Modelling Pro-poor Agricultural Growth Strategies in Malawi: Lessons for Policy and Analysis

Andrew Dorward, Jamie Morrison, Peter Wobst,
Hans Lofgren & Hardwick Tchale

African Development and Poverty Reduction: The Macro-Micro Linkage

Forum Paper 2004

13 - 15 October 2004
Lord Charles Hotel, Somerset West, South Africa

Development Policy Research Unit
Trade and Industrial Policy Strategies
Cornell University

Sponsors
Cornell
gtz
USAID
IDRC CRDI
Friedrich Ebert Stiftung

Modelling Pro-Poor Agricultural Growth Strategies in Malawi: Lessons for Policy and Analysis

Andrew Dorward and Jamie Morrison
Centre for Development and Poverty Reduction,
Department of Agricultural Sciences,
Imperial College London, Wye Campus,
Ashford, Kent TN25 5AH, UK.
(A.Dorward@imperial.ac.uk)

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

Hans Lofgren
International Food Policy Research Institute,
2033 K Street, N.W.,
Washington DC 20006-1002, USA.

Hardwick Tchale
Center for Development Research (ZEF),
University of Bonn and
Bunda College, University of Malawi,
P O Box 219, Lilongwe, Malawi.

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). However, 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.

EXECUTIVE SUMMARY

This paper pulls together insights from related farm-household and CGE modelling for Malawi to suggest wider methodological and policy lessons for pro-poor policy analysis in poor agrarian economies. The farm-household and CGE models and the principal results are summarised, and their strengths and weaknesses discussed. The discussion demonstrates the potential benefits of greater integration between farm-household and economy wide models, and suggests ways in which this should be achieved. A number of conclusions also emerge regarding policies promoting pro-poor economic growth. These emphasise

- the importance of growth that raises real wage rates,
- the need for growth in smallholder agriculture where more productive labour demanding technologies exist,
- the complementary relationships between growth in agricultural and non-agricultural activities,
- the complementary relationships between growth promoting and welfare supporting policies, and
- the limited scope for substantial pro-poor economic growth without major structural change and longer-term tradable non-agricultural growth drivers.

Policy interventions are needed to reduce transaction costs in agricultural output and input markets and to increase household liquidity: infrastructural investments, market interventions (to stimulate otherwise thin food grain and input markets) and welfare support can all play important complementary roles in this, although there are particular challenges in developing effective intervention policies. Good governance, good macro-economic management, and access to substantial and long-term external finance are critical underlying conditions.

Table of contents

Tables

1 Introduction

This paper describes work undertaken as part of a wider project investigating alternative institutional and economic policies to promote pro-poor agricultural growth[1]. Earlier outputs from the project have reviewed progress in agricultural development and poverty reduction around the world over the last 50 years, the policies associated with success and failure, and the challenges facing agricultural economies that have yet to raise their productivity as the first part of an economic transformation out of an agrarian economy (Dorward *et al.* 2004). They have also examined these issues in relation to specific countries selected for case studies (Smith and Urey 2002, Poulton *et al.* 2002, Dorward and Kydd forthcoming). This paper summarises and pulls together the findings from two further papers that, using Malawi as a case study, developed micro-economic (farm-household) models (Dorward 2003) and economy wide (CGE) models (Wobst *et al.* 2004) to examine specific questions raised in the earlier project papers cited above.

The paper is structured in five sections. Following this introduction we provide brief separate descriptions of the methodology and results for the micro-economic and CGE models developed for Malawi. This sets the agenda for a comparison of the two models in section 4, as regards their analytical strengths and weaknesses, and as regards the results that they yield. The final section draws conclusions. The work described in this paper is ambitious as regards both the scope of policy analysis attempted, and the development and integration of different modelling methods. We therefore pay attention to both the policy questions that are the focus of the project, and the methodological issues raised in model development and application.

2 Micro-economic models

2.1 Methodology

Dorward 2003 describes the development of a set of farm/household models that replicate the behaviour of major Malawian farm/household types in response to various exogenous changes, and the impact of these changes on their welfare. The essential elements of the approach involved the development of (1) a typology of farm/household types across the country, (2) a set of farm/household models describing the behaviour of these different farm/households, and (3) a system for tying these farm/household models into a model of the informal rural economy in which they are located, to capture the partial equilibrium interactions between their behaviour and local wage rates and maize prices.

[1] Institutions and Economic Policies for Pro-Poor Agricultural Growth. Project R7989 funded by the Social Science Research Committee, Department of International Development. See www.wye.ic.ac.uk/AgEcon/ADU/projects/ppag

2.1.1 The farm household typology

The development of the typology is described in detail in Dorward 2002. Farm/households were differentiated first as regards agro-ecological zone and second as regards socio-economic characteristics within each zone. Three agro-ecological zones were identified, representing mid altitude plateau (including the Shire Highlands, Lake Chilwa plains, and central and northern mid altitude plateau, with 60% of rural households); the lakeshore and the Shire Valley; and highlands. Using data from the 1997/98 Integrated Household Survey (IFPRI and NSO 2002), cluster analysis was used to identify types of household within each area. Seven household types were identified for each of the three agro-ecological zones. The main features of these households are shown in table 2.1, for the largest zone.

Table 2.1: Farm household classification for Plateau zone

	% rural hh		ha per hh member	Assets MK/hh	Kept maize kg/member	*Cons. MK/day*	*Poverty count*
	zone	national					
Larger Farmers	4%	2%	0.86	165	315	*16*	*29%*
Medium & assets	18%	10%	0.36	975	203	*10.3*	*49%*
Borrowers	9%	5%	0.28	695	107	*9.2*	*57%*
Poor male headed	34%	18%	0.2	208	50	*6.6*	*72%*
Poor female headed	18%	10%	0.22	105	50	*6.6*	*75%*
Employed	13%	7%	0.18	360	81	*9.8*	*53%*
Remittance	4%	2%	0.31	540	128	*11.2*	*49%*
All	100%	53%	0.28	240	83	*8.4*	*62%*

Note: MK = Malawi Kwacha (in 1997/98 approx. 25MK equivalent to US$1.00); Cons. = consumption.

2.1.2 The farm/household model

The model was designed to include the following features:

1. Seasonality in terms of prices, labour use, income and expenditure, and seasonal stocks of maize and cash.
2. Engagement in a range of different major activities, including different intensities of maize production; root crops (sweet potato and cassava); different cash crops (including groundnuts, cotton, and burley tobacco; and off farm employment opportunities including low pay casual labour (known as *ganyu* in Malawi) and higher return activities from higher waged employment or engagement in small scale enterprises.

3. Heterogeneity between different farm/households in the same zone as regards land, labour and capital resources (and with differing consumption requirements according to household composition and wealth).
4. Partial engagement with imperfect markets, with high transaction costs affecting demand for and access to inputs, financial services and output markets.
5. Food security objectives in the context of uncertain farm gate and consumer prices in produce markets, and uncertain access to these markets.
6. The integration of farm and non-farm productive activities with household activities, resources and constraints (non-separability), with competition for resources between production and consumption activities.

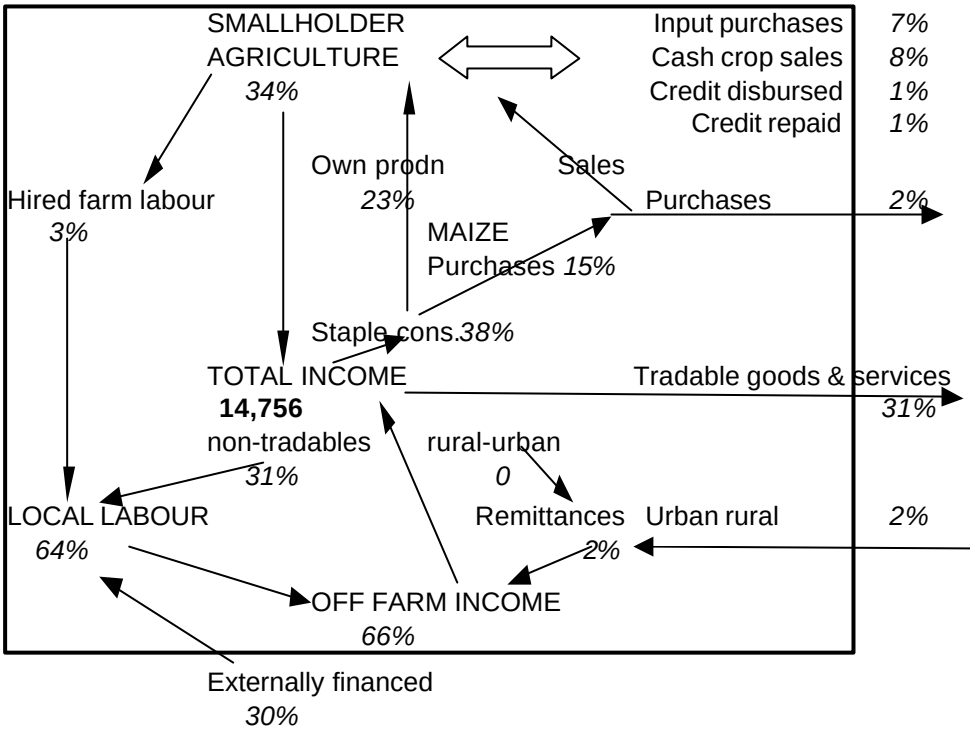
A non-linear programming model was developed using a Stone-Geary utility function with a linear expenditure system relating seasonal consumption of cash, calories and leisure time across cropping, pre-harvest, harvest and post harvest periods (see Dorward 2003).

2.1.3 Modelling the informal rural economy

The farm/household models developed were found to perform well for the 'Plateau' zone, which includes 60% of Malawian rural households, but not for the two smaller zones. Working only with the Plateau zone, therefore, farm/household model results were aggregated across the different household types, according to the estimated total number of households of each type in the zone, to build up a model of income flows and resource allocations within the informal rural economy[2]. This is shown diagrammatically in figure 2.1 for the base scenario (using 1997/98 prices).

[2] The 'informal rural economy' is distinguished from commercial or estate agriculture and from the activities of organisations operating in rural areas (whether businesses, government agencies, or NGOs). It is defined to include all the activities of the rural households described by the household models and allows for interactions between the informal economy (these households) and the rest of the world (other agents and activities not explicitly allowed for in the household models, whether located physically in rural space, in other parts of Malawi, or abroad). Within the informal rural economy, households interact by buying and selling maize and local labour services and products.

Figure 2.1: The Informal Rural Economy, Plateau Zone
(Income flows in million MK and in percentages of total income)



Informal rural economy responses to policy and other change were then modelled by iteratively running the farm/household models with modified wage rates and maize prices until these and aggregate maize and labour balances were consistent with assumptions about elasticities of demand and supply for annual labour exports and maize imports or exports from the area. An extension of this approach broke the year into two parts, the cropping and pre-harvest seasons, and the harvest and post-harvest seasons, allowing separate equilibration of wages and maize prices in these two parts of the year.

2.2 Principal results

2.2.1 Farm/household model results

The farm/household models were used first to explore structural livelihood differences between different household types and then to examine differential responses to and impacts of exogenous change.

Table 2.2: Farm and Non-Farm Activities and Income by Household Type, Plateau Zone

Farm/ Household type	Area (ha/hh)					Ganyu	Income / cap	
	Local Maiz	Hyb. Maiz	Tob.	Cass.	All	NJ	Net	Non Farm
Large Farm	0.66	0.76	0.08	0.00	1.50	-881	5,109	64%
Medium	0.45	0.59	0.27	0.00	1.30	-393	3,191	51%
Borrower	0.74	0.29	0.27	0.00	1.30	401	2,363	48%
Poor M	0.54	0.00	0.00	0.03	0.57	875	2,210	73%
Poor F	0.36	0.00	0.00	0.03	0.39	642	1,955	73%
Employed	0.22	0.58	0.00	0.00	0.80	59	3,767	76%
Remittance	0.58	0.57	0.05	0.00	1.20	150	3,742	66%
Average	0.47	0.26	0.08	0.01	0.83	118	2,667	66%

Note: Hyb.Maize = Hybrid maize; Tob. = Burley tobacco; Cass. = Cassava; Ganyu NJ = Hired out labour in November to January (hired in if negative); income in MK/capita.

Table 2.2 shows that there are noticeable differences between the different household types as regards their cropping activities and the structure of their livelihoods. It also indicates a remarkably low proportion of income from own-farm activities.

Even with the simplistic characterization of only seven household types, a complex set of differential responses to and impacts of different changes were found. Some responses do not fit normal patterns of expected economic behaviour, with, for example negative supply responses for hired labour and maize observed among the poorest households over some price and wage ranges. These arise from market failures (in credit markets) and poverty[3], lead to often inelastic supply response across the population as a whole and may also lead to perverse effects in other markets. Varying wage rates and maize prices also have significant impacts on the real incomes of poor people, and hence on the incidence and severity of poverty. There are also strong interactions between maize prices and wage rates on the one hand and maize production, marketing costs, incomes and welfare on the other hand. Together with the observation that maize prices and wage rates are critical to the livelihoods of the poor, this suggests that second order effects of policies on maize prices and wage rates are likely to have substantial effects on poor peoples' livelihoods and on the incidence and severity of poverty, and that these impacts need to be given very careful attention in policy analysis and policy making. Model results also illustrate the disastrous impacts of HIV/AIDS on the livelihoods of poor and vulnerable households.

[3] Thus increasing maize prices or falling wages in the pre-harvest period tighten household short term capital (grain and cash) constraints causing them to hire more labour out (to meet immediate consumption needs) and divert labour from on-farm activities such as maize production, although these yield a higher return over the year.

2.2.2 Informal rural economy model results

As for the farm/household model, the informal rural economy model yields insights from examination both of the base structure and of responses to exogenous changes.

The base structure of the economy is shown in figure 2.1. As noted earlier in the discussion of results from the farm/household models, the high share of non-farm income and of non-farm activities is surprising[4]. However, analysis of the share of activities which may be classed as 'drivers' and 'supporters' of growth[5] shows that even with smallholder agriculture accounting for under 40% of household incomes, as estimated here, it may account for 70% or more of the current activities with the potential to 'drive' rather than 'support' rural growth.

The rural economy model was then used to investigate potential impacts of a number of different exogenous changes resulting from different agricultural sector policies. These scenarios, which were also investigated with the CGE model, are detailed in table 2.3.

[4] In fact the 34% of income from smallholder agriculture is an underestimate as income from livestock, vegetables, scattered crops, fruits etc are not accounted for in the models.

[5] See Poulton and Dorward 2003 for a more in-depth discussion of growth processes and the role of growth 'drivers' and 'supporters'.

Table 2.3: Scenarios simulated with the informal rural economy and CGE models

Description	Scenario Name	*CGE implementation**		
			Maize productivity change	
			Labour	Land
Universal 10% subsidy on smallholder farm inputs (principally fertilisers)	InpSub10	10% subsidy on all smallholder chemicals	-2.5	0.7
Universal 20% subsidy on smallholder farm inputs (principally fertilisers)	InpSub20	20% subsidy on all smallholder chemicals	-2.3	4.3
50% reduction in crop marketing costs	Wedge50	50% reduction in crop marketing costs, 10% annual increase in infrastructure investment	8.8	16.5
As for Wedg50, plus universal access to cash on credit at 10% interest over 6 months	WedgeCred	As above	2.1	36.7
Universal distribution of start of season cash transfer of equal value to seed and fertiliser, i.e. worth 204MK per household	Cash100	Cash transfer of MK204 per hhold to all rural households, 50% administration costs	8.0	8.9
Targeted distribution of start of season cash transfer of equal value to seed and fertiliser pack, to poor male and female headed household types, 52% of households, i.e. worth 204MK per recipient household	Cash52	Cash transfer of MK204 per hhold to rural households with < 1 ha, 50% administration costs	5.2	4.4

* See text in section 3.1

The simulated impacts of implementing these policy scenarios are shown in table 2.4, arranged from left to right in order of declining estimated impact on incomes of the two poorest household types. Greatest poverty reduction is achieved from the best-case scenarios where marketing margins are reduced by 50% (Wedge50 and WedgeCred), leading to a very significant stimulus to the agricultural sector. These results are over-optimistic and included as a bench-mark, as they assume unrealistically first that farmers are able to respond to such improved incentives with substantial increases in tobacco supply and second that such dramatic increases in supply do not depress tobacco prices. Other policy scenarios lead to much more modest growth and reductions in poverty incidence. Targeted transfers tend to be less effective in raising target households' incomes and in reducing poverty than more general policies that directly benefit less poor households, but, by stimulating growth, raise real wages that benefit the poor. Results reported in table 2.4 are achieved using approximately unit elasticity of demand for unskilled rural labour by the rest of the economy. More inelastic demand for labour would increase wages when the rural labour market is tightened and increase the poverty reduction impacts of the different scenarios, which tighten labour markets. The effects of more inelastic grain markets in the rest of the economy are more ambiguous.

Extension of the informal rural economy model to allow seasonal wages and price equilibration yielded some different insights from simpler analysis that aggregates market behaviour across seasons, as a result of greater maize price instability and variation between seasons. This is an issue that needs further investigation.

3 CGE Model

3.1 Methodology

Wobst *et al.* 2004 describe the development of a dynamic CGE model of the Malawian economy to analyse the impacts of different policy scenarios over time. The dynamic model is an extension of the static, standard CGE model in Lofgren *et al.* 2002, tracing growth in population and production factors (labour, capital and land) over time and incorporating the process of technical change through adjustments in factor productivity. The model is described in terms of a 'within-period' module, modelling the behaviour of the economy across a particular year, and a 'between period' module linking the behaviour of the economy between years.

The initial period of the model is calibrated to a 1998 social accounting matrix (SAM) derived from national accounts and the 1997/98 Integrated Household Survey for Malawi (Chulu and Wobst 2001). The SAM is disaggregated into 22 production activities, 20 commodities, 5 factors, 8 households, 2 other institutions (government and rest of the world) and 5 tax collection accounts. Eight agricultural activities were included: smallholder maize production, separate smallholder and large-scale tobacco production, separate smallholder and large-scale production of other crops, livestock, fishing and forestry. Households were divided into eight types, comprising three smallholder farming household types with unskilled labour and differing access to land, one rural household type with skilled labour and no land, one rural household type with unskilled labour and no land, and three urban household types with different levels of education. Five factors of production were defined (smallholder and large farm land, skilled and unskilled labour, and capital), and 20 commodities (six agricultural activities, eight manufacturing commodities, three industry and three service commodities).

Supplies of primary factors are fixed, with variable prices and wages. Other features of the 'within-period' module include household consumption of non-marketed (or "home") commodities and an explicit treatment of transport and other marketing costs for commodities that enter the market sphere.

Table 2.4: Results of scenario simulations with the informal rural economy and CGE models

	WedgeCred	Wedge	InpSub20	InpSub10	Cash100	Cash52
Informal rural economy model (all shown as % change from the base unless stated otherwise)*						
Nominal wage rate	+50.00	+35.00	+10.50	+6.00	+1.00	+0.50
Maize price	-1.50	+1.00	-0.50	-0.25	0	0
Real wage rate	+28.5	+20.0	+6.7	+3.9	+0.7	+0.3
Poverty head count	*-16.9*	*-19.6*	*-4.7*	*-2.6*	*-2.0*	*-1.3*
Target group real income	*+34.3*	*+29.7*	*+7.9*	*+5.0*	*+3.6*	*+3.3*
All hhds real income	*+17.5*	*+20.9*	*+4.9*	*+2.7*	*+2.2*	*+1.3*
Maize consumption	*+19.6*	*+15.2*	*+5.7*	*+3.3*	*+2.0*	*+1.5*
Maize area	-32.0	-26.3	+2.5	+3.5	+4.6	+3.9
Tobacco area	+113.7	+113.7	+12.6	+3.6	-6.4	-0.0
Real Rural GDP	*+18.9*	*+20.3*	*+3.3*	*+1.7*	*+1.7*	*+1.1*
Real Agric GDP	*41*	*+63.9*	*+6.7*	*+3.1*	*+7.9*	*+5.2*
Total cost excl. admin (mill MK)	*??*	*??*	*299*	*129*	*247*	*128*
Dynamic CGE model after 10 years (all shown as % change from the base) *						
Poor rural hhd (=1 ha) real consumption	*4.1*	*2.5*	*0.1*	*-0.1*	*1.5*	*1.9*
Landless rural hhd (unskilled) real consumption	*4.1*	*2.8*	*0.5*	*0.1*	*2.1*	*2.0*
Poor urban hhd (unskilled) real consumption	*2.6*	*2.4*	*1.0*	*0.4*	*2.8*	*1.6*
All households real consumption	2.0	1.5	-0.2	-0.2	-0.7	-0.4
Unskilled wages	3.2	2.4	0.3	0.1	-1.6	-0.9
Smallholder Maize area	*-5.2*	*-3.0*	*-0.8*	*-0.1*	*-1.9*	*-1.0*
Smallholder Tobacco area	*9.4*	*7.2*	*7.8*	*3.6*	*-0.8*	*-0.5*
Agricultural GDP per capita	3.5	2.4	0.2	-0.1	0.7	0.4
Non-agric GDP per capita	-0.4	-0.4	-1.0	-0.5	-3.0	-1.7
Total GDP per capita	0.9	0.5	-0.6	-0.4	-1.8	-1.0

* The results for the informal rural economy model refer to percentage changes for comparative static simulations capturing short-run effects. The figures in the CGE section indicate percentage changes from the final-year values under the BASE scenario (without policy change) to the final-year values of the scenario for which the column applies. For example, in the final year, the poor rural household (= 1 ha) real income is 2.8 higher under the scenario WedgeCred than under the BASE scenario.

The between-period module links the different time periods with each other using equations that define the stocks of different assets by institution and factor income shares. Land availability is fixed over the ten-year period, but labour stocks are updated on the basis of exogenous trends, with labour determined by population growth, which is set exogenously at 1.94 p.a. for 1998, and declines by 2 per year to 1.59 in 2008. Labour force growth is set at 95 of population growth. The accumulation of capital stocks, government bonds, and foreign government debt is endogenous, with capital stocks changing from year to year with new investments and depreciation (both determined endogenously). Land to capital ratios are fixed in smallholder agricultural activities to reflect low capital use and limited opportunities for substitution of labour for capital. The model is solved simultaneously for the 11 periods 1998-2008.

The CGE model was then run using a set of policy scenarios, which were intended to mimic those run with the IRE model. The structure of the data from which the CGE model was constructed did not allow it to properly represent micro-economic policy impacts described in the farm-household and IRE models. To describe these impacts, IRE estimates of changes in labour and land productivity in small-scale maize production were fed into the CGE (as detailed in columns 4 and 5 of Table 2.3), together with other changes (representing policy measures and related fiscal costs) as detailed in column 3 of Table 2.3. Costs of policy implementation were generally introduced immediately (in year 1 of the simulation) whereas the benefits (proxied by higher labour productivity estimates derived from estimates from the IRE model) were phased in steadily over a period of five years to simulate delays in smallholder farmers adjusting to and benefiting from the effects of policy change.

3.2 Principal results

We consider first the simulated CGE results for the period 1998 – 2008 for the base scenario, which is without any specific policy interventions promoting pro-poor agricultural growth.

Table 3.1 shows estimated changes in per capita GDP by sector and in per capita income by household type over the period 1998 to 2008 for the base scenario. Change in the economy is driven by the effects of population growth and an increasing labour force, growing faster than productivity, which leads to depressed returns to unskilled labour, with increasing returns to (constant) land. There is a general shift of non-land factors of production (notably unskilled labour) out of agriculture due to the fixed supply of land constraining expansion of those activities. This is accompanied by falling skilled and unskilled wages but rising returns to land. The result is that households without land suffer significant losses of income over the 10-year period. For agricultural households with a small amount of land the loss of returns to unskilled labour outweighs the gain in income from increased returns to scarce land. Households with more land enjoy increased incomes[6].

These estimates present a grim picture of economic stagnation and continuing, indeed increasing poverty, in Malawi without substantial changes to the structure of the economy.

[6] Skilled urban households do well in table 3.1 because in the typology used these households are estate owners who have significant income from land.

Table 3.1: Estimated per capita GDP and income changes 1998-2008 in the base

Indicator	***Household type / sector***	***% change 1998 – 2008***
Population		+18.3
Per capita income by household type	Rural agric: = 1 ha land	-0.7
	Rural agric: 1-2 ha land	-2.2
	Rural agric: = 2 ha land	+7.8
	Rural non-agric: unskilled	-10.9
	Rural non-agric: skilled	-8.5
	Urban with agriculture (peri-urban farm households)	-7.4
	Unskilled Urban	-29.2
	Skilled Urban (estate owners)	+12.7
	All	+0.3
GDP per capita	Agricultural	-3.6
	Non-agricultural	+5.6
	Total	+2.3

The lower part of table 2.4 presents selected results from the CGE simulations of the different policy scenarios. The range of policy scenario simulations deliver very limited changes to the economy as a whole, with only small positive impacts on the welfare of poorer households (those depending on unskilled labour, with little or no land). However, all policy scenarios (including the input subsidy scenarios) are 'pro-poor' in that poorer households benefit more (proportionately) than other households. The poor benefit from wages rises for unskilled labour except under the cash transfer scenarios – with wage increases associated with (a) greater labour demanding technical change in maize production (as shown by the differences between gains in land and labour productivity in table 2.3) and (b) movement out of maize into tobacco (a more labour demanding crop). The gains over the base in the agricultural sector are however achieved at the cost of reduced non-agricultural sector per capita growth. It appears that the growth in the agricultural sector is not sufficiently high to stimulate per capita growth in the rest of the economy as the fiscal costs weigh down the non-agricultural sector and, except for the Wedg50 and WedgCred scenarios, exert a drag on the economy as a whole.

4 Comparison of the methods

4.1 Methodology and scope

Table 4.1 compares the two different types of model as regards a wide range of features, demonstrating their often complementary strengths and weaknesses. The Informal Rural Economy (IRE) model gives a more detailed representation of the opportunities and constraints faced by farm households, and captures interactions with the rural non-farm economy. The CGE model covers the economywide effects of policy changes on the economy over a 10-year period but at the cost of a less detailed representation of farm household livelihood constraints and opportunities. The two models therefore differ in time frames (static vs. dynamic), coverage and factor mobility across sectors (rural economy vs. economywide) and in the representation of farm household activities and technical change. Use of IRE model estimates of scenario impacts on productivity for the CGE scenario modeling was intended to introduce in the latter allowance for the impact of household seasonal capital constraints on household activities and productivity. This appears to have been an effective 'fix' in many ways, capturing the effects of labour demanding technical change in the IRE model, a critical element in pro-poor agricultural growth in green revolution areas in Asia (see for example Hazell and Rosenzweig 2000). The CGE model does not, however, adequately describe growing demand for unskilled labour services in the informal non-farm rural economy as a result of labour demanding technical change in agriculture, and therefore misses the other main process driving rural poverty reduction in green revolution areas in Asia. This is because the CGE model probably overestimates unskilled labour mobility between the rural and urban sectors and does not allow sufficiently for differences between formal and informal service activities in the urban and rural economies. On the other hand, the IRE model does not allow for the sticky structure of the national economy, for the impact of population growth, and for the dampening effects of direct and indirect costs of the different policies on other parts of the economy, with delays between these costs being incurred and the full realization of productivity and poverty reduction benefits. *Ceteris paribus*, a dynamic, economy-wide model generates weaker policy impacts for comparable simulations since it incorporates countervailing changes in input and output prices, longer-term adjustments, and views the policy impact in the context of growth in the overall economy. Given these structural differences and the relative strengths and weaknesses of the two modelling approaches, we conclude that reality probably lies somewhere between the two sets of results.

Table 4.1: Comparison of Informal Rural Economy and CGE modelling of policy impacts

Scenario Impacts	***IRE Model***	***CGE Model***
Seasonal livelihood opportunities & constraints, household working capital accumulation	Yes	Addressed by using IRE model estimates of labour and land productivity changes
Technology changes	Yes	No
Informal rural non-farm economy growth	Yes	Not treated differently from the rest of the economy.
Labour shifts	Between different farm & non-farm activities, and between rural & non-rural sectors	Across broad activities / sectors
Equilibrium effects	Partial	General
Government expenditure	No	Yes
Population growth	No	Yes
Phasing of scenario benefits	No	Yes
Cross border leakages	No	No

Where do the model results therefore lead us regarding policy lessons for pro-poor agricultural growth?

4.2 Principal results

We discuss below a set of strategic and operational questions raised by Dorward 2003. At the outset of this discussion, however, it is necessary to ask if the development problems faced in Malawi are representative of other poor agrarian economies, particularly in Africa. Malawi undoubtedly faces a particularly challenging set of conditions in terms of its landlocked location and poor communications, small size, very high dependence on smallholder agriculture, high poverty incidence and severity, difficulties with governance, and very high population density in the South where most of the poor live. All these problems are common in sub Saharan Africa (except perhaps the high population density, but this is likely to become more common), but their combination does present a particularly intractable set of problems in Malawi. On the other hand, rainfall patterns and agricultural potential in Malawi are more favourable than in extensive semi-arid areas in, for example, southern Zimbabwe, parts of Kenya and large areas in the Sahel, which means that there are currently available technologies with the potential to substantially increase agricultural productivity (this is not the case in semi-arid areas, where the possibilities for pro-poor agricultural led growth are much more limited). Malawi would therefore appear to be an appropriate case from which to draw conclusions about pro-poor agricultural growth potential for countries with agro-ecological conditions that can support substantial agricultural productivity increases with currently available technologies.

4.2.1 Strategic questions

These address the scope for poverty reducing economic growth in the smallholder agriculture sector as compared with other sectors:

1. What scope is there for economic growth that will benefit the rural poor in Malawi?
2. What limits are there on growth as a means of rural poverty reduction, and what is the balance between welfare support and growth?
3. What scope does the smallholder agriculture sector have for driving pro-poor growth?

Dorward *et al.* 2004 argue that despite its problems, smallholder agricultural development has the greatest scope for initiating poverty reducing rural economic growth in many poor agrarian economies (where currently available labour demanding technologies can generate significant yield increases), but that this should stimulate non-agricultural growth opportunities which must then be exploited. Model results suggest that with the current economic structure, growing population and HIV/AIDS pandemic there is only limited scope for pro-poor economic growth in Malawi, but short to medium term growth in smallholder agriculture could be achieved and could benefit very poor people, provided that such growth arises from labour-demanding technical change. In the longer term, however, other, non-agricultural growth drivers are needed to change the structure of the economy and to raise economic activity and unskilled wages. Model results also show that there are important potential synergies between welfare support and growth, as welfare support can ease short-term seasonal capital constraints on poor households' agricultural productivity. However, there are also increasing numbers of households who are not in a position to take advantage of such opportunities (through sickness, lack of labour, etc) and continued straight welfare support will be needed for such households.

There are obvious difficulties in raising domestic finance on a sufficient scale to fund the investments needed for growth (and for transitional welfare support until growth gets going), and very substantial and long term external finance is needed – but this can be offset against reduced expenditure on relief and safety nets otherwise needed in the absence of growth. The models discussed in this paper have not directly addressed the major constraints to growth from poor governance, poor macro-economic management, and very high interest rates, but these are clearly critically important, as evidenced by the current situation in Malawi.

4.2.2 Operational questions

These concern the conditions necessary for different types of agricultural development strategy to be effective; what conditions are necessary for the achievement of different types of agricultural growth, and for such growth to benefit the poor?

A fundamental need is for labour demanding technologies that can support substantial agricultural productivity increases under prevailing agro-ecological conditions[7].

[7] CGE simulations where technical change was labour saving rather than labour demanding led to strong trade-offs between growth and poverty reduction, as under these conditions increasing labour productivity led to falling unskilled wages, reducing incomes of the poor.

However, these must also 'fit' the economic and institutional environment, so that the technology uptake is financially and institutionally attractive and feasible to large numbers of farm households. Dorward *et al.* 2004 argue that institutional interventions to reduce transaction costs and risks are therefore crucially important for traders, farmers, and financiers to invest in smallholder agriculture. The models described in this paper have not attempted to explicitly describe institutional innovations for traders, farmers and financiers, but the IRE and CGE models demonstrate benefits from reduced transaction costs in output markets and from increased smallholder liquidity. Coordination problems constraining market development are discussed more fully in Dorward and Kydd (forthcoming).

The scenarios investigated with the IRE model examined a dilemma as regards input subsidies and maize prices with, on the one hand, high grain prices stimulating potential surplus producers to increase marketed maize production (with higher farm incomes and labour demands), and, on the other hand, low maize prices raising the real incomes of poor maize consumers (and deficit producers) and promoting higher food consumption. Results from the IRE model suggest that high maize prices can stimulate pro-poor growth if the interests of the poor are protected by welfare support (such as cash transfers) to compensate them for the higher maize prices they pay[8]. Both models suggest that input subsidies can lead to benefits for the poor, by tightening the labour market, although the CGE model suggests that this only occurs with higher levels of subsidy. There are major practical difficulties with maize or input market interventions, as regards limiting cross border leakages, scope for rent seeking, and pressure for subsidies to continue as large fiscal burdens after they are needed for 'kick-starting' pro-poor growth. However these policies were used widely in areas that have been through a smallholder agricultural transformation (see Dorward *et al.* 2004), and these difficulties should be seen as challenges that need to be addressed, not insuperable problems that prevent these historically successful policies from being considered and developed in today's poor agricultural economies.

5 Conclusions

This paper has described an ambitious attempt to use a combination of farm/household, partial equilibrium and general equilibrium models to examine the role and scope of smallholder agriculture in pro-poor economic growth in Malawi, and to compare alternative policy instruments for promoting pro-poor agricultural growth. The endeavour has yielded valuable methodological and policy lessons, which we summarise in turn.

5.1 Methodological lessons

We structure our discussion of methodological lessons in terms of (a) the value the different methodologies add to existing methods and (b) difficulties faced in their development and application (considering separately household typology and model development). We then discuss the need for further development of the methodology.

[8] India has followed a similar approach with price support for rice accompanied by fair price shops where the poor can buy maize at lower prices.

5.1.1 'Value added' by the methodology

The ambition of the work described in this paper was to effectively model more differential and detailed farm/household livelihood constraints, opportunities and activities as they interact with other major elements of the national economy, in order to describe the micro- and macro-economic processes involved in poverty reducing growth. We anticipate that in further work, the modelling of the micro- and macroeconomic processes would be more strongly integrated, not only in terms of the definitions of the simulations but also in terms of the depiction of farm household behaviour (in the CGE model) and of economywide price responses (for the IRE model). Nevertheless, the output of the different models has demonstrated the relevance and importance of this task, describing major differential changes in productivity, wages and incomes, and their impacts on welfare. The detailed and differentiated micro-economic work brings a major benefit in its analysis of differentiated *responses* to change as a result of the different types of constraints and opportunities faced by different rural households. Understanding differentiated responses of different household types is important not only because it allows better analysis of the differentiated *impacts* of change (critical for poverty analysis), but because it can also allow better understanding of the economic system as a whole, and hence of overall impacts of change on that system and on all stakeholders within it. This is demonstrated by the complementary strengths and weaknesses of the informal rural economy and CGE models.

5.1.2 Difficulties with farm household typology development

Two principle difficulties were faced with development of the farm household typology: the extent of heterogeneity of households within the rural economy, and the availability of data on which to base the development of that typology. Development of a typology would not, of course, be necessary if a suitable typology already existed. However, typologies developed for other purposes, such as poverty or vulnerability monitoring and analysis and for less disaggregated economy wide modelling tend to over-emphasise characterisation according to welfare or over-simplify welfare/behaviour interactions and use very simple categorisations based on, for example, holding size, gender of household head, and/or skilled and unskilled labour. Such characterisations will not normally be adequate for the type of models developed here. However, use of a tailor made typology can then pose difficulties in subsequent policy discussion and application, unless a clear relationship can be established between this particular typology and more widely recognised and simpler typologies that already exist.

Typology development is paradoxical in the sense that the greater the heterogeneity in the population, the greater both the need for a typology and the difficulties in developing one. The typology developed in this study was highly successful in that it defined different zones and found consistent patterns differentiating between households across those zones. Furthermore, for one zone subsequent modelling of different household types generated a very plausible and useful set of household models. However, the approach failed to develop valid household models for the other two agro-ecological zones, and it was fortunate that the one zone where the typology 'worked' includes 60% of Malawi's rural households. The difficulty with the other two zones resulted from the much greater degree of agro-ecological variability within them, and it was not possible to link the household data set used for the cluster analysis to any definition of zones that allowed more agro-ecological disaggregation. Even if it had been

possible to address this issue, it would have been difficult and time consuming to obtain information needed for model construction about conditions in more disaggregated agro-ecological zones.

The second major problem with typology development concerns limitations on data availability. National data sets are generally only available from household surveys designed primarily to provide national information on household consumption and expenditure patterns. Such surveys do not normally cover many items of information needed for classifying households on behavioural rather than welfare characteristics. There are also often serious questions about the reliability of data from such surveys[9]. Where reliable national data sets are not available then other approaches to household typology development are needed (see for example Poulton 2002) Whatever the approach adopted, typology development requires very detailed knowledge and understanding of the livelihood systems being classified.

5.1.3 Difficulties with model development

Wider application of the farm/household modelling methodology may be limited by difficulties in developing a standard model structure that could capture for different systems the essential components of different rural livelihoods while remaining sufficiently simple in its information requirements and outputs to be a practical tool. For example, different areas may have unimodal or bimodal seasonal structures and a range of cropping, livestock and non-farm activities with different seasonal profiles. There is no standard livelihood model structure (such as the IFPRI standard CGE model for economy wide analysis, for example). Without such a standard model the task of livelihood model construction is very demanding of time and resources, and even with such a model considerable skill will be needed to ensure that it fits local circumstances. Effective combination of the necessary modelling skills with detailed knowledge and understanding of the different livelihoods being modelled is difficult to develop, unusual and expensive.

As discussed earlier, there are considerable challenges in linking livelihood and economy wide models. The study recognised difficulties with conventional CGE models if they do not allow for critical liquidity constraints. It was hoped to address this by integrating farm/household models (with seasonal and non-separable multi-activity characteristics of peasant household livelihoods) with the economy wide CGE model, with its explicit allowance for dynamic change and for marketing costs. The different structures of the CGE and household models, however, prevented their formal integration and instead policy impacts on labour and land productivity were estimated by the informal rural economy model and fed into the CGE model. While this appears to have worked quite well, another important element needed in the CGE model is fuller and more explicit representation of (principally income and labour) interactions between farm and non-farm activities within the informal rural economy. Structural and data difficulties prevented this from being addressed with the time and resources available to the research team. Another issue needing attention in some circumstances is seasonal disaggregation of markets (allowing them to clear separately at different times of year, see Dorward 2003).

---

[9] In this case major difficulties were encountered during survey implementation and a very high proportion of observations had to be discarded during data cleaning (IFPRI and NSO 2002).

Apart from difficulties in model construction and their relation to livelihood structures and typology development, there are also (as always) serious difficulties in data availability and quality. Few household studies collect the range of data needed for model development. Programming models are perhaps particularly demanding in the scope of data they require, although it can be gathered from many different sources. There are particular difficulties with labour data (wage rates, labour use for different activities and elasticities of demand by the wider economy). There have also been difficulties in gaining detailed information about non-farm activities, although it is critical to build these into livelihood and rural economy models.

Finally, it is important to recognise difficulties in the policy application of findings from the use of these models. Critical issues concern demand by policy makers for such work, and the validity of the results – their reliability, sensitivity to particular data and assumptions (and combinations), and the processes linking policy analysis to policy formulation for effective use of models without either excessive scepticism or trust in their results. However, the benefits of ambivalent results should also be recognised, in calling for caution and for careful combination of complementary policies to achieve both growth and poverty reduction outcomes.

5.1.4 Further methodological development

Discussion of the difficulties with the methodology used in this study suggests a number of ways in which the methodology should be further developed. Four options for further work deserve particular mention:

- Alternative and less data demanding methods for typology development;
- The development of a 'standard' livelihood model structure applicable to different systems with only minor, documented modifications;
- Better formal or informal integration of differentiated and detailed livelihood models with economy wide CGE models to better describe differential livelihood responses, the informal rural economy, and labour demanding technical change; and
- The development of simpler but still robust methodologies that are less demanding of data and analytical resources but still capture the essential linkages between broader policy, trade or macro-economic changes and differentiated household responses to and impacts of such change within a general equilibrium framework.

5.2 Policy conclusions

Policy lessons have been discussed in some detail in section 4.2, and we therefore only list the main conclusions here, some of them only applicable where agro-ecological conditions can support substantial agricultural productivity increases with currently available technologies:

- Growth that raises real wage rates is critical to sustained poverty reduction, and hence poor people benefit from measures that reduce market labour supply, raise market labour demand or stimulate grain supply and reduce grain prices.

- In economies dominated by a large subsistence agriculture sector and very weak formal non-agricultural sectors and rapidly growing populations there is only limited scope for substantial pro-poor economic growth without major structural change.
- Where agro-ecological conditions can support substantial agricultural productivity increases with currently available but not widely adopted labour demanding technologies, smallholder agriculture is well placed to initially drive pro-poor growth but this requires large productivity increases from labour demanding technical change.
- Both own-farm and non-farm activities and the agricultural and non-agricultural sectors are critical to the welfare of the rural poor and to pro-poor growth, and longer-term tradable non-agricultural growth drivers are needed if substantial poverty reduction is to be achieved.
- Short to medium term growth in smallholder agriculture can benefit very poor people, and there are important potential synergies between welfare support and growth, as welfare support can not only ease short term seasonal capital constraints on poor households' agricultural productivity but also, when combined with measures promoting economic growth, promote balanced development in consumption and production, stimulating both supply and demand.
- Substantial numbers of households need welfare support where they are not in a position to take advantage of economic growth opportunities, as a result of wider problems of lack of labour, remoteness, lack of infrastructure, as well as particular problems of sickness, old age, etc.
- Substantial and long-term external finance is needed to fund investments for growth and welfare support.
- Good governance, good macro-economic management, and low real interest rates are critical to pro-poor economic growth.
- Where agro-ecological conditions can support substantial and labour demanding agricultural productivity increases, there can be major potential pro-poor growth benefits from reduced transaction costs in agricultural output markets and from increased smallholder household liquidity.
- Market intervention policies that stimulate the development of otherwise thin food grain and input markets can stimulate pro-poor growth if the poor are protected by countervailing welfare support to compensate them for higher food prices, and if practical problems in the implementation of these policies can be addressed.

References

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

Dorward, A. and Kydd, J. (forthcoming). The Malawi 2002 Food Crisis: The Rural Development Challenge. *The Journal of Modern African Studies* 42(3), September 2004.

Dorward, A. R. (2002). A Typology of Malawian Rural Households. Working Paper: Institutions and Economic Policies for Pro-Poor Agricultural Growth, July 2002. Imperial College, London; Wye Campus.

Dorward, A. R. (2003). Modelling poor farm-household livelihoods in Malawi: lessons for pro-poor policy. Wye, Ashford, UK, Centre for Development and Poverty Reduction, Department of Agricultural Sciences, Imperial College London.

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

Ellis, F. (1993). Peasant Economics. Cambridge, Cambridge University Press.

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

IFPRI and NSO (2002). Integrated Household Survey, Malawi, 1997-98, Data CD. Washington D.C., International Food Policy Research Institute; National Statistical Office, Malawi.

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

Poulton, C. (2002). Derivation of the Zimbabwe Communal Household Typology, 1996: Draft. Wye, mimeo: Imperial College London, Department of Agricutural Sciences.

Poulton, C., Davies, R., Matshe, I. and Urey, I. (2002). A review of Zimbabwe's agricultural economic policies: 1980 - 2000. Working paper, Institutions and Economic Polices for Pro-Poor Agricultural Growth. London, Imperial College.

Poulton, C. and Dorward, A. (2003). The Role of Market Based Economic Development in Strengthening Food Security. Paper prepared for the ODI Southern Africa Forum on Food Security, June 2003. London, Overseas Development Institute.

Smith, L. and Urey, I. (2002). Institutions and economic policies for pro-poor agricultural growth: India literature review. Working paper, Institutions and Economic Polices for Pro-Poor Agricultural Growth. London, Imperial College.

Wobst, P., Lofgren, H., Tchale, H. and Morrison, J. A. (2004). Pro-Poor Development Strategies for Malawi: An Analysis of Alternative Scenarios. Washington DC, IFPRI.