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Impacts and Policy Responses to a commodity price boom. The case of Malawi

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Abstract: This work analyzes the medium term effects of the recent commodity price spike in a typical Low-Income-Food-Deficit country, Malawi, as well as a set of possible policy responses. Simulations were performed with a single-country static Computable General Equilibrium model, based on the 2004 Malawi Social Accounting Matrix provided by IFPRI, modified with data from the 2004 household budget survey. Results indicate that the increase in agricultural domestic prices was mainly driven by the raise in the cost of imported oil and chemical products. Reductions in tariff and domestic taxes, as well as subsidies on chemicals inputs, appear capable of counteracting the terms of trade shocks to some extent. However, tackling structural constraints, such as those affecting the size of agricultural marketing margins, would produce wider benefits, and improve the resilience of the economy to external shocks.

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1. Introduction

The instability which was recently observed in world commodity prices has raised widespread concerns, especially for its possible consequences on weak economies such as those of the Least Developed Countries (LDCs) and the Low-Income Food-Deficit Countries (LIFDCs). During 2008, grain price rose by more than 60 percent, doubling the 2006 level. Rice prices almost tripled between January and May 2008. By mid-2008, agricultural commodity prices were showing signs of stabilization, followed by a consistent reduction. The last OECD-FAO Agriculture Outlook (OECD/FAO, 2008) argues that prices will remain at a high level compared to the last decade, at least in the medium term. The possibility of observing in the future more and wider spikes in commodity prices is also mentioned frequently, with reference to long-term global issues such as climate change and population dynamics.

Likely effects of the terms-of-trade shock in food- and oil-importing countries and LIFDCs are an increase in the import bill, and a shift of domestic production toward more tradable products. Such effect may have been further deepened by the depreciation of most LIFDCs currencies with respect to the US dollar.

Despite being over, the price spike is deemed to have triggered an increase in poverty and food insecurity, and to have contributed worsening income distribution in many developing countries, hence reversing positive recent achievements (World Bank, 2008a; FAO, 2008a). Likely macroeconomic impacts, such as imported inflation and balance of payments disequilibrium, amplify the vulnerability of poor countries and their ability to cope with similar types of shock in the future. Fiscal constraints can reduce the effectiveness of policies in alleviating negative effects on households; indeed, policies can shape size and distribution of terms-of-trade shocks.

Most governments reacted quickly to the price boom, with short-run measures. Some introduced consumer subsidies, or cuts in indirect taxation on food, and in import tariffs, to facilitate imports, while banning exports of certain goods to enlarge domestic availability. However easy to implement, these trade measures can bring about negative impacts in world food markets: by restricting supply they may drive prices further up. Also, they can contribute to tighten governments' budgets, which often rely on tariff revenues as a key source of finance.

The consequence of a terms-of-trade shock on the population certainly depends on the relative share of net food sellers and buyers, but not only on that. Labour markets in agriculture, which involve high shares of the population in low income countries, are likely to be affected: hence better prices may represent an opportunity to improve agricultural income. Also, higher prices affect import and export decisions, if producers manage to perceive and react fast enough to changes. Oil and fertilizers constitute key input costs for most agricultural and non-agricultural activities, and price changes can affect sectors to a different extent depending on their dependence upon petroleum. Moreover, the degree of price transmission between world and local markets determines the impact of world price change on domestic prices. Domestic trade policies, such as tariffs and subsidies, and the presence of high marketing margins following from infrastructural and institutional constraints, can inhibit arbitrage and reduce the transmission of price signals (Rapsomanikis et al., 2004).

Maize in Eastern and Southern Africa is presented as an example of poor price transmission between world and domestic markets (FAO, 2008b). High transport costs, a weak US dollar, consumers' preferences for white maize -- domestic and foreign maize are not always perfect substitutes – lack of access to markets, inadequate availability of finance and other inputs can combine to hinder the pass trough of world prices signals in

the domestic markets. If this is the case, LIFDCs in the region should be protected from world price volatility. From a partial equilibrium perspective, this could be an advantage for consumers, at least in the short run; which can however hinder producers' gains over the medium term. However, the story can be more complex, given the mentioned interactions with the factor markets, trade and macroeconomic variables, as well as due to the structural constraints that characterize LIFDCs.

The causes of the recent price boom are multifaceted, and their analysis is beyond the scope of this paper[1]. Rather, our aim is to analyze the medium-run effects of the commodity price soar, and the possible policy responses in a typical LIFDC, like Malawi. Understanding the impacts of a price shock on the production structure and different population groups is important for the design of policies aimed both at counteracting such shocks, and especially at making the economy more resilient in the medium run. In order to accomplish this task while adding an original point of view on Malawi, we employed a single-country static Computable General Equilibrium (CGE) model provided by IFPRI (Lofgren et al., 2002), based on a 2004 SAM (Thurlow et al., 2008), which we modified with data from the 2004 Second Integrated Household Survey (NSO, 2005). CGEs provide a complete description of the economy which allows the assessment of second round effects in all markets - including those of factors – and of distributional effects; at the same time, macroeconomic constraints of an economy are taken into account. For this reason CGEs have been extensively used to analyze the impact of the recent price boom (Al-Amin et al., 2008; Arndt et al., 2008; Conforti and Sarris, 2008; Nouve and Wodon, 2008).

The price shock we considered is the change in trade unit values for Malawi – food, non-food and petroleum -- observed between 2004 which is the base period of our dataset, and 2007. Policy experiments were then implemented on top of the price scenarios, including

[1] See FAO (2008a), World Bank (2008a), von Braun et al. (2008) for a complete discussion over the causes of soaring food prices.

changes in trade policies and different kinds of input subsidies, including those which have been promoted in recent years. Given that Malawi is a landlocked country, structural constraints play a significant role in shaping the response of the economy to external shocks. To capture these features, our policy scenarios were simulated on two different baselines: one reporting the observed marketing margins, and another one implying lower marketing margins; this allowed testing the differential effects of world prices and policies on the Malawian economy.

The remainder of the paper is organized as follows. Next section discusses a number of facts observed in Malawi during the recent world price soar, in connection with the general characteristics of the Malawian economy. Section 3 describes the dataset and the CGE model employed in the analysis, while the following section illustrates the price and policy scenarios. Section 5 analyzes the results of the simulations, as well as a set of validation and sensitivity experiments. Finally, the last section concludes.

2. Malawi and the 2007-08 price spike

Malawi is an agricultural land-locked LIFDC country, and a net importer of oil, oil products and fertilizers. In 2005, the last Integrated Households Survey (IHS) showed that 52 percent of the population was living below the poverty line; a proportion that was even higher in rural areas (NSO, 2005). Poverty and productivity traps constrain economic development, and limit the ability of the economy to grow faster. In agriculture, the average plot size is 1.13 hectares (Benin et al., 2008), and low revenues reduce smallholders' chances to access fertilizer and other inputs; this is especially the case for maize, which is the main staple crop. The reduced availability of maize is judged to pose serious constrains to the achievement of poverty reduction and improvements in food security (Harrigan, 2008). As it is the case in most LIFDCs, backward technologies, the

lack of credit towards smallholders and the persistence of poor infrastructure and high transport costs, result in large marketing margins, which reduce the completeness and competitiveness of markets (Dorward et al., 2008). Consequently, in the last decade value added growth in agriculture has been erratic (NSO, 2007).

The Comprehensive Africa Agriculture Development Programme (CAADP) set a 6 percent target for agricultural growth[2]. Within this framework, the Government of Malawi committed to raise public expenditure in the sector, by financing an investment plan and an input subsidization programme. In fact, public resources allocated to agriculture are gaining momentum in absolute and relative terms (Benin et al., 2008). Nonetheless, public finance constitutes a key constraint.

Since the mid 1990s, adjustment and liberalization policies have removed most subsidies in the economy. In agriculture, this resulted in an increase of input prices (Dorward et al., 2008) and a rapid decline of soil fertility (Harrigan, 2008). By the end of the decade the Government decided to promote a new policy to support smallholders, involving input subsidies, in order to reduce poverty and food insecurity. Between 1998 and 2000, the Starter Pack Programme provided smallholders with hybrid maize and legume seeds and fertilizers. In 2000, critiques concerning the cost of such programme led to a downsizing of the Starter Pack, which was replaced by the Targeted Input Programme (TIP) (Harrigan, 2008). In 2005, the TIP was transformed into the Agricultural Input Subsidy Programmes (AISP) for seasons 2005-06 and 2006-07. The broad purpose of AISP is "to improve land and labour productivity and production of both food and cash crops by smallholder farmers with heavy cash constraints that preclude their purchase of inputs, to promote economic growth and reduce vulnerability to food insecurity, hunger and poverty" (Dorward et al., 2008, p. 20). Implementation was based on the distribution of coupons allowing to

[2] CAADP is part of the New Partnership for Africa's Development (NEPAD) under the African Union (AU).

purchase fertilizers for maize and tobacco at a subsidized price, and to receive hybrid maize seeds for free.

Given that 97 percent of Malawian households grow maize - either for sale or own-consumption (NSO, 2005) -- the poverty elasticity of this product is estimated to be high, like that of pulses, groundnuts and horticulture, and certainly higher than that of export crops, such as tobacco, cotton, sugar and tea (Benin et al., 2008). The importance of maize stems from its large (potential) spill-over effects on other agricultural and non agricultural activities. Poor farmers are unable to afford fertilizers, whose limited use is among the reasons why maize yields are low. Higher maize price could make input use more profitable. At the same, only 10 percent of maize producers are net sellers, while 60 percent are net buyers and the majority of them are exclusively buyers (Dorward et al., 2008). Therefore, an increase in local price of maize can directly worsen food security and poverty conditions in many households.

In this context, the recent world price soar should have brought about mostly negative effects. Analyses simulating changes in food prices in a short-run model of partial equilibrium framework (Zezza et al., 2007; Ivanic and Martin, 2008), raised concerns for poor households in rural areas, where the median welfare losses of the last quintile were projected to be twice as large as in the first. Sarris and Rapsomanikis (2009) also found that an increase in maize and meat prices is likely to bring about an increase in poverty and food insecurity. However, these results were obtained by assuming that households would not adjust to the change in relative prices, neither in terms of production or consumption.

A number of international observers claimed recently that the 2008 spike in world food price did not affect Malawi to a significant extent (FAO, 2009; World Bank, 2008b; IMF, 2009). Still, the high prices of other key imported commodities, such as fuels and fertilizers, must have put some pressure on the balance of payments. In fact, the

Government requested and received from the International Monetary Fund (IMF) a one-year Exogenous Shocks Facility Arrangement of 77 millions of US dollars (IMF, 2009).

The impact of increased agricultural prices largely depends on the degree of integration between domestic and world markets. Evidence for Malawi, in this respect, is mixed. Chirwa and Zakeyo (2006) found weak price transmission, albeit showing improvement from the mid 1990s on, following trade and price liberalization. On the contrary, Sarris and Rapsomanikis (2009) show econometric evidence of price transmission between Malwian and world markets, particularly with South Africa. With few exceptions, domestic markets are found to be in a long-run equilibrium with world prices.

A comparison of world reference prices and retail prices in Lilongwe for maize and rice shows a similar pattern of growth between 2006 and 2008 (Figure 1; Figure 2). It is known that changes in retail prices in Lilongwe do not follow necessarily from changes in world reference prices. In 2007, for instance, a bumper harvest put pressure on prices (Jayne et al., 2008). From then on, maize prices have been increasing steadily. In August 2008, the maize price was 186 percent higher than in the same period of 2007 (FAO, 2009), due to a number of localized maize shortages in the 2007-08 season, as well as to the overestimation of maize production in the Government forecasts (Jayne et al., 2008). Based on those forecasts, the Government purchased more maize than the year before, in an attempt to prevent a further price decrease. This resulted in increased speculation, which contributed to determine the observed dramatic price surge. At that point, the Government resorted to banning private trade, with the stated objective of removing speculation, and the only authorized transactions were those operated by ADMARC[3] at fixed-prices (FAO, 2009). However, informal flows of maize from neighbouring countries continued, especially from Mozambique and Tanzania (Jayne et al., 2008). From the summer of 2008,

[3] ADAMARC is the Agricultural Development and Marketing Corporation, a parastatal organization that provides input and output markets for smallholder farmers.

when world cereal prices have started to fall sharply, maize prices in Lilongwe remained about 107 percent higher than the year before (FAO, 2008c)[4].

Inflation in Malawi soared between 2003 and 2005, when a drought reduced food supplies[5]. A new acceleration took place from 2007 to 2008 inflation, mainly pulled by world prices of oil and fertilizer; food inflation, instead, remained subdued (Figure 3). Only urban consumers perceived this rebound (Figure 4): thus one likely effect of the soar in food prices is an income transfer from urban households, who are net maize buyers, toward the share of rural households who sell maize (Jayne et al., 2008). Within urban areas, the low income population group experienced the highest increase in food CPI, as well as the net purchaser of staple food (Figure 5; Figure 6). Altogether, this evidence supports the idea that Malawi is protected from world price variability.

The objective of this paper is to contribute towards clarifying these dynamics by assessing the adjustment of the Malawian economy to the described price shock over the medium term from an economy-wide perspective. We started from the cumulative price changes between 2004, the dataset base year, and 2007, which is the last year for which reliable data on world trade are available. Previous works on this issue addressed price scenarios in two different ways: either by applying the changes observed in world reference prices for food and oil[6]; or by computing changes in import and export unit values (Conforti and Sarris, 2008). We followed the second approach, which captures the entire terms-of-trade shock. Table 1 shows cumulative changes in trade unit value expressed in current US

[4] This increase is even higher in local currency terms.

[5] According to some studies (Tschirley and Jayne, 2008) the price increase has been exacerbated by raising transport costs which accounted for almost half of the maize price rise.

[6] As stated by Arndt et al. (2008) some of the shocks, like for instance the price of oil that in 2006 was three folds its level of 2003, were so huge that the model could not response in a realistic way. So, they decide to reduce the size of price changes reducing the magnitude of the shocks.

dollars between 2004 and 2007[7]. Nominal changes in US dollars were deflated with the US GDP deflator.

Trade unit values show a considerable increase in chemicals, which includes oil and fertilizers; a more moderate rise of import unit value of some crops, as well as a reduction in the import unit value of maize and rice. A substantive share of maize is imported informally from Mozambique, where 2007 brought about a bumper harvest, albeit of low quality (Jayne et al., 2008). Apparently Mozambican farmers at the border to Malawi have few alternative market outlets other than Malawian traders: such oligopsony power, together with the bumper harvest, has most likely put pressure on import prices. For rice, data from COMTRADE show that between 2004 and 2007 Malawian rice imports were increasingly sourced from China, and less from the US. This has contributed to reduce the import unit value, and should in itself be considered a coping strategy against raising prices, which was implemented by several other LIFDCs even before the world price spike of 2008[8].

A static measure of the terms-of-trade change that followed from the changes in trade unit values reveals that Malawi experienced a negative shock, corresponding to 2.5 percent of GDP (Table 2)[9]. The shock arises primarily from the change in the import unit value of chemicals, which in itself correspond to 7 percent of the GDP. This is partially

[7] Changes in unit values are computed from the COMTRADE database, using the SITC 2 classification at five digits. The resulting price changes have been compared with similar data provided by the Malawian National Statistical Office (NSO), which in most cases is consistent with the COMTRADE data. For some product groups, however, COMTRADE data would not appear to be reliable, due to changes in the composition of the group of products. In such cases, world price changes were retrieved from the database of the CO.SI.MO.-AGLINK model employed by OECD and FAO in the preparation of the world agricultural commodity outlook. For the same reason, the unit value changes for export of Manufacture, Tea and the Forestry were retrieved directly from the Malawian NSO, valued at current US dollars.

[8] This change cannot be captured by the CGE model of this work where Malawi trades internationally with a single entity called "Rest of the World".

[9] This is computed by considering changes in imports costs and export revenues in absence of any adjustment in the economy.

compensated by gains in agricultural and food exports unit values. The importance of chemicals – both in terms of import share and intensity explains this result (Table 4).

In order to assess the medium terms reaction to this shock we need a comprehensive dataset and a behavioural model for Malawi, which are described in the next section.

3. Data and model

3.1. The Dataset: a Modified Social Accounting Matrix for Malawi

The most recent Social Accounting Matrix (SAM) for Malawi, referred to year 2004, has been computed by Thurlow et al. (2008); it reports thirty-six activities, of which seventeen are part of agriculture, livestock, forestry and fisheries. Each activity produces one single commodity, and each commodity is produced by one single activity. Given our emphasis on agriculture, the first step in building our modified dataset, was to aggregate non-agriculture and non-food items into ten sectors: processed food, beverage and tobacco, one single manufacture sector, one chemical sector, and six service sectors, including trade and public administration. Hence the SAM we used includes twenty-seven sectors, twenty-one of which are related to agriculture and food production and processing.

The SAM reports details for nine factors of production: three types of labour, agricultural and non-agricultural capital and four kinds of land. Elementary labour is employed only in agriculture; unskilled labour is employed by all activities, while skilled labour is employed only in manufacture and services[10]. Land is employed only in agriculture, and is divided into four categories: small, medium, large plots -- which are held respectively by small, medium and large rural farmers – and urban land, which is cultivated by urban farmers.

[10] Elementary labour is category 9; and unskilled labour includes categories from 8 to 4, while skilled workers are included in category 3 of the ISCO classification -- the ILO International Standard Classification of Occupations (http://www.ilo.org/public/english/bureau/stat/isco/index.htm).

Concerning institutions, the SAM takes into account the specificities of the Malawian economy. The country has one of the highest rural population densities in Sub-Saharan Africa, since more than 80 percent of households are rural (NSO, 2005). Hence land availability is a constraint in agriculture, as seen from the small size of the average plot. The SAM divides rural population into smallholders, medium scale farmers and large owners. Small farmers are those that access less than 0.75 hectares; they produce mainly maize, and few other crops. Medium size farmers, which are the majority of rural households, access between 0.75 and three hectares; they show a more differentiated cropping pattern, including maize and other crops. Large farmers are those that access more than three hectares, and produce mainly exportables: tobacco, which is the most important, followed by sugar, tea and cotton (Benin et al., 2008). Rural households, as defined in the SAM, also include non-farmer households. Other households are classified as urban and metropolitan – those living in Lilongwe and Blantyre – non-farmer, and urban farmers households. Therefore, the SAM includes seven households. The rest of the private sector is represented by an enterprise sector

The 2004 SAM by Thurlow et al. (2008), which we used as a starting point, does not report own-consumption, despite this is very common, especially in rural households, but also in urban households (NSO, 2005). Maize is the product whose share in own-consumption is higher, but high shares of the other agricultural and food product are also directly consumed, apart from livestock, fisheries and export crops. Therefore, we modified the original SAM computed by Thurlow et al. (2008) to include own-consumption of agricultural and foods based on data from the IHS (NSO, 2005)[11].

[11] For each commodity the SAM reports a value of total consumption. We assumed that this would correspond to the sum of the value of marketed consumption ($P_m.Q_m$) and the value of own-consumption ($P_{oc}.Q_{oc}$). We computed quantities of marketed and own-consumption from the IHS (NSO, 2005), which also reports market price of commodities. Based on these three terms we derived the implicit unit value of own-consumed agricultural commodities P_{oc}. and multiplying physical quantities for it, in order to obtain a value

Including own-consumption in the SAM required also another modification: the inclusion of marketing margins, which are a wedge between unit values of own-consumption and marketed consumption. Thurlow et al. (2008) report Agricultural and Non-Agricultural Trade as two separate distribution activities, for agricultural and non agricultural goods. For the purpose of our work, we treated margins as costs associated with domestic sales, exports and imports; hence we added three accounts representing margins, paid by the commodity account in exchange for the purchase of trade and transport services. In the modified SAM, income from these accounts accrues to a single trade sector which sums agricultural and non-agricultural margins.

In adding the margins, we also assumed that those reported by Thurlow et al. (2008) refer to the domestic market. The size of margins on imported and exported goods were assumed similar to those observed in other countries of the region, as reported by Arndt et al. (2000) for Mozambique, Wobst (2003) for the whole region; and Sarris et al. (2006) for Tanzania. Import and export margins were assumed to be percentages of the values of exported and imported commodities[12]. The difference in the SAM generated by the margins was subtracted from the income of the respective producers; consequently the SAM had to be rebalanced.

To this end, we adopted the cross entropy approach (Robinson and El-Said, 2000; Robinson et al., 2001), which allows to use all information, including errors in variables, inequality constraints, and prior knowledge about any part of the dataset. Starting from the

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of own-consumption. We assumed that also in "Food processing", and "Beverages and Tobacco" households would consume directly part of the production. Since these items in the SAM collect highly heterogeneous activities, it was impossible to derive from the budget survey an implicit price; hence we applied an average share of own-consumption.

[12] For exported commodities, we assumed the margins amount to 50 percent of the exported marketed values for agricultural goods and to 25 percent for manufacture, as in Conforti and Sarris (2008). This high level of marketing margins come from the special position of Malawi which is land-locked, and from the analysis of the trade flows which reveal how the majority of Malawian exports reaches countries outside the region. For imports the same margin was set at 10 percent for maize, whose imports, instead, originate mainly neighbouring countries; for manufactured goods the margin was assumed to be 20 percent.

original matrix and taking into account new information, cross entropy estimates a new group of matrix coefficients, which are as close as possible to the previous ones, minimizing the entropy 'distance' measure between the final and the prior, unbalanced SAM. Some of the data included in the original SAM was left unchanged: this is the case of the balance of payments, transfers, taxation, public expenditure and investments, as well as marketing margins. Constraints were imposed also on changes of the other data. A 1 percent maximum standard deviation constraint was imposed on prior error distribution in GDP at factor cost, investments, own-consumption and marketed consumption, while a maximum 5 percent standard deviation constraint was set for all other entries, so that the final SAM we obtained (Table 3) shows small deviations from the one computed by Thurlow et al. (2008).

Trade is the largest sector in terms of value added share (Table 4), followed by public administration, which includes government administration, health and education. In agriculture, maize is the main product, while tobacco accounts for a quarter of total Malawian exports in terms of value; export crops are not consumed domestically, apart from very small amounts. Agricultural commodities and processed foods represent 70 percent of Malawian exports, while manufactured goods are the main import items. Chemicals and agricultural and food products account for more than 15 percent of imports. Overall, import intensity, which is the share of imports in absorption, is more than 18 percent for maize, other cereals and other crops.[13].

Parameters employed in the model were retrieved from the literature on Malawi and other countries in the region (Ecker and Qaim, 2008; Simler, 1997; Wobst, 2004; Conforti and Sarris, 2008). Demand elasticities for each household group for the domestic consumed

[13] These characteristics are virtually unchanged in our SAM compared to the version produced by Thurlow et al (2008). Also in that version trade was the main activity in terms of value added share, followed by the public administration; and all other shares are also similar. Also, a comparison with the 1998 SAM (Wobst et al., 2004) shows that structural features are substantially unchanged.

food commodities were estimated on the basis of data from the 2004-05 IHS (NSO, 2005). For this purpose we employed a demand system in which Engel curves are compatible with those of the Linear Expenditure System (LES) included in the CGE model. Calibration ensured symmetry, homogeneity and negativity[14].

3.2 The Computable General Equilibrium Model

Computable General Equilibrium (CGE) models allow to capture the economic, distributional and structural effects of external shocks, and to analyze in detail the effect of policies (Benson et al., 2008). Several studies adopted this approach in analyzing the effect of the recent soar in commodity prices, particularly on developing countries, including Al-Amin et al. (2008) on Malaysia, Arndt et al. (2008) on Mozambique, Conforti and Sarris (2008) on Tanzania, and Nouve and Wodon (2008) on Mali.

Being an economy-wide model, a CGE includes a complete description of the economy, and shows the functioning of all markets, including commodities and factors of production. Compared to partial equilibrium models, CGEs allow evaluating second round effects of price changes, adjustments of agents on both the supply and the demand side, reactions in the labour market, and changes in resources allocation across activities. Moreover, CGEs capture the major budget constraints of an economy, particularly the balance of payment and the macroeconomic constraints; as well as the distributional impact on households in terms of both income and welfare.

In this work we present a set of simulations implemented with a single-country static CGE model provided by IFPRI (Lofgren et al., 2002) which follows standard specifications for production, allocation of output and consumption. Producers allocate value added and aggregate intermediate inputs according to a Leontief function, which determines the final

[14] Details on this estimation were not included in the paper due to space reasons. They are available from the authors upon request.

domestic production of each activity. Factors allocation -- different kinds of labour, capital and land -- is determined by a Constant Elasticity of Substitution (CES) function. The profit maximization hypothesis ensures that marginal revenue equals marginal cost for each factor. Intermediate inputs are determined through fix coefficients, according to the Leontief specification.

Production is allocated to domestic market and exports through a Constant Elasticity of Transformation (CET) function, which allows producers to shift between markets according to changes in relative prices, following the assumption of imperfect substitutability. Export prices are world prices multiplied by the exchange rate, and adjusted for export taxes or subsidies and marketing costs. In the same vein, final domestic availability of outputs for consumption and intermediate use is determined through an Armington (1969) specification, implying imperfect substitutability between domestic and imported goods. Under a cost minimization assumption, the CES Armington function determines the quantity of composite goods on the basis of relative world and domestic prices, which are also adjusted for taxation and marketing costs. The small country assumption holds for imported and exported goods, whose world prices are assumed exogenous, with perfectly elastic world supply and demand. The trade sector collects all margins paid for by different commodities; margins take the form of exogenous wedges affecting price formation.

Households and enterprises receive incomes from factors, Government transfers and transfer from rest of the world. They save a quota of their earnings, receive transfers from enterprises, and consume the remaining income. Demand is modelled separately for own-consumption and marketed consumption; the former surges directly from activities, and is evaluated at its opportunity cost, that is, at an activity-specific producer price without taxes and marketing margins. Marketed consumption is made up of composite goods, evaluated

at market price including taxes and trade margins. Households maximize a Stone-Geary utility function, subject to a consumption expenditure constraint. The first order condition of the demand system is a Linear Expenditure System (LES) function, where spending on a single commodity is a linear function of the total consumption. Two separate LES functions are employed to model the two types of consumption.

Government income is made up of indirect taxes on commodities, import tariffs and direct taxes - levied on enterprises, rural large landowners and urban households - and transfers from the rest of the world[15]. Government expenditure includes consumption, through the public administration, and transfers arising from industrial and welfare policies. The difference between Government income and expenditure is saved[16]. The sum of households, Government and foreign savings is collected by one single account, which finances investment spending. Investment demand is modelled by multiplying the base-year amount of investments by an adjustment factor.

Changes in welfare are measured in terms of "Money Metric Utility (MMU) (Deaton, 1980). Households' expenditure under the simulated scenario is compared with the expenditure that the same household would have incurred in order to obtain the same welfare of the baseline, but at current prices.

Being comparative, the model does not report information on the adjustment path and the costs associated to each scenario. As a proxy of the adjustment costs associated with each simulation, we computed a Structural Change Index (SCI) (Clark et al., 1996), which offers a comparative measure of the amount of resources that migrate from one activity to another within the economy, and is computed as

$$SCI = 0.5 * \Sigma_i |a_{is} - a_{i0}|$$

[15] No export taxes were imposed in Malawi in 2004.
[16] In 2004, the Malawian Government reported positive savings.

where a_{is} and a_{i0} are the percentage shares in value added of sector i in the base run and the scenario respectively. The index can be computed for different variables, including skilled and unskilled labour in each activity, and is bounded between 0 and 100, with 0 meaning no structural change and 100 implying a complete transformation of the economic structure.

Being based on a complete representation of the real economy, CGEs require a number of assumptions on the functioning of markets, which are embedded in the so-called closure rule. This states how equilibrium is reached in commodities markets, factors markets, and in the three macroeconomic balances: the public sector, the external and the saving-investment balance. The closure rule adopted in this work is based on available evidence for the Malawi. Commodity markets are assumed to close following a flexible price rule, since there are no output price controls in the economy.

The labour market is assumed to be segmented, with separate markets for skilled and unskilled labour, based on the assumption that movements of work force from one to the other are unlikely in the time framework of the model, and wages are different. Both markets, however, are assumed to adjust through wage changes and fixed supply. For skilled labour, the assumption is that this is a scarce factor in the country; for unskilled labour, evidence indicates that it is difficult to find unemployed unskilled workers (Alwang and Siegel, 1999; Dorward 2008)[17]. Also capital - both agricultural and non-agricultural – and land are assumed to be fixed and fully employed. Capital is immobile, and receives a fixed sector-specific return, while land can shift across agricultural activities following changes in relative prices.

Given the regime of flexible exchange rate adopted in Malawi, we assumed that the exchange rate is endogenously determined. For the public sector, we assume that

[17] It must be noted that this is an unusual condition in developing countries, where the presence of excess unskilled labours is deemed likely.

Government savings are flexible, while direct taxation and other fiscal tools are exogenously determined by policymakers (Benin et al., 2008). Finally, investments are assumed to be determined by available savings, given that the lack of private savings is considered a binding constraint in the economy (Record and Davies, 2007).

4. Scenarios

The analysis is based on two distinct sets of counterfactual scenarios. Firstly, we analyzed the impact of world commodity price changes, as computed from the unit trade values of the COMTRADE database between 2004 and 2007 (Table 1). In order to assess the differential effect of the structural constraint and the landlocked condition of the Malawian economy, we implemented the price change scenarios on two different baselines (Table 5). The first one reports marketing margins as in the SAM, and is called BASE_A because it is just the calibration of the SAM. The second one, called BASE_B, includes 20 percent lower marketing margins, both on foreign trade and the domestic market. This allows to gauge the importance of the marketing margins in constraining trade, and to compare the effects of the price shocks under two different structural conditions. BASEPR_A implements exogenous world price changes, whereas in BASEPR_B the same price shocks apply to a SAM with reduced marketing margins (Table 5).

Secondly, we analyze a number of policy scenarios, which are run on top of world price changes, as they are meant to represent possible reactions to the terms of trade shock. Policy experiments are also run on the two alternative baselines, implying different marketing margins. Hence there are two versions for each policy experiment. In TARCUT_A and TARCUT_B, the Government is assumed to reduce import tariffs by 20 percent (Table 6), in order to downsize the impact of the world prices rise on domestic consumers (Table 5).

Scenarios EXPTAX_A and EXPTAX_B simulate the introduction of a 5 percent export tax (Table 6). The Government may consider this policy as a mean to lower the incentive to produce exportables, while raising supply of domestic staples, and redistributing the advantages accruing to large farmers.

Scenarios DOMTAX_A and DOMTAX_B imply a 20 percent reduction in indirect taxes on agricultural products and processed foods (Table 6). This option could be considered as a mean to alleviate the position of net food buyer households, by reducing food prices.

The last three couples of scenarios analyze the effect of the input subsidization policies discussed in Section 2, in relation to the terms of trade shock. As seen, the AISP is currently distributing coupons for purchasing fertilizers for maize and tobacco at a subsidized price, and to receive hybrid maize seeds for free. Scenarios CHEMSEL_A and CHEMSEL_B are aimed at mimicking this policy: maize and tobacco receive an input subsidy corresponding to 50 percent of the value of chemicals utilized. The true discount on market price granted under the programme is 70 percent, and only applies to poor smallholders and to certain chemical fertilisers (Dorward et al., 2008); in absence of specific information on small-scale maize and tobacco activities and on the specific chemicals, we arbitrarily set the subsidy at a lower level, to take targeting into account.

Given that observed changes in trade unit values highlighted the importance of oil and chemicals in producing inflationary pressure (Table 1), we explored the impact of a wider scheme of subsidization, as a possible measure to counteract changes in world prices. Based on the assumption that resources to finance this type of policies would be limited, it is assumed that less targeted subsidies, compared to the AISP, would imply a lower degree of subsidization. Hence scenarios CHEMAGR_A and CHEMAGR_B assume a 15 percent subsidy on chemical use in all agricultural products except cassava, pulses, groundnuts, livestock and forestry products which are not reported using chemicals. Finally, scenarios

CHEMALL_A and CHEMALL_B, are built on the same logic: a 10 percent subsidy is assumed to be granted on chemicals use in all agricultural and non agricultural activities.

5. Results

5.1 Changes in world prices

The simulations presented here highlight the full medium to long-run reaction of the economy to the negative terms-of-trade shock (Table 7). BASEPR_A shows that the reduction in maize and rice import unit values causes a significant increase in imports of these products, and in total imports[18], which implies a positive effect on consumption. Imports of non-agricultural products decline, due to increased world prices of chemicals and manufactured goods, and to the decrease in urban consumers' income, consumption and investments, which account for most of the demand for these products. Given that the closure maintains the current account in equilibrium, the nominal exchange rate appreciates to reduce the value of imports and enhance that of exports. The depreciation of the real exchange rate – which is computed as a ratio of the price of tradables and non-tradables – shows an improvement in Malawian price competitiveness.

The contraction in maize and rice production makes land and labour available for other activities[19]. Output of other cereals increases, following the raise in import unit values, as well as output of fruits and vegetables; the latter products gain importance among export crops[20]. Tobacco and sugar outputs also increase, while cotton and tea are downsized. With very few exceptions, the domestic price of agricultural goods increases: this is due to the

[18] Maize imports represent 4 percent of imports in the baseline; under BASEPR they reach 6 percent. This is also the largest observed increase in absolute terms.

[19] For all scenarios, the main results are in the Tables included in the text; more details on output and domestic prices are reported in the Appendix.

[20] The wide increase in the export unit value of fruits, vegetables and other crops doesn't seem to be arising from a composition effect: products grouped under these items appear to be fairly stable in the COMTRADE data between 2004 and 2007.

generalized increase in oil and chemical prices employed in agriculture. Therefore, rather than the transmission of world food prices changes to the domestic markets, the CGE model emphasizes the impact of the increase in oil and chemical prices. Changes in the production pattern point to a specialization of the economy in unskilled-labour-intensive products, like cereals other than maize and rice, fruits and vegetables; while wages are reduced in skilled employment (Table 8).

The observed decrease in Government savings (Table 7) is due to the appreciation of the exchange rate, which reduces the value of foreign transfers; these account for almost 40 percent of Government's revenues. The reduction in Government savings and urban households' income – the households with the highest propensity to save – determines a contraction of investments.

Under BASEPR_A, all farmers, rural and urban, benefit in terms of welfare (Table 9). Much of this stems from the increase in land and elementary labour wages. Urban households, instead, experience a welfare reduction, due to the contraction of skilled labour wages, and the increase in domestic prices of agriculture and foods. For urban consumers, such price increase is not counteracted by an increase in own-consumption, as it happens for rural households. The SAM does not report details in terms of households' income levels; hence we cannot detect the outcome for vulnerable groups. Consistently with what was observed in Figure 4 for inflation, households located in large urban areas and rural landless are the hardest hit.

The SCIs is consistent with what was observed in terms of specialization towards unskilled-labour-intensive sectors, as a reaction to the terms-of-trade shock: unskilled labour is the factor that would be subject to the highest changes under the price change scenarios (Table 10).

Compared to the standard baselines, those with reduced marketing margins (BASE_B and BASEPR_B) show how such wedges interact with foreign trade: both on the import and export side, the economy appears more sensitive and open to trade. The level of consumption would consequently be higher, while Government savings would be lower due to a higher price of the public administration services, and this would depress investments, which depends upon the public component to a large extent. Altogether, lowering margins appear to imply an effect similar to that of an increase in total factor productivity: economic efficiency is improved, hence more output is produced, and there's an almost generalized increase in the level of factors return (Table 8). As domestic prices become more similar to import and export prices, the former increase, in both tradable and non-tradable activities. Consequently, also welfare is higher for all households types, and especially for agricultural households, in both rural and urban areas, given the (assumed) wider size of margins in agriculture (Table 9).

Compared to the calibrated baseline, under the assumption of lower marketing margins the impact of the observed terms of trade shock would emphasize mainly the effect on imports, which would increase by a higher percentage, starting from an already higher base (Table 7). Agricultural exports would decrease - rather than increase as with standard parameters - due to the reduced gap between domestic and export prices which would reduce incentives to move resources toward producing exportables. Changes in consumption would also be smaller, while Government savings, which would start from a smaller budget surplus, would shrink as a consequence of the increased price of public administration services. Changes in both the nominal and the real exchange rates would be amplified, due to the wider variation of trade, and the larger increase in the tradable to non tradable price ratio. Altogether, lower marketing margins would make the economy more resilient to the terms of trade shock: while foreign trade would react to a grater extent, there would be a smaller

shift of domestic agricultural resources towards exportables. Consequently, welfare gains would be higher for small scale rural agriculture and for urban agriculture (Table 9). Adjustment costs would also be smaller, as shown by the SCI for unskilled labour (Table 10).

In order to check the sensitivity of these results to the assumptions adopted in the labour market, we run a test with an alternative closure for elementary and unskilled labour markets, implying excess unskilled labour, with variable supply and returns are fixed at the base level. The last column of Table 6 reports results for BASEPR_A with this unemployment closure. Discrepancies with the standard closure are small, both in terms of signs and in terms of the size of impacts. One minor difference which arises is the reduced pressure on agricultural prices arising from fixed wages, which causes a slightly increase in GDP, agricultural exports, production and consumption. The reduced price increase translates into a diminished welfare loss for urban consumers, and an increased gain for small, medium and urban farmers (Table 9).

5.2 Policy responses

Policy experiments are performed on the two different baselines, reporting the marketing margins of the SAM (BASEPR_A), and the 20 percent reduced margins (BASEPR_B). Main results are in Tables 11 and 12. A generalized reduction in import tariffs - scenarios TARCUT_A and TARCUT_B - implies mainly a further growth of agricultural imports, entailing small benefits from the point of view of consumption. Total imports shrink, since the demand for manufactured products diminishes. The reduced Government savings induce a contraction in investments which contributes to reduce supply, more than demand. In terms of welfare, this policy shows a positive effect on all households, albeit minimal, which would however come at a considerable cost in terms of Government savings and

reduced investment and consumption. The low impact of this policy in stabilizing domestic prices is due to the low level of applied tariff rates (Table 6) and the consequent impossibility to compensate with their reduction the high rise in international prices.

Taxing export revenues mostly imply negative consequences. An across-the-board tax on exports, modelled in scenarios EXPTAX_A and EXPTAX_B, produces counter-intuitive effects. By depressing returns to factors, the tax reduces output prices in most agricultural activities. The consequent changes in factors' allocation are such that domestic production migrates towards exportables, overshooting the reduction in export prices brought about by the tax. Hence exports end up increasing for most of the main agricultural exportable products[21]. At the same time, the reduction in factors' returns associated with the export tax depresses households' incomes and consumption, and results in a welfare loss. The only large gainer, under these scenarios, is the public sector, whose savings increase due to the proceedings of the export tax. Investment, in which public investment is a large share, increases as a consequence. Exports and imports growth brings about a significant devaluation of both the nominal and the real exchange rates.

Scenarios DOMTAX_A and DOMTAX_B simulate a reduction in domestic taxation on agricultural and food products. The effect of these policies on consumption shows the expected positive sign. Tax reduction enhances consumption and production, but it also drives up prices, especially those of agricultural products. In turn, this produces an increase in agricultural imports, which become relatively cheaper, with the exception of processed foods, whose price diminishes. Following the increase in consumption, welfare effects are positive for all households, and especially for urban consumers, due to their higher reliance on marketed production.

[21] A similar outcome is found by Conforti and Sarris (2008) for Tanzania

Trade policy experiments show very little differentiation between the two alternative baselines. Only those implying across-the-board tariff changes and the introduction of export taxes in all sectors show marginally lower changes under the assumption of reduced marketing margins.

As mentioned, the last three policy experiments deal with input subsidization in agriculture. Those mimicking the AISP programme – CHEMSEL_A and CHEMSEL_B - produce a decrease in the price of chemicals and in the domestic price of maize and tobacco, which drives up production of these crops, while reducing imports (Table 11). Following increased production of tobacco, agricultural exports increase. The reduction in maize imports under this scenario is stronger than the increase observed in other agricultural products, so that total agricultural imports shrink. Exports of other agricultural and non agricultural products also diminish, so that total exports decrease. Government revenues also decrease under this scenario, due to the reduced proceeding from import taxes, and the reduction in public savings shrinks investment. In turn, this determines a contraction in the demand for imported manufactured goods, which contributes to reduce total imports. This effect holds also for the other two policy experiments implying input subsidization; and so does also the appreciation of the real exchange, given that non-tradables prices tend to increase relative to tradables. In terms of welfare agricultural households benefit relatively more from this policy (Table 12), and targeting tobacco implies benefits for large farmers. However, gains arise also for urban households, following the reduced domestic price of maize, which is the major staple, and increased wages for elementary labour, which contribute to increase consumption.

Differences in the results for the two baselines are minimal, and mostly related to the public sector accounts, which however depend from the difference in the starting points. Changes in output, domestic prices and trade are smaller under the assumption of reduced

marketing margins, indicating a higher resilience of the economy to the terms of trade shock.

Smaller and less targeted input subsidies, applying to the whole agriculture - scenarios CHEMAGR_A and CHEMAGR_B -- produce an increase in domestic prices of maize and other staples, such as cassava and pulses, as well as groundnuts; and a price decrease for exportables, such as tobacco. As a result, imports of staples become relatively cheap, and domestic production decreases, partly crowded out by imports. On the export side, the generalized subsidy results in an expansion of exports, driven by tobacco (Table 11). Non agricultural imports, at the same time, increase. Households' consumption still increases, as well as welfare (Table 12): despite gains are concentrated in agricultural households, some positive effects arise also for non-agricultural and urban households.

Finally, scenarios CHEMALL_A and CHEMALL_B – assuming a 10 percent subsidy on all activities employing chemicals and oil – are not too different from those of the previous scenarios. The generalized subsidy still determines an increase in the domestic price of maize, cassava, groundnuts and vegetables; and a reduction in those of agricultural exportables and manufactured goods. On the exports side, non agricultural products are hindered, while export crops benefit, with the exception of tobacco. The comparison of all policies under the two different baselines chosen shows very similar effects on the economy.

5.3 Sensitivity and model validation

A number of tests where run on the results with the aim of understanding their degree of robustness. Firstly, sensitivity was assessed with respect to the value of key parameters: we repeated the simulations described in the last section with different values for the constant elasticity of transformation (CET), that allocates production between domestic markets and

exports; for the Armington constant elasticity of substitution (CES), that controls consumers' preference between domestically produced and imported goods; and for the constant elasticity of substitution (CES) at the bottom nest of the production function, which rules the substitution among factors. Besides sensitivity, changes in these parameters can also be interpreted as counterfactual scenarios in which the economy is assumed to be more integrated in world markets, and more rapidly reacting to foreign price signals.

Trade elasticities were augmented by 50 percent, while production parameters were doubled. These tests were performed on all activities, as well as for agricultural and processed food products only, so that six different alternative sets of results were generated for all scenarios. Results are reported here only for BASEPR_A compared to the calibrated solution (BASE_A) (Table A1)[22]. Parameters changes do not appear to invalidate the result presented above: most macro variables do not show changes in the sign when the parameters set is changed, and also percentage changes appear to be very similar.

However, it is worth noticing that when the CET elasticity is increased, that is when we assume a higher degree of substitutability between domestic and exports markets, changes in trade and consumption are amplified. Sign changes, appear for instance, in tobacco - and total agricultural - exports. With the change in world prices, agricultural exports show a reduction - instead of an increase as with standard parameters - when simulations are run with a higher value of the CET. Under increased sensitivity of imports, urban consumers appear to be better-off, due to improved consumption, production and even exports; as a result, total exports increases, while they were shrinking with standard parameters.

Secondly, a set of experiment were conducted with the aim of understanding the extent to which the model is capable of reproducing observed trends in the Malawian economy, or at

[22] Results of the sensitivity for the other scenarios are available from the authors upon request.

least capturing the main driving forces that characterized it. To this end, we considered changes occurred in a number of variables between the reference year of the SAM, which is 2004, and 2007, which is the reference year of our simulations; and shocked the model with these changes to check on its performance. Several economic modifications took place in Malawi over that period, and the model only allows shocking few of them; hence we choose investment, public expenditure, total factor productivity and labour supply[23].

The results of this experiment (Table A2) highlight that the model produces a reasonable approximation of the observed economic performance in terms of GDP growth at constant prices, value added, and change in the exchange rate; results for trade, however, appear to be less accurate.

Concluding remarks

Price spikes like the one observed in 2007-08 are likely to affect Malawi and its agriculture to a significant extent. Despite available data for 2007 show a reduction in the import unit values for key food staples such as maize and rice, the simulations presented point to an increase in the domestic price of these products and of most agricultural products, which is confirmed by inflation observed in the country. The main reason of the price increase, however, is the increase in the cost of imported oil and chemical products, which affects production costs in agriculture. Therefore, both the evidence of weak integration in world maize markets due to transport costs and structural constraints, and that of co-movement of domestic and world maize prices are plausible: domestic food prices in Malawi have been raising following an increase in production cost, while cheap imports from neighbouring

[23] Data on total investments and public expenditure were retrieved from the United Nations Statistical Division, labour force from International Financial Statistics (IFS), productivity from Nin et al. (2003). In order to be able to use invested resources as an exogenous information, we had to adopt an investment-driven closure for this test.

countries, which took place in isolation from world markets – through the Mozambican border –have partly substituted domestic production.

In general, our results indicate that the presence of structural constraints in the economy may have dampened the effect of the food price spike by hindering transmission of price signals for key staples, this was not an advantage for urban and non agricultural households. Once shifts in land, labour and capital allocation among crops are taken into account, it becomes evident that raising production costs may result in small benefits for farmers. In our results, gains accruing to farmers are smaller than losses experienced by urban consumers, due to a polarization of agriculture toward unskilled-labour-intensive products.

Policy experiments confirmed the notion that export taxes are mostly ineffective in counteracting a price spike. They certainly generate public revenues, but hamper producers' incentives. In our results, this effect is so pronounced that it produces a counter-intuitive effect, by which relative prices lead to a further concentration of activities in exportables. Indirectly, experiments with export taxes also underline the ineffectiveness of exports bans in counteracting the negative impacts of a commodity price spike.

Tariff and domestic taxes reductions appear more beneficial; most households show welfare increases with these policies. However, public revenues would be reduced considerably under these scenarios; an outcome that may imply negative dynamic consequences, given the tight relation between public resources and investment in the economy.

Subsidies on the use of chemicals in agriculture appear as an effective mean to support agriculture, at least in the short run, which turns out to be beneficial to most households. In our results, this outcome also stems from the fact that inflation, based on the COMTRADE import unit value data, is imported mainly through chemicals and oil. For this policy,

however, the reduction in public savings produces a decrease in investment, whose effects are not evident, but likely to be significant throughout time.

More importantly, our results show that if it would be possible to tackle some key structural constraints – as represented by the 20 percent reduced marketing margins baseline – the economy would become more resilient, also to a terms-of trade shock like the one experienced in 2007 and 2008. Domestic demand and supply would react more directly to the new prices, and imports and exports patterns would adjust faster to compensate for the change in the terms of trade. Therefore, the main implication of the simulations presented is that increased efforts should be devoted to improve physical infrastructures and institutions allowing to make the economy more integrated, both domestically and internationally.

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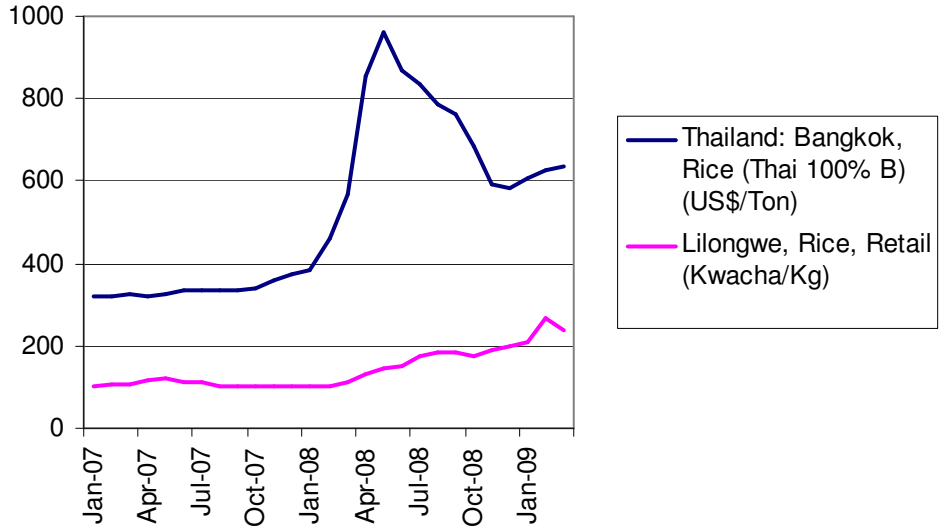
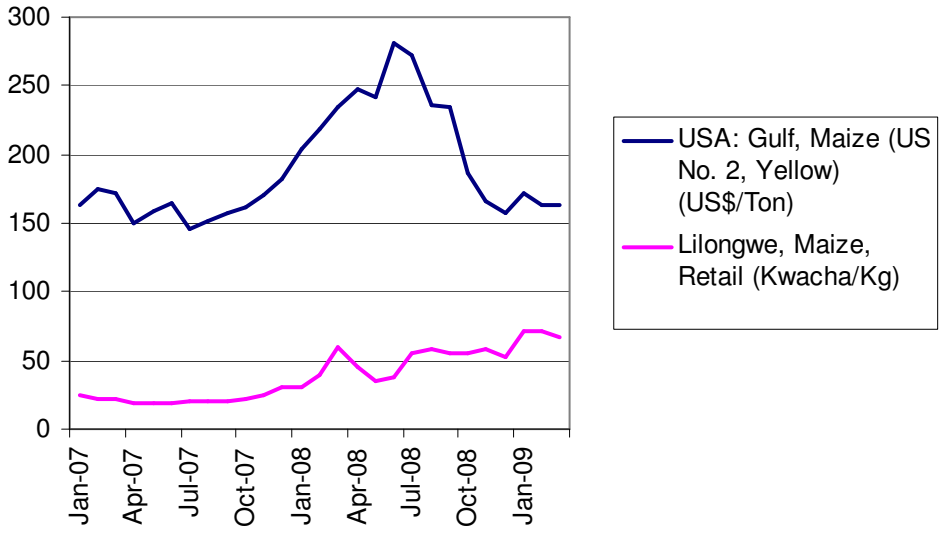
Figure 1. Changes in World and Malawian rice price



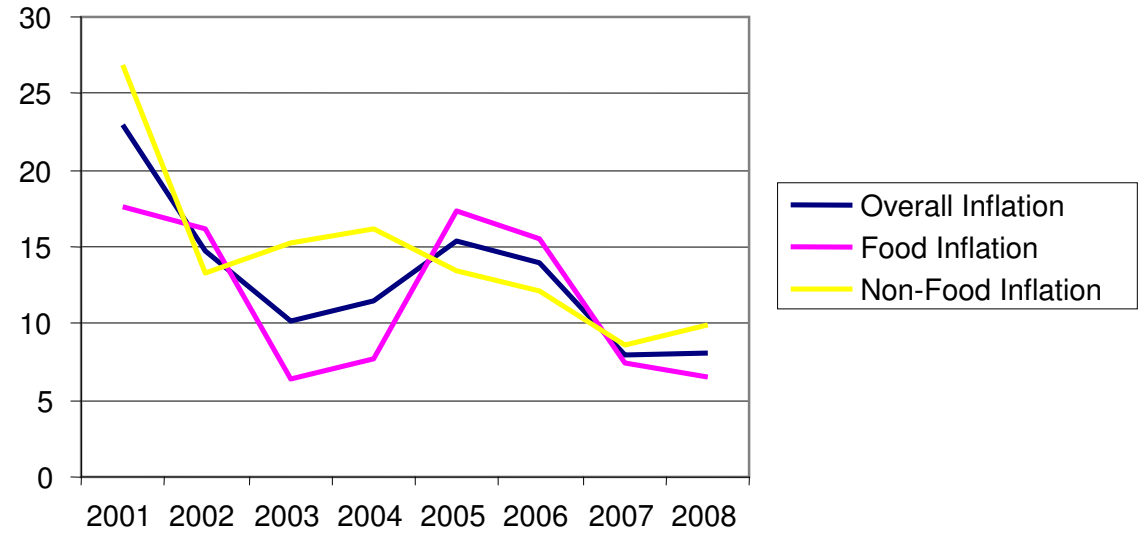
Sources: FAO-GIEWS

Figure 2. Changes in World and Malawian maize price



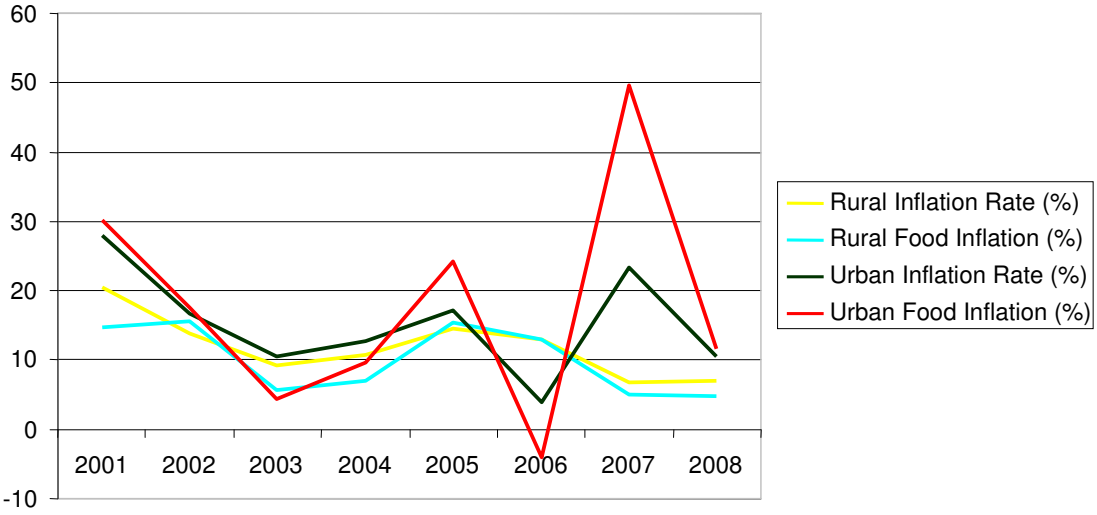
Sources: FAO-GIEWS

Figure 3. Malawian Food, Non-food and Overall Inflation



Source: Malawian National Statistical Office

Figure 4. Total, Rural and Urban CPI percentage change

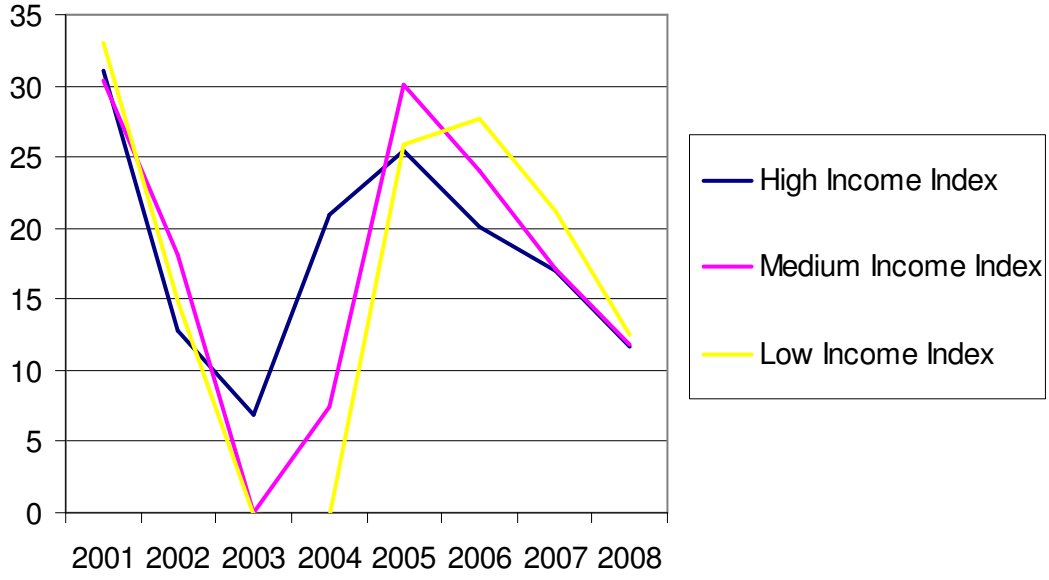


Source: Malawian National Statistical Office

Figure 5. Percentage change in Food CPI: Lilongwe, for Low, Medium and High income households

Source: Malawian National Statistical Office

Figure 6. Percentage change in Food CPI: Blantyre, for Low, Medium and High income households



Source: Malawian National Statistical Office

Table 1. Percentage changes in Malawi export and import unit values

	Export unit value 2007-2004	source	Import unit value 2007-2004	source
Maize	48.6	COMTRADE	-15.8	COMTRADE
Rice			-13.2	COMTRADE
Other Cereals			42.7	COMTRADE
Pulses	40.3	COMTRADE	22.0	COMTRADE
Vegetables	128.4	COMTRADE	32.8	COMTRADE
Fruits	106.8	COMTRADE	38.4	COMTRADE
Tobacco	21.9	COMTRADE		
Cotton	10.8	COMTRADE		
Sugar	27.6	COMTRADE		
Tea	13.6	NSO		
Other Crops	105.2	COMTRADE	12.6	COMTRADE
Poultry			48.4	COMTRADE
Livestock	8.5	COMTRADE	10.6	COMTRADE
Fishing and Hunting	-17.9	COMTRADE	40.2	COMTRADE
Forestry	-60.8	NSO	-85.6	COMTRADE
Other Processed Foods	8.8	COMTRADE	13.3	COMTRADE
Beverages and Tobacco	63.6	COMTRADE	0.7	COMTRADE
Manufacture	7.4	NSO	5.5	COMTRADE
Chemicals			78.1	COMTRADE

Source: author's calculations

Table 2. Origin of the external price shock before adjustments
(Million Kwc and percentage of GDP)

	Exports (Qx*Δpx)	Imports Qm*Δpm	Exports (Qx*Δpx)/GDP	Imports (Qm*Δpm)/GDP
Agriculture, Fishery & Forestry	6256.64	866.88	3.45	0.48
Food	5517.27	374.59	3.04	0.21
Manufactures	605.69	2757.84	0.33	1.52
Chemicals	0	12857.20	0	7.08
Total	12379.6	16856.5	6.8	9.3
Total Change percentage of GDP (exports-imports)				-2.5

Source: author's calculations

Table 3. The SAM for Malawi
(2004, Million Kwc)

	Act. (27)	Comm. (27)	margins (3)	labour (3)	capital (2)	land (4)	Ent. (1)	HH (7)	Gov.	taxes (3)	ROW	S-I	TOTAL expend
Activities (27)		268						25					293
Comm.(27)	110		43					169	35		56	30	442
Margins (3)		43											43
Labour (3)	104												104
Capital (2)	51												51
Land (4)	26												26
Enter. (1)					37				28		11		75
HH(7)				104	15	26	63		2				210
Gov.										44	27		71
Taxes (3)		26					12	6					44
ROW		106											106
S-I								11	6		13		30
TOTAL	292	442	43	104	51	26	75		71	44	106	30	1284

Source: author's calculations on Thurlow et al. (2008)

Table 4. Production and trade structure of the Malawian economy in 2004

	Share in value added	Export Share	Export Intensity	Share of exports in GDP	Import share	Import Intensity	Share of imports in GDP	Share of marketed production in total production	Ratio of domestic margin to marketed production
Maize	9.84	0.27	0.67	0.08	3.97	18.99	2.32	51.57	0.25
Rice	1.16	0	0	0	0.10	2.75	0.06	90.39	0.19
Other Cereals	0.64	0	0	0	1.01	36.07	0.59	78.47	0.18
Cassava and Roots	2.77	0	0	0	0	0	0	70.97	0.20
Pulses	3.21	3.09	18.51	0.95	0.20	2.33	0.12	84.59	0.30
Groundnuts	1.82	0	0	0	0	0	0	18.90	0.49
Vegetables	2.77	0.51	3.17	0.16	0.33	3.87	0.19	84.76	0.24
Fruits	1.37	0.56	7.76	0.17	0.31	8.21	0.18	65.00	0.35
Tobacco	5.65	25.82	82.37	7.91	0	0	0	100	0.17
Cotton	0.91	4.16	81.56	1.27	0	0	0	100	0.20
Sugar	1.51	8.07	88.72	2.47	0	0	0	100	0.21
Tea	1.62	8.32	99.06	2.55	0	0	0	100	0.17
Other Crops	0.23	0.84	28.97	0.26	0.73	48.51	0.43	100	0.09
Poultry	1.06	0	0	0	1.32	17.33	0.77	95.52	0.18
Livestock	1.31	0.10	1.35	0.03	0.63	15.99	0.37	89.98	0.18
Fishing and Hunting	2.24	0.03	0.28	0.01	0.07	1.26	0.04	97.36	0.13
Forestry	0.85	2.88	44.12	0.88	0.09	2.63	0.05	100	0.39
Other Processed Foods	3.57	1.79	5.53	0.55	2.42	14.30	1.42	80.16	0.07
Beverages and Tobacco	1.65	15.34	48.45	4.70	4.76	28.70	2.78	94.41	0.30
Manufacture	5.71	14.56	9.18	4.46	47.26	56.86	27.63	100	0.09
Chemicals	1.32	0	0	0	15.52	52.91	9.07	100	0.10
Electricity and Water	1.34	0	0	0	10.30	62.72	6.02	100	0
Trade	20.17	0	0	0	0	0	0	100	0
Traded Services	2.75	13.65	51.19	4.18	6.44	46.09	3.76	100	0
Communication	1.56	0	0	0	4.52	48.28	2.64	100	0
Financial Services	6.47	0	0	0	0	0	0	100	0
Public Administration	16.51	0	0	0	0	0	0	100	0

Source: author's calculations on Thurlow et al. (2008)
Export (Import) Share= percentage of exports (imports) on total exports (imports)
Export (Import) Intensity= percentage of exports (imports) on total output (domestic demand)

Table 5. The scenarios simulated

BASE_A calibration		**BASE_B** updated base with 20 percent decrease in marketing margins	
BASEPR_A updated base with increased world prices		**BASEPR_B** updated base with 20 percent decrease in marketing margins and increased world prices	
	policy scenarios		
TARCUT_A	20 percent cut in import tariffs, on BASEPR_A	**TARCUT_B**	20 percent cut in import tariffs, on BASEPR_B
EXPTAX_A	5 percent export tax on all exports, on BASEPR_A	**EXPTAX_B**	5 percent export tax on all exports, on BASEPR_B
DOMTAX_A	20 percent decrease in sales taxes on basic foods, on BASEPR_A	**DOMTAX_B**	20 percent decrease in sales taxes on basic foods, on BASEPR_B
CHEMSEL_A	50 percent subsidy on chemicals for maize and tobacco, on BASEPR_A	**CHEMSEL_B**	50 percent subsidy on chemicals for maize and tobacco, on BASEPR_B
CHEMAGR_A	15 percent subsidy on chemicals for agricultural sectors, on BASEPR_A	**CHEMAGR_B**	15 percent subsidy on chemicals for agricultural sectors, on BASEPR_B
CHEMALL_A	10 percent subsidy on chemicals for all sectors, on BASEPR_A	**CHEMALL_B**	10 percent subsidy on chemicals for all sectors, on BASEPR_B

Table 6. Import, Domestic and Export Tax rate under Base and Simulations

	Import Tariff Rate		Sale Tax Rate		Export Tax Rate	
	BASE_A	TARCUT_A	BASE_A	DOMTAX_A	BASE_A	EXPTAX_A
maize	*0.001*	*0.00092*	*0.012*	*0.01*	*0*	*0.05*
rice	*0.051*	*0.04*	*0.074*	*0.059*	*0*	*0*
other cereals	*0.046*	*0.037*	*0.104*	*0.083*	*0*	*0*
cassava and roots	*0*	*0*	*0.084*	*0.067*	*0*	*0*
pulses	*0.05*	*0.04*	*0.079*	*0.063*	*0*	*0.05*
groundnuts	*0*	*0*	*0.172*	*0.138*	*0*	*0*
vegetables	*0.05*	*0.04*	*0.101*	*0.081*	*0*	*0.05*
fruits	*0.051*	*0.041*	*0.085*	*0.068*	*0*	*0.05*
tobacco	*0*	*0*	*0*	*0*	*0*	*0.05*
cotton	*0*	*0*	*0*	*0*	*0*	*0.05*
sugar	*0*	*0*	*0*	*0*	*0*	*0.05*
tea	*0*	*0*	*0*	*0*	*0*	*0.05*
other crops	*0.232*	*0.186*	*0*	*0*	*0*	*0.05*
poultry	*0.063*	*0.05*	*0.04*	*0.032*	*0*	*0*
livestock	*0.061*	*0.049*	*0.048*	*0.038*	*0*	*0.05*
fishing and hunting	*0.063*	*0.05*	*0.04*	*0.032*	*0*	*0.05*
forestry	*0.064*	*0.051*	*0.025*	*0.025*	*0*	*0.05*
other processed foods	*0.116*	*0.093*	*0.073*	*0.058*	*0*	*0.05*
beverages & tobacco	*0.04*	*0.032*	*0.044*	*0.044*	*0*	*0.05*
manufacture	*0.081*	*0.065*	*0.092*	*0.092*	*0*	*0.05*
chemicals	*0.05*	*0.04*	*0.077*	*0.077*	*0*	*0*
electricity and water	*0*	*0*	*0.033*	*0.033*	*0*	*0*
trade	*0*	*0*	*0.027*	*0.027*	*0*	*0.05*
traded services	*0*	*0*	*0.056*	*0.056*	*0*	*0*
communication	*0*	*0*	*0.047*	*0.047*	*0*	*0*
financial services	*0*	*0*	*0.033*	*0.033*	*0*	*0*
public administration	*0*	*0*	*0.008*	*0.008*	*0*	*0*

Source: author's calculations

Table 7. Aggregated results under the basic scenarios
(Million Kwc in BASE and percentage changes from BASE in other scenarios)

	BASE_A	BASEPR_A	BASE_B	BASEPR_B	BASEPR_B on BASE_B	BASEPR_A with unemployment
GDP	181525.9	*-0.5*	*-0.1*	*-0.7*	*-0.6*	*0.0*
Agricultural Imports	11883.1	*60.4*	*13.9*	*81.1*	*58.9*	*57.8*
Total Imports	106112.9	*1.5*	*2.5*	*4.8*	*2.3*	*1.9*
Agricultural Exports	30391.2	*1.1*	*-2.2*	*-2.5*	*-0.3*	*2.6*
Total Exports	55595.8	*-0.7*	*1.7*	*0.6*	*-1.1*	*-0.3*
Consumption	192878.9	*0.5*	*6.3*	*7.6*	*1.3*	*1.1*
Investments	29880.3	*-7.8*	*-1.2*	*-11.2*	*-10.7*	*-8.6*
Government Savings %	5764.2	*-39.9*	*-23.2*	*-74.1*	*-66.3*	*-43.9*
Government Expenditure	64988	*66558*	*64234*	*66452*	*-105*	*3235.4*
Government Income	70753	*70983*	*67600*	*67942*	*-3040*	*67990*
Unskilled and Elementary Labour	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*1.6*
Nominal Exchange Rate	1.000	*-12.1*	*-1.7*	*-14.2*	*-2.4*	*-12.1*
Real Exchange Rate (trd/nontrd)	1.000	*3.5*	*1.4*	*3.2*	*1.8*	*1.9*

Source: author's calculations

Table 8. Factor price changes in basic scenarios
(Percentage change from BASE)

	BASEPR_A	BASE_B	BASEPR_B	BASEPR_B on BASE_B
Elementary Labour (ILO 9)	*7.6*	*14.0*	*20.2*	*5.5*
Unskilled Labour (ILO 4-8)	*-0.2*	*3.6*	*4.7*	*1.1*
Skilled Labour (ILO 1-3)	*-3.0*	*6.8*	*6.4*	*-0.3*
Small-Scale Rural Farm Land	*10.9*	*15.2*	*24.5*	*8.1*
Medium-Scale Rural Farm Land	*9.9*	*14.3*	*23.2*	*7.8*
Large-Scale Rural Farm Land	*7.1*	*9.4*	*17.1*	*7.0*
Urban Farm Land	*12.8*	*13.0*	*22.5*	*8.4*

Source: author's calculations

Table 9. Welfare results under basic scenarios
(Percentage change from BASE)

	BASEPR_A	BASE_B	BASEPR_B	BASEPR_B on BASE_B	BASEPR_A with unemployment
Agricultural Small-scale	*0.9*	*6.3*	*7.4*	*1.0*	*1.2*
Agricultural Medium-scale	*0.1*	*5.6*	*6.0*	*0.4*	*0.6*
Agricultural Large-scale	*2.2*	*6.1*	*8.0*	*1.8*	*2.2*
Rural non-Agricultural	*-3.3*	*2.6*	*0.7*	*-1.9*	*-2.1*
Lilongwe and Blantyre (non-Agricultural)	*-2.3*	*4.2*	*3.7*	*-0.5*	*-1.0*
Urban non-Agricultural	*-2.0*	*3.4*	*2.7*	*-0.7*	*-1.1*
Urban Agricultural	*1.0*	*4.6*	*5.8*	*1.2*	*1.4*

Source: author's calculations

Table 10. Structural Change Indexes in the basic scenarios
(Percentage change from BASE)

	SCI Value Added	SCI Elementary and Unskilled Labour	SCI Skilled Labour
BASEPR_A	3.93	6.16	2.86
BASE_B	2.40	4.23	3.70
BASEPR_B	5.24	8.56	4.32

Source: author's calculations

Table 11. Aggregated results under the policy scenarios
(Percentage change from BASEPR and BASEPRTD)

	TARCUT_A	EXPTAX_A	DOMTAX_A	CHEMSEL_A	CHEMAGR_A	CHEMALL_A
GDP	*0.00*	*-0.01*	*0.00*	*0.00*	*-0.03*	*-0.01*
Agricultural Imports	*1.00*	*-8.38*	*0.47*	*-0.58*	*1.07*	*0.93*
Total Imports	*-0.30*	*1.14*	*-0.45*	*-0.58*	*-0.52*	*-0.52*
Agricultural Exports	*-0.18*	*0.29*	*-0.64*	*0.42*	*0.81*	*0.31*
Total Exports	*-0.36*	*1.37*	*-0.68*	*-0.57*	*-0.48*	*-0.49*
Consumption	*0.67*	*-2.85*	*0.84*	*0.57*	*0.79*	*0.73*
Investments	*-4.23*	*19.97*	*-5.51*	*-5.13*	*-5.74*	*-5.38*
Government Savings %	*-39.23*	*170.57*	*-41.66*	*-40.96*	*-46.63*	*-43.78*
Government Expenditure	*64465.5*	*63107.5*	*64677.2*	*64375.6*	*64293.4*	*64363.1*
Government Income	*66571.3*	*72483.0*	*66698.9*	*66421.5*	*66142.6*	*66311.4*
Nominal Exchange Rate	*0.20*	*4.18*	*0.38*	*-0.57*	*-0.52*	*-0.44*
Real Exchange Rate	*-0.25*	*1.60*	*-0.60*	*-0.94*	*-0.51*	*-0.56*
	TARCUT_B	EXPTAX_B	DOMTAX_B	CHEMSEL_B	CHEMAGR_B	CHEMALL_B
GDP	*-0.01*	*0.02*	*-0.01*	*-0.02*	*-0.03*	*-0.01*
Agricultural Imports	*0.99*	*-8.20*	*0.59*	*-0.44*	*0.92*	*0.81*
Total Imports	*-0.25*	*0.88*	*-0.45*	*-0.52*	*-0.46*	*-0.46*
Agricultural Exports	*-0.12*	*0.02*	*-0.68*	*0.27*	*0.98*	*0.46*
Total Exports	*-0.27*	*0.94*	*-0.67*	*-0.53*	*-0.36*	*-0.36*
Consumption	*0.62*	*-2.69*	*0.84*	*0.51*	*0.70*	*0.65*
Investments	*-4.41*	*20.98*	*-6.07*	*-5.19*	*-5.73*	*-5.37*
Government Savings%	*158.5*	*7320.7*	*-26.5*	*138.9*	*-25.5*	*65.4*
Government Expenditure	*66677.4*	*65325.4*	*66896.9*	*66586.5*	*66494.0*	*66563.2*
Government Income	*66836.0*	*72646.1*	*66870.4*	*66725.4*	*66468.5*	*66628.6*
Nominal Exchange Rate	*0.23*	*4.02*	*0.37*	*-0.54*	*-0.45*	*-0.38*
Real Exchange Rate	*-0.20*	*1.37*	*-0.51*	*-0.85*	*-0.42*	*-0.46*

Source: author's calculations

Table 12. Welfare results under the policy scenarios
(Percentage change from BASEPR and BASEPRTD)

	TARCUT_A	EXPTAX_A	DOMTAX_A	CHEMSEL_A	CHEMAGR_A	CHEMALL_A
Agricultural Small-Scale	0.53	-2.30	0.63	0.83	1.42	0.88
Agric. Medium-Scale	0.53	-2.25	0.59	0.83	1.31	0.81
Agricultural Large-Scale	0.47	-2.01	0.16	0.99	1.75	0.91
Rural Non-Agricultural	0.46	-2.38	0.82	0.37	0.15	0.31
Lilongwe And Blantyre	0.64	-3.42	1.06	0.46	0.25	0.44
Urban Non-Agricultural	0.55	-2.92	0.84	0.35	0.38	0.48
Urban Agricultural	0.46	-2.30	0.52	0.53	1.14	0.74
	TARCUT_B	EXPTAX_B	DOMTAX_B	CHEMSEL_B	CHEMAGR_B	CHEMALL_B
Agricultural Small-Scale	0.48	-2.09	0.64	0.76	1.25	0.78
Agric. Medium-Scale	0.48	-2.04	0.59	0.74	1.14	0.71
Agricultural Large-Scale	0.44	-1.90	0.19	0.84	1.58	0.83
Rural Non-Agricultural	0.42	-2.22	0.78	0.34	0.10	0.25
Lilongwe And Blantyre	0.56	-3.14	1.00	0.40	0.17	0.36
Urban Non-Agricultural	0.51	-2.72	0.80	0.31	0.31	0.41
Urban Agricultural	0.43	-2.18	0.53	0.48	1.03	0.67

Source: author's calculations

APPENDIX

Table A1. Aggregated results for BASEPR under different parameters

(Million Kwc in BASE and percentage changes from BASE in other scenarios

	BASE_A	BASEPR_A						
		standard parameters	higher CET elasticity, all products	higher CET elasticity, agricultural and food products only	higher CES elasticity, all products	higher CES elasticity, agricultural and food products only	higher supply elasticity in all activities	higher supply elasticity in agriculture and food production only
GDP	181525.9	*-0.5*	*-0.6*	*-0.6*	*-0.7*	*-0.6*	*-0.8*	*-0.8*
Agricultural Imports	30391.2	*60.4*	*68.2*	*68.3*	*86.1*	*86.1*	*65.3*	*65.7*
Total Imports	55595.8	*1.5*	*2.2*	*2.2*	*3.5*	*3.4*	*1.8*	*1.7*
Agricultural Exports	9314.3	*1.1*	*-1.9*	*-2.0*	*4.0*	*4.0*	*3.1*	*2.0*
Total Exports	106112.9	*-0.7*	*-3.4*	*-3.3*	*0.9*	*1.0*	*-2.0*	*-1.0*
Consumption	192878.9	*0.5*	*1.4*	*1.4*	*0.8*	*0.8*	*1.0*	*0.9*
Investments	29880.3	*-7.8*	*-9.2*	*-9.4*	*-8.4*	*-8.6*	*-8.6*	*-8.3*
Government Savings %	5764.2	*-39.9*	*-50.7*	*-51.3*	*-42.3*	*-43.2*	*-44.8*	*-43.8*
Nominal Exchange Rate	1.0	*-12.1*	*-13.7*	*-13.7*	*-11.4*	*-11.4*	*-12.7*	*-12.7*
Real Exchange Rate	1.0	*3.5*	*3.8*	*3.7*	*1.3*	*1.3*	*4.0*	*4.1*
SCI Value Added	0.0	3.9	*4.5*	*4.5*	*4.7*	*4.6*	*4.4*	*4.1*
SCI Unskilled Labour	0.0	6.2	*6.8*	*6.7*	*7.1*	*7.0*	*7.1*	*6.5*
SCI Skilled Labour	0.0	2.9	*2.9*	*2.9*	*2.8*	*2.6*	*3.1*	*2.9*

Source: author's calculations

Table A2 Model validation

	2007/2004	2007/2006	VALIDATION
GDP at constant 1990 prices			
	19.03	7.40	18.88
GDP by Type of Expenditure at constant 1990 prices in Million Kwacha			
Household consumption expenditure	27.86	-1.50	6.77
Exports	28.81	19.88	43.14
Imports	52.80	6.33	22.26
Value Added by Kind of Economic Activity at constant 1990 prices in Million Kwacha			
Agriculture	11.33	8.96	21.54
Manufacturing	23.92	7.05	23.37
Wholesale, retail trade, restaurants and hotels	25.23	6.32	19.24
Other activities	22.06	4.98	13.10
Exchange Rate			
	28.52	2.90	10.42

Source: United Nations Statistical Division, International Financial Statistics (IFS), World Development Indicators (WDI) and author's calculations