Pro-poor Development Strategies for Malawi: An Economy-wide Analysis of Alternative Policy Scenarios[1]

Peter Wobst[*], Hans Lofgren[#], Hardwick Tchale[@] and Jamie Morrison[+]

[*] Center for Development Research (ZEF), University of Bonn and International Food Policy Research Institute, 2033 K Street, N.W., Washington DC 20006-1002 USA.

[#] International Food Policy Research Institute, 2033 K Street, N.W., Washington DC 20006-1002 USA.

[@] Center for Development Research (ZEF), University of Bonn and Bunda College, University of Malawi, P O Box 219, Lilongwe, Malawi

[+] Centre for Development and Poverty Reduction, Department of Agricultural Sciences, Imperial College London, Wye Campus, Ashford, Kent TN25 5AH, UK.

February 2004

Introduction and Project Objectives

The report describes the results and issues emanating from an economy-wide analysis undertaken to assess the relative merits of a number of alternative pro-poor development strategies for Malawi. The analysis forms part of a wider project aiming to identify institutional and policy packages that can promote pro-poor agricultural growth. A key objective of the study is to examine the issues associated with the success and failure of alternative agricultural strategies, as well as the challenges facing agrarian

[1] This research was funded by the Department for International Development of the United Kingdom under research project Institutions and Economic Policies for Pro-Poor Agricultural Growth. (R7989). It involved researchers from the Imperial College of the University of London, the International Food Policy Research Institute (IFPRI), Jawarhal Nehru University in India, University of Zimbabwe, Bunda College of the University of Malawi, and the Center for Development Research (ZEF), University of Bonn.The findings, interpretations and conclusion expressed in this paper are entirely those of the authors and should not be attributed to the Department for International Development, which does not guarantee their accuracy and can accept no responsibility for any consequences of their use.

economies in a pre-green revolution period. Of particular importance is the need to draw lessons from the relatively successful green-revolution story from India for possible adaptation into the growth strategies for the African case study countries of Malawi and Zimbabwe[2].

This paper describes an analysis of the economy-wide potential for pro-poor agricultural growth in Malawi. The first part provides the background to Malawi's recent performance from an economy-wide perspective, with specific focus on agricultural development and poverty reduction. This is followed by a detailed description of the dynamic computable general equilibrium (CGE) model and database that are used for the analysis, as well as the baseline results. The third section outlines the results of the counterfactual scenarios that were investigated in the analysis and the last section draws conclusions and policy recommendations emanating from the results.

Background on Malawi

Despite embarking on economic stabilization programmes aimed at accelerating agricultural and economic growth in the early 1980s, economic performance has been dismal with negative per-capita growth in most years, both for agriculture and the economy as a whole. The recent poverty profile indicates that Malawians are poorer now than a decade or two ago although income distribution has become slightly more equitable (NSO/NEC, 2000; UNDP, 2002). Malawi's economic structure remains much the same as it was before the economic reforms. Today, after more than two decades of implementation of the reforms, agricultural technologies employed by most farmers are still rudimentary, associated with declining productivity and extensive food insecurity.

There is detailed description of the impacts of the reform processes in Malawi and its neighbours (see Jayne and Jones 1997; Kherallah and Govindan 1999; Jayne *et al.* 2001;Chilowa 1998; Deininger and Olinto 2000; Dorward *et al*. 2004, Chirwa and Zakeyo 2003). A review of this literature reveals that there is disagreement regarding the impacts of the reform processes, largely based on the difficulty of (i) establishing counterfactual arguments regarding the effects of alternative policies to liberalization and

[2] The detailed research and review questions are outlined in the Project Memorandum document (www.wye.ci.ac.uk/AgEcon/ADU/projects/ppag/).

(ii) separating the effects of different elements of reform process from other changes that have been happening concurrently, for example in national governance and in international markets (Kherallah 2000, Jayne *et al.* 2001, Dorward *et al.* 2004; Orr and Mwale 2001). Given its purpose, this report will not go into further detail in these areas. However, there are a few issues worth noting regarding the overall impact of the economic reforms on economic growth and poverty reduction in Malawi.

The overall assessment of the impact of policy reforms to-date suggests that they have had a negative impact on the living standards of the predominantly rural agricultural population. Per capita food availability as measured through both physical quantities and calorific value displayed a significant downward trend during the 1980s (World Bank, 1990). Per capita maize supply fell during the 1990s, although data suggest that this fall was partially offset by an increase in cassava and potato production (Chirwa and Zakeyo 2003). Additionally, as a direct consequence of declining agricultural terms of trade, the real value of the minimum wage has been on the decline (Sahn *et al*., 1990; OPC, 1989).

However, despite the commitment by the government to reduce poverty (as evidenced in the Malawian PRSP), there are still a number of structural and institutional impediments that militate against the effective implementation of poverty reduction strategies. Dorward and Kydd (2002) and Devereux (2002) have discussed in more detail the underlying factors that make achievement of poverty reduction still largely unattainable. Key among these factors is the low level of market development resulting from excessively low level of economic activity, the associated risks from lack of diversification, and of poor communications, set against a background of thin markets. Due to low volumes of trade, the costs and risks of trading are high, and this is exacerbated by the high transactions costs related to low development of market and transportation infrastructure as well as information asymmetry. This requires high risk premiums and margins to make it profitable to engage in markets, but these high margins themselves depress demand for agricultural products (since those who collect the margins have relatively low spending shares for agricultural products), and the result is a low level equilibrium trap and market failure (Dorward and Kydd, 2002). These problems are particularly acute in the input, output and financial markets needed for the intensification of seasonal food crop production.

As noted by Dorward and Kydd (2002), the excessively low levels of financial and physical capital together with reliance on agriculture and natural resources make poor rural economies and livelihoods highly exposed and vulnerable to risks of natural shocks. These might arise from adverse weather (affecting crop yields or damaging physical assets); human, crop or animal disease; or physical insecurity (as a result of crime, or political violence, or conflict). All these problems characterize the state of market failure in Malawi after the implementation of the reforms.

When markets are largely non-functional with only limited responses of poor producer households to policy changes, the design of strategies for poverty reduction becomes more difficult. This report and its underlying analysis aims to contribute to the challenge of designing policies that *can* reduce poverty in Malawi.

Model and Data

A dynamic CGE model is used to simulate the impact of policies on growth and poverty. Its structure permits the analysis of trade-offs and synergies between different policies and the consequences of alternative financing mechanisms (including reliance on foreign borrowing).

The dynamic model is an extension of the static, standard CGE model set out in Lofgren *et al.* (2002). It is formulated as a simultaneous equation system, including both linear and non-linear equations. The equations define the behaviour of the agents, including the government, as well as the environment under which these agents operate: market equilibrium conditions, macro balances, and dynamic updating equations.

Apart from being dynamic, it extends the earlier model by endogenizing the process of technical change. More specifically, it incorporates links between, on the one hand, factor productivity and, on the other hand, government spending and openness to foreign trade.

The model belongs to the recursive strand of the dynamic CGE literature, which is used more extensively in policy analysis than the alternative intertemporal optimization models. A recursive model may be solved one period at a time. The equations are divided into a *within-period module*, which defines the decisions in each time period, and a *between-period module*, which provides a link between different periods. Selected

parameters (factor supplies, population, and factor productivity) are updated on the basis of both exogenous trends and the simulated results from previous periods. All agents (private and public) are myopic, making their decisions on the basis of past and current conditions with no explicit account of the future. As opposed to other recursive models the model is solved for all time periods in a single pass. This is computationally more efficient (reducing the time needed to carry out simulations) and permits extensions where the decision rules of agents are reformulated to selectively draw on knowledge about future periods.

The preference for assuming myopic agent behaviour stems from the fact that there is little empirical support for the notion that, as a general rule, agents act on the basis of perfect foresight. The factors that prevent agents from realizing patterns of savings and investment that, according to some criterion, are intertemporally optimal are not explicitly specified. However, they may include credit constraints and/or the belief that any knowledge about the future is too uncertain to act on.

Other model features, which also appear in the static model version and which are of particular importance in a Sub-Saharan African setting, include an explicit treatment of transactions costs for commodities that enter the market sphere. The *within-period module* that defines a one-period, static CGE model as well as the *between-period module* that covers the links between different time periods are described in detail in the Appendix.

The model database consists of a Social Accounting Matrix (SAM), data on labour force and population, and a set of elasticities for trade, production and consumption. Appendix Table A.1 shows the values of the elasticities for trade, production and consumption, selected on the basis of previous econometric and other model-based studies of Malawi and other Sub-Saharan African countries notably those by Kenneth Simler at IFPRI.

The key database is the 1998 SAM for Malawi constructed by Chulu and Wobst (2001), which is based on the Integrated Household Survey (IHS) conducted in 1997/98 by the National Statistical Office (NSO) in collaboration with the International Food Policy Research Institute (IFPRI). The IHS was a comprehensive socio-economic survey of the living standards of households in all districts of Malawi. The NSO administered

the IHS questionnaire to more than 10,000 households over a 12-month period from November 1997 to October 1998. The survey was designed so that the information gathered could be used for assessment of the incidence of poverty in the population at district level and above as well as being used a basis for policy analysis with regard to poverty reduction. In addition to the IHS data, the SAM incorporates national accounts data, foreign trade statistics, government budget and current account information (among others).

The SAM used for this analysis was disaggregated into 22 production activities, 20 commodities, 5 factors, 8 households, 2 other institutions (government and rest of the world) and 5 taxes. There is no one to one mapping between activities and commodities because some activities (for example, small-scale and large-scale tobacco as well as small-scale and large-scale other agriculture) produce the same commodity (tobacco and other agriculture, respectively). Table 1 presents all SAM accounts.

Table 1: SAM accounts disaggregation

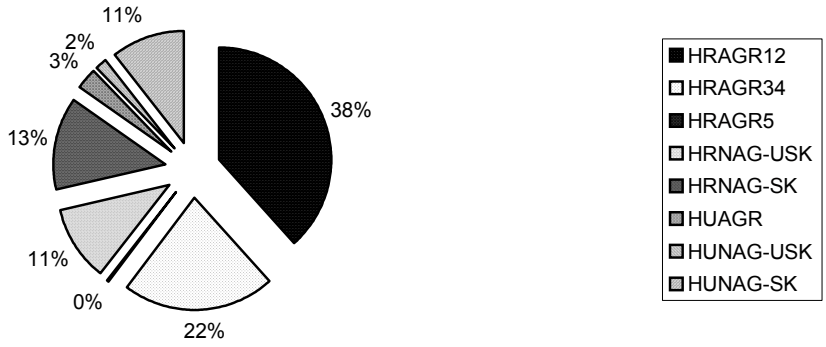
Main account	Level of disaggregation	Description of disaggregated accounts
Agricultural activities (8)	AMAIZ	Maize production
	ATOBAS	Small-scale tobacco production
	ATOBAL	Large-scale tobacco production
	AOAGDOMS	Other domestic small-scale agricultural
	AOAGDOML	Other domestic large-scale agricultural
	AFISH	Fishing
	ALIVE	Livestock
	AFORE	Forestry
Manufacturing activities (8)	AMEAT	Meat processing
	ADAIR	Dairy processing
	AGRAI	Grain milling
	AOFOOD	Other food processing
	ATEXT	Textiles
	AWOOD	Wood manufacturing
	ACAPI	Capital goods
	AOMAN	Other manufacturing
Industrial activities (3)	AMINE	Mining industry
	AELEC	Electricity generation industry
	ACNST	Construction industry
Service activities (3)	ADIST	Distribution services
	APUBS	Public services
	APRVS	Private services
Commodities (20)	Agricultural (6)	Agricultural commodities
	Manufacturing (8)	Manufactured commodities
	Industry (3)	Industrial commodities
	Services (3)	Services
Factors (5)	LANDS	Small-scale land
	LANDL	Large-scale land
	LAB-SK	Skilled labour (with middle to high education)
	LAB-USK	Unskilled labour (with no or low education)
	CAP	Capital
Households (8)	HRAGR12	Rural agric. households with < 1.0 ha of land
	HRAGR34	Rural agric. households with 1-5 ha of land
	HRAGR5	Rural agric. households with > 5 ha of land
	HRNAG-USK	Rural non-agric. households with skilled labour
	HRNAG-SK	Rural non-agric. households with un-skilled labour
	HUAGR	Urban agric. households
	HUNAG-USK	Urban non-agric. households with un-skilled labour
	HUNAG-SK	Urban non-agric. households with skilled labour
Other Institutions (2)	GOV	Government account
	ROW	Rest of the world account
Taxes (5)	Export taxes	Export taxes
	Import taxes	Import taxes
	Sales taxes	Sales taxes
	Factor taxes	Factor taxes
	Direct taxes	Direct taxes

The household disaggregation is on the basis of factor ownership and locality. Agricultural households own land and may be located rurally (HAGR12, HAGR34 and HAGR5) or may be urban agricultural households (HUAGR) with access to land (peri-urban agriculture). The remaining households are classified on the basis of their level of education into unskilled rural or urban and skilled rural or urban. The factor distribution by household is explained in more detail below. All household types have access to differing levels of each factor, except for land, which is exclusively held by agricultural households.[3]

Figure 1 shows the respective population sizes for the different household categories. In line with Malawi's population structure from the 1998 Demographic Census, over 85% of the population is rural. Thirty-eight percent of total population are poor agricultural rural households with less then one hectare of land, while another 22% of agricultural rural households own between one and five hectares of land. Apart from these agricultural rural households that comprise 60% of total population, non-agricultural skilled and non-skilled rural households make up another 25% of total population. The urban agricultural and non-agricultural households comprise the remaining 15% of the population.

[3] With the exemption of large-scale land that is partly owned by urban non-agricultural skilled households (HUNAG-SK) who own most large-scale land in rural areas, but live in urban areas (absentees).

Figure 1: Population proportions across household types in the base



Note: *HRAGR12* = Rural agric. households with < 1.0 ha of land
HRAGR34 = Rural agric. households with 1-5 ha of land
HRAGR5 = Rural agric. households with > 5 ha of land
HRNAG-USK = Rural non-agric. households with skilled labour
HRNAG-SK = Rural non-agric. households with unskilled labour
HUAGR = Urban agric. households
HUNAG-USK = Urban non-agric. households with unskilled labour
HUNAG-SK = Urban non-agric. Households with skilled labour

Baseline Economic Structure

Table 2 provides an overview of the structure of the economy in 1998 with emphasis on the production side. Agriculture provides about 36% of the total value added of which maize, tobacco and other domestic agriculture are the dominant commodities. Agriculture also dominates the production shares, taking up 31% of total production. The sector employs about 89% of the labour force, 23% in maize, 8% in tobacco and 48% in the production of other agricultural commodities. The export share is also dominated by the agricultural sector, with 72% of the total exports originating from the sector, of which tobacco alone contributes about 56% and other agricultural commodities contribute about 16%. The non-agricultural sector does dominate the import shares, totaling about 92% of the imports, mostly in manufactured commodities, capital and private services.

Table 2: Economic structure in 1998

Sector	Value-added share	Production share	Employ-ment share	Export share	Export-output share	Import share	Import-demand share
Maize	8.7	6.4	22.8	0.5	1.9	7.6	27.3
Tobacco	5.7	7.8	8.2	55.6	99.4		
Fishing	0.5	0.4	2.0	0.0	1.9	0.0	2.9
Livestock	1.0	1.3	3.0			0.0	0.7
Forestry	1.2	0.9	4.6				
Other agric.	18.4	14.3	48.1	15.8	23.9	0.4	1.7
Mining	1.3	0.9	0.3				
Meat	0.7	1.5	0.1	0.0	0.4	8.4	63.2
Dairy	0.6	0.6	0.1			0.5	25.4
Grain milling	2.9	10.6	0.3	0.2	0.5	5.3	14.0
Other food	3.2	3.4	0.3	7.5	41.1	3.3	35.1
Textile	1.0	2.0	0.1	7.6	89.5	9.6	94.2
Wood	1.0	1.6	0.2	0.7	10.3	1.6	28.3
Capital goods	2.1	2.8	0.3	1.9	14.7	17.9	71.4
Other manufac.	4.8	6.1	0.3	1.6	5.9	23.6	57.1
Electricity	1.5	2.3	0.1				
Construction	2.1	3.8	0.2				
Distribution serv.	16.0	11.6	3.2				
Public services	9.2	6.6	2.4				
Private services	18.0	15.0	3.4	8.4	12.6	21.7	33.8
TOTAL	100.0	100.0	100.0	100.0	17.4	100.0	28.2
Total agriculture	35.7	31.0	88.6	72.0	36.4	8.1	11.1
Total non-agric.	64.3	69.0	11.4	28.0	8.8	91.9	32.2

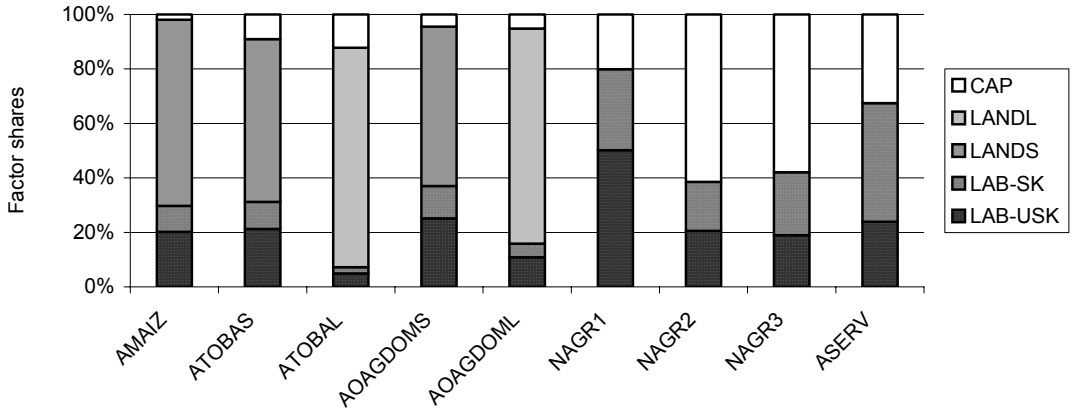
In terms of production and trade aggregates, the data in the baseline shows the reliance that the production structure has on the agricultural sector, particularly the production of primary commodities.

The factor composition structure indicates that both small-scale and large-scale agriculture are land and labour-intensive. With the possible exception of large-scale tobacco production, the proportion of capital used in the production of maize and tobacco is minimal. Production of maize and tobacco absorbs most of the unskilled labour. Capital intensity increases in the manufacturing and industrial activities. The service sectors absorb most of the skilled labour.

In line with the factor composition, Figure 2 presents the activity factor shares in the base scenario in 1998. Agriculture has high shares of land and unskilled labour use,

with a small amount of capital and skilled labour use in the production of large-scale tobacco and other agricultural commodities. Capital shares are high in the industrial and manufacturing activities while the service sectors use relatively more of the skilled labour as compared to the other activities.

Figure 2: Activity factor shares in the base

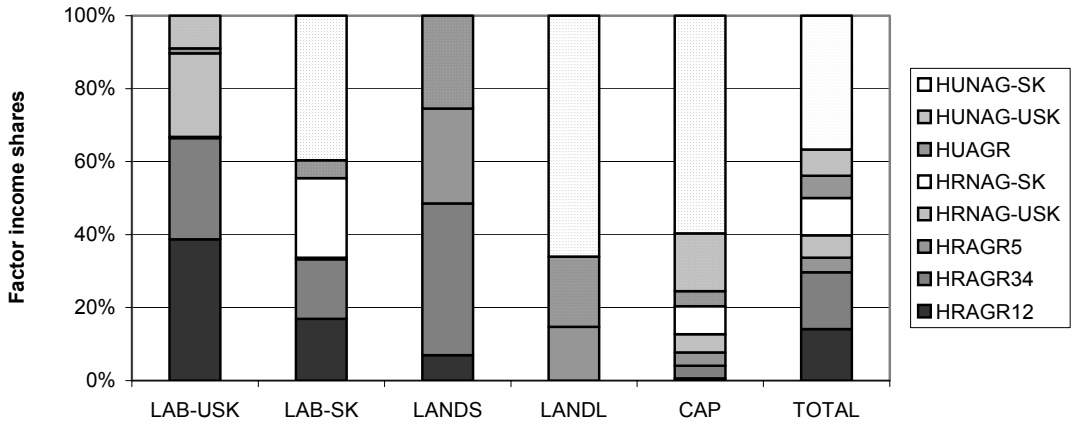


Note: ***CAP*** = Capital; ***LANDL*** = Land large-scale; ***LANDS*** = Land small-scale; ***LAB-SK*** = Labour skilled; ***LAB-USK*** = Labour unskilled
NAGR1 (Non-crop agriculture) = Fishing, Livestock, and Forestry, also including Mining;
NAGR2 (Food processing) = Meat, Dairy, Grain milling and Other food;
NAGR3 (Other industry) = Textile, Wood, Other manufacturing, Electricity and Construction;
ASERV (Services) = Distribution, Public, Private

Factor endowment determines the distribution of factor incomes across the different household categories. As shown in Figure 3, the poorest rural agricultural households (those with less than 0.5 ha) receive about 39% of the unskilled labour income, followed by the second poorest group of rural agricultural households with 28% and then the rural non-agriculture households with unskilled labour with 23%. This is in line with one of the key vulnerability arguments that most of the Malawian smallholders engage in off-farm casual labour (*ganyu*) as a means of earning a livelihood (Moriniere *et al*. 1996 and Pearce *et al*. 1996). Nearly 40% of the skilled labour income is received by the urban skilled households and about 22% is earned by the rural non-agricultural households with skilled labour. The small-scale land is shared by three main categories of households: the intermediate group of rural agricultural households earn about 42%, the richer rural agricultural households with more than 5 ha earn about 26% and a similar

share also goes to the urban agricultural households. These figures reflect the population sizes of the respective household categories as presented in Figure 1. Most of the income from large-scale land goes to the urban non-agriculture skilled labour category (66%), followed by the urban agriculture category with 19% and the richer rural agriculture households with 15%. This could be explained by the fact that a greater proportion of the large-scale land is either rented or leased by the urban dwellers, most of whom are endowed with skilled labour and thus work in town and remit some capital for use on their farms in the rural areas. This category also forms the demand base for most of the commodities produced by both the large-scale and small-scale agricultural sector.

Figure 3: Factor income distribution across households in the base



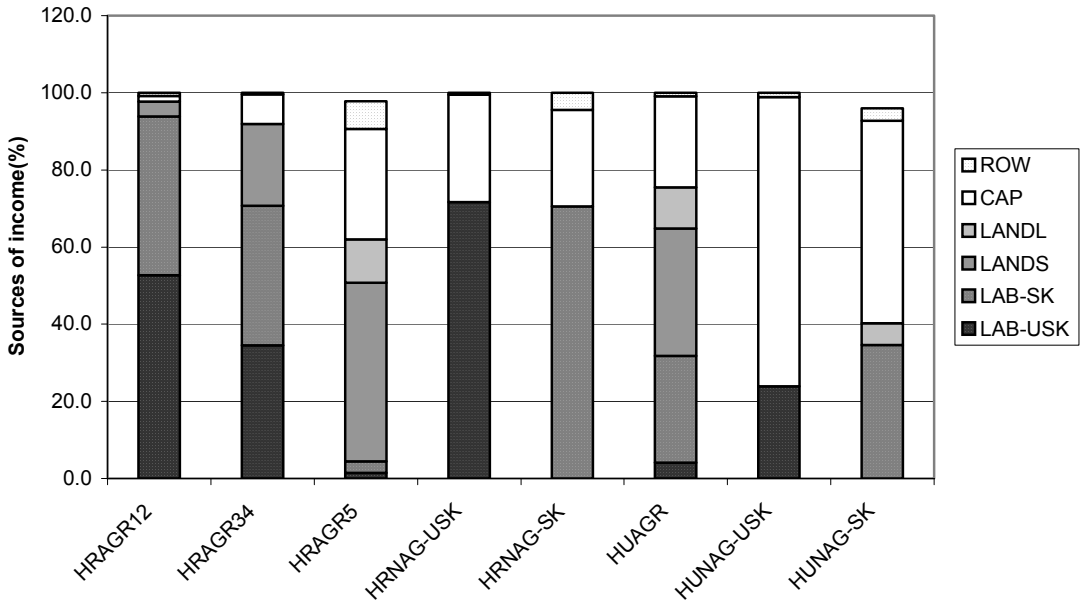
Note: Abbreviations for household and factor categories as in Figures 1 and 2, respectively.

Apart from factor incomes, households also received some income from the other institutions, mainly the government, through transfers and from the rest of the world through remittances. Figure 4 shows the sources of the total household incomes in the base. The database for 1998 does not record any government transfers to households, although it is highly likely that in some years this has actually been the case especially among the poorest household groups.[4] Almost all household income is therefore from

[4] Malawi has been implementing a number of safety-net programmes such as the Starter-Pack Scheme in 1997/98, the Targeted Inputs Programme (TIP) from 1998/99 till now and other small-scale food-for-work and cash-for-work programmes implemented by the government through the Malawi Social Action Fund (MASAF) since the mid-1990s.

factor endowments, with agricultural and unskilled households mainly earning from land and labour and non-agricultural and skilled labour endowed households earning from wages and returns from capital. A relatively greater proportion of the remittances are received by the richer rural agricultural households (about 7%) and the rural non-agriculture skilled labour households (4.5%). This could be explained by the fact that these are capable of investing in the requisite human capital in their children, for instance, who then are able to remit back some money once they secure employment elsewhere.

Figure 4: Sources of household income in the base



Note: ***ROW*** = Rest of the world
Abbreviations for household and factor categories as in Figures 1 and 2, respectively.

The Dynamic Base

The dynamics of the model are driven by technological change and factor accumulation. In the labour market, the changes originate from assumed growth rates of the skilled and unskilled labour force. The rate of labour force growth per time period is given as a 95% share of the population growth rate of initially 1.94%, assuming a 2%

annual decline of the population growth rate[5]. For the capital market, the net capital income in any period is given as the difference between gross capital income and capital consumption, where capital consumption is capital stock multiplied by the depreciation rate, assuming a given net profit rate for capital.[6] The exogenously specified change in total factor productivity for all production activities in the baseline scenario is set to zero for the 10-year simulation period, assuming no significant technical change in the medium run. However, the overall change in total factor productivity through factor reallocation to more productive activities over the simulation period is around 0.2% annually.

Despite this general specification of factor market behavior, this version of the model constraints the use of capital in small-scale agricultural sectors by fixing the capital intensity with respect to the land area used. Hence, capital and land need to be employed in fixed proportions indicating a given technology in small-scale crop production, which cannot alter over the simulation period of 10 years. Consequently, the use of capital in the aggregate small-scale agricultural sector follows the (re-)distribution of land across the three small-scale agricultural sub-sectors. In the case that some land is shifted from the less capital-intensive maize production into the more capital-intensive tobacco production, the aggregate small-scale agricultural sector needs to attract additional capital from the rest of the economy. If the opposite shift in land use occurs, the aggregate small-scale agricultural sector releases capital that needs to be absorbed by the rest of the economy. This is important because of the central role that land plays in terms of capital mobility and technology uptake with the smallholder sector.

Factor endowments do not change much over time, if we assume constant rates of change of net profit and depreciation rates. However, since different households are endowed differently with the various factors, per capita *factor* income by household category does differ. The level of per capita factor income is positively related to endowment of the more productive factors such as capital and skilled labour and

[5] The initial population growth used is estimated by NSO from the 1998 Population Census (1.94% p.a.). The population growth rate is assumed to decline at a rate of 2% per year, i.e. after 10 years the annual growth rate has declined from initially 1.94% to 1.59% reflecting (among other factors) the impact of HIV/AIDS on population growth in Malawi. The share of labour force growth in population growth is assumed to be 95% reflecting an increasing dependency ratio.

[6] Net profit rate for capital is assumed at 20% while depreciation is set at 5%. Capital stock is given as the gross capital income divided by the sum of net profit rate and depreciation rate.

negatively related to population growth. For the aggregate of all households, the per capita level of factor income remains more or less the same throughout the 10-year period increasing by about 2%, but there is significant variation by household type. For example, the larger agricultural households obtain an 11% increase in factor incomes and the urban skilled households experience a 17% increase in per capita factor income. By contrast, the rural non-agricultural skilled households lose 9% per capita and the rural non-agricultural unskilled households lose 11%. The largest decrease is however observed in the urban unskilled households where per capita factor income falls by 31% over the 10-year period. Interestingly, there is little change in per capita factor income for the smaller agricultural households. The relative differences in the impact on respective household incomes depend on (i) the household-specific factor endowment, (ii) the relative share of individual factor incomes in total factor income, and (iii) the change in real wages across the various factors.

The evolution of additional macroeconomic aggregates over the 10-year period in the base run can be found in Table 4 below, which compares the simulation results with the base scenario. The results indicate that in the base, total annual GDP growth rates are about 2% over a 10-year period (see column "BASE" in Table 4). This is as a result of proportionately higher annual growth rates in the non-agricultural sector at 2.3% while the annual growth rates in the agricultural sector are only 1.4%. In per capita terms, annual growth rates are 0.2% for total GDP, 0.5% for non-agricultural GDP, and –0.4% for agricultural GDP. The negative per capita growth in the agricultural sector results from the lower productivity of the agricultural sector relative to the non-agricultural sector. Due to lower productivity in the agricultural sector, fewer of the additional productive resources (added through population growth and through capital accumulation) are employed in agriculture. In fact, factor use in agriculture may decline as a result of shifts of capital and labour migration into the non-agricultural sector. Consequently total per capita agricultural production and the per capita growth rate of GDP at factor cost decline.

Simulations and examination of alternative growth strategies

The model was then used to investigate the potential impacts of a number of different agricultural sector policies. These policies, which are detailed in Table 3, approximate to some policies that have been implemented, or considered for implementation, in Malawi in the recent past[7].

Table 3: Description of alternative policy scenarios analyzed

Policy scenario	Description [1]	Factor productivity growth in the maize sector (in %) [2]	
		Unskilled labor	Small-scale land
CASH52	Targeted cash transfer of MK204 per household from the government to 52% of the poorest households plus 50% administration costs [3]	5.2	4.4
CASH100	Universal cash transfer of MK204 per household from the government to all rural households plus 52% administration costs	8.0	8.9
WEDG50	Reduction of market wedges by 50% plus increase in government infrastructure investment by 10% annually	8.8	16.5
WEDGCRD	As for WEDG50 plus total relaxation of the cash constraint, equivalent to an universal cash credit	2.1	36.7
INPSUB20	20% input subsidy on all smallholder chemicals	-2.3	4.3
INPSUB10	10% input subsidy on all smallholder chemicals	-2.5	0.7

Note:
1 The policy changes are implemented over the entire 10-year period. The GAMS code of the model and the simulations is available on request.
2 These columns show *additional* factor productivity changes in the maize sector for unskilled labor and small-scale land as compared to the Base scenario. The respective factor productivity for all policy scenarios are increased stepwise over the first five-year period in 20% increments, because we assume that the full impact of a new policy will come about gradually. The second five-year period accounts for the full factor productivity increase.
3 Poorest households are defined as being those in the following household categories: HRAGR12 and HRNAG-USK which together comprise approximately 52% of the population

The structure of the data from which the CGE model was constructed does not allow it to properly represent the micro-economic impacts of these policies—non-separability of crop production, unskilled employment and household consumption in poorer households who face severe seasonal capital constraints means that the major

[7] An attempt to include scenarios with fixed maize prices, above and below the current equilibrium, were abandoned due to difficulties in representing the effects of this, both in the CGE model described here and in the farm-household models described by Dorward (2003).

micro-economic impact of most of these policies are likely to involve some relaxation of those constraints. To describe these impacts, equivalent scenario simulations were conducted on a micro-economic, partial equilibrium model of the informal rural economy (Dorward, 2003) and then for each scenario the micro-model estimates of changes in labour and land productivity in small-scale maize production were fed into the CGE (as detailed in column 3 and 4 of Table 3), together with the policy changes as detailed in column 2 of Table 3.

Dorward *et al.* (2004) provide a more detailed comparison of the micro- and CGE models and their results, but it is important to note that the dynamic CGE model allowed more sophisticated consideration not only of the economy wide impacts of policy changes (allowing for the impact of fiscal costs throughout the economy) but also of phased introduction (over 5 years) of the scenario policies and of the productivity changes that they stimulate. The household classifications used in the two models also differed in terms of coverage (all households in the economy are represented in the CGE model as opposed to just rural households in the micro model) and in the criteria used for classification (households in the micro model were disaggregated by indicators related to household structure, cash flow and credit access, as well by land holding, see Dorward, 2003).

Turning to consider the different simulations, two (WEDG50 and WEDGCRD) are designed to provide an indication of the gains that could potentially be made if "all" constraints to productivity growth in the agricultural sector were alleviated. The simulations are achieved by (a) reducing the trade and transportation wedge (the costs of transacting) by 50%, and (b) reducing the wedge together with the provision of a universal cash credit. Although these simulations may give an indication of the gains generated from reducing the costs of transacting, they are not costed and should therefore simply be used to provide a gauge against which the other simulations can be assessed in terms of their strategic objectives, operational requirements and cost effectiveness.

The remaining simulations can be grouped into two broad categories: (a) cash transfers intended to allow households to overcome credit constraints at crucial stages in the year—these are universal and targeted transfers to all (CASH100) and 52% of the

poorest households (CASH52) respectively, and (b) input subsidies (on chemicals) at 10% and 20% levels for smallholders (INPSUB10 AND INPSUB20).

All simulations except CASH52 lead to labour demanding technical change in maize production. The strongest productivity changes come from WEDG50 and WEDGCRD, then CASH 100 and CASH52, and finally INSUB20, with very small changes from INSUB10.

In interpreting the results of the simulations, the two broad categories of alternative policy interventions are assessed against both the dynamic base and the results of the simulations of the removal of all constraints (WEDG50 and WEDGCRD).

Simulation Results and Discussions

The results of the simulations are first presented and briefly discussed under four main sub-sections in line with the different types of impacts of interest to the project. These are (i) the impacts on macro-aggregates such as total and per capita GDP (disaggregated into agriculture and non-agriculture components) and on trade aggregates, (ii) impacts on factor employment levels, (iii) impacts on maize consumption, production and prices and (iv) overall impacts on household welfare in terms of incomes levels and consumption and welfare indicators. In the concluding section we draw these findings together to consider the relative merits, from an economy-wide point of view, of the simulated policy alternatives.

Macroeconomic Aggregates

Table 4 shows the percentage changes in a range of macroeconomic indicators over the 10-year period (1998-2008). Differences from the dynamic base are generally small. However, the two scenarios designed to simulate an alleviation of constraints to productivity increase in the agricultural sector (WEDG50 and WEDGCRD) have a minor positive impact on GDP levels. With these scenarios total GDP in the terminal year 2008 is 0.5% and 0.9% higher respectively as compared to total GDP in the terminal year of the base scenario. In these (as with the other) scenarios there are larger increases in agricultural compared to non-agricultural GDP. In both scenario the agricultural GDP effect more than compensates for the negative effect on non-agricultural GDP.

The input subsidy simulations have a minimal impact on total and on non-agricultural GDP because these scenarios are related to a small factor productivity *decrease* for unskilled labor. However, the 20% input subsidy has a slight positive impact on the level of agricultural GDP. The cash transfer simulations all have a small negative impact on total GDP, with a decline in non-agricultural GDP masking small increases in agricultural GDP. It should be noted that the targeted cash transfer has a more negative impact on non-agricultural and total GDP than the universal transfer.

Table 4: Selected macro indicators

	BASE	**CASH52**	**CASH100**	**WEDG50**	**WEDGCRD**	**INPSUB20**	**INPSUB10**
Agricultural GDP at factor cost	*1.4*	1.004	1.007	1.024	1.035	1.002	0.999
Non-agric GDP at factor cost	*2.3*	0.983	0.970	0.996	0.996	0.990	0.995
Total GDP at factor cost	*2.0*	0.990	0.982	1.005	1.009	0.994	0.996
Agricultural GDP per capita	*-0.4*	1.004	1.007	1.024	1.035	1.002	0.999
Non-agric GDP per capita	*0.5*	0.983	0.970	0.996	0.996	0.990	0.995
Total GDP per capita	*0.2*	0.990	0.982	1.005	1.009	0.994	0.996
Total Absorption	*1.9*	0.990	0.983	1.011	1.015	0.994	0.996
Total Household Consumption	*1.7*	0.996	0.993	1.015	1.020	0.998	0.998
Total Investment	*2.2*	0.932	0.883	0.942	0.941	0.967	0.983
Total Government Consumption	*2.3*	1.013	1.023	1.055	1.055	1.000	1.000
Total Exports	*2.2*	0.983	0.971	1.013	1.014	0.994	0.996
Total Imports	*1.9*	0.985	0.975	1.009	1.010	0.994	0.997
Real Exchange rate	*0.1*	1.005	1.008	1.008	1.014	0.996	0.997
Nominal Exchange rate	*0.0*	1.005	1.008	1.005	1.010	0.998	0.998

Note:
The BASE column shows annual growth rates 1998-2008 (%). The other columns show the ratios between terminal year (2008) variable levels for the simulation in question and for the BASE. (I.e., for agricultural GDP at factor cost and the scenario WEDGECRD, a value of 1.030 indicates that in 2008, the level for this variable is 3.0% higher under this scenario than for the BASE.)

Total exports are a little higher under the WEDG50 and WEDGCRD scenarios compared to the base. This stems directly from the increase in the production of non-maize commodities in the economy, particularly tobacco, by far the most important cash crop in Malawi. Of the other policy scenarios, cash transfer simulations reduce levels of

total exports relative to the base because of their impact on driving resources away from exportables towards supporting the production of non-tradables and/or import substitutes.

Compared to the base, the levels of government consumption and total household consumption are consistently improved in the WEDG50 and WEDGCRD scenarios, which impacted positively on GDP levels. Total household consumption in the terminal year under WEDGCRED changes by 2.0% as compared to the base scenario. In contrast, household consumption in the terminal year falls in the cash transfer simulation. These results reflect attributes already discussed in terms of corresponding changes in per capita GDP growth rates as well as exports. Total investment declines for all simulations (in the terminal year relative to the base), but is most significantly reduced in the case of a universal cash transfer (minus 11.7% for CASH100).

The impacts on the macro indicators show that policies that are targeted at the poor and/or at the agricultural sector will not necessarily result in the greatest positive impact at the economy-wide level, indeed, there appears to be a demonstrable trade-off between growth and the policies that are targeted at reducing poverty. In the following sections, we present results that allow a better appreciation as to why this may be the case and for informing the trade-offs that will inevitably need to be made.

Factor Employment

As explained in previous sections, the rates of accumulation of factors and the manner in which they are allocated are the driving forces of the dynamic model. This section presents the results of the simulations in terms of factor shifts across sectors: unskilled and skilled labour, large and small-scale land and capital.

Unskilled Labour

As shown Table 5, in the dynamic base, unskilled labour use in large-scale and small-scale tobacco production increases by about 3% annually over the 10-year period, a rate greater than that at which the unskilled labour force is increasing in size. This is offset by lower rates of growth in demand for labour in maize and other agricultural activities. Notable increases in demand for unskilled labour are also observed in the manufacturing and service sectors. Both scenarios that reduce the cost of transacting, WEDG50 and WEDGCRED, result in a shift of labour into small-scale tobacco

production at the expense of maize production because the profitability of tobacco increases proportionately more.

Table 5: Unskilled labour—Activity demand and wages

	BASE	CASH52	CASH100	WEDG50	WEDGCRD	INPSUB20	INPSUB10
Labor demand by activity							
Maize	*1.5*	0.987	0.978	0.968	0.968	1.002	1.005
Small-scale tobacco	*2.7*	0.994	0.988	1.055	1.053	1.075	1.036
Large-scale tobacco	*3.1*	0.979	0.963	1.036	1.025	0.977	0.989
Small-scale other agric.	*1.5*	1.013	1.022	1.012	1.017	0.998	0.997
Large-scale other agric.	*1.8*	0.999	0.998	0.996	0.988	0.987	0.993
Use (intensity) maize[1]		-1.3	-2.2	-3.2	-3.2	0.2	0.5
Use (intensity) tobacco[1]		-0.6	-1.2	5.5	5.3	7.5	3.6
Economy-wide wage[1]		-0.9	-1.6	2.4	3.2	0.3	0.1

Note:
The BASE column shows annual growth rates 1998-2008 (%). The other columns show the ratios between terminal year (2008) variable levels for the simulation in question and for the BASE. (I.e., for maize and the scenario WEDGCRD, a value of 0.969 indicates that in 2008, the level for this variable is 3.1% lower under this scenario than for the BASE.)
1 Percentage change last period of simulation as compared to last period of the base scenario.

The cash transfers have the effect of reducing unskilled labour use from maize and large-scale tobacco as compared with the base. However, the universal cash transfer slightly increases labour use by small-scale tobacco. The impact of the input subsidy, on the other hand, is to slightly increase labour allocation to both maize and small-scale tobacco production, generally at the expense of large-scale tobacco and other agricultural production. The 20% input subsidy results in a greater increase in labour use by the small-scale tobacco sector than the 10% input subsidy. However, the reverse is true for maize, where the lower rate of subsidy results in marginally higher demand. These differences are related to differences in labour use intensity and wage rates shown in Table 5.

Skilled labour

The pattern of changes in demand for skilled labour follows that of unskilled labour (see Table A.2 of the Appendix), with changes in large and small-scale tobacco production being more responsive than in the production of other agricultural commodities. This is because the technologies employed change in more or less constant relative shares of factor inputs used since the constant elasticity of substitution (CES) function allows limited substitutability between skilled and unskilled labour. Thus, as unskilled labour becomes more productive and consequently abandoned as compared to skilled labour, all sectors will substitute skilled with the cheap unskilled labour. The extent to which this is possible depends on the initial relative factor use.

Land use

The dynamic base results in a shift of small-scale land from the dominant activity, maize, into small-scale tobacco production. This shift is particularly accentuated in the WEGD50 and WEDGCRED simulations due to the greater increases in land productivity in maize (Table 6).

Table 6: Land demand by activity

	BASE	CASH52	CASH100	WEDG50	WEDGCRD	INPSUB20	INPSUB10
Small scale							
Maize	*-0.05*	0.990	0.981	0.970	0.948	0.992	0.999
Small-scale tobacco	*1.07*	0.995	0.992	1.072	1.094	1.078	1.036
Small-scale other agric.	*-0.07*	1.014	1.026	1.029	1.056	1.000	0.997

Note:
The BASE column shows annual growth rates 1998-2008 (%). The other columns show the ratios between terminal year (2008) variable levels for the simulation in question and for the BASE. (I.e., for small-scale tobacco and the scenario WEDGCRD, a value of 1.043 indicates that in 2008, the level for this variable is 4.3% higher under this scenario than for the BASE.) Total small-scale and large-scale land areas used are constant over the simulation period 1998-2008.

Capital

Changes in the allocation of capital to the different activities show a more mixed pattern (see Table A.3 of the Appendix), but it must be remembered that for small-scale agricultural activities the land:capital ratio is fixed, and capital shifts therefore basically reflect land shifts. Looking across all other activities, capital demand falls relative to the base in the cash transfer and input subsidy simulations (CASH52, CASH100, INPSUBb20 and INPSUB10). By contrast, there is an increase in capital demand in the WEDGCRD and WEDG50 simulations for many activities both agricultural and non-agricultural.

Maize Consumption and Production

Given the demonstrated importance of maize in the Malawi economy in general and to rural smallholder livelihoods in particular, we now look at how its production and consumption are influenced by the policy scenarios.

Figure 5 provides an indication as to how the allocation of land to maize production changes over the period. It shows that even though the targeted cash transfer simulation (CASH52) results in an initial increase in land allocated to maize production, resources are increasingly "pulled out" of the activity by other more profitable agricultural activities. Thus it is clear that in the absence of any scenarios that radically change the incentive structure in favour of maize production, over time land devoted to maize declines. However, in the Malawian case, the rate at which this shift occurs in the base is so gradual that one can conclude that over a decade the production structure of agriculture remains almost unchanged.

Only in the WEDG50 and WEDGCRD simulations are there significant declines in land allocation to maize production. To a more limited extent, the cash transfer simulation allows a transfer of land out of maize production, but the input subsidy simulations have limited impact as compared with the base.

Figure 5: Changes in quantity of land use in maize production

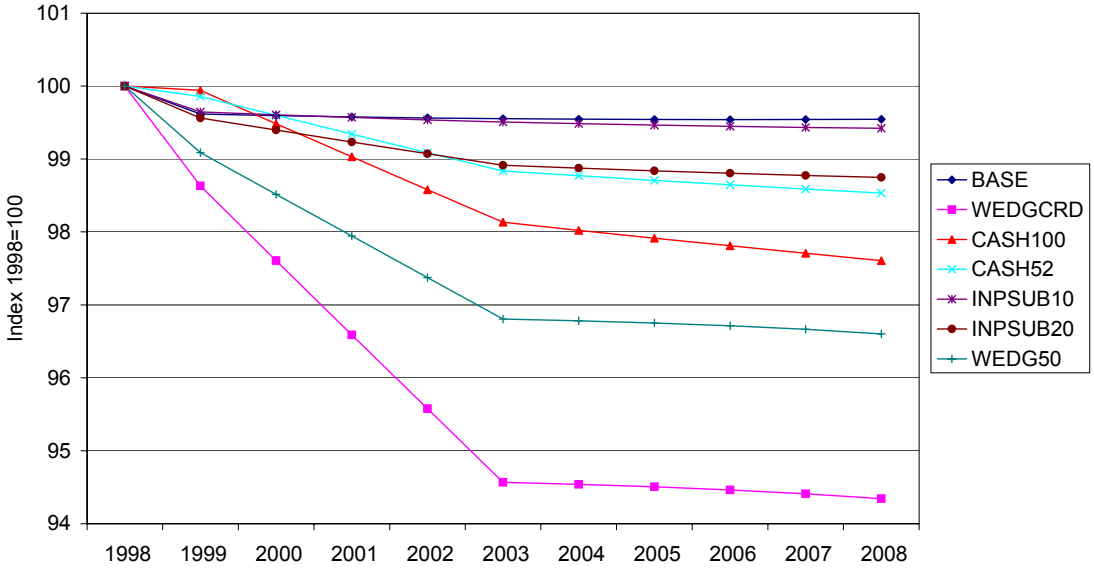


Figure 6 shows a declining trend in terms of per capita maize production in the base, due largely to the increasing population, limited TFP growth and minimal changes in factor composition and technologies. Different patterns are shown by the different scenarios depending upon the balance between land productivity increases on the one hand and shifts of land out of maize on the other. For the two scenarios that more fully release the productivity constraints (WEDGCRD and WEDG50) there is an initial increase in production (despite a larger shift of land out of maize), but then a similar rate of decline. The CASH52 and CASH100 scenarios, with lower productivity increases than the WEDGCRD and WEDG50 scenarios, but lower switches of land from maize to tobacco, have lower levels of per capita maize production, but these are more stable than those in the base as long as productivity increases are still coming through, but as with all scenarios, a similar decline then sets in. The INSUP10 and INSUB20 scenarios show very little difference from the base as regards maize production, with the smallest productivity increases and the smallest movements of land out of maize.

Figure 6: Changes in per capita maize production by scenario

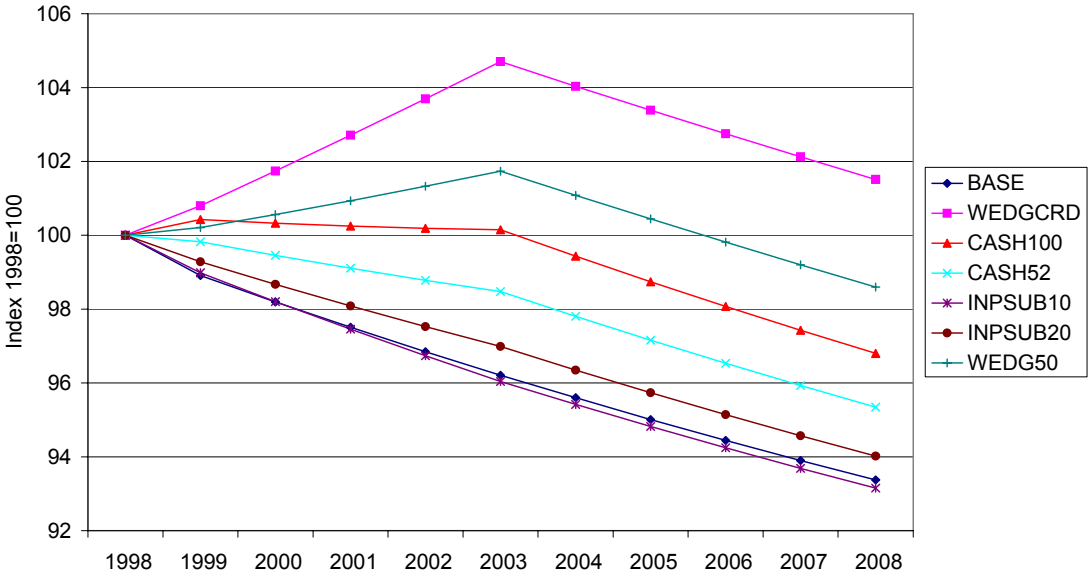
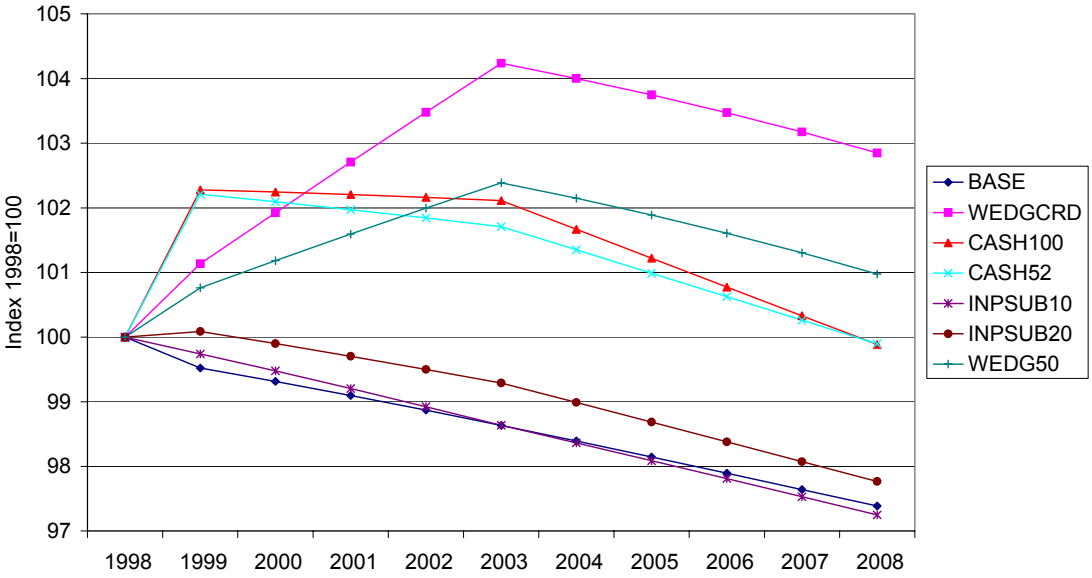


Figure 7: Changes in per capita grain consumption in poor households



Per capita grain consumption among poor rural agricultural households (Figure 7) shows a very similar pattern to overall per capita production as discussed above, with a steady decline in the base and in the different scenarios after there are no more productivity changes coming through. The WEDG50 and WEDGCRD scenarios show similar small absolute gains (totaling 3-4%) above initial levels before this decline sets in. The INSUB10 and INSUB20 scenarios are very similar to the base (the INSUB20 scenario performing a little better), while the CASH100 scenario lies between these two groups. The CASH52 scenario, however, which is targeted at these households, provides an immediate welfare gain from the receipt of the cash transfer in year 1 of policy implementation, but only small gains from the productivity increases in subsequent years.

The only policy scenario that reduces total grain consumption relative to the base is the 10% input subsidy. This reduction in total grain consumption is however compensated to a certain extent by an increase in the aggregate consumption of other foods. Households respond differently in terms of grain consumption. Two of the richer household categories, rural agricultural households with more than 5 ha of land and the urban households with skilled labour, both continue increasing their per capita grain consumption as they are endowed with adequate production factors and purchasing power. At the other extreme the poorest household groups, the rural unskilled and urban unskilled, experience a decline in per capita grain consumption under the base and the input subsidy scenarios over the 10-year period. All other scenarios cause slight increases in per capita grain consumption of poor households (Figure 7).

Household Welfare

One of the key issues in the research is to determine the most promising set of policy interventions for reducing poverty by assessing the simulated impact of the different policy scenarios on factor incomes and overall household incomes, and on household welfare through an assessment of the changes in the equivalent variation.

Tables 7 and 8 show that household factor incomes and consumption levels depend on factor endowments in general, and endowment of factors that yield a higher return such as capital and skilled labour and in particular land. Given this, households that are poorly endowed with productive factors such as those in rural areas with little

landholding and the rural and urban households with no skills tend to lose in relative terms.

Table 7: Disaggregated factor income shares, 1998-2008 (%)

	BASE 1998	BASE 2008	CASH52	CASH100	WEDG50	WEDGCRD	INPSUB20	INPSUB10
LAB-USK	*18.7*	*18.4*	0.0	-0.1	0.0	0.1	0.0	0.0
LAB-SK	*34.3*	*34.5*	-0.1	-0.2	-0.1	0.0	0.0	0.0
LANDS	*7.7*	*7.7*	0.0	0.0	-0.1	-0.2	0.0	0.0
LANDL	*3.3*	*3.6*	0.0	-0.1	0.1	0.1	-0.1	0.0
CAP	*36.0*	*35.8*	0.2	0.3	0.0	0.1	0.0	0.0

Note:
The first two columns show the shares (in %) of disaggregated factor income by factor for the base scenario in 1998 and 2008 respectively. The other columns show percentage point deviations of the respective simulation results for 2008 with respect to the 2008 BASE scenario shares. Abbreviations for factor categories as in Figure 2.

All scenarios result in factor incomes to unskilled labour either the same as, or falling relative to, the base. This implies that agricultural technology development may reduce the welfare of the unskilled labour category, to the extent that new technology does not increase labour demand and that there are limited off-farm employment opportunities elsewhere to absorb the excess labour leading to declining wages. Only for capital do the simulations increase factor share relative to the falling base. Small-scale land, although maintaining a constant factor share in the base, is negatively impacted under the universal cash transfer, WEDG50 and WEDGCRD.

Table 8: Real consumption by household type

	BASE	CASH52	CASH100	WEDG50	WEDGCRD	INPSUB20	INPSUB10
HRAGR12	*16.5*	2.2	1.8	2.9	4.1	0.2	-0.1
HRAGR34	*14.5*	-0.5	0.7	2.7	3.4	0.3	0.0
HRAGR5	*28.4*	-1.7	-3.0	1.5	0.9	-0.5	-0.3
HRNAG-USK	*4.7*	2.1	2.2	2.9	4.1	0.5	0.1
HRNAG-SK	*8.1*	-0.2	1.1	2.3	3.1	0.1	-0.1
HUAGR	*10.5*	-0.6	-1.1	1.7	1.3	0.0	0.0
HUNAG-USK	*-15.6*	1.3	2.4	2.0	2.6	0.8	0.3
HUNAG-SK	*36.0*	-2.6	-4.6	0.5	0.8	-1.3	-0.7

Note:
The BASE scenario column shows percentage changes at the end of the 10-year period (numbers in *italics*). All other simulation columns show percentage point deviations of the respective simulation results from the BASE column results. Abbreviations for household categories as in Figure 1.

Table 8 shows that all simulations except the 10% input subsidy positively impact real consumption relative to the base for the poorer households (HRAGR12, HRAGR34, HRNAG-USK, HUNAG-USK and HRNAG-SK). On the other hand, all simulations except for WEDG50 and WEDGECRED impact negatively on the other (richer) households (because of the re-distributional elements of these scenarios, which are only offset by wider growth in the WEDG50 and WEDGCRED scenarios). However, it should be noted that the different scenarios' results tend to deviate from the base by very small amounts—a deviation of 3.2% over 10 years, for example, representing an annual difference of just over 0.3% per year. With this proviso, however, it is worth noting that for poor households, the targeted cash transfer has a more positive impact than the universal cash transfer, which in turn has a more positive impact than the input subsidies. For the richer households the reverse is the case. Even the INSUB20 scenario is pro-poor, however, despite the direct benefits of input subsidies being captured largely by less poor

smallholders households with more land[8]. This mimics the pro-poor benefits of input subsidies in successful green revolution areas in Asia described in Hazell and Rosenzweig (2000). These policies can all be labeled pro-poor, but with the cash transfers more pro-poor than the input subsidies.

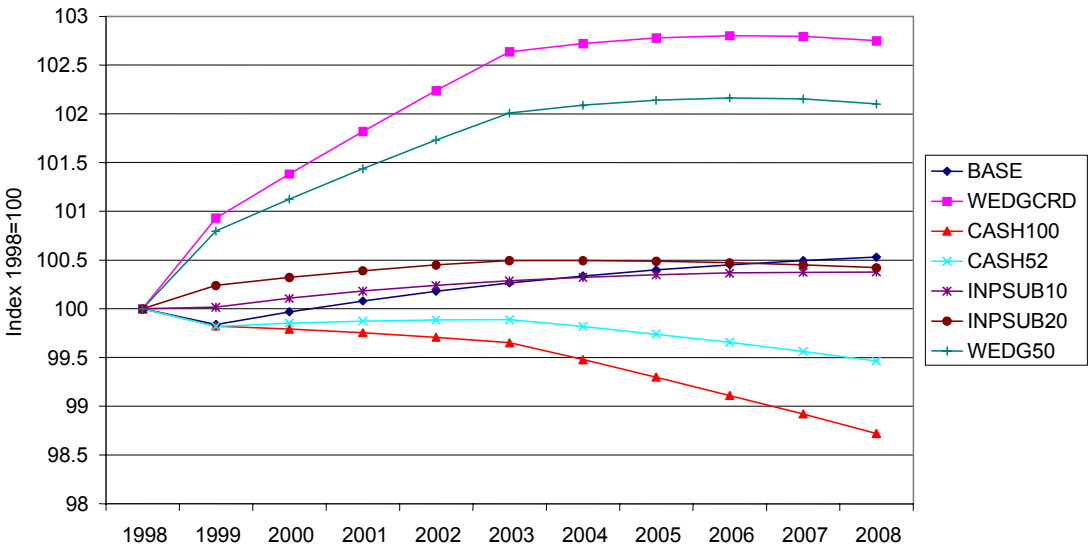
Relative to the base, the welfare increases most significantly under the scenarios WEDG50 and WEDGCRD as indicated by the changes in real consumption reported in Table 8. For the poor agricultural households with an increase in population of over 18%, per capita consumption declines in the base. Cash transfers offset this decline to a greater extent than the input subsidies. In the rural sector, the unskilled labour households also face a reduction in per capita consumption under the WEDGCRD and WEDG50 simulations.

The skilled labour endowed rural non-agricultural households gain relative to the base under all scenarios except the input subsidies and CASH52 scenarios, albeit with reduced per capita consumption over the decade in all cases. Again, the WEDG50 and WEDGCRD simulations have the greatest impact.

Turning to the agricultural landowning households, the larger (>5ha) households *gain* relative to the base only in the WEDG50 and WEDGCRED scenarios. The universal cash transfer results in the lowest rate of welfare gain for these households. The smaller agricultural households (HRAGR12 and HRAGR34) face a negative trend in welfare in the base. This is reversed for the WEDG50 and WEDGCRD simulations for HRAGR12.

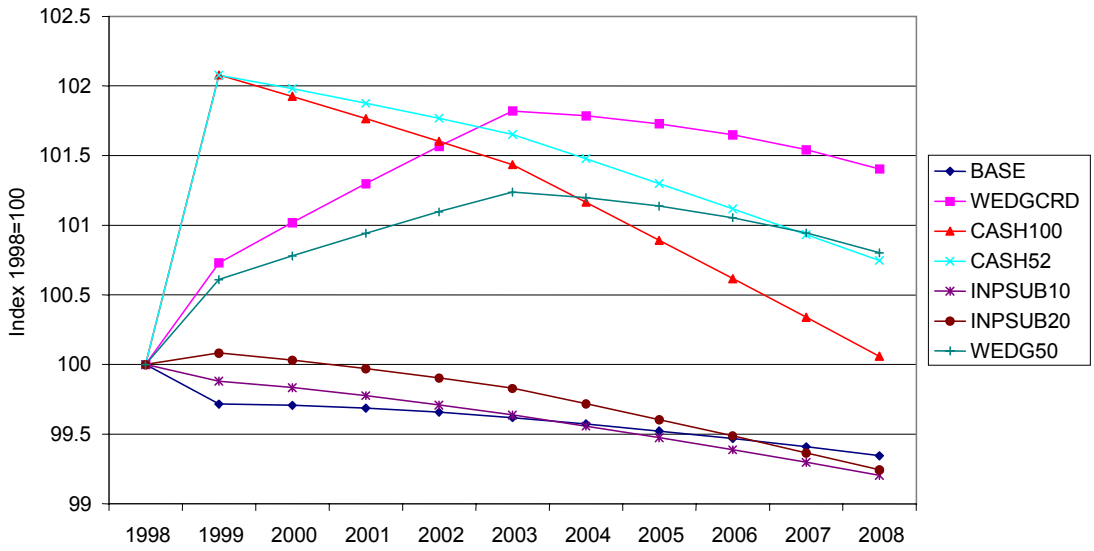
[8] The model makes no allowance for the effects of leakages to large-scale commercial producers or to neighbouring countries. Even here, however, Malawian smallholder farmers would presumably gain from a cash injection equal to the (marked down) value of the inputs.

Figure 8: Changes in per capita factor income of rural agricultural households (HRAGR12)



On a per capita basis, factor income declines less relative to the base for the input subsidy simulations, but more for the cash transfer simulations (Figure 8). Thus the positive welfare impacts of the cash transfers are partially offset by lower factor incomes under these scenarios. This is demonstrated by *total* per capita income for the poor agricultural households under the cash transfer scenarios, where there is a notable positive impact relative to the base for the poorest rural agricultural households (HRAGR12). Figure 9 shows that these households initially gain from the targeted transfer, and by the end of the decade the increase is sustained above the base, although close to the initial 1998 position for the universal transfer (due to the greater fiscal burden to the economy). The 20% input subsidy also provides a small initial boost to incomes, but as with the 10% input subsidy, is approximately the same as the base by 2008.

Figure 9: Changes in per capita income in poor agricultural households (HRAGR12)



Conclusions and Policy Implications

This section summarizes the findings of the impact of various policy scenarios on overall economic performance, factor employment, maize production and consumption and household welfare over a period of 10 years (1998-2008). On the basis of the findings, some policy implications are drawn in the hope of better informing pro-poor growth policy debates.

In general, the policy simulation results as compared to the base scenario are relatively small. Two major reasons contribute to this phenomenon:

(1) The dynamic base itself constitutes *the* development trajectory for Malawi's economy and the policy simulations implemented are mere variations on the (base) theme. The base scenario considers four major sources of growth that, together, constitute the dynamics of the system: (i) population growth, (ii) labour force growth, (iii), total factor productivity increase (technical progress—here exogenously set to zero—and reallocation of factors to more productive activities), and (iv) capital accumulation. Hence, the sources of real economic growth are either additional productive factors (through population growth and capital accumulation) or factor reallocation to more

productive activities. Labour force growth and productivity growth for factors other than unskilled labor are exactly the same for the base and the simulation scenarios, while capital accumulation varies moderately across different scenarios. In terms of overall economic growth, the policy scenarios therefore only vary from the base scenario through the simulation-specific changes in factor productivity of unskilled labour and small-scale land employed in the maize sector, which were generated through the micro analysis and adopted in the economy-wide analysis.

(2) The structure of the Malawian economy is dominated by agriculture, small-scale production, and a limited number of major crops cultivated. The relative factor shares in the different production sectors change only moderately according to sector-specific production elasticities that allow a certain degree of (imperfect) substitutability across different factors. Like the structure of sectoral production, the foreign trade structure is also limited in its ability to adjust across sectors. Imports change relative to domestic supply according to sector-specific substitution elasticities, while the overall magnitude of a sectoral change is limited by the sector's initial import over absorption share. Similarly, exports change according to sector-specific transformation elasticities and their overall changes depend on their initial export over production shares. Consequently, the existing economic structure is rather sticky and adjusts only gradually over time, particularly given the more or less constant levels of foreign capital inflows and investment. From a demand perspective, the existing consumption shares of most Malawian households for food and agricultural products are large and their responsiveness to changes in relative prices is limited (with low income elasticities on basic food products). All this leads to an economy that grows over time as a consequence of additional productive resources (labour growth and capital accumulation) and some increase in productivity through sectoral reallocation of factors, but only experiences moderate sectoral shifts—for example increased cash crop and agricultural export production, growing non-agricultural rural economy, and increased manufacturing/industries production.

The results of the simulations designed to replicate a lifting of "all constraints" to agricultural production indicate that this is likely to provide a boost to a number of sub-

sectors including cash crops, particularly tobacco, which ultimately improves exports and GDP growth. As a result of the combined impact of factor supply growth rates (zero for land), the limited substitutability between skilled and unskilled labour as well as the limited employment opportunities outside agriculture, unskilled labour cannot be fully absorbed by other sectors. Consequently, unskilled labour becomes proportionately more abundant as compared to other productive factors, resulting in a decrease of its relative wage. As a result, households for which unskilled labour is the dominant factor endowment face reduced levels of income, consumption and thus welfare. In an economy-wide sense, the resulting decline in maize production and consumption is more than compensated for by the increase in exports and GDP growth. It is important to stress that the extent to which various household categories respond to the different policy scenarios depends mostly on their factor endowment and hence source of income. In the context of this pattern of change in factor productivity growth, those households that are endowed with land and skilled labour tend to respond more favorably than those that are endowed with unskilled labour. Generally, households experience growth in income and consumption if the factors they own are used in sectors with rapid growth in (production and) factor demand, relative to growth in factor supply.

From a macroeconomic point of view, the less favorable policy scenarios are the input subsidies (INPSUB20 and INPSUB10). While the cash transfers simulate a reduction in the cash constraint among households, the extent to which it would be beneficial in the economy-wide sense depends on whether the gains outweigh the losses in terms of deadweight loss and the market distortion effects. Cash transfers suppress aggregate household consumption growth, because besides the transfer costs the government also incurs 50% administration costs. However, cash transfers appear to be more pro-poor than input subsidies.

The simulation results suggest that there may be a trade-off between overall economic growth and equity or poverty reduction and that, as a result, there may be a need for associated complementary and/or compensatory policies to alleviate the particular difficulties faced by the poorest categories of the population. Improving the incentives for increased maize production, for example, may assist the poorer farmers and the poor non-agricultural households as it is an activity that intensively uses the factors

with which they are relatively well endowed. However, it is not necessarily the optimal intervention in terms of promoting overall economic growth. To promote equity and poverty reduction within the short and medium term, there may therefore be a need for specific policy strategies that target the poorest households.

The findings above may provide an explanation for the failure of the structural adjustment programs implemented in Malawi as well as in other African countries. In this context, it is of great concern that even policies that aim at pro-poor agricultural growth may not necessarily be able to address the needs of the poorest households. There is an obvious need to combine different policy measures in order to promote agricultural and economic growth in general and the economic opportunities of unprivileged and vulnerable (agricultural) households in particular.

References

Chilowa, W. (1998). Structural Adjustment and Poverty in Malawi. DERAP Working Paper D 1998:3 Norway: Chr. Michelsen Institute. Department of Social Science and Development.

Chirwa, E. and C. Zakeyo (2003). *Impact of Economic and Trade Policy Reforms on Food Security in Malawi*. Draft report prepared for FAO/AERC Trade and Food Security Project. December.

Chulu, O. and P. Wobst (2001). *A Social Accounting Matrix for Malawi.* International Food Policy Research Institute, Washington D.C.

Deininger, K. and P. Olinto (2000). *Why liberalization alone has not improved agricultural productivity in Zambia: The Role of Asset Ownership and Working Capital Constraints*. World Bank Policy Research Working Paper Series 2302.

Delgado, L.C., J. Hopkins and V.A. Kelly (1998). *Agricultural Growth Linkages in Sub-Saharan Africa*. IFPRI Research Report. Washington D.C.

Dervis K., J. de Melo and S. Robinson (1982). *General Equilibrium Models for Development Policy*. Cambridge: Cambridge University Press.

Devereux, S. (2002). *The Malawi Famine of 2002: Causes, Consequences and Policy Lessons*. Institute of Development Studies. Draft May 2002.

Dorward, A. (2003) *Modeling Poor Farm-Households in Malawi: Lessons for Pro-poor Policy*. Centre for Development and Poverty Reduction, Wye, Imperial College, London.

Dorward, A. and J. Kydd (2002). *The Malawi 2000 Food Crisis: The Rural Development Challenge.* Paper presented at 'Malawi after Banda: Perspectives in a Regional African Context'. Centre for Commonwealth Studies, University of Stirling. http://www.wye.ic.ac.uk/AgEcon/ADU/publications/index.html.

Dorward, A., J. Kydd, J. Morrison and I. Urey (2004). A Policy Agenda for Pro-poor Agricultural Growth. *World Development* **32**(1): 73-89.

Dorward, A., P. Wobst, H. Lofgren, H. Tchale and J. Morrison (2004). *Modelling pro-poor agricultural growth strategies in Malawi: lessons for policy and analysis*. Wye, Ashford, UK, Centre for Development and Poverty Reduction, Department of Agricultural Sciences, Imperial College London.

Government of Malawi (2000). *Profile of Poverty in Malawi—Poverty Analysis of the Integrated Household Survey 1997-98*. National Economic Counsel, Lilongwe and National Statistics Office, Zomba.

Hazell, P. and M. Rosenzweig (2000). *Rural Asia: Beyond the Green Revolution*. OUP/ADB.

Jayne, T.S. and S. Jones (1997). Food Marketing and Pricing Policy in Eastern and Southern Africa: A Survey. World Development 25(9): 1505-1527.

Jung, H.-S. and E. Thorbecke (2003). The Impact of Public Education Expenditure on Human Capital, Growth, and Poverty in Tanzania and Zambia: A General Equilibrium Approach". *Journal of Policy Modeling* 25:701-725.

Kherallah, M. (2000). *The Road Half Traveled: Agricultural Market Reforms in Sub-Saharan Africa*. IFPRI Food Policy Report. Washington D.C.

Kherallah, M. and K. Govindan (1999). The Sequencing of Agricultural Market Reforms in Malawi. Journal of African Economies 8(2):125-151.

Kydd, J., A. Dorward and M. Vaughan (2002). *The Humanitarian Crisis in Southern Africa: Malawi*. Submission to the International Development Committee.

Kydd, J. and R. Christiansen (1982). Structural Change in Malawi since Independence: Consequences of a Development Strategy based on Large-scale Agriculture. World Development 10:355-375.

Lofgren, H., R.L. Harris and S. Robinson (2002). *A Standard Computable General Equilibrium (CGE) Model in GAMS*. Microcomputers in Policy Research 5. International Food Policy Research Institute. Washington D.C.

Moriniere, L., S. Chimwaza and E.Weiss (1996). *Malawi Vulnerability Assessment and Mapping (VAM) Baseline: A Quest for Causality*. World Food Programme, Government of Malawi and Famine Early Warning Systems.

NSO/NEC (2000). Poverty Profile for Malawi: An Analysis of the Integrated Household Survey (1997/98). National Statistics Office, Zomba and National Economic Counsel, Lilongwe.

Orr, A. and B. Mwale (2001). Adapting to Adjustment: Smallholder Livelihood Strategies in Southern Malawi. World Development 29(8):1325-1343.

OPC (1989). *Food Security and Nutrition Bulletin*. October 1989. Vol. 1. No. 2. Office of the President and Cabinet, Lilongwe Malawi.

Pearce J., A. Ngwira and G. Chinseu (1996). *Living on the Edge: A Study of the Rural Livelihoods in Mchinji and Salima Districts in Malawi*. Save the Children Fund (UK).

Peters, P.E. (1996). *Failed Magic or Social Context? Market Liberalization and the Rural Poor in Malawi*. Harvard Institute for International Development.

Sahn D.E., J. Arulpragasam and L. Merid (1990). *Policy Reform and Poverty in Malawi: A Survey of a Decade of Experience*. Ithaca, New York : Cornell Food and Nutrition Policy Program Monograph 7.

Subramanian, S., E. Sadoulet, and A. de Janvry (1994). *Structural Adjustment and Agriculture: African and Asian Experiences*. Economics and Social Development Paper 124. FAO: Rome.

UNDP (2002). *Human Development Report: Deepening Democracy in a Fragmented World*. United Nations: New York.

World Bank (1990). *Malawi Food Security Report*. Washington D.C.

Appendix

Detailed description of the within-period and between-period modules of the applied dynamic CGE model

Within-period module

The within-period module defines a one-period, static CGE model.[9] It includes the first-order conditions for optimal production and consumption decisions, given available technology and preferences, respectively. The technology is defined by a nested, two-level structure with, at the top, a Leontief aggregation of value-added and an aggregate intermediate and, at the bottom, a CES aggregation of primary factors and a Leontief aggregation of intermediate inputs. Consumer preferences are represented by LES demand functions, derived from a maximization of a Stone-Geary utility function subject to a spending constraint. Both producers and consumers behave myopically, considering only current conditions when making their decisions. They take relevant prices (of outputs, factors, and intermediate inputs) as given.

For primary factors, demanded by the production activities, the supplies are fixed. An economy-wide wage variable is free to vary to assure that, for each factor, the quantity demanded equals the quantity supplied. Each activity pays an activity-specific wage that is the product of the economy-wide wage and a fixed, activity-specific wage (distortion) term.

The bulk of household income comes from factors—each household group receives factor incomes in proportion to the share that it controls of each factor stock. The main items on the household spending side are direct taxes, savings, and consumption. Taxes and savings are determined on the basis of simple rules.

The government earns most of its income from direct and indirect taxes and spends it on consumption, investment, and interest payments (on its foreign and domestic debt). Government demand (consumption and investment) is disaggregated by function (into agriculture and natural resources, transportation and communications, and other).

[9] Apart from the fact that variables are time indexed, the "within-period" module is very similar to IFPRI's standard, static CGE model. We keep the discussion of these features brief, focusing our attention on new features. The reader is referred to Lofgren *et al.* (2002) for more details on model features.

Government consumption is represented by a Leontief function of the corresponding government capital stock, reflecting the notion that, in order to be efficient, government consumption (e.g. teacher employment) and capital stocks (e.g.. school buildings) should appear in relatively fixed proportions. In the basic model version, total government investment is a fixed share (in value terms) of total investment. It is split across different functions in fixed real shares. Government capital stocks by function are updated over time on the basis of the initial stock, new investment, and the rate of depreciation

All commodities (domestic output and imports) enter markets. For marketed output, the ratio between the quantities of exports and domestic sales is positively related to the ratio between the corresponding supply prices. The price received by domestic suppliers for exports depends on the world price, the exchange rate, the transactions cost (to the border) and export taxes (if any). The supply price for domestic sales is equal to the price paid by domestic demanders minus the transactions cost of domestic marketing (from the supplier to the demander) per unit of domestic sales. If the commodity is not exported, total output is passed to the domestic market.

Domestic market demand is the sum of demands for household market consumption, government consumption, private and public investment, intermediate inputs, and transactions (trade and transportation) inputs. Typically, domestic market demands are for a composite commodity that is made up of imports and domestic output. The ratio between the demand quantities for imports and domestic output is inversely related to the ratio between the corresponding demand price ratio. Total market demand is directed to imports for commodities that lack domestic production and to domestic output for non-imported commodities. The import prices paid by domestic demanders are determined by the world prices, the exchange rate, import tariffs, and the cost of a fixed quantity of transaction services per import unit (which cover the cost of moving the commodity from the border to the demander).[10] The prices paid by the demanders for domestic output include the cost of transaction services (in this case reflecting that the commodity was moved from the domestic supplier to the domestic demander). The prices received by domestic suppliers are net of this transactions cost. Flexible prices equilibrate

[10] Note that these transactions costs are not *ad valorem* – the rates (the ratio between the margin and the price without the margin) change when there are changes in the prices of transactions services and/or the commodities that are marketed.

demands and supplies of domestically marketed domestic output. In international markets, the small-country assumption is followed: export demands and import supplies are infinitely elastic at exogenous world prices.

In its balance of payments, the country receives foreign exchange in the form of export revenue, net transfers to domestic institutions, foreign borrowing by the government (which may be negative if the government is repaying debt), foreign grants to the government, and foreign direct investment. These earnings are allocated to imports, interest payments on the foreign debt, and repatriation of profits to foreign investors.

The model includes three macroeconomic balances: the government balance, the savings-investment balance, and the balance of payments. For the current part of the government balance, the default closure is that government savings (the difference between current government revenues and current government expenditures) is a flexible residual while all tax rates are fixed. In the savings-investment balance, which is divided into private and public components, we use a savings-driven closure—the aggregate investment adjusts to available savings. The value of private investment is defined as the sum of total household savings and foreign direct investment net of domestic government borrowing. Government savings, augmented by net foreign and domestic borrowing and grants from abroad determines government investment. As noted above, in the basic model version, government investment is a fixed share (in value terms) of total investment; government domestic borrowing is the adjusting variable that assures that this relationship holds. Foreign borrowing and grants are fixed. In the balance of payments, the real exchange rate (influencing the trade balance) is the clearing variable.

Given homogeneity of degree zero in prices, a numéraire that anchors the overall price level, is needed. The consumer price index is used as the numéraire and thus all simulated changes in nominal prices and incomes are relative to a fixed CPI.

Finally, the within-period block also includes relationships defining total factor productivity (TFP) by activity. For each activity, two sources of endogenous change in TFP are covered: (i) changes in the economy-wide trade-GDP ratio relative to the base year ratio; and (ii) the ratio between relative changes in government capital stocks by function and the total production level of the activity. These relationships are captured by constant-elasticity functions. It is assumed that government capital stocks in each of the

three government functions (agriculture and natural resources, transportation and communications, and other) have a mild positive impact on TFP for the activities within its domain (i.e., agricultural activities, the distribution activity, or other activities).

Between-period module

The between-period module covers the links between different time periods. It includes equations that define the stocks of different assets: factors (land, labour, and capital), government bonds, and foreign debt (held by the government). All stocks are disaggregated by institution. This information is used to define the shares of each institution in the total income of each factor, the interest earnings of domestic households from government bonds, and the interest payments of the government to the rest of the world.

Labour, and land stocks are updated on the basis of exogenous trends. The population in each time period is also exogenous. The accumulation of capital stocks, government bonds, and foreign government debt is endogenous. For capital, the stock in any given year depends on past stocks, new investments, and depreciation rates. The definitions of the stocks of government bonds and foreign debt depend on past stocks and new borrowing (or the value of new bonds that have been issued).

The model is solved annually for the period 1998-2008.Each model solution generates an extensive, economy-wide dataset (covering both the micro and macro levels) on the state of the economy in each solution period. This information is summarized to a manageable set of policy-relevant indicators, including data on macroeconomic growth, changes in the structure of production and trade, and the evolution of disaggregated household welfare, inequality, and poverty.

Table A.1: Model elasticities

Commodity category	Trade		Production	Consumption expenditure (LES)
	Armington	CET		
Agriculture	0.8	2.0	0.4	0.7
Industries	0.8	0.8	0.8	1.1
Services	0.8	0.8	0.8	1.1

Sources: Jung and Thorbecke (2003, p.709), Subramanian, Sadoulet and de Janvry (1994, p.125-126), and Dervis *et al*. (1982, p.484).

Table A.2 Demand for skilled labour by activity

	BASE	CASH52	CASH100	WEDG50	WEDGCRD	INPSUB20	INPSUB10
Maize	*1.3*	0.997	0.994	0.987	0.977	1.001	1.003
Small-scale tobacco	*2.5*	0.994	0.989	1.058	1.059	1.079	1.039
Large-scale tobacco	*2.9*	0.979	0.963	1.039	1.030	0.981	0.992
Small-scale other agric.	*1.3*	1.013	1.023	1.015	1.022	1.001	1.000
Large-scale other agric.	*1.6*	0.999	0.998	0.999	0.993	0.991	0.996
Fishing	*1.0*	1.011	1.018	1.020	1.023	1.003	1.001
Livestock	*1.0*	1.004	1.006	1.020	1.024	0.999	0.999
Forestry	*1.1*	1.000	1.000	1.007	1.009	1.000	1.000
Mining	*1.9*	0.950	0.914	0.963	0.963	0.975	0.988
Meat	*0.8*	1.023	1.038	1.033	1.038	1.006	1.002
Dairy	*1.3*	1.009	1.016	1.016	1.020	1.002	1.000
Grain milling	*0.5*	1.035	1.061	1.048	1.070	1.014	1.003
Other food	*1.9*	0.998	0.996	1.006	1.008	0.989	0.994
Textile	*1.7*	0.993	0.989	0.973	0.978	0.943	0.970
Wood	*1.0*	1.008	1.013	1.006	1.009	1.000	0.999
Capital goods	*2.0*	0.969	0.947	0.972	0.972	0.980	0.990
Other manufac.	*1.9*	1.000	1.000	1.004	1.006	0.995	0.997
Electricity	*1.6*	1.004	1.008	1.010	1.013	0.996	0.997
Construction	*1.7*	0.952	0.917	0.955	0.955	0.975	0.987
Distribution serv.	*1.8*	0.991	0.984	0.932	0.932	1.003	1.001
Public services	*2.2*	0.996	0.993	1.012	1.014	0.996	0.997
Private services	*2.0*	1.005	1.008	1.016	1.017	0.997	0.998

Note:
The BASE column shows annual growth rates 1998-2008 (%). The other columns show the ratios between terminal year (2008) variable levels for the simulation in question and for the BASE. (I.e., for maize and the scenario WEDGCRD, a value of 0.969 indicates that in 2008, the level for this variable is 3.1% lower under this scenario than for the BASE.)

Table A.3: Demand for capital by activity.

	BASE	CASH52	CASH100	WEDG50	WEDGCRD	INPSUB20	INPSUB10
Maize	*0.0*	0.990	0.981	0.970	0.948	0.992	0.999
Small-scale tobacco	*1.1*	0.995	0.992	1.072	1.094	1.078	1.036
Large-scale tobacco	*3.5*	0.945	0.906	1.027	1.016	0.967	0.985
Small-scale other agric.	*-0.1*	1.014	1.026	1.029	1.056	1.000	0.997
Large-scale other agric.	*2.1*	0.964	0.938	0.988	0.979	0.977	0.990
Fishing	*1.6*	0.975	0.957	1.009	1.009	0.989	0.995
Livestock	*1.6*	0.969	0.945	1.008	1.010	0.984	0.992
Forestry	*1.6*	0.965	0.940	0.996	0.995	0.986	0.993
Mining	*2.5*	0.916	0.859	0.952	0.949	0.961	0.981
Meat	*1.3*	0.987	0.976	1.021	1.024	0.992	0.995
Dairy	*1.9*	0.973	0.955	1.004	1.006	0.988	0.994
Grain milling	*1.1*	0.999	0.998	1.036	1.055	0.999	0.996
Other food	*2.4*	0.963	0.937	0.995	0.994	0.975	0.987
Textile	*2.3*	0.958	0.930	0.962	0.964	0.929	0.963
Wood	*1.6*	0.972	0.952	0.995	0.995	0.985	0.993
Capital goods	*2.5*	0.935	0.890	0.962	0.958	0.966	0.984
Other manufac.	*2.4*	0.965	0.940	0.993	0.992	0.981	0.990
Electricity	*2.2*	0.969	0.947	0.999	0.999	0.982	0.991
Construction	*2.3*	0.918	0.862	0.944	0.942	0.961	0.981
Distribution serv.	*2.3*	0.956	0.925	0.921	0.920	0.988	0.994
Public services	*2.8*	0.961	0.934	1.001	1.000	0.982	0.991
Private services	*2.5*	0.969	0.948	1.005	1.003	0.983	0.992

Note:
The BASE column shows annual growth rates 1998-2008 (%). The other columns show the ratios between terminal year (2008) variable levels for the simulation in question and for the BASE. (I.e., for maize and the scenario MAZP110, a value of 1.032 indicates that in 2008, the level for this variable is 3.2% higher under this scenario than for the BASE.)