.

One can arrive at the change in the total incomes of poor smallholders by combining the results of the model in terms of the counterfactual change in overall value added and the share that accrues to smallholders. The results indicate that during the 1980s, the incomes of smallholders with less than 1.5 hectares would have been 13.7 percent higher if they were offered export parity prices for cash crops. This increase would have been mediated by a shift in land use and a significant rise in the contribution of export-crop sales to incomes. Conversely, the share of household income received in the form of food crops would have fallen. This suggests the need to explore the effects of these changes in level and source of income on nutritional status.

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[8] This counterfactual simulation also eliminates the subsidy on smallholder fertilizer, in keeping with the concept of adhering to the principles of border pricing. In fact, the effects of eliminating the fertilizer subsidy in the model are felt through the balance-of-payments block of the model and the foreign exchange savings to the government.

Figure 3 — Simulation of Effects of Eliminating Export Crop Taxation During the 1980s

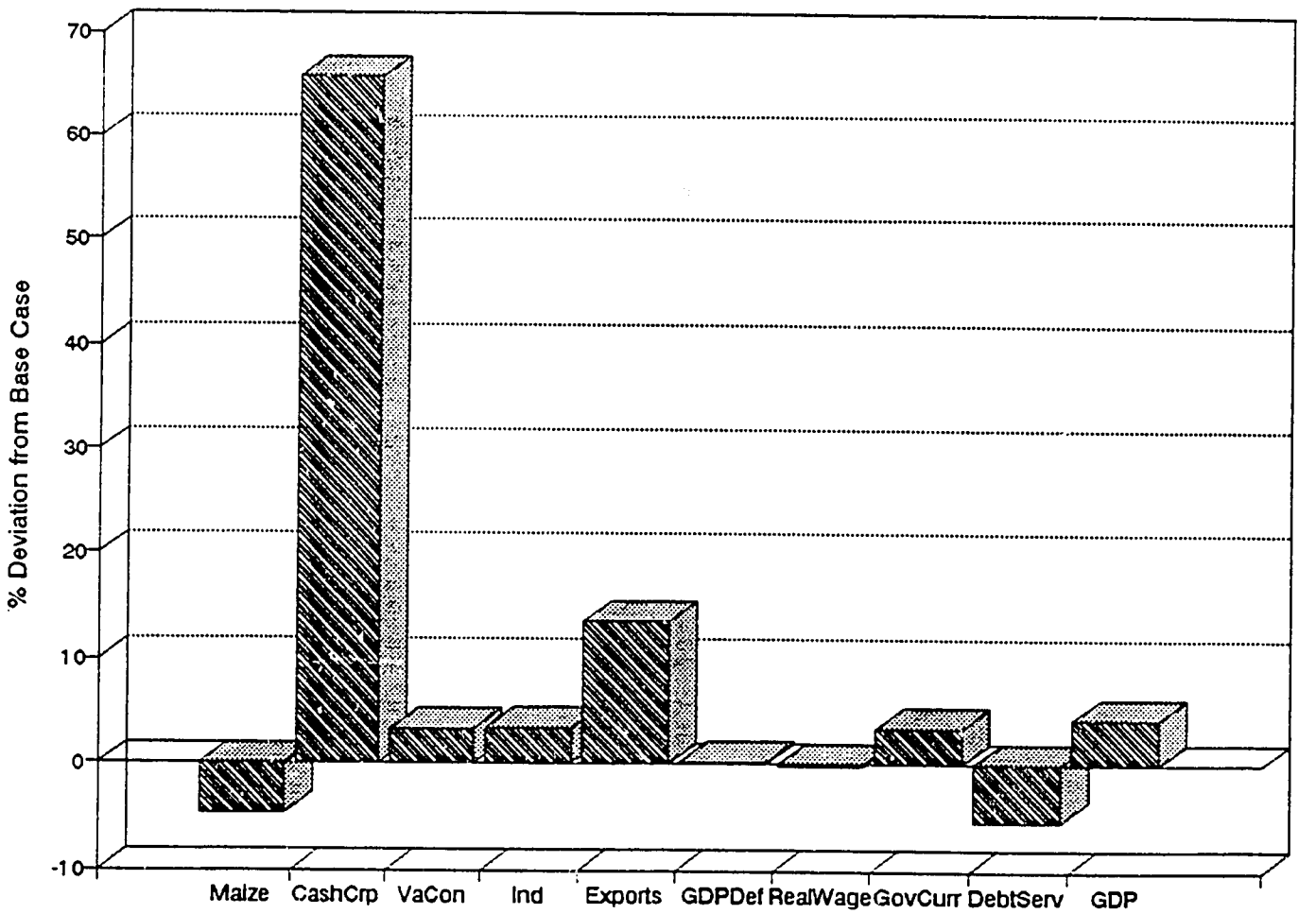
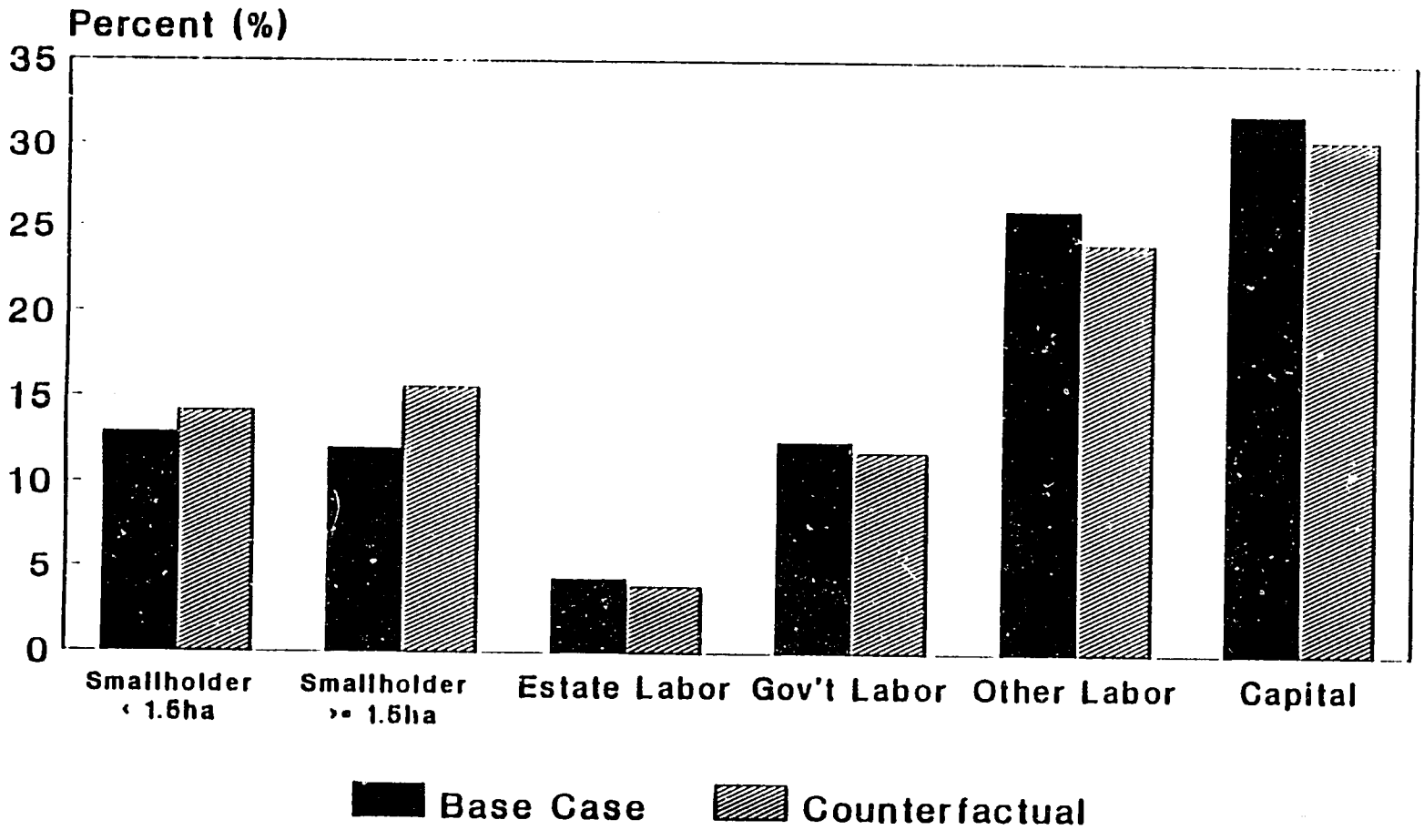


Figure 4 — Functional Distribution of Income of Policy Simulation in Comparison to Base Case



3. CROP CHOICE AND NUTRITIONAL OUTCOMES

THE DATA AND HOUSEHOLD MODEL

The evidence that improving incentives to produce export crops, and consequent shifts in production, will raise household incomes suggests that we turn our attention to analyzing how the nutritional status of preschool-aged children will be affected by higher incomes and a change in the source of income. In the absence of reliable national data on incomes, expenditures, and nutrition with which to estimate the parameters linking incomes and its source to nutritional outcomes, we rely on a regional survey covering 210 households in six clusters in Zomba district in Malawi's southern region in 1986-1987.[9] The population included in the study is poor by any standards, with mean per capita expenditures of MK 9 per month.[10] This represents only $0.16 per person per day. Likewise, using height-for-age as an indicator of long-term nutritional well-being among preschool-aged children,[11] we find that 62 percent of the preschoolers fall 2 standard deviations below the median, the commonly used cutoff point to classify a child as chronically malnourished or stunted.[12] This corresponds closely to the 56 percent of preschoolers observed to be stunted during the previous national survey of smallholders that collected anthropometric data (World Bank 1984). As for the size of the holdings in this sample, 14.2 percent of the households had less than 0.7 hectare, and 65.4 percent less than 1.5 hectares. Comparison with the most recent official government statistics

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[9] For a detailed discussion of the survey, see Peters and Herrera (1989) who were responsible for collecting the data and who kindly allowed us to analyze the data for this paper.

[10] This includes the value of all non-earned income and home consumption. In comparison, the average wage for all workers in Malawi during the survey period was MK 33 per month. Assuming a household size of 6 (the average for our sample), this would translate into a monthly income of MK 5.5 per person for a household with a single, full-time working member, and MK 11 for a household with two working members.

[11] We do not estimate an equation for weight-for-height, or current nutritional status, since the growing evidence is that a combination of health status, as determined by community health services and stochastic events, are the major determinants rather than the general level of household welfare.

[12] The normative standard employed in this analysis is the U.S.-based National Center for Health Statistics' reference population, as recommended by the World Health Organization (1983).

(World Bank 1984) for Liwonde Agricultural Development District (the area in which the survey was performed) indicates that the distribution of landholding size in our sample is slightly skewed toward larger holdings.

As alluded to earlier, our goal is not only to explore the role of income per se, but also the often-made assertion that income earned from producing nonfood export crops, rather than home-consumed food crops, adversely affects nutritional status. To address this concern, we include a cash-cropping indicator in our models of child growth. To amplify, the preschool-age nutritional status models (with the dependent variable measured using the height-for-age standard deviation score, alternatively referred to as a Z-score[13]) are based on the standard model put forth by Becker, in which household utility is derived not only from market goods, but also other home-produced goods, such as child health and nutrition, that are desirable in their own right.

In particular, we estimate a reduced form nutritional status function for children conditional on the households' per capita income and its source. This function takes the following form:

$$Height\text{-}for\text{-}age_i = f(X, TOB, Z, I_i, e_i) \quad (1)$$

where X represents the household's per capita expenditures, TOB the share of tobacco in the household's total agricultural income, Z and I_i represent a vector of observable household and individual i's characteristics, and e_i is an error term.

Both expenditures and tobacco share are choice, or endogenous, variables, undoubtedly functions of many of the same characteristics that simultaneously determine calorie intake and child growth. For example, the factors that induce a household to place a greater value on nutrition may also induce a household to work harder to earn more income. Or, similarly, if the factors that encourage households to devote a larger share of their holdings to tobacco rather than food crops are the same ones that would discourage inputs into child nutrition, it would be incorrect to specify a model with the former on the right-hand side.

Consequently, both per capita expenditures and tobacco share are instrumented using a linear combination of exogenous variables. The expenditure and height-for-age functions were estimated using consistent two-stage least square estimates (2SLS), with assets used to identify per capita expenditures.

The tobacco share was also instrumented, and the predicted value used as an exogenous variable in the 2SLS estimator. However, owing to a number of observations with zero values, a maximum likelihood Tobit was employed to address the fact that the variable in question is drawn from a truncated normal

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[13] The standard deviation score, also referred to as a Z-score, is simply: $Z_i = (W_i - M_j) / S_j$ where W_i is the individual i's height-for-weight, M_j is the median value of the reference population j, and S_j is the standard deviation of the reference population j.

distribution.[14] Among the identifying instruments employed in the Tobit is a "cluster" variable that captures the effects of local farming patterns as well as unobserved community characteristics and regional features on the choice of crops cultivated. The cluster variable is calculated as the share of tobacco in total production averaged over all households within the cluster, TOB_C, exclusive of the household j for which TOB_C enters the instrumenting equation.[15] The results of the estimation indicate that land,[16] household size, and the cluster-specific characteristics variable are all positively associated with the household tobacco share, and all are significant at the 95 percent level or above. The fact that the predicted share of tobacco derived from this Tobit equation is only instrumented but not derived as part of the 2SLS estimation implies an unknown (although generally upward) bias in the standard errors; the parameter estimates themselves, however, are not biased.

CHILD NUTRITION RESULTS

We turn now to the determinants of child nutrition, focusing on the long-term growth of preschoolers between birth and 6 years of age. The results of the child growth functions are presented in Table 4, where the height-for-age Z-score is the dependent variable. Two sets of models are presented. Model I excludes household demographic variables, reflecting the concern that household size and composition are endogenous and may bias the estimation results. Recognizing, however, that household demographic variables may significantly affect nutritional outcomes, we add a vector of these variables to Model II, despite our inability to endogenize them owing to the lack of identifying instruments. At the same time, we add three female-headed household dummy variables to our model: one indicates whether the male spouse is deceased or the couple is divorced (zero otherwise), one whether the male spouse is working outside the village but within

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[14] For further information on Tobit estimation, see Maddala (1983). Details on the results of the Tobit, as well as the instrumental variable used to predict expenditures, are available from the authors.

[15] In other words, the cluster average value of tobacco share, TOB_C, implicitly contains information on prices, quality of infrastructure, and other important cluster characteristics, for which data are not available. It represents an alternative to employing a fixed-effects model as an instrumenting equation, which would be problematic for a variety of reasons, given the Tobit estimation being employed. It is also emphasized that removing household j in cluster c in calculating TOB_C avoids introducing a correlation of errors in the model. The idea for using this approach comes from Alderman and Garcia (1990) who employ cluster average values to estimate a health production function.

[16] A quadratic term for land was tested, but found statistically insignificant, with no impact on the other parameter estimates, and was therefore excluded from the reported model.

Table 4 — Child Growth Function

Dependent Variable: Height-for-Age Z-Score

Independent Variables	Model I		Model II	
	Parameter Estimate	Standard Error	Parameter Estimate	Standard Error
Intercept	-5.248	1.825	-5.492	2.142
ln per capital expenditure[a]	0.584	0.282	0.555	0.355
Tobacco share[a]	4.479	12.126	1.383	11.760
Tobacco share x expenditure[a]	-0.894	2.471	-0.055	2.411
Oldest male's education	0.081	0.181	—	—
Oldest female's education	-0.227	0.148	-0.103	0.136
Oldest male's age	0.407	0.578	—	—
Oldest female's age	-0.382	0.551	0.122	0.296
Zomba	0.063	0.152	0.056	0.155
Catholic	0.446	0.159	0.385	0.144
Fem HH (male in Malawi)	—	—	0.489	0.259
Fem HH (male in South Africa)	—	—	-0.259	0.260
Fem HH (male deceased or divorced)	—	—	0.476	0.283
ln HHSIZE	—	—	0.067	0.265
Percent females > 14 years	—	—	-1.149	1.003
Percent 6-14 years	—	—	0.425	0.785
Percent < 6 years	—	—	0.184	0.861
Age of child in months	-0.013	0.017	-0.011	0.016
(Age of child in months)^2	0.0003	0.0002	0.0003	0.0002
Child's sex (male=1)	-0.414	0.140	-0.408	0.131
R^2	0.162		0.152	
F	4.0		3.1	

[a] Endogenous variables.

Malawi, and the last whether the male spouse is working in South Africa.[17] Finally, household composition variables are included, recognizing that they, like the gender of the household head, are not truly exogenous. Caution is warranted in interpreting the parameter values of Model II, especially the household composition variables, because of the issue of possible endogeneity.

In both models, per capita expenditures show a positive and significant effect on child nutrition of additional income. Of equal importance is that the tobacco parameter and its interaction with income are not significant.[18] This indicates that while higher incomes will improve child nutrition, the fact that the income increment comes from switching land from cultivating maize to cultivating tobacco will not have an adverse nutritional impact.

More specifically, in the previous section we showed that the change in income that would result from eliminating taxation on poor smallholders with less than 1.5 hectares of land was nearly 14 percent. Based on the parameters in Model I, this suggests that such a policy change would raise the Z-score of the average child in the sample by 0.36.[19] Since there is no adverse effect due to the shift in the cropping pattern toward tobacco, it is quite clear that there were substantial nutritional costs of failing to adhere to the principle of parity pricing for export crops during the 1980s.

The age and educational level of parents were found to have no significant impact on child growth. This is not altogether surprising given the extremely limited education of most people in the sample. Children from Catholic households, however, do show increased linear growth over non-Catholic households. Boys, however, do worse than girls. This finding is consistent with an increasing body of evidence from Africa, including results from Kenya (Kennedy and Cogill 1987), Ghana (Alderman 1990), and Côte d'Ivoire (Sahn 1990), as well

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[17] The regressions exclude from the analysis households for which one or more variables are missing. Consequently, the sample size is larger in Model II because it deletes the variables for male education and age, which allows inclusion of female-headed households where there is no male present. This, of course, raises the possibility of introducing a missing variable bias in Model II. It is also noteworthy that in Model I we have also introduced a possible bias in the parameter estimates because of the sample censoring that eliminates female-headed households. Both concerns were shown to be of little relevance by the fact that when we run Model I without male education and age, thereby including female-headed households, the parameter values do not differ from the truncated Model I.

[18] If the interaction term between tobacco share and income is dropped, the tobacco share parameter is still not significant, indicating no problem of multicollinearity.

[19] This is at the mean height-for-age Z-score of 2.46. For those who are worse nourished, the benefits of the incremental income would be greater, and vice versa for children with higher Z-scores.

as recent results from urban Malawi (Shively and Chilowa 1989). The variables for child age and age-squared had the expected signs suggesting that older children have lower Z-scores than younger children. This reflects the cumulative effects of undernutrition.

In Model II, children from female-headed households, with the exception of those in which the male works in South Africa, show decreased levels of stunting compared with children from male-headed households. This finding, consistent once again with the work of Kennedy and Cogill (1987) and Greer and Thorbecke (1986) for Kenya, may reflect an increased emphasis on purchasing and providing inputs into child care in those households where women control the decisionmaking process. No effect of household size was observed in the model.

4. CONCLUSIONS

This paper has combined the use of a macroeconometric model and a household nutrition model to show that the Government of Malawi's policy of taxing smallholder export crops had adverse consequences on household incomes and preschool-aged child nutrition among poor smallholders. Counterfactual simulations suggest that if Malawi had adhered to the principles of export parity pricing, smallholders would have shifted their land use away from maize toward export crops, particularly tobacco. This would have given rise to a substantial increase in the output of tobacco and a small decrease in maize production. The effects of such a policy change would have filtered through the economy, to raise overall GDP and redistribute the value added toward smallholders and away from other functional income groups.

It is of equal importance is that these higher incomes were shown to have substantial benefits in terms of improving child nutrition. At the same time, the concern that there may be deleterious consequences for nutrition of a higher share of income coming from the sale of export crops instead of from subsistence maize production was shown to be unwarranted. This is important because it reinforces the central message: government policymakers must focus on eliminating distortions in markets to raise the extremely low incomes and reduce the high level of malnutrition in Malawi. The policy of taxing smallholders, which remains despite a decade of structural adjustment, needs to be quickly addressed both to increase growth and to improve nutrition.

Table A.1 — A Prototype Econometric Model for Malawi

Production Block

(1)	maize production (ton)	= f1 (rainfall, time, [maize price / fertilizer price], [maize price / cash crops price])
(2)	maize availability per capita (kg)	= (production - exports + imports) / population
(3)	cash crop production smallholder (constant prices)	= f3 (time, [cash crops price / minimum wage rate], [cash crops price / maize price], [cash crops price / fertilizer price])
(4)	estate crop production (constant prices)	= f4 (rainfall, time, [price estate crops / price fertilizer], [price estate crops / wage rate])
(5)	value-added construction sector (constant prices)	= f5 (gross fixed capital formation government, gross fixed capital formation private sector)
(6)	index industrial production	= f6 (constant prices imports of intermediate goods, capital stock GOV-GFCF, capital stock equipment, time, [import deflator / wage rate])
(7)	GDP factor cost (constant prices)	= f7 (index industrial production, VA construction, constant prices GOV expenditure on wages + goods + grants, maize production, cash crops production, estate crop production)
(8)	GDP factor cost (-subsistence sector) (constant prices)	= GDPfc - f8 (maize production, cash crops production)
(9)	GDP factor cost (-subsistence sector) (current prices)	= GDPfc (constant prices) * GDPdef

Balance-of-Payment Block

(10)	exports80(FOB) (constant prices)	= f10.1 (cash crop production smallholders, estate crop production) + f10.2 (wage rate shipment factor) / (exchange rate * $price index of competitors, time)
(11)	exports(FOB) (current prices)	= exports (FOB) * export deflator
(12)	exports non-factor services	= f12 (time, GDPdef / [$price index of competitors * exchange rate], number of visitors)
(13)	export revenue: net private transfers	= f13 (time, number of refugees)
(14)	export revenue: factor receipts (K)	= exports factor receipts (USD) * exchange rate
(15)	GOV: interest payments (foreign debt)	= implicit interest rate * stock external debt (GOV,t-1)
(16)	other factor payments	= implicit interest and dividends rate * stock other external liabilities (non-GOV,t-1)
(17)	total factor payments	= GOV interest payments on foreign debt + other factor payments

Table A.1 (continued)

(18) official transfers	=	official transfers (USD) * exchange rate
(19) foreign exchange availability (excl. external borrowing)	=	exports of goods + exports non-factor services + export revenue net private transfers + export revenue factor receipts + official transfers - total factor payments
(20) imports(goods+non-factor services) (current prices)	=	f20 ([foreign exchange availability + government external borrowing - government foreign debt repayment], creditworthiness)
(21) current account (+ surplus, - deficit)	=	foreign exchange availability - Imports (goods + non-factor services)
(22) imports goods (CIF)	=	f22 (imports goods + non-factor services)
(23) external debt(t)	=	(external debt(t-1) / exchange rate[t-1]) * exchange rate(t) - current account(t)
(24) non-government external liabilities (Kwacha)	=	external debt - GOV stock external debt
(25) creditworthiness	=	external debt / exports of goods
(26) imports capital goods / imports(CIF) (current prices)	=	f26 (advances to government / advances to private sector)
(27) imports capital goods (constant prices)	=	imports capital goods(curr pr) / ($price index competitors * shipment factor * exchange rate)
(28) imports intermedt goods / imports(CIF) (current prices) exclud. fertilizer, petroleum products, construction prod.	=	exogenous
(29) imports intermediate goods (constant prices)	=	imports intermediate goods (current prices) / import price index
(30) imports fertilizer (smallholders) (ton)	=	imports(CIF) * share total fertilizer imports in imports(CIF) * share smallholder fertilizer in total fertilizer imports / import price fertilizer
(31) imports fertilizer (estates), (ton)	=	total fertilizer imports - imports fertilizer(smallholders)
(32) debt service ratio	=	(GOV interest payments foreign debt + GOV debt repayment + [Implicit interest rate non-GOV debt + implicit principal repayment rate non-GOV debt] * non-GOV debt) / (exports goods + exports non-factor services + exports factor services)

Government Finance Block

(33) GOV: import taxation revenue	=	implicit import tax rate * imports(CIF)
(34) GOV: other indirect tax revenue	=	implicit tax rate(ind) * GDPfc - subsistence sector

Table A.1 (continued)

(35) GOV: other domestic revenue	=	implicit tax rate(oth) * GDPfc - subsistence sector
(36) GOV: interest payments, domestic debt	=	implicit interest rate * stock domestic debt(t-1)
(37) GOV: total interest payments	=	GOV interest payments on foreign debt + GOV interest payments on domestic debt
(38) GOV: foreign debt repayment	=	implicit repayment rate * stock external GOV debt(t-1)
(39) GOV: expenditure excl. debt service	=	import taxation revenue + other indirect tax revenue + other domestic revenue + official transfers + net domestic borrowing + foreign (current prices)borrowing - loans to sectors - total interest payments - foreign debt repayment - change in cash position & other financing
(40) GOV: expenditure, wages+goods+grants (current prices)	=	GOV expenditure * distribution parameter
(41) GOV: expenditure, wages+goods+grants (constant prices)	=	GOV expenditure(w+g+g) / deflator(w+g+g)
(42) GOV: expenditure, gross fixed cap form (current prices)	=	GOV expenditure * (1 - distribution parameter)
(43) GOV: expenditure, GFCF (constant prices)	=	GFCF(curr. pr.) / deflatorGFCF
(44) Capital stock of GOV-GFCF	=	capital stock GOV-GFCF(t-1) + GOV-GFCF(t)
(45) GOV: stock domestic debt(t)	=	stock domestic GOV-debt(t-1) + net domestic borrowing(t)
(46) GOV: stock foreign debt(t) (in USD)	=	stock of foreign debt(t-1) + foreign borrowing(t) - foreign debt repayment(t)
(47) GOV: stock foreign debt(t) (in Kwacha)	=	stock foreign debt(t) in USD * exchange rate

Prices Block

(48) retail price index	=	f48 (import deflator, import tax rate, money supply proxy, ADMARC-price index, per capita maize availability, other indirect taxes rate)
(49) GDP-deflator	=	f49 (import deflator, import tax rate, ADMARC price index, per capita maize availability, nominal minimum wage rate, other indirect taxes rate)
(50) real wage rate private sector	=	f50 (population, terms of trade, real minimum wage rate, productivity index private sector, nominal exchange rate)
(51) deflator GFCF	=	f51 (GDPdef, wage rate private sector, import deflator)

Table A.1 (continued)

(52) deflator GOV-expenditure (w+g+g)	=	f52 (GDPdef)
(53) free market exchange rate K/USD	=	f53 (GDPdef, $price of competitors, creditworthiness)

Monetary Sector

(54) advances from commercial banks	=	f54 (foreign exchange availability, real interest rate on savings deposits)
(55) advances to GOV+parastatals by RBM and commercial banks	=	exogenous
(56) advances to GOV+parastatals by commercials banks	=	advances to GOV + parastatals by Reserve Bank of Malawi and commercial banks
(57) advances to private sector by commercial banks	=	advances from commercial banks - advances to GOV+parastatals from commercial banks

Miscellaneous Equations

(58) gross fixed capital formation by private sector (constant prices)	=	f58 (imports capital goods, real price of GFCF * (1 + lending interest rate)
(59) capital stock equipment(t) (constant prices)	=	0.9 * capital stock equipm(t-1) + imports capital goods(t)
(60) productivity index private sector	=	index industrial production / employment

Figure A.1 -- Smallholder Maize Production, Dynamic Simulation, 1980-1989

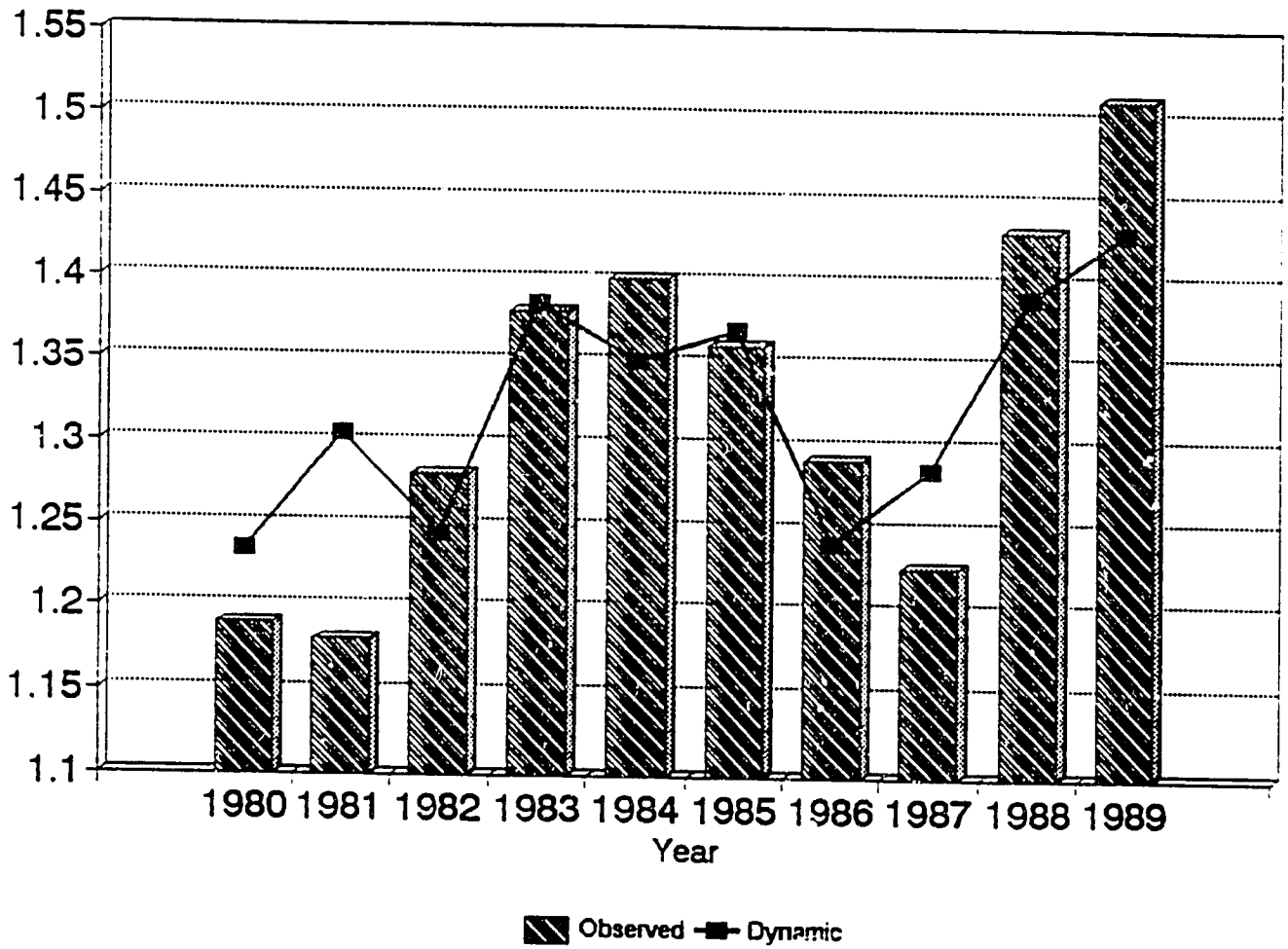


Figure A.2 — Smallholder Cash-Crop Production, Dynamic Simulation, 1980-1989

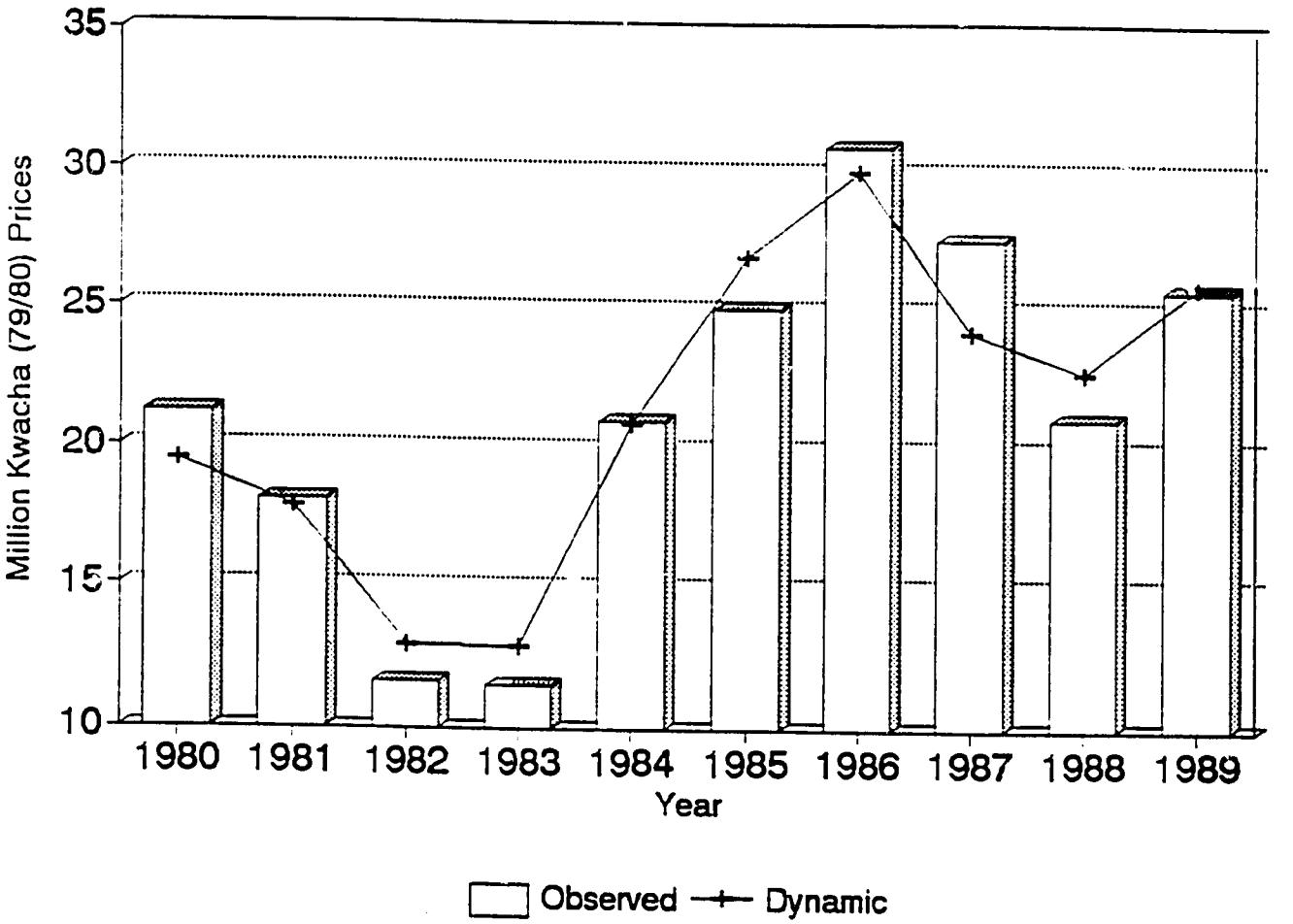
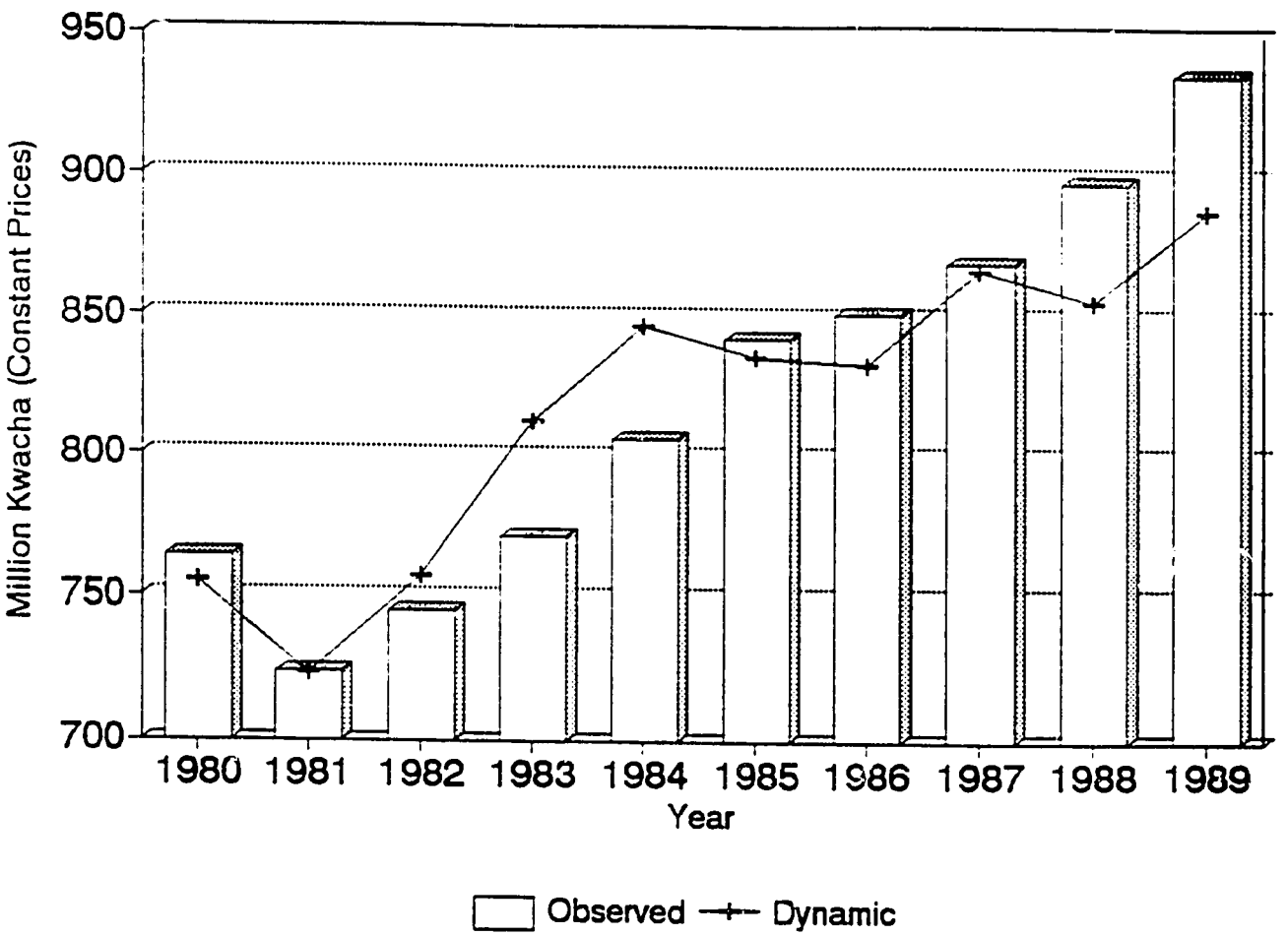


Figure A.3 — Real GDP at Factor Cost, Dynamic Simulation, 1980-1989



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