The Transition to a Market-Based Agricultural Economy in Malawi: A Multi-Market Analysis

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1. INTRODUCTION

Malawi is one of the world's poorest countries. Furthermore, the distribution of income and wealth are highly skewed, with a majority of the population living in a state of absolute poverty. Public policy measures to address this situation have long been a focus of government and donors alike. Extremely low average incomes indicate that purely redistributive measures are obviously inadequate, and that sustainable economic growth is a prerequisite to improving living standards in Malawi. The distribution of the benefits of economic growth is also important for the alleviation of poverty. In addition, effective policies for growth and poverty reduction will have to address the inherent volatility of the Malawian economy, due to highly variable weather and fluctuations in prices for major exports.

The many agricultural commodities produced in Malawi compete for the same set of limited resources: land, labor, marketing infrastructure, and foreign exchange for imported inputs. Furthermore, demands for domestically-consumed commodities are jointly constrained by extremely limited household budgets. This suggests that changes in the production, consumption, and marketing of any one commodity will have direct effects on other commodities and that these cross-commodity effects and production-consumption linkages should be explicitly integrated in any analysis of these policies. However, this type of analysis has been absent from most policy discussions, and even when these aspects are taken into consideration there is little empirically-based quantitative evidence available (e.g., price elasticities) to help inform policy decisions.

The interactions are complex, especially because most households both produce and consume many commodities. If recent reforms give smallholder farmers more opportunities to grow high value export crops, or lead to higher producer prices for these crops, how will these households change their production patterns as they try to raise household incomes without exposing themselves to too much risk? How much will consumer price changes affect real incomes, what demand shifts will take place in response to changing real incomes and consumer prices, and how might this alter subsequent production decisions? How will the gains and losses from all of these changes be distributed? These are only some of the important questions related to a more liberalized economy in Malawi, and a multi-market model is an ideal tool for investigating these questions.

In this study, we extend Cornell's earlier work on the analysis of agricultural policy issues and poverty in Malawi by developing a multi-market model to analyze the effects of policy changes on commodity markets and on real incomes and consumption of poor households. Several key policy issues related to agricultural pricing, liberalization, and trade are analyzed, with a focus on the distributional impact of policy change. By modeling several commodities together in a consistent fashion, the multi-market framework allows policy analysts to take into account the important cross-commodity effects in Malawi's agriculture — effects arising through choices made by both producers and consumers in the economy.

This paper is organized as follows. The next section provides a brief review of policies enacted to increase the market-orientation of Malawi's agricultural economy, which has been an on-going process for over a decade. The details of the Malawi multi-market model are presented in section three. Section four discusses the results of several simulations conducted using the multi-market model, followed by a discussion of the lessons to be learned from this analysis in section five. Appendices provide further details on the structure of the multi-market model.

2. BACKGROUND TO AGRICULTURAL MARKET LIBERALIZATION IN MALAWI

Generating sustained economic growth requires increases in productivity, which in turn requires significant investments in human and physical capital, and accelerated technological change. As labor power is the most important asset controlled by the poor, equity considerations suggest that increases in labor productivity are paramount. This may occur through increases in the value of the output produced by a unit of labor input, or through technological progress that increases the marginal physical product of a unit of labor input. Recent moves to expand smallholder opportunities for high value (export) crop production, and to promote the use of high yielding maize varieties, are good examples of public policies to improve labor productivity. It has also been recognized that inefficient markets, especially those dominated by state enterprises, have impeded development and economic growth by severely limiting the gains from specialization and trade. For this reason several steps have been taken to liberalize markets in Malawi in recent years, and to promote the development of competitive markets.

For a long time, a major component of government's agricultural policy has been to promote increased production of the primary staple food in Malawi, maize. This has largely been through programs intended to increase the use of high-yielding varieties (HYV) of maize and to increase the use of fertilizers, through increasing both the prevalence and the intensity of fertilizer application. In addition, programs have existed to increase the efficiency of fertilizer use, reduce the level of post-harvest maize storage losses, and maintain soil quality.

The results have been mixed. For a time great strides were made in increasing the usage of HYV maize and fertilizer, although the positive impact on yields and production was considerably less than expected (World Bank 1995). Much of this gain was reversed when the credit system for smallholder farmers collapsed in 1994; efforts since then have still not returned HYV and fertilizer use to the levels that existed before the collapse of the Smallholder Agricultural Credit Administration (SACA). Perhaps most important, the effects of these changes were largely dwarfed by an input that is outside the scope of programs and policies: the weather. It is also important to note that because ADMARC (and to a lesser extent, government and SFFRFM, the Smallholder Farmer Fertilizer Revolving Fund of Malawi) continued to play the dominant role in maize input and output markets, the net impact of all of these changes were not reflected in maize prices. Under a market-based system, prices serve an important function as signals of the economic value of a resource. However, extensive government and parastatal

intervention created considerable price distortion, thus sending erroneous signals to producers, consumers, and traders.

Because of the importance of agriculture in the Malawian economy, the liberalization of markets for agricultural inputs and products has been at the center of Malawi's economic reforms, particularly since 1987. Government has committed to far-reaching reforms, although actual implementation of many of these reforms has been erratic, and is still in process. The most significant reforms have been the privatization of grain trading, the phased removal of smallholder fertilizer subsidies, and the easing of restrictions on the production and marketing of export crops. This last item includes the removal of the ban on private exports of groundnuts, the liberalization of marketing arrangements for dark-fired and oriental tobacco, and the extension of burley tobacco licenses to farmers on customary land (smallholders). Production and marketing arrangements for burley tobacco are certain to continue to evolve, including the possibility of complete elimination of the burley tobacco quota system.

These major reforms are bound to have a profound impact on Malawi's economy. However, despite the considerable attention given to market liberalization by government and donors, major knowledge gaps remain, particularly with regard to producer and consumer responses to price changes — responses that have an important bearing on the equilibrium prices for these commodities, and therefore real incomes and consumption, and ultimately the welfare effects of policy changes. Policies that increase the market orientation of Malawian agriculture affect agricultural input prices and the producer and consumer prices of agricultural outputs. As producers and consumers respond to these price changes one can expect important changes in the composition of agricultural production and aggregate supply. Because agriculture accounts for 35 percent of national income and approximately 90 percent of export earnings, agricultural policies have major effects on the macroeconomy, in terms of export earnings and the government deficit, through taxes on agricultural products, as well as through costs of supporting the development functions of statutory corporations, such as ADMARC's (Agricultural Development and Marketing Corporation) mandate to protect minimum producer and maximum consumer prices. Because agricultural products represent large shares of household incomes and expenditures, especially for poor rural households, agricultural policy choices by the government can have major effects on poverty (Sahn, Dorosh, and Younger 1994; MoALD 1994).

3. THE MALAWI MULTI-MARKET MODEL

Like any model, formal or informal, the multi-market model for Malawi is intended to capture the most important effects of policy changes or external shocks on the Malawian economy, and the resultant impact on individuals and households. In constructing the model certain simplifications and categorizations must be made in order to keep the model tractable. More important, these simplifications are necessary to facilitate interpretation of the model structure, and the results generated from application of the model. This section describes the main components of the Malawi multi-market model, namely: the definition of household groups, the consumption or demand side of the model, the production or supply side of the

model, the base levels of economic variables, and the methods of price determination used in the model.

While multi-market models are complex enough to address the important cross-commodity issues that characterize the production and consumption of agricultural products in Malawi, they require less data than computable general equilibrium (CGE) models. More important, multi-market models have proven to be extremely useful tools for policy analysis because they are generally accessible to non-specialist users such as policymakers (Braverman and Hammer 1988). One of the earliest multi-market models developed was used to analyze questions of agricultural policy in Malawi (Singh, Squire, and Kirchner 1985; GOM 1984). These early models suffered from a paucity of data and over-reliance on complex calibration methods that severely limited the pool of potential users of these policy tools and their results. Rather than modeling production functions with land, labor, and capital inputs, simpler approaches using supply elasticities can be used to model changes in production in terms of changes in prices of inputs and outputs. Combined with user-friendly software, these simplifications have made multi-market models useful tools for policy analysis in other African countries such as Mozambique (Dorosh, del Ninno, and Sahn 1994) and Guinea (Arulpragasam Sahn, 1997). Analysis using the multi-market model can help quantify the gains from liberalization policies, as well as highlight potential problem areas, especially as new market patterns emerge and new markets evolve.

3.1 Household groupings

The Malawi multi-market model specifies five household groupings: food-deficit farming households, food-surplus farming households, rural households primarily dependent upon wage income, low income urban households, and high income urban households. It is recognized that in Malawi no household depends solely upon smallholder farming, as members of households typically engage in some form of non-farm activity as well (Simler, 1994a). Likewise, urban households typically have ties to the rural economy and farming. Nevertheless, this categorization captures the most important differences.

In the multi-market model, food surplus/deficit status is used to disaggregate rural households because it is a characteristic that is both convenient and important. Many of the market-oriented reforms enacted in Malawi in recent years have aimed to expand the range of options available to households, and thereby raise their incomes. To take advantage of these new opportunities, they must provide greater returns to the household than their present activities, and returns to food production is one of the important differences between food deficit and food surplus households. This is simply because the value of an extra unit of food production to the food surplus household is the producer price of that food, whereas the value to the food deficit household is the consumer price of that food.[1] In recent years it has not been unusual for the

[1] This glosses over some potentially important issues regarding the timing of food sales and purchases. A household might produce enough food to meet consumption needs for an entire year, but still sell some food at harvest time and purchase food later in the year. Nevertheless, the distinction drawn between

difference between consumer and producer prices of maize to be as much as 40 percent, and even greater at times (Simler, 1994b). Furthermore, there is considerable risk of crop failure in Malawi, as evidenced by recent drought years. Although it is not necessary for a household to produce all the food it needs to be food secure, sufficiency of own food production is an important risk mitigator that helps enable poor households to diversify into non-food crop production (Jayne, 1994).

The percentage of farming households in Malawi that do not produce enough food for their own consumption requirements varies considerably from year to year. However, estimates for an average year are typically around 65 to 70 percent of all farming households (MoALD, 1994). In the present analysis it is assumed that 67 percent of Malawian farming households are food deficit households, with the balance of farming households considered food surplus households. When all households are considered in the model, food deficit farming households represent 52 percent of all households, and food-surplus farming households represent 26 percent of all households.

Note that we have not adopted the common categorization of the farming sector into smallholder and estate subsectors. This is quite deliberate, as the process of agricultural market liberalization in Malawi removes most of the institutional characteristics that distinguished smallholders from estates. Although it is true that important differences remain with respect to land tenure and availability of commercial credit, the removal of restrictions on crops that smallholders can grow, and the unification of marketing channels and pricing for smallholders and estates makes this distinction much less important than the food deficit/food surplus distinction.[2]

As noted earlier, in Malawi, even households whose dominant economic activity is farming tend to be involved in non-farm economic activities as well, including micro-enterprises and wage labor. Likewise, those whose main source of income derives from wage employment or self-employment typically engage in agricultural production to some degree as well. The impact of market liberalization policies, and exogenous events in a liberalized market, will undoubtedly be considerably different for a rural household that derives 90 percent of its income from farming than it will for a rural household that derives only 10 percent of its income from that source. This is because even though the effects on consumption behavior might be quite similar, the effect on agricultural production decisions, and outcomes, will be much greater for the former household than for the latter. Although in reality the composition of income from farm and non-farm sources is a continuum, it is useful for the purposes of the present model to

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gross surplus and gross deficit households remains the more important characteristic.

[2] For ease of reference this report will sometimes refer to food-deficit farming households as small farmers and food-surplus households as large farmers. However, this should be regarded only as a form of shorthand, and is not intended to reflect the size of landholding, the tenure status of the farmer, or anything except the food surplus/deficit status of the household in a "normal" year.

consider them as polar cases, that is, households who depend upon farming as the main source of income (sub-divided into food-deficit and food-surplus households, as described above) and rural households whose main income source is something other than farming for themselves. Based upon analysis of the most recent census data, this group is assumed to represent ten percent of the rural population and nine percent of the national population in the multi-market model.

Urban households are a small but growing proportion of the population in Malawi. Like the rural households who depend primarily upon sources of income other than agricultural production, for urban households the main effects of agricultural market liberalization policies and exogenous shocks tend to work through consumption linkages with the agricultural economy. Because consumption patterns vary with income, two categories of urban household are defined in the multi-market model: low income and high income. In the absence of detailed data on income levels in urban areas of Malawi, the two groups were identified on a somewhat arbitrary basis, with 50 percent of urban households assigned to the low income group and the other half to the high income group, each group representing 6.5 percent of all households in Malawi.

3.2 Demand parameters

The core of the demand side of the multi-market model is a matrix of own- and cross-price elasticities for a number of food and non-food commodity groups, and a vector of income elasticities of demand for these same commodity groups; one set of these demand parameters is defined for each of the five household groups defined in the multi-market model. These parameters measure how consumers change their consumption patterns when there is a change in the price of any commodity, a change in income (or total consumption expenditure), or both. They also make it possible to decompose any observed change in consumption patterns into a commodity substitution component and an income change component.

In empirical studies, total expenditure is often used instead of income, for several reasons. Expenditure is typically less volatile than income, and it is widely observed that households smooth their expenditures, especially consumption expenditures, over time to dampen this volatility. This is true even in situations where opportunities for consumption smoothing are limited, as in Malawi, especially for the poor. Expenditure is also widely believed to be more representative of permanent income than is income, and it is believed that households plan their expenditures with permanent income, rather than current income, in mind. Finally, expenditure data is usually easier to collect, and is also usually more reliable. The present study followed this convention of using total expenditure rather than income, both because of the aforementioned advantages of using expenditure data, but also because satisfactory data on incomes was not available.

A handful of studies in Malawi over the past 10 years have reported estimates of income elasticities of demand for various commodity groups (see, for example, Peters and Herrera, 1987 and Simler, 1994c). Despite differences in timing, location, and methods of the respective surveys and analytical techniques, the findings have been relatively consistent. This is easy to explain, as households in Malawi have stable demand patterns; although they may shift their

consumption bundle in response to changes in available income, these changes are intuitive and predictable. Furthermore, income levels have not changed radically over the past 10-20 years at least, indicating that the changes in income elasticities that accompany changes in income levels has been a gradual movement.

Estimates of price elasticities of demand in Malawi are much more scarce. In fact, a thorough search could not find any demand price elasticity estimates other than those Singh et al. (1984) used in their multi-market model. The absence of such estimates is a puzzle, as surveys that have collected the requisite consumption and price data have certainly been conducted over the past ten years. Thus, one contribution of the present analysis is the presentation of own- and cross-price elasticity estimates for a range of consumption commodity groups. As there are no other estimates with which to compare the estimates presented here, the estimates should be treated with caution. This is done in the multi-market analysis by extensive sensitivity analysis.

The data used to generate the demand elasticity estimates are from MoALD's Food Security and Nutrition Monitoring (FSNM) survey conducted in November 1991. The FSNM survey was a nationwide survey, although urban areas and agricultural estates do appear to be somewhat under-represented. The November 1991 round of the survey yielded useful expenditure and consumption information for 3,732 households. The FSNM survey recorded the amount spent by the household on each of 27 food and non-food commodities over the 30 days preceding the survey. For cases in which an item was acquired by means other than purchase (e.g., payment in kind, own-production, barter, etc.) the survey recorded the respondent's estimate of the value of the commodities consumed that were obtained from these sources. Although data on the quantities consumed were ostensibly collected as well, these values do not appear in the available data files. Price information was collected in the FSNM survey of November 1991 via interviewer visits to local markets, where they negotiated the purchase of an item and recorded the price and quantity. Price data were collected for each of 35 commodities in each of 234 Enumeration Areas (EA).

As is typical with such surveys, the FSNM required some aggregation to generate useful estimates of demand parameters. The 27 commodities included in the expenditure survey were combined to form 10 commodity groups: maize (including grain and flour), other grains, root crops, vegetables and fruits, milk and eggs, meat, clothing, tobacco and beverages, fuel and lighting, and other commodities. The exact aggregation used is shown in Table 1, with the aggregated commodity groups in the left column and the commodity groups listed in the November 1991 FSNM survey shown in the right column of the table. A number of the commodity groups, such as fruits and vegetables, are not of direct interest themselves, but are included to reflect as accurately as possible the full range of consumption choices that the household makes. Similarly, price data were aggregated from the EA level to the Rural Development Project (RDP) level, and price data were grouped to correspond to the commodity grouping used for the expenditure data, using a price index constructed from the weighted averages of the price observed for individual commodities within each commodity group.

The demand parameters were estimated using a linear approximation of the Almost Ideal Demand System (LA/AIDS) model suggested by Blanciforti and Green (1983) as a variant of Deaton and Muellbauer's (1980) Almost Ideal Demand System (AIDS). The LA/AIDS model employs Stone's (1953) geometric price index instead of the standard AIDS model price index. As demonstrated by Green and Alston (1990), if prices are highly collinear, then the LA/AIDS model can be used to estimate the parameters of the AIDS model because the factor of proportionality between the Stone index and the AIDS price index is incorporated in the intercept term.

As there are many observations with zero expenditures for one or more of the commodity groups, resulting in a censored distribution of the dependent variable, the model was first estimated as a two step procedure, following Heien and Wessells, 1990. First, probit models were estimated for the binary dependent variable representing whether any of the commodity group was consumed at all during the recall period. This procedure estimates the probability that a household would consume something from that commodity group during the one month recall period. The explanatory variables for the probit equations included the prices of all commodities, household size and composition, educational level of the household head, gender of the household head, distance to the nearest market, staple food (maize, cassava, or other), and whether or not the household's primary economic activity is smallholder farming. The estimated coefficients from the probit analysis are then used to construct the inverse Mills ratio, which is used as an instrument that accounts for the censoring latent variables in the second stage of the estimation procedure. The second stage is an ordinary least squares (OLS) regression of the usual LA/AIDS equations, namely the budget share of the commodity group on a set of explanatory variables. In the OLS regressions the right-hand side variables included the natural logarithms of price indices for each of the commodity groups, real per capita total household expenditure (also in logarithmic form), the number of persons in the household, and the inverse Mills ratio.

We estimated the demand system with and without the correction for a censored dependent variable and found that more stable and credible estimates were obtained when the Mills ratio was not included as an explanatory variable, so that is the set of elasticities we chose to use in the multi-market model. Ideally, we would estimate the demand elasticities separately for each of the five household groups, as demand patterns are likely to differ with income level and location (rural or urban). However, suitable urban-specific data are not available, so the FSNM data was used for all households. We used two approaches to developing distinct elasticity matrices for high and low income households. The first was to estimate the demand system separately for each group. The second was to estimate a single demand system for all households, and then use the product of the common set of regression coefficients with household group-specific variable means to produce household group-specific elasticity estimates. As is often the case, the first approach proved unsatisfactory, largely because dividing the survey sample by the level of total expenditure eliminates a great deal of the variability in expenditure levels that is needed to produce stable and credible coefficient estimates. We therefore chose the second approach, using the 67th percentile as the dividing line between low and high income groups, i.e., the means for the poorest two-thirds of the sample were used

alongside the estimated coefficients to produce a low income demand elasticity matrix, and the means for the richest one-third were used to produce the elasticities for the high income groups. In the multi-market model the high income elasticity estimates are associated with the large farmer and high income urban household categories, with the low income elasticity estimates applied to the other three household groups. The estimated own- and cross-price elasticities, as well as the expenditure (income) elasticities of demand, are presented in Table 2 and Table 3.

3.3 Supply parameters

Although it is often remarked that Malawian farmers are responsive to input and output price signals (see, for example, Lele (1989), World Bank (1989)), there is extremely limited empirical information about agricultural supply response in Malawi, particularly price elasticities. Although there exists regular data series on the area planted to different crops and the estimated production volume for each crop, these data are rarely collected or combined in a manner that permits estimation of a farmer's change in area planted, input use, or quantity harvested in response to changes in output or input prices.

The most notable exceptions to this pattern are two studies by Duncan Chembezi (1990, 1991). In one (Chembezi 1990) he draws upon aggregate annual data from the period 1966 to 1988 to generate estimates of own-price elasticities for fertilizer, maize, and tobacco in the smallholder farming sub-sector of Malawi. In the other study (Chembezi 1991) he employs a simple econometric risk model to estimate short- and long-run supply elasticities (measured as planted area) for maize and tobacco; separate estimates are provided for estate and smallholder subsectors.

An additional source of information for supply elasticities in Malawian agriculture is the elasticities derived from linear programming (LP) models of smallholder households in Malawi (Simler 1994b), which can be used to estimate supply elasticities for maize, tobacco, and groundnuts. The set of LP models explicitly takes into consideration the differing resource bases of smallholder households in Malawi, including landholding size, land productivity and suitability with respect to different crops, household size and composition, and cash and credit resources for purchase of inputs and consumption requirements. The models include a number of major and minor crops, allow for variable levels of input use, account for household food security and risk concerns, and incorporate the hiring of outside labor or working off-farm among the options available to the smallholder households. Because the LP models do not rely entirely upon historical data they are particularly useful for modeling situations such as the expanded range of opportunities open to smallholder farmers in Malawi, as well as ex ante analysis of alternative agricultural policies, and have been shown to have good predictive capability, even within the changing policy environment of Malawi in the 1990s (World Bank 1995).

We developed the supply side of the multi-market model by synthesizing the information from Chembezi's studies, Simler's LP models, results from other countries (Rao 1989), and standard results and restrictions from economic theory, such as symmetry and homogeneity of degree zero in prices. We did this separately for the small and large farmer household groups because of considerable evidence that the elasticities vary with the scale of the operation. In

general, elasticities are greater for larger farmers, reflecting the relative ease with which they can alter their farming operations in response to changes in market conditions. The base set of supply elasticities for the multi-market model for each of the groups are shown in Table 4 and Table 5.

As shown in the tables, the commodities included are maize, burley tobacco, other tobaccos, groundnuts, grains other than maize, root crops, fruits and vegetables, milk and eggs, meat, and pulses. As with the consumption side of the model, the production side of the model includes minor crops because they are part of the farmer's decision set, and thus lend additional realism to the model. Likewise, rural farming households in Malawi also typically produce non-crop agricultural commodities such as meat, milk, and eggs, so their presence adds realism. Furthermore, we wanted to include these commodities in the production side of the model because they are non-tradables, as discussed in more detail below; allowing for changes in domestic consumption of the commodities implies that we need to allow for changes in domestic production as well. No hard data were available on the magnitude of the supply elasticities for these commodities in Malawi, so we chose plausible estimates and tested a range of alternative values in the model simulations. This sensitivity analysis confirmed that these commodities play a small enough role in the Malawian agricultural economy, and that different elasticity estimates for these commodities do not change outcomes appreciably.

3.4 Base data

The final data requirement for the multi-market model is the base levels of all important variables. That is, the volumes of the different commodities produced and consumed, disaggregated by household groups. These data are presented in appendix [Tables A1 - AX].

3.5 Price formation in the multi-market model

In addition to the aforementioned matrices of supply and demand elasticities and base-level values, one must specify how prices are determined in the multi-market model, i.e., whether they are determined by domestic supply and demand (non-tradables), or by world prices and applicable transaction costs (tradables). In other words, when supply exceeds demand at the current market price for a non-tradable, the domestic price of the commodity falls until supply and demand reach equilibrium; when supply exceeds demand for a tradable commodity, the price is unaffected and the market reaches equilibrium by increasing net exports by the amount of the excess supply (that quantity by which supply exceeds demand at the current prices).

For the present analysis, the set of tradables comprises burley tobacco, other tobaccos, groundnuts, pulses, fuel, clothing, beverages and tobacco, and "other," a residual category. Maize, other grains, roots and tubers, fruits and vegetables, milk and eggs, and meat are considered non-tradables. As maize is an important commodity in Malawi that has at times been a tradable and at times a non-tradable it is worth taking a moment to explain the decision to classify it as non-tradable in the multi-market model. In general, a commodity is a non-tradable if its domestic price is higher than the export parity price (EPP) and lower than the import parity price (IPP). That is, the commodity is not exported because it can be sold for a higher value within the country, and is not imported because local supplies are less costly than imports.

Because maize is a low-value commodity and transaction costs in Malawi, especially transportation to and from international markets, there is usually a wide spread between the EPP and IPP for maize in Malawi. Government policies and exogenous shocks will change the supply of and demand for maize, thus changing the domestic price. It is conceivable that the price changes could be great enough to push the domestic price below the EPP or above the IPP, in which case exporting or importing maize becomes economical. Therefore, when conducting the model simulations the price changes of non-tradables are monitored closely, and if a policy or shock causes the maize price to move outside of the band between EPP and IPP, maize is reclassified as a tradable, with market-clearing accomplished by changes in the volume traded, and the model is re-run. The same principle is applied to other commodities.

4. MODEL SIMULATIONS

The multi-market model is used to simulate the effects of several alternative policies and events on food prices, real household incomes, income distribution, crop production, and a number of other important economic variables. Because the model is based upon consumer and producer responses to changing incomes, prices, and other conditions, this approach is consistent with the increased reliance on market mechanisms in the Malawian economy. A particularly useful aspect of the multi-market model is that it allows close examination of the counter-factual, i.e., what would have been the likely outcome under conditions that are largely the same, yet with some different policies in place? Because the supply and demand sides of the equation are specified explicitly in the multi-market model, it is possible to examine not only the projected outcome from a given set of policies and exogenous conditions, but also to trace the path that leads to that outcome.

The simulations considered in this paper include:

- maize yield increase of 20% (two simulations showing both short run and medium term effects),
- increased market efficiency (maize marketing margin reduced by 50%),
- changes in world tobacco prices (increases and decreases of 20%), and
- changes in world groundnut prices (increases and decreases of 20%).

Increase in Maize Yields

The first two simulations illustrate the effects of a 20 percent increase in maize yields, separated into short run and medium run outcomes (Table 6). In Simulation 1, production of maize is exogenously increased by 20 percent, while production of other crops is held fixed, thus modeling a situation in which there is no change in farmers' price expectations. Simulation 2 models the effects of both a productivity gain of 20 percent, and expected lower maize producer prices, which occurs as the supply of demand increases faster than the demand for maize. Iif the yield increases are not transitory, Simulations 1 and 2 provide a basis for comparison between a model such as this one that allows for endogenous determination of prices based on consumer and producer behavior (Simulation 2), and commonly-encountered naive models that take no account of these responses (Simulation 1).

Because of the short-run nature of Simulation 1, understanding the effects is quite simple. As maize is a usually a non-traded good in Malawi, the 20 percent increase in production must be absorbed domestically. This implies that the market producer price for maize will fall; as shown in Table 6 it falls by 16.17 percent. It is assumed that the full amount of this decline will be passed through to the consumer price, which is equivalent to assuming that the marketing margin will remain constant in percentage terms. Because maize is a large component of household expenditure, the fall in price translates into an increase in real income of between 5.72 and 10.04 percent. The magnitude of the change in real income varies by household group, as it is positively related to the household's budget share for maize, and negatively related to the volume of maize sold by the household. As this latter effect is zero for Rural Wage Workers and urban households, their real income rises in direct proportion to their maize budget shares, which is larger for the low income households. Similarly, small farmers experience a larger boost in real income than large farmers because on the consumption side their maize budget shares are larger, and because the increase in large farmers' real farm income is dampened by the effect of lower maize prices on revenue from maize sales.

If the increase in maize yields is perceived not as a transitory event, but rather as a permanent situation, households will take account of the new, lower maize price in their consumption decisions, as well as in their production decisions. Lower producer prices for maize will encourage producers to shift production to other crops, as they are now relatively more profitable than before the decline in maize prices. As shown in Simulation 2 in Table 6, over the medium term the initial 20 percent increase in maize production is reduced to a 13.86 percent increase, as resources (land, fertilizer, labor, input finance, etc.) are moved out of maize and into other crops. The shift away from maize is greater for large farmers than it is for small farmers, as shown by the different changes in maize production levels (13.50 percent increase and 14.90 percent increase, respectively). The flip side of this shift is seen in the increase in tobacco and groundnut production; again the increase is larger for larger farmers.

As farmers adjust their production patterns to grow less maize at the lower prices the price of maize rebounds slightly, to a level 11.68 percent below the original price. Changes in real income remain positive for all groups, although less so than was the case in the short run. Again, the urban poor and rural wage workers see the greatest benefit from the increased maize supplies and lower maize prices, followed closely by small farmers, with large farmers and the urban non-poor seeing the smallest gains in real income, but still impressive at more than four percent. Thus, policies that promote a sustainable increase in maize yields can be seen to be beneficial to all household groups. Furthermore, these policies are progressive: low income groups receive greater benefits than high income groups.

Increased maize market efficiency

Malawi's markets, especially markets for relatively low value crops such as maize, have historically exhibited a large difference between the producer and consumer prices for a commodity. In some respects this difference, or price wedge, has not been directly attributable to market conditions, but rather to pricing decisions made by the Ministry of Agriculture and

ADMARC.[3] However, it is also a reflection of the poorly-developed state of markets in Malawi. Weak or non-existent market information systems, a dearth of heavy duty vehicles for transporting maize, the high cost of acquiring and operating vehicles in Malawi, the poor state of many rural roads, and the conscious lack of development of private markets all contribute to high transaction costs and high marketing margins. Furthermore, because markets are still at an early stage of development, over most of the country markets cannot be characterized as competitive, but rather as oligopsonistic (Scarborough, 1994; Brown et al. 1996). This also increases marketing margins.

It has been observed in Malawi and in neighboring countries such as Zimbabwe (Jayne, 1994) that high marketing margins can inhibit farmer diversification into commercial crops, retarding the process of specialization and trade and adversely affecting farm income and total income. Simulation 3, presented in Table 6, illustrates the effects of a 50 percent decline in the maize gross marketing margin. When a new equilibrium is established, the simulation shows a new maize producer price that is 8.53 percent higher than before the improvement in market efficiency, and a maize consumer price that is almost 7 percent lower than the initial consumer price. Maize production and consumption increase by 3.52 percent. As maize is now more profitable to produce, production of other crops is projected to fall, although only very slightly.

Real income increases for all groups except large farmers. For the three non-maize-producing household groups this is directly attributable to the decline in the consumer price of maize, which forms a large share of total household expenditure. Real income gains are larger for small farmers because of the lower consumer price of maize and the increased value of their agricultural production. Maize consumption increases by between 9 and 12 percent for all household groups except for large farmers, who experience a decline in maize consumption, largely due to their lower incomes.

Changes in world tobacco prices

Tobacco is clearly Malawi's largest export earner, and liberalization of the tobacco production environment has been a central component of Malawi's agricultural market liberalization efforts, including removal of the ban on smallholder production of burley and flue-cured tobaccos, and permitting all tobacco producers to sell all types of tobacco directly to market. Prior to the reforms all of the tobacco types that smallholders were allowed to grow -- NDDF, SDDF, sun-air, and oriental -- could only be sold through ADMARC, which paid farmers only a small portion of the world prices for these tobaccos.

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[3] A classic example is the 1987/88 and 1988/89 seasons. ADMARC paid 16.7 tambala for a kilogram of maize harvested in 1988, and resold this maize at a consumer price of 24.0 tambala per kilogram, for a gross marketing margin of 44 percent. Because the 1988 maize harvest was well below normal, officials wanted to increase producer incentives, but also wanted to keep a lid on consumer prices. As a result, in 1989 the (administered) producer and consumer prices for maize were 24.0 and 24.4 tambala per kilogram, respectively, implying a gross marketing margin of less than two percent, which meant that ADMARC was trading maize at a significant loss.

Broadening the opportunities to smallholder farmers is unquestionably a step forward in terms of promoting efficiency and equity in the Malawian economy. However, commodity prices are volatile, and broadening participation in tobacco production also broadens the positive and negative impacts of increases and decreases in world tobacco producer prices. More significantly new tobacco opportunities for smallholders means a larger set of possibilities to consider in their production decisions, and consumption decisions, since their production decisions typically include consumption considerations.

Simulations 4 and 5 consider the effects of a 20 percent increase and a 20 percent decrease in prices paid to Malawian tobacco growers, respectively. The results of these simulations are presented in Table 6; again, these are medium term effects that are shown in the table. In response to the increased tobacco prices, producers increase production of burley tobacco by 6.24 percent and production of other tobacco by 4.13 percent. The increase in burley production is greater for large farmers (6.28 percent) than it is for small farmers (5.02 percent), and the reverse is true for other tobaccos (3.92 percent versus 7.02 percent).

Production of maize, other grains, and roots increase slightly when tobacco prices increase, because higher tobacco earnings raise incomes, thereby raising food demand and food prices. For example, in this simulation the increased maize demand leads to an increse in the maize price of 4.18 percent. As shown in Table 6, both large and small farmers are predicted to have increased incomes as a result of the increase in tobacco producer prices. However, the real income gains for small farmers are extremely small, because the higher price of purchased maize has a direct negative real income effect on the consumption side. On the production side other factors limit small farmers' capacity to switch to more profitable tobacco, including other production constraints, which are reflected in their lower supply elasticities.

The increase in maize and other food commodity prices leads to an unambiguous decline in real incomes for the three household groups who do not have farm income. These drops in income, all in the range of 3 to 3.5 percent, occur because for these households the negative real income effect of higher food prices is not offset by higher farm incomes generated by higher tobacco and other commodity prices. Finally, note that the increase in production and consumption of food crops in this simulation does not extend to groundnuts. This is because for the purposes of the simulations only the role of groundnuts as an export crop was considered. Certainly groundnuts are consumed in Malawi as well, but for the purposes of this analysis we felt that under the recent market liberalizations the production of groundnuts as a non-tobacco export crop was more relevant and interesting, and groundnuts were therefore assumed to be a tradable commodity, whose price is determined by the world market price.

As one might expect, the simulation results for a 20 percent decrease in the tobacco producer price are more or less the mirror image of the results of a similar increase in the price.

However, this simulation highlights the role of groundnuts as an alternative export crop.[4] Groundnut production is projected to increase by 6.2 percent, the resources coming in large part from the 7.2 percent decrease in the production of burley tobacco and the 4.9 percent decrease in the production of other tobaccos. Domestic production and consumption of other food crops is essentially unchanged. Real incomes for large farmers decline by 5.31 percent as a result of the drop in tobacco prices; real farm incomes decline for both small and large farmers.

Initially the decline in tobacco prices would lead to an increase in maize production (a substitute in production), which would reduce the domestic price, causing producers to scale back maize production to a level close to the initial level, so that the ultimate change is a decline in maize production of less than one-half percent. The real incomes of non-farmers increase by 2.9 to 3.6 percent, in part because of the fall in maize prices. The fall in maize prices is also responsible for offsetting the decline in real farm income experienced by small farmers, so that total real income is unchanged for this group.

Changes in world groundnut prices

The effects of 20 percent increases or decreases in the producer price of groundnuts is shown in Simulations 6 and 7 of Table 6, respectively. The results are similar to those for changes in the producer price of tobacco, with the major exceptions that (a) the change in groundnut production associated with a price change is greater than is the case with tobacco, and (b) the magnitude of all other changes (real income, maize prices, production of other crops, etc.) is considerably less than is the case with tobacco. The reasons for this are quite straightforward. First, it is generally easier to switch in and out of groundnut production than it is tobacco production, and this is reflected in the supply elasticities for the two crops. Second, because groundnut production is so small in the base year (as it has been since the late 1980s), even modest increases in groundnut production appear large in percentage terms. Third, because groundnut production is so small, even large percentage changes in groundnut production and price will have only a small impact on other variables such as real income, production of other crops, and prices of other commodities.

To summarize the results of Simulations 6 and 7, a 20 percent increase (decrease) in groundnut producer prices is projected to increase (decrease) groundnut production by 10 to 11 percent, with small and large farmers showing roughly identical responses. Increases (decreases) in groundnut production are accompanied by small or negligible changes in the production of other crops. Production of food crops tends to move in the same direction as groundnut prices and production, because of the link between groundnuts and farm income, and the fact that prices for food crops are determined by domestic supply and demand. Production of tobacco tends to move in the opposite direction of groundnut prices and production, reflecting their role as

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[4] This is not to suggest that production of groundnuts and production of tobacco are mutually exclusive, because they most certainly are not. It is intended to illustrate the changes in production that farmers make in response to changes in commodity prices, and to show the downstream effects on consumption as well.

substitutes in production and the fact that tobacco prices are determined exogenously. Real incomes of small and large farmers are positively related to groundnut price movements, as the effect on farm incomes is stronger than the effect of maize price changes on real income. Real incomes of non-farming households are negatively related to groundnut price movements because maize prices tend to increase with groundnut price increases, reducing real income. It is worth reiterating, however, that with the exception of groundnut production, all of the changes shown are extremely small, typically less than one-quarter of one percent.

5. SUMMARY AND CONCLUSIONS

Thus far, the Malawi multi-market model has been useful for examining the structure of the Malawian economy, particularly household responses to changing prices and incomes in a market environment. In addition to these insights concerning the structure of the Malawian economy, we have also used the model to conduct simulations that provide quantitative estimates of the impact of hypothetical events on the prices, incomes, consumption, and production. What are some of the general lessons that we can draw from this exercise?

One clear lesson from the simulations described earlier is that price fluctuations have a differential impact on different household groups, depending upon their sources of income, their flexibility in production decisions, and their consumption patterns. This should not be surprising. In some cases, all households benefit (such as in the simulations of maize yield increases or maize marketing margin reductions), or all households lose; the only difference from one household group to the next is in the magnitude of the benefit or loss. However, in other circumstances, such as the cases of exogenous changes in the producer prices of tradable commodities like tobacco and groundnuts, some household groups gain while other household groups lose. As noted earlier, this is because the price changes on world markets influence the production decisions of Malawian farmers, which in turn affects the supply and price of crops that are produced and consumed domestically. In general, the prices of these domestic non-tradables will move in the same direction as the price of the tradable commodity, which reinforces the positive or negative effect of the change in world prices on farm incomes for agricultural producers. This effect on farmers is offset to some extent by the effect on them as consumers of domestic crops; whether farmers gain or lose in a particular situation depends upon the relative strengths of the supply response and the demand response. Non-farmers experience only the effect on real incomes from the change in the domestic prices of their consumption bundles.

Among the simulations considered, it is clear that a sustainable increase in maize yields — say, from more extensive adoption of yield-enhancing technologies such as the simulations of maize yield increases or maize marketing margin reductions — has an unambiguously positive impact for all households. Furthermore, in addition to being pro-growth it is also pro-poor, as low income households benefit more than higher income households. In particular, one does not have to adopt the improved technology, or even produce any maize whatsoever, to reap the benefits: in both the short-run and the medium-run simulations it is the urban poor and rural

wage workers who receive the greatest benefit, because of the lower maize price that results from increased production of a non-tradable commodity.

Generally speaking, this kind of all winners and no losers outcome is likely to occur with any policies that result in increased productivity. Just as adoption of improved agricultural technologies enhances the productivity of land, labor, and other farm inputs, leading to benefits for all groups, all groups will also benefit from policies that improve the productivity or efficiency of Malawi's markets. Investments in infrastructure, market information systems, and other measures that reduce transactions costs, foster competition, and narrow the gap between consumer and producer prices will have widespread benefits. The progressivity of these measures will likely vary with the commodity in question. In the case of improving maize marketing efficiency (Simulation 3) the outcome is clearly pro-poor. One would expect that a greater share of the benefits would go to high income households if the commodity in question were one that figured prominently in the budgets of high income households but had a small budget share among poor households.

At times government and donors have been accused of being overly concerned with maize and tobacco, to the exclusion of other crops and the detriment of development in Malawi (UNICEF 1993). Certainly, other crops have important roles for incomes, diets, nutrition, risk mitigation, spreading labor demand, enhancing soil fertility, and many other facets of Malawi's agricultural economy. However, maize is such a dominant crop in both the consumption and production spheres that any serious attempt to spur growth and reduce poverty in Malawi must address maize production and marketing. Simulations conducted with the multi-market model (but not presented in the preceding section of this paper) demonstrate that even major increases in the production of other commodities such as root crops (including sweet potatoes and cassava) or other grains has only a negligible effect on real farm incomes, consumption, or welfare. The same is true for crops that might be grown primarily for export, such as groundnuts, as demonstrated in Simulations 6 and 7: the current share of these crops in production is so small that even major changes in their prices will not have a large impact on economic growth or poverty, at least in the near term. This is not to say that other crops should be ignored. Rather, one should not expect a significant impact on incomes and poverty from policies promoting production of these crops, or changes in the prices of these crops, at least not until they constitute a larger share of household production or consumption.

As mentioned in the introduction, some of the market reforms in Malawi that enhance opportunities for smallhoder farmers, such as the removal of the prohibition on smallholder burley tobacco production, removal of trading restrictions on various export crops, and greater access to world market prices, will affect production of other crops such as maize, too. Prior to market liberalization maize was often the most profitable "commercial" crop available to smallholders. As smallholders are allowed to grow and receive better prices for other crops, it is to be expected that resources will be shifted from maize production to production of these other crops, with a consequent increase in the domestic price of maize, as demonstrated in the multi-market simulations. The real income effects of this are important, particularly as they relate to concerns about equity and poverty reduction, and the multi-market model is a useful analytical

tool for quantifying these relationships. It is worth noting, however, that over fairly large range of changes in the level of domestic maize production, the market price of maize does not exceed the import parity price or fall below the export parity price, implying that maize will continue to be a non-tradable commodity in Malawi. This result holds whether the change in domestic production is due to greater adoption of yield-increasing technologies or because of shifts in the world prices of crops that are substitutes in production, such as tobacco, groundnuts, and pulses. There are exceptions, of course, for maize imports from or exports to neighboring countries, for which transport costs are lower, from time to time. Therefore, unless very pronounced shifts in maize production occur, it is likely that Malawi will continue to produce its own maize requirements under a market-based regime.

The multi-market model presented here does not have a temporal dimension, and therefore does not consider changes in crops stocks to smooth the inherent year to year volatility of rainfed agriculture. All evidence to date has shown that private grain traders do not engage in significant storage of maize to take advantage of seasonal price fluctuations. Rather, their role as intermediaries has been generally limited to transporting maize from surplus to deficit areas and reselling. Nevertheless, all market players have some interest in price stabilization, and government has a particular interest in providing some form of safety net in the event of a major crop failure. The Strategic Grain Reserve has sometimes been a useful mechanism with regard to the latter, and a potentially fruitful area of future research is to incorporate a time element in the multi-market model that will facilitate analysis of stabilization of supplies and prices.

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Table 1: Commodity aggregation for demand parameters in Malawi multi-market model

Commodity groups in demand system	Commodity groups in FSNM survey
Maize	Maize grain
	Maize flour
Other grains	Rice
	Sorghum & Millet
	Other food grains
Roots & Tubers	Cassava
	Other roots
Fruits & Vegetables	Vegetables & Fruits
	Plantains
Milk & Eggs	Milk & Milk products
	Eggs
Meat & Fish	Meat & Poultry
	Fish
Clothing & Footwear	Clothing & Footwear
Fuel	Fuel & Lighting
Beverages & Tobacco	Beverages & Tobacco
Other	Other foods
	Oils & Fats
	Pulses
	Household durables
	Sundries
	Other nonfoods
	Rent & Taxes
	Health & Medicine
	Education expenses
	Transportation
	Food processing

Table 2: Demand Elasticities for Small (maize-deficit) Farmers, Rural Wage Earners, and Low Income Urban Households

	Price										
Quantity	Maize	Roots	Other Grains	Fruit & Vegetables	Milk & Eggs	Meat	Clothing & Footwear	Fuel	Beverages & Tobacco	Other	Income
Maize	-1.115	0.040	0.077	0.009	0.108	0.123	-0.066	0.065	-0.098	0.044	0.815
Roots	0.118	-0.958	-0.111	-0.145	-0.006	0.083	0.435	-0.152	0.071	-0.288	0.952
Other Grains	-0.418	-0.793	-2.842	-0.014	0.589	0.073	1.719	-0.371	0.291	-0.018	1.780
Fruit & Vegetables	0.399	-0.211	-0.078	-1.632	0.539	-0.050	-0.078	-0.032	-0.332	0.194	1.281
Milk & Eggs	0.434	-0.033	0.427	0.156	-1.890	-0.286	-0.140	-0.164	0.206	0.082	1.208
Meat	0.519	0.091	-0.006	0.041	-0.176	-1.443	0.020	-0.099	0.244	0.010	0.800
Clothing & Footwear	-0.734	0.473	-0.057	0.418	-0.167	-0.060	-1.525	0.050	-0.117	0.105	1.610
Fuel	0.723	-0.331	-0.021	-0.144	-0.265	-0.244	0.168	-1.053	0.017	0.429	0.724
Beverages & Tobacco	-2.123	0.197	-0.786	0.204	0.589	0.933	-0.379	-0.016	-0.626	0.281	1.723
Other	0.710	-1.254	0.517	-0.012	0.278	0.009	0.393	0.773	0.323	-2.904	1.164

Source: FSNM Survey (November 1991)

Table 3: Demand Elasticities for Large (maize-surplus) Farmers and High Income Urban Households

	Price										
Quantity	Maize	Roots	Other Grains	Fruit & Vegetables	Milk & Eggs	Meat	Clothing & Footwear	Fuel	Beverages & Tobacco	Other	Income
Maize	-1.215	0.058	0.125	0.018	0.158	0.172	-0.056	0.094	-0.144	0.070	0.723
Roots	0.118	-0.955	-0.116	-0.153	-0.007	0.086	0.472	-0.163	0.076	-0.306	0.949
Other Grains	-0.121	-0.319	-1.756	-0.012	0.242	0.044	0.647	-0.146	0.114	-0.010	1.315
Fruit & Vegetables	0.355	-0.169	-0.071	-1.513	0.437	-0.029	-0.097	-0.023	-0.270	0.153	1.226
Milk & Eggs	0.532	-0.036	0.480	0.174	-2.015	-0.316	-0.196	-0.185	0.232	0.091	1.237
Meat	0.815	0.150	0.002	0.075	-0.299	-1.756	0.084	-0.169	0.412	0.020	0.667
Clothing & Footwear	-0.217	0.161	-0.027	0.138	-0.054	-0.011	-1.209	0.020	-0.042	0.033	1.206
Fuel	1.001	-0.489	-0.017	-0.205	-0.395	-0.378	0.309	-1.083	0.029	0.635	0.594
Beverages & Tobacco	-1.368	0.136	-0.551	0.129	0.407	0.657	-0.333	-0.005	-0.752	0.186	1.492
Other	0.552	-0.940	0.384	-0.011	0.210	0.013	0.276	0.581	0.241	-2.429	1.123

Source: FSNM Survey (November 1991)

Table 4: Supply Elasticities for Small (maize-deficit) Farmers

	Price									
Quantity	Maize	Roots	Other Grains	Fruit & Vegetables	Milk & Eggs	Meat	Ground-nuts	Burley Tobacco	Other Tobaccos	Pulses
Maize	0.350	0.000	-0.001	0.000	0.000	0.000	-0.001	-0.002	-0.002	-0.005
Roots	0.000	0.100	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other Grains	-0.007	0.000	0.200	0.000	0.000	0.000	-0.005	0.000	0.000	-0.005
Fruit & Vegetables	0.000	0.000	0.000	0.150	0.000	0.000	0.000	0.000	0.000	0.000
Milk & Eggs	0.000	0.000	0.000	0.000	0.050	0.010	-0.001	-0.015	-0.015	-0.015
Meat	0.000	0.000	0.000	0.000	0.008	0.050	0.000	-0.010	-0.010	-0.010
Groundnuts	-0.032	0.000	-0.043	0.000	-0.013	0.002	0.500	-0.250	-0.080	-0.100
Burley Tobacco	-0.024	0.000	0.000	0.000	-0.037	-0.033	-0.046	0.300	-0.010	-0.020
Other Tobaccos	-0.021	0.000	0.000	0.000	-0.033	-0.029	-0.013	-0.009	0.400	-0.030
Pulses	-0.073	0.000	-0.010	0.000	-0.045	-0.040	-0.023	-0.024	-0.041	0.250

Table 5: Supply Elasticities for Large (maize-surplus) Farmers

	Price									
Quantity	Maize	Roots	Other Grains	Fruit & Vegetables	Milk & Eggs	Meat	Ground-nuts	Burley Tobacco	Other Tobaccos	Pulses
Maize	0.450	0.000	-0.006	-0.005	0.000	0.000	-0.001	-0.040	-0.035	-0.005
Roots	0.000	0.120	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other Grains	-0.065	-0.001	0.150	0.000	0.000	0.000	-0.008	0.000	0.000	-0.004
Fruit & Vegetables	-0.028	0.000	0.000	0.200	0.000	0.000	-0.010	-0.100	0.000	0.000
Milk & Eggs	0.000	0.000	0.000	0.000	0.050	0.000	0.000	0.000	0.000	0.000
Meat	0.000	0.000	0.000	0.000	0.000	0.050	0.000	0.000	0.000	0.000
Groundnuts	-0.023	0.000	-0.017	-0.042	0.000	0.000	0.550	-0.120	-0.120	-0.150
Burley Tobacco	-0.042	0.000	0.000	-0.019	0.000	0.000	-0.005	0.400	-0.050	-0.015
Other Tobaccos	-0.074	0.000	0.000	0.000	0.000	0.000	-0.011	-0.101	0.329	-0.080
Pulses	-0.041	0.000	-0.003	0.000	0.000	0.000	-0.053	-0.118	-0.310	0.500

Table 6: Malawi Multi-Market Model Simulation Results

	Simulation 1	Simulation 2	Simulation 3	Simulation 4	Simulation 5	Simulation 6	Simulation 7
	Maize Yields Increase 20% -- Short run effects	Maize Yields Increase 20% -- Medium run effects	Maize Marketing Margin Reduced by 50%	Tobacco prices (both burley and other) Increase by 20%	Tobacco prices (both burley and other) Decrease by 20%	Producer prices of Groundnuts Increase by 20%	Producer prices of Groundnuts Decrease by 20%
Production							
Maize	20.00	13.86	3.52	0.67	-0.47	0.05	-0.04
Roots	0.00	-0.19	0.18	0.43	-0.42	0.02	-0.01
Other Grains	0.00	0.62	-0.12	0.44	-0.42	-0.10	0.13
Groundnuts	0.00	0.43	-0.32	-4.86	6.20	10.41	-11.42
Burley Tobacco	0.00	0.59	-0.38	6.24	-7.20	-0.13	0.16
Other Tobacco	0.00	0.90	-0.58	4.13	-4.88	-0.21	0.26
Maize Production							
Small farmers	20.00	14.90	2.91	1.37	-1.36	0.05	-0.04
Large farmers	20.00	13.50	3.73	0.42	-0.15	0.05	-0.04
Burley Tobacco Production							
Small farmers	0.00	0.56	-0.29	5.02	-5.90	-0.86	1.05
Large farmers	0.00	0.59	-0.39	6.28	-7.24	-0.11	0.13
Other Tobacco Production							
Small farmers	0.00	0.50	-0.26	7.02	-8.04	-0.25	0.31
Large farmers	0.00	0.93	-0.61	3.92	-4.65	-0.21	0.25
Groundnut Production							
Small farmers	0.00	0.42	-0.35	-6.17	8.02	9.53	-10.54
Large farmers	0.00	0.44	-0.32	-4.70	5.97	10.53	-11.53
Consumption							
Maize	20.00	13.86	3.52	0.67	-0.47	0.05	-0.04
Roots	0.00	-0.19	0.18	0.43	-0.42	0.02	-0.01
Other Grains	0.00	0.62	-0.12	0.44	-0.42	-0.10	0.13
Maize Consumption							
Small farmers	18.93	13.12	12.31	-0.11	0.35	0.06	-0.05
Large farmers	20.57	14.33	-7.18	3.16	-3.01	0.13	-0.10
Rural Wage Workers	20.00	13.74	8.94	-3.08	3.29	-0.12	0.10
Urban Poor	20.00	13.74	8.94	-3.08	3.29	-0.12	0.10
Urban Non-poor	21.38	14.67	10.01	-2.77	2.99	-0.10	0.09
Maize Prices							
Producer price	-16.17	-11.68	8.53	4.18	-4.10	0.17	-0.14
Consumer price	-16.17	-11.68	-6.97	4.18	-4.10	0.17	-0.14
Real Income							
Small farmers	8.83	6.21	6.47	0.15	0.01	0.07	-0.05
Large farmers	5.72	4.22	-0.71	5.47	-5.31	0.19	-0.15
Rural Wage Workers	10.04	6.92	2.56	-3.49	3.62	-0.15	0.13
Urban Poor	10.04	6.92	2.56	-3.49	3.62	-0.15	0.13
Urban Non-poor	6.69	4.65	1.54	-2.83	2.89	-0.13	0.11
Real Agricultural Income							
Small farmers	8.18	5.82	8.59	2.11	-1.94	0.19	-0.15
Large farmers	5.30	4.03	0.30	9.03	-8.82	0.33	-0.26