Agricultural Policy and Trade Reform

POTENTIAL EFFECTS AT GLOBAL, NATIONAL AND HOUSEHOLD LEVELS

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This work is published under the responsibility of the OECD Committee for Agriculture.

Also available in French under the title :

Réformes des politiques agricoles et commerciales

RÉPERCUSSIONS POTENTIELLES AU NIVEAU MONDIAL, AU NIVEAU NATIONAL ET SUR LES MÉNAGES

Foreword

Reducing agricultural trade protection and trade distorting budgetary support to farmers have long featured prominently among the shared goals of OECD member countries. Reforming agricultural policy is viewed as desirable, not only because of the net gains in global economic welfare it engenders, but also because it improves the prospects for progress in global trade negotiations more generally. Although cutting tariffs, export subsidies and domestic farm supports would lead to net gains in overall economic welfare for most countries, some developing countries may lose overall, and within most countries there are likely to be some sectors and households that are adversely affected.

This report attempts to quantify the likely distributional consequences of a widespread and simultaneous reduction in trade protection and agricultural domestic support. The first part of the analysis examines the implications for global commodity markets, for national economic welfare, and for sectoral terms of trade for an extensive list of individual countries and regions. The second part of the study tracks these aggregate impacts down to the household level for five case study countries: Brazil, Italy, Malawi, Mexico and the United States, considering the implications for net household incomes in each case.

The study was carried out by the OECD Directorate for Food, Agriculture and Fisheries. The principal authors are Joe Dewbre and Jonathan Brooks. Hsin Huang and Frank van Tongeren contributed the analysis of global, national and sectoral impacts based on simulations with the GTAPEM model. Pete Liapis contributed the AGLINK analysis of global commodity market impacts.

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Executive Summary

This study looks into the implications of reducing agricultural trade protection and trade distorting domestic support, with a focus on the level and distribution of income across nations and within countries. The findings corroborate those obtained in many previous studies, showing that such policy reform would improve both global economic welfare and the welfare of the countries implementing such reforms. Other exporting countries would also benefit when world agricultural commodity prices increase in the process. Of course, those same price increases can lead to overall net losses for some countries that rely heavily on agriculture and food imports. In all countries, there will be some sectors and households that gain and others that lose.

Agricultural policy reform is difficult to achieve, perhaps in part because those who fear they would lose are able to block or water down reform initiatives. Indeed, except as dictated by economic emergency, successful agricultural policy reform has rarely been achieved without accompanying arrangements to compensate some of the losses and to assist those negatively affected to adjust to reform-induced changes in their economic environment.

Implementing policy reform usually requires that policy makers not only understand the benefits of doing so, but also that they can identify those who stand to lose, quantify their potential losses, and then design policies that make policy reform politically feasible. Policy makers increasingly recognize that it is not enough to assert that there are potential global gains from policy reform; it is also necessary to ensure that gains are realised and widely shared, that those who may lose in the short to medium term are ultimately in a position to benefit, and that no country or group of households within a country incurs unacceptable losses. The results of this study can assist in such efforts.

Purpose and analytical approach

The analysis described in this report uses a combination of economic models to quantify the market and welfare effects of agricultural trade and domestic policy reforms. The guiding purpose is to clarify the likely distributional consequences of agricultural liberalisation in order to better design adjustment assistance and compensation policies. The policy scenario evaluates market and welfare changes that might accompany an imaginary halving of all merchandise tariffs, of agricultural export subsidies worldwide, and of agricultural domestic support in OECD countries.

The analysis begins by asking what the supposed cuts in trade protection and farm support would mean for world market prices of key agricultural commodities. It then proceeds to ask which countries would gain/lose from reform, and within each country how different sectoral and household constituencies would be affected. In answering these questions, the study highlights the relative importance of different kinds of trade and domestic policy instruments and of reforms undertaken at home compared with reforms implemented by trading partners. Household level analysis then adds a degree of

refinement by considering how different types of agricultural and non-agricultural households will be affected by reform, and what factors determine their ability to share in the benefits or to accommodate the losses.

This study employs the Secretariat's AGLINK and GTAPEM models to measure policy effects at the global, national and sectoral levels. Household level policy effects are evaluated using a variety of different micro-level models in five country case studies: Brazil, Italy, Malawi, Mexico, and the United States. The case studies differ in their construction, reflecting the different structures of the economies as well as data availability. They nevertheless share two core characteristics. First, they embed micro (household) level information in a macro (region or economy-wide) behavioural model. Second, they contain groups of representative households that collectively represent the totality of household types in the economy. The key elements in tracing out the distributional impacts of reform are household responses to policy change, products and factor market interactions, and economy-wide linkages.

Global commodity markets

The reforms generally lead to reductions in agricultural production and increases in consumption in countries that currently offer farmers high rates of trade protection and support. AGLINK shows this combination would increase world market prices for most agricultural commodities produced in OECD countries. The largest simulated price increases are for tradable dairy products: cheese, butter and powdered milk, where reform produces simulated price gains averaging well above 10%. Simulated increases in world prices for other livestock and crop commodities are more modest, ranging on average from 2-3%. World prices of oilseed meal and oilseeds are shown to decline slightly.

National economic welfare

Economy-wide welfare gains obtained from simulations undertaken with the GTAPEM model are positive for the great majority of individual countries and regions included in this analysis. The magnitude of multi-sector reform benefits, when expressed as a percentage increment in GDP, is higher for the non-OECD region than the reform-induced gain in welfare estimated for the OECD region.

Welfare gains for the OECD region stem mostly from agricultural policy reforms, while the non-OECD region is shown to gain significantly more from reductions of non-agricultural tariffs. These simulated income gains are substantially less than obtained in some other studies. This is largely due to the fact that this study uses more recent and more precise data to measure trade protection and domestic agricultural support – refinements that lower the implied level and distortiveness of present-day agricultural support measures. Further, these results are comparative static while some other studies also incorporate assumed dynamic gains from induced productivity improvements and economic growth.

Welfare gains attributable to agricultural policy reforms come mainly from the simulated reductions in import tariffs and flow mostly to consumers in those countries where tariffs are decreasing. Reducing government budgetary payments to farmers provides small aggregate welfare benefits to the countries implementing the policy change but makes almost no difference to welfare outcomes for other countries. However, in some countries these payments constitute substantial redistribution of income from taxpayers to farmers and landowners.

The study distinguishes multiple categories of budgetary payments generally following procedures used for classifying support measures for the Producer Support Estimate (PSE).[1] For the policy simulation all these various categories of payments were allocated to specific commodities and all were assumed to require either planting or production as a condition of eligibility. In reality, some kinds of budgetary payments do not require production. Although such programs may still encourage higher-than-otherwise output levels through non-price channels the incentive effect would be lower than assumed in this analysis. Correspondingly, the simulated welfare gains from reducing budgetary payments would also be lower than suggested by the results.

The implications of reforming OECD agricultural policy for any non-OECD country or region are difficult to determine *a priori*. Competitive suppliers will of course gain from more open markets and from commodity price increases. Net importers of commodities whose world prices increase with policy reform may lose if there are no corresponding increases in the prices of commodities they export. Moreover, some countries who are net exporters of the commodities most affected by OECD agricultural support might lose if reform erodes the economic benefits of any preferential trading arrangement they have with an OECD trading partner. The study finds that the non-OECD region gains overall from world price increases engendered by OECD agricultural policy reforms, but the total gain is relatively small (about USD 1.8 billion, which is approximately 0.03% of the total GDP for the region). Moreover, those gains are concentrated in a few countries only, and more than half the estimated net welfare gain for the non-OECD region from reductions in OECD agricultural support accrues to just one country, Brazil.

Farm sector impacts

Net economic returns to land, labour and capital employed in agriculture (value added) fall in most OECD countries where trade protection and domestic support is reduced, but increase in some OECD and non-OECD countries where current levels of trade protection and domestic support are relatively low. The most important contributor to the estimated falls in farm value added are the simulated sharp reductions in the returns to land, and these are due mainly to the assumed cuts in budgetary payments tied to land. Reductions in trade protection contribute only marginally to farm income losses in OECD countries. Strikingly, however, the increase in world market prices caused by those same reductions in trade protection explain most of the income gains experienced in countries where farm sector returns increase.

Among the developing countries given individual treatment in this study, further trade reform may add to ongoing downsizing of the agricultural work force in some of them, *e.g.* India, but may offset some of that pressure in others, *e.g.* Brazil. However, where pressure for downward employment adjustment in the sector is created by trade liberalisation, this may not add greatly to pressure associated with the ongoing process of economic development and growth. Undoubtedly, some people currently working in agriculture in such countries will experience a reduced demand for their services.

Household level effects: general observations

Within the aggregate effects discussed above, the effects within each country will vary considerably by commodity and among farm households. The country case studies measure the within-country distributional effects of agricultural and trade policy reforms

undertaken at the national and/or multilateral level. Given the limited number of studies, their interest is in drawing illustrative insights and suggesting ways these insights can assist in the design of policy responses.

Each of the case studies distinguishes multiple household types, and employs its own classification in order to best represent the structure of the economy under study. For purposes of comparison, a broad distinction can be made in each case between commercial and non-commercial farm households (with one or more sub-categories). The former tend to behave more like firms, consuming little of their own output and supplying few of their own inputs. This group tends to be better integrated with formal markets. Two further broad categories of households are agricultural wage earners and urban households. These groups may be particularly important in developing countries, where there are more landless workers and the urban population spends a substantial share of its income on food.

Despite the difficulty of making strict comparisons between the country case studies, there are some common threads running through the results. In all cases, the biggest immediate impacts of reform tend to be on commercial producers. When domestic protection is low and prices received increase as a result of reforms in other countries, commercial farm households gain the most. Similarly, they lose most when confronted with the loss of domestic protection. This result holds in both absolute terms and relative to other types of household. Three factors explain this key finding.

First, non-commercial farm households tend to have more diversified monetary income sources, with a greater share of income coming from non-farm activities. This tends to limit the impact of sector-specific reforms. Second, in non-commercial farm households (notably subsistence households in developing countries) there is significant self-consumption of farm products, which dampens or even reverses the benefits of price increases. Indeed, many poor farm households in developing countries are net consumers of commodities they produce, which means they are likely to lose from higher prices. Third, non-commercial households are likely to incur higher transaction costs than their commercial counterparts. This can further dampen the beneficial effects of price increases and can lead to factor market impacts (such as higher land rents) dominating. In many cases, therefore, it appears that reforms that benefit commercial producers are likely to have mixed effects within the overall category of non-commercial farm households.

One caveat is that commercial farm households may have more or less adjustment capacity than do non-commercial farm households, depending on the circumstances. For example, commercial farmers may have better access to credit and therefore better able to respond to improved market opportunities. They may also have better management skills. On the other hand, non-commercial farmers may have less specific skills that enable them to find off-farm employment more easily and thus shift labour out of (into) farm activities as prices fall (rise). In short, the adjustment capacity of different household types is context-specific and could, in some cases, reverse the general result that commercial farmers have more to win or lose than do their non-commercial counterparts.

Household level effects: case study findings

In specific terms, the case studies suggest the following distinctions between impacts on commercial and non-commercial farm households:

- In Brazil, the domestic prices of most agricultural goods are expected to increase as a result of the multilateral trade reform scenario specified in the GTAPEM analysis. The

incomes of commercial agricultural producers are expected to increase by 3-4% as a result of a 50% liberalisation scenario, with the per capita gains to non-commercial family-farm households about half that percentage. The main reason for the difference is that commercial farmers are more specialised in export products, such as meat and sugar, the prices of which are likely to rise significantly as a result of multilateral reforms.

- In Malawi, the vast majority of households are poor. Commercial producers of the dominant cash crop, tobacco, who are less poor gain from higher prices. GTAPEM simulation results suggest price increases of less than 5% for the principal cash crop (tobacco) from a 50% global reform scenario, which will raise tobacco farmers' incomes by less than 1%. The resulting increase in tobacco farmers' demand for labour benefits poor non-commercial households who cannot grow tobacco, but lowers the incomes of poor farm households that hire in labour. The simulations suggest it is actually farm wage-earners who gain most from tobacco price increases. The poorest households do not benefit as they do not grow the crop due to the lack of cash to buy inputs.

- In Mexico, commercial farm households lose most from lower market prices for both maize and cash crops, while the impacts on smaller farm households (less than five hectares) differ significantly from one region to the next. Following multilateral reforms as described in the GTAPEM experiment, the estimated real incomes of all agricultural households fall, but the declines are greatest for producers with more than 5 ha of land (-0.4%). There are similar, but much smaller impacts for landless households and smaller producers with less than 5 ha (-0.1%). There are two principal reasons why larger farmers lose more: first, they tend to consume a smaller share of their own output, so declining output prices have a bigger impact on net income; second, larger scale producers on balance rent land out to smaller farmers and lose out from declining land rents. Within these national impacts, the regional effects depend on the extent to which farmers are integrated with functioning markets. For example, in the North−West a decrease in the maize price lowers maize production by all household types, with the result that the real incomes of small farm households fall (after offsetting wage and land rent reductions). In Central Mexico, on the other hand, a lack of integration with commercial maize markets means that small farmers do not suffer from these price reductions; but they still pay less in land rents, with the result that their incomes rise fractionally.

- For Italy an analysis of the distributional effects of widespread reductions in support under the global reform scenario produces income losses for the larger farm types that are substantially greater than for the small holders. The simulated income losses stem almost entirely from sharp drops in the returns to land that follow support reductions. Another simulation shows that the recent shift of the EU agricultural policy towards single farm payments reduced production and trade distortions and improved national welfare with only small overall effects on income distribution. Although the effects were small, that change in policy mix seems to have benefited medium and large farms relatively more than small and resource-limited farms.

- The United States study considers a full global reform scenario, albeit with no reductions in those categories of US direct payments deemed to be non trade-distorting (*e.g.* the Production Flexibility Contract payments). All categories of US farm

households gain income under this scenario. This happens because simulated income losses coming from cuts in all the other kinds of US farm support and trade protection are more than offset by income gains stemming from higher world commodity prices. There are interesting distributional effects nonetheless. The greatest gains go to residential and lifestyle farms, which have higher part-time spousal employment and show the greatest capacity for labour substitution and strongest on-farm labour response. These types of farms also tend to be more specialised in beef products, for which prices increase. Within each household group, those with higher adjustment capacity earn a greater share of the group's overall benefits.

Findings from the Brazil, Malawi and Mexico case studies show that the distributional effects on non-farm households, notably agricultural wage earners and consumers, are particularly important in developing countries, given the relatively large numbers of agricultural labourers and the fact that the poorest households often spend a large share of their incomes on food (40% or more).

The impact of reforms on agricultural employees depends on the hiring decisions of commercial farm households. In many cases, farm workers are relatively poor, even compared with non-commercial farm households. An increase in wages, or an expansion in employment, mitigates the rise in inequality as the incomes of commercial farms rise. These effects are important in the three developing country studies. Moreover, wage increases may also benefit semi-subsistence households to the extent that they obtain income from off-farm work.

Food price changes can have significant impacts on the real incomes of consumers. However, consumers are less specialised in their consumption patterns than producers are specialised in their income sources, and can switch more quickly to cheaper foodstuffs than producers can adjust their supplies. Hence, the effects of any particular price increase will be less acute. In the case of Brazil, the agro-food industry is sufficiently important that the losses to urban households from higher food prices are, on balance, outweighed by higher profits and labour income from agro-food exports. In this study, therefore, the income gains are spread across all groups, and while inequality among agricultural producers increases, poverty declines and there is little economy-wide impact on inequality.

The case studies demonstrate the inherent difficulty of achieving aggregate efficiency gains without making some households worse off as an immediate effect of the policy reform. In OECD countries with high support, uncompensated reforms will inevitably reduce the incomes of protected farm households. In many developing countries, it is probably impossible to change price policies and accompanying border measures without making some poor households even poorer. These are not reasons to avoid reform, as there are also those that gain, and society overall gains as well. But these are reasons to consider appropriate policy measures to facilitate the efforts of households who have to adjust to changes that are beyond their control.

The policy story

Trade policy implications

The majority of individual countries and regions covered in this analysis are shown to gain economically from agricultural and trade reforms. These potential welfare improvements justify continued efforts to obtain widespread agreement to future trade

reform. The trade and agricultural policy reform scenarios examined are based on 50% cuts in applied tariffs, export subsidies and agricultural domestic support. A less ambitious, less inclusive policy reform effort would not yield reform benefits that are as large or as widespread as those found here.

The largest share of the estimated welfare gains from multilateral, multisectoral policy reform for OECD countries comes from cuts in their own agricultural trade protection and support, and most of the gains stem from reductions in tariffs. Implicit in this result is the assumption that where tariffs constitute only one component of a package of mutually re-enforcing price support instruments, tariff reductions would be accompanied by complementary reductions in all related policy instruments in the package. Reductions in budgetary payments, especially those tied to land, yield relatively small estimated net welfare gains, but result in relatively large reductions in farm value added. This implies that a policy reform package containing tariff cuts could achieve larger welfare reform benefits.

Estimated reform benefits for the non-OECD region are dominated by those arising from cuts in non-agricultural merchandise tariffs in OECD countries. The smaller welfare gains for the region from agricultural policy reforms come both from own tariff reductions and the cuts in tariffs and domestic support occurring in OECD countries. Of course, these findings for the region as whole hide a wide diversity of estimated results for individual countries. Some of the individual non-OECD countries studied, notably Brazil, gain substantially more from agricultural than from non-agricultural liberalisation. Although only one of the individual countries and regions studied, Sub-Saharan Africa, is shown to lose overall from multisectoral policy reforms, several individual countries would experience welfare losses with partial reforms, whether agriculture-only or non-agriculture only. A multisectoral, multilateral reform offering the fewest possible exemptions and exclusions would maximize both potential reform benefits and the breadth of political support needed to achieve them.

Compensation and adjustment assistance

Findings obtained both in analysing reform impacts on the farm sector as a whole and in the household level analyses reveal that in countries reducing above-average protection and support levels, landowners constitute the group likely to suffer most from agricultural policy reform, even if such reform excluded cuts in land based payments. A broader grouping of those who stand to lose the most would include owners of other assets fixed in agricultural production, with the most important example being perhaps the owners of production quota rights. In the past, policy-makers have responded to concerns about policy induced write-offs of farm asset values by implementing programs that compensate potential losses. Such a shift from more to less distorting support measures is to be encouraged.

Much discussion of adjustment policy focuses on the need to address concerns of people who may lose their job or suffer reduced wages as a consequence of policy reform. Findings from both the aggregate, sector level analysis and the case studies put such concerns in perspective. Sector level analysis shows simulated reductions in wage rates and employment in the countries where these occur are small. Findings from the case studies based on household models reveal that the effects of policy reform, be they positive or negative, fall most heavily and directly on commercial farmers, *i.e.* those producing commodities that potentially could be bought or sold at world market prices. There can be knock-on effects for hired farm workers as was shown in the Brazil case.

Commercial farmers in both developed and developing countries typically constitute a small share of the farm population and thus often a tiny share of the entire work force. Moreover, although not universally the case, commercial farms producing commodities benefiting from high rates of trade protection and domestic support tend to be highly capital intensive and do not employ a large number of farm workers. Thus, the number of people likely to suffer job losses or a loss of wage-type earnings following agricultural policy reform would be small.

Even if according to the simulations the number of individuals significantly affected is small, consideration should be given to policies that might facilitate adjustment. In the case of developed countries, economy-wide social safety nets are generally in place and, if readily available to farm households, can provide the support necessary for those unable to adjust and remain productively engaged in agriculture. The situation in developing countries may be more complex. In order to improve the competitive position of at least some farm households, additional public investment can be considered in areas such as education and training, research and extension, health services, food safety and accreditation systems, and physical infrastructure. Such policies may be targeted regionally or at the household level. It is clear in developing countries as well that not all households will have the potential to adjust, or to respond effectively to adjustment assistance. Alternative employment opportunities may be limited, and effective labour market policies and social safety nets may or may not be in place; consideration would need to be given to the establishment of such measures.

Many farm households are capable of adjusting, and it is important that policies should not impede their incentives to do so. This means that the emphasis should be on allowing and facilitating adjustment rather than compensating households for any adverse effects of reform, since the latter approach may act as a disincentive to adjustment. At the same time, there may be a need for safety nets for those households that are not capable of adjusting.

Note

1. The annual monetary value of gross transfers from consumers and taxpayers to agricultural producers, measured at the farm gate level, arising from policy measures that support agriculture.

PART I.

Global, National and Household Level Effects of Trade and Agricultural Policy Reform

Abstract

Part I focuses on measuring the impact of multilateral agriculture and trade policy reforms on global commodity markets, inter-sectoral terms of trade, and national economic welfare. Global commodity market effects are estimated using the OECD AGLINK model while the reform implications for inter-sectoral terms of trade and national economic welfare were assessed using a global CGE model, the GTAPEM. The reform scenario combined 50% reductions in merchandise tariffs for agriculture and non-agriculture products with a similar halving for all forms of domestic agricultural support. The results that were obtained allowed for estimates of the separate influence of trade policy interventions: tariffs and export subsidies as well as individual types of budgetary support given to farmers. These include area payments, and output and input subsidies. Estimated factor market and welfare impacts are presented separately for selected developed and developing countries and regions.

Introduction

Governments of most countries, developed and developing alike, impose tariffs on imports of agricultural goods in order to boost the prices their farmers receive on the domestic market. Some governments, especially those in richer OECD countries, either directly subsidize or by other means encourage exports and provide additional financial help to farmers through direct budgetary payments, concessions on taxes, subsidized credit, fuel and fertilizer. Developing countries, typically not having the financial resources to offer direct budgetary support, rely nearly entirely on import tariffs to support domestic market prices. Such interventions change the landscape of relative prices guiding producer decisions about the mix of outputs to be produced and the mix of inputs to be used in producing them. Through trade and world market links, the trade protection and domestic support afforded farmers in one country lead to changes in the pattern of output and factor choices internationally. Reducing agricultural trade protection and support would not only lower the domestic consumer and taxpayer costs of such interventions, but would through induced improvements in domestic and international resource allocation, lead to net gains in global economic welfare as well.

Though most countries would likely experience net income gains from widespread agricultural policy reform, some could lose. Increases in food commodity prices internationally following reform could raise the cost of food imports in net food importing countries by enough to offset any economic benefits of those same higher prices for farmers in those countries. Farmers in some developing countries benefit from privileged access to developed country markets under bilateral trade agreements. It is possible that the economic benefits associated with such favourable access could be eroded with global reform of agriculture and trade policies to such a degree that some countries would experience net national income losses. Of course, within countries, some economic sectors will expand while others contract; those farm households that are net sellers of farm commodities whose prices rise because of reform may benefit but some farm, rural and urban households who are net buyers of those same commodities might lose. Conversely, where policy reforms lead to lower prices, *e.g.* when import tariffs are reduced, domestic buyers gain at the expense of domestic suppliers.

The main purpose of this study is to obtain a better understanding of the potential magnitude and the distribution of these reform induced gains and losses among and within countries, focusing especially on how policy reform effects may be different for different household types in developed and developing countries. Another purpose is to gain insight into alternative ways of analyzing distributional impacts of policy reforms. A better understanding of policy effects, and how to measure them, is needed to enable governments to identify adjustment needs and then design appropriate adjustment policies both domestically and internationally.

The analysis is based mostly on policy simulations done using economic models. Analyses of policy effects on global, national and sectoral aggregates (global commodity market prices, national incomes, sectoral terms of trade and so on) was done using the OECD's AGLINK and GTAPEM models. Analyses of policy effects on different types of farm and non-farm households were done in five country case studies (Brazil, Italy, Malawi, Mexico, and the United States) each using a model tailored specifically to study objectives and data availabilities. All of the case studies look at the potential impacts of policy reform on household incomes and expenditures for multiple categories of farm and non-farm households. Although the particular categories identified for analysis differ

somewhat from one study to another, in all cases it was possible to distinguish distinct household types within the two broadly defined groups of commercial versus non-commercial farm households. Another feature common among the case studies is that for each one results obtained simulating global and national aggregate market effects are fed into the models used to measure household effects. GTAPEM simulation results provided the basis for studying household level effects for the Brazil, Italy, Malawi, and Mexico studies. Analysis of household effects in the US study was based on results obtained in simulating a national model.

There are two main parts to this report. Part I comprises this introduction and three chapters. Part II contains extended summaries of the individual country case studies providing additional detail on the analyses, models and data used in each case. The immediately following chapter in this first part of the report is devoted to a brief review of the evolution of agricultural support and trade protection, focusing especially on trends and levels of support as estimated for the PSE. This leads naturally to the question motivating the entire analysis, "What are the implications: for global commodity markets, for farm sector and national GDP and for the economic well-being of different kinds of farm and non-farm households of widespread, deep cuts in farm support and trade protection?" The analytical findings responding to those questions are presented in Chapters 2 and 3. Chapter 2 reports results from analyses aimed at measuring global, national and sectoral level effects while Chapter 3 synthesises results from the case studies of household level effects. Chapter 4 summarises and addresses potential implications for policy.

Chapter 1.

Extent and Composition of Agricultural Support and Trade Protection

A starting point for examining the effects of reform is to consider the existing level and types of support given farmers. The OECD monitors and evaluates trends in both the overall level and the composition of agricultural support in its member countries using the Producer Support Estimate, the PSE, and various subsidiary indicators. (See OECD (2004) and previous issues.) The PSE sums up the monetary value of government interventions that result in financial transfers from consumers and taxpayers to support agricultural producers. When expressed as a percentage of total farm receipts the PSE allows economically meaningful comparisons of the extent of support across both countries and commodities.

In constructing PSE's, the various policy measures that governments use in channelling financial support to farmers are categorized according to a system of classification that begins by distinguishing between market price support and budgetary payments. Each of these two broad categories is then further broken out according to the way the associated policy is implemented. For example, some programs of milk market price support require that producers abide by a production quota; others do not, a distinction that is crucial in assessing the degree to which higher producer prices distort production decisions.

Likewise, in classifying budgetary payments, an important criterion is whether entitlement to a payment made to a crop farmer requires production or planting of a specific crop or merely that the recipient retains the land in good agricultural condition. A related set of requirements may condition entitlement to payments made to livestock producers. The system of classifying PSEs based upon implementation criteria constitutes an essential first step in evaluating the associated trade, market and economic welfare effects of agricultural support.

Market price support

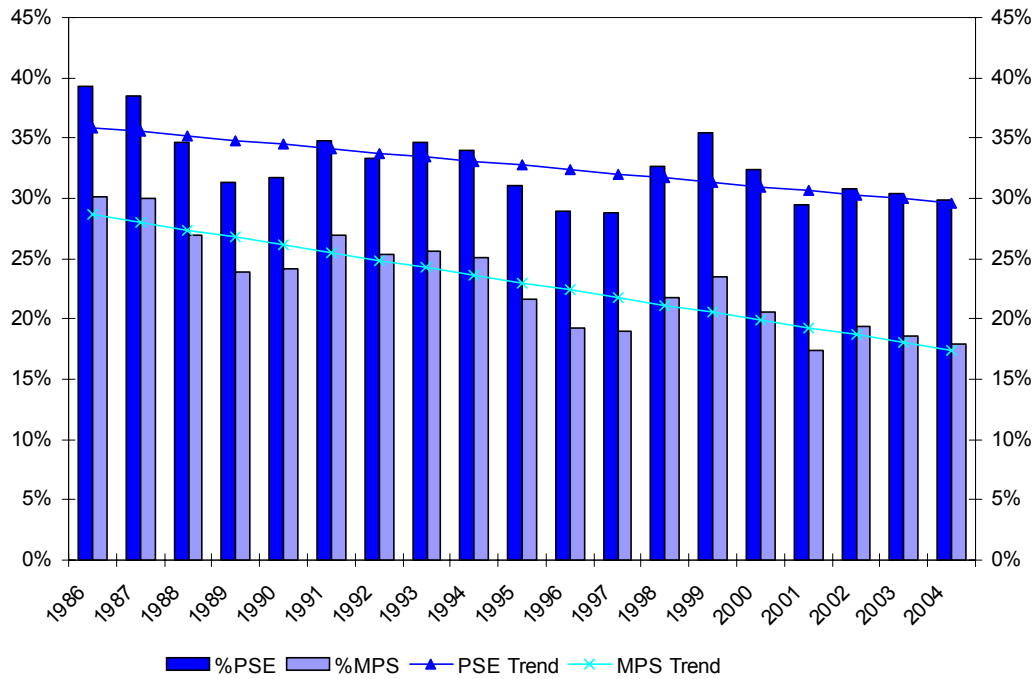
Market price support is the most important cause of farm trade surpluses and depressed world prices of agricultural commodities. There are two connected reasons for this. First, a given monetary amount of market price support has a greater impact on production and trade than most types of direct financial support governments provide farmers (OECD, 2001a). Second, for most countries and commodities, market price support dominates other kinds of support, accounting for upwards of two-thirds of the OECD-wide percentage PSE in recent years (Figure I.1).

Government intervention aimed at supporting market prices of tradable farm commodities almost always requires trade interventions: import tariffs or quantity limits to staunch the flow of imports and, in some cases, export subsidies to encourage foreign buyers to purchase surplus production. The higher domestic prices caused by trade interventions simultaneously discourage domestic consumption and encourage domestic production. Thus, compared to direct budgetary support that directly affects only the supply side of the market, *e.g.* a payment per unit of output produced or area planted, market price support provokes a greater change in the volume of trade for a given monetary amount of support provided.

Figure I.1 traces the evolution of OECD agricultural support as measured by the %PSE and the %MPS. The %PSE indicates the percentage share of total farm receipts that comes from the combined total of market support and government payments to farmers. For example, in recent years, the OECD average %PSE has hovered in a very narrow range around 30%, implying that just under one-third of total OECD-wide farm receipts result from transfers associated with agricultural policies. The %MPS refers to the share of farm receipts attributable to just those interventions aimed at boosting the prices farmers get on the domestic market above what they would get if they had to sell the product on world markets. As Figure I.1 shows, the trends of both the %PSE and the %MPS have declined somewhat in the last fifteen or so years, with the %MPS falling at a faster rate than the %PSE.

Figure I.1 Evolution of Producer Support Estimate (%PSE) and Market Price Support (%MPS)

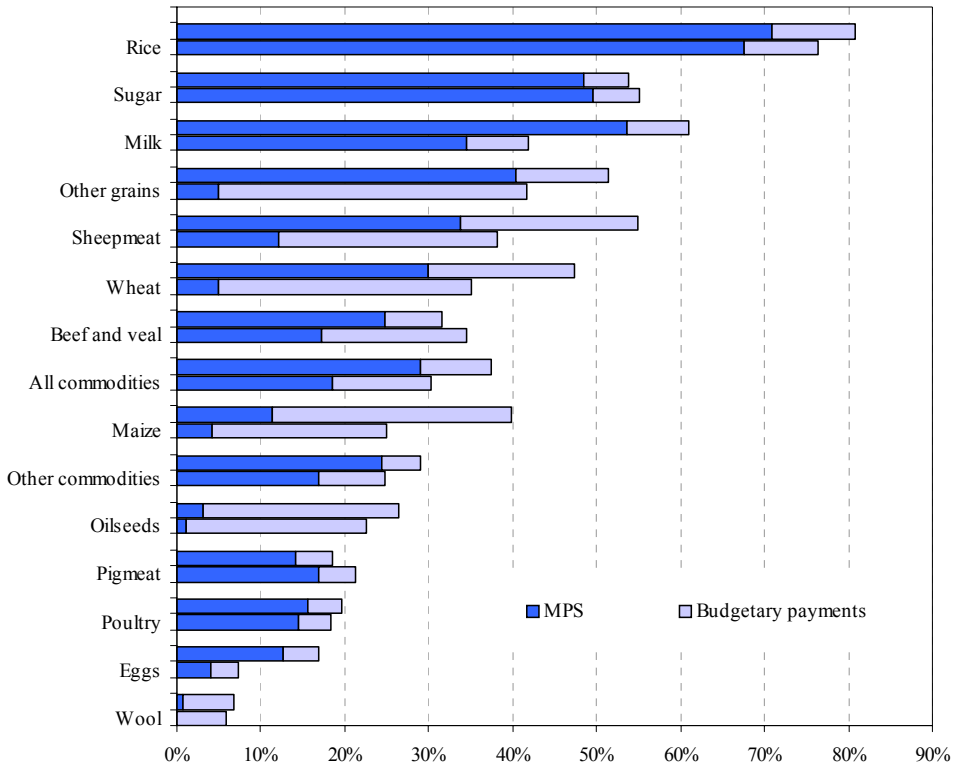
1986-2004



Source: OECD, PSE/CSE database, 2005.

Figure I.2 compares the %PSE and %MPS for selected commodities using three year averages of annual values for two periods, 1986-88 and 2002-04. Average commodity support levels have decreased compared with 1986-88 for all commodities except pigmeat and beef and veal which increased only slightly. Especially noteworthy are the sharp reductions in the levels of support afforded producers of cereal crops (wheat, maize and other coarse grains) and oilseeds. Notice, moreover, that these falls were the net consequence of substantial reductions in market price support, partially offset in total PSE terms by increases in budgetary payments.

Figure I.2 Producer Support Estimate by commodity OECD average as% of value of gross farm receipts 1986-88 and 2002-04



For each commodity the first horizontal bar relates to 1986-88, the second to 2002-04. Commodities are ranked according to 2002-04 levels

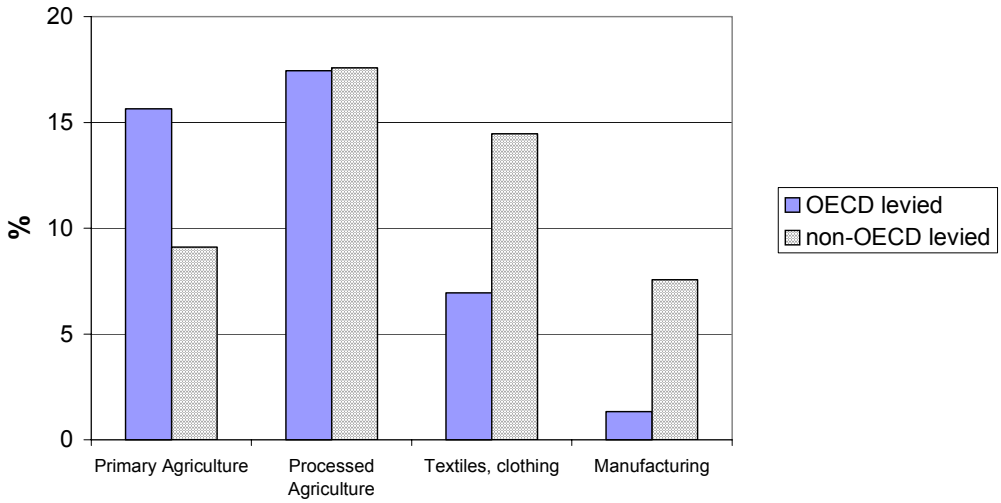
Source: OECD, PSE/CSE database, 2005.

The most heavily protected commodities in OECD countries are rice, sugar and milk. Moreover, while the rates of market price support have been falling for most commodities, including for milk, those for rice and sugar are nearly the same today as fifteen years ago when the OECD started regularly monitoring policy developments using the PSE. Sugar and milk benefit from high rates of trade protection in almost all OECD countries, with the notable exceptions of Australia and New Zealand. Note, however, that in the EU, the largest OECD producer of both these commodities, production is limited by quotas that mitigate the supply inducing effects of a given level of market price support. Likewise, milk quotas limit excess production in Canada, Switzerland, and

Japan. Rice is produced in only a few OECD countries but benefits from high support in Japan, Korea and the United States. Prices received by producers and those paid by consumers were, on average in 2002-04, around twice the level of world market prices for sugar and milk and about four times higher than the world prices for rice.

Market price support usually requires, but is not exclusively the consequence of, tariffs applied to the price of imported substitutes for protected commodities. In many countries, the transactions costs of trade, phyto-sanitary restrictions and other kinds of non-tariff measures may add to the protective effects of tariffs in creating the gap between domestic and world market prices. OECD estimates of the Nominal Protection Coefficient (NPC) for PSE commodities tend to confirm this. NPC's constitute a 'tariff-like' indicator of trade protection calculated using data directly comparing domestic and world prices rather than tariff data. OECD-wide averages of NPC's are typically higher than average tariffs on agricultural goods such as those reported in Figure I.3. (See OECD (2004) and earlier issues.) Figure I.3 compares average tariffs between regions and between agricultural and industrial goods. The source and methods used in making these calculations are explained later.

Figure I.3. Average applied import tariffs by sector and region 2001



Additional tariff information can be found at www.oecd.org/agr/reform/gtapem.

Import tariffs applying to primary agricultural products average around 15% in the OECD region and just under 10% in the non-OECD region. In both regions import tariffs applied to processed agricultural products average above those for primary commodities. In the OECD and to a lesser extent in the non-OECD region, agricultural tariffs are higher on average than those applied to textiles and other industrial goods. However, as reported below, the effects of multi-sectoral tariff reductions depend not only on the initial rates but also on the size of the sector being reformed. Even when combined, primary and processed agriculture account for significantly less economic activity than do non-agricultural sectors in all developed countries and in virtually all developing countries.

Moreover, although agriculture remains a relatively more important sector of the economy in developing countries, the situation is changing rapidly in some of them. Citing World Bank (2003) estimates, Charlton and Stiglitz (2005) note that the share of manufacturing in total exports by low income countries rose from 20% in 1981 to more than 80% in 2001. Over the same period, growth in exports of primary commodities was only 2% per annum, far exceeded by the growth in exports of processed agriculture (8%) and textiles (15%), trends that are generally consistent with the well-established pattern of a declining relative importance of agriculture in growing economies.

One reason to expect that the effects of trade policy reform will be different for different commodities, sectors and households is because the pattern of cuts in applied tariffs undertaken in implementing trade reform will itself be highly uneven, regardless of the particular tariff cutting formulae adopted as part of a future trade agreement. Part of the explanation lies in the distinction between bound tariffs which are the basis for multilateral negotiations on market access at the WTO and the tariffs which importing countries actually apply to imports purchased from their various exporting country trade partners. Box I.1 explores this issue in some depth.

In the GTAPEM policy scenarios to be discussed subsequently, a big assumption is that the supposed cut in tariffs, however they may eventually be implemented, deliver an across the board halving of pre-existing applied rates. In the AGLINK analysis of global commodity market impacts, the hypothesised tariff cuts are from bound rates. In reality however, the distinction is not quantitatively significant for AGLINK policy scenarios since AGLINK country coverage emphasises mainly OECD countries where, as the data discussed in Box I.1 illustrate, binding overhang tends to be small.

Box 1.1. Bound, applied and preferential tariffs

In reality, the tariff bindings, the main focus of the WTO negotiation process, refer to the agreed maximum tariff that a country may charge on a given product. Typically though, countries actually apply tariffs that are below the negotiated maximums. And, unless negotiated cuts in bound tariffs result in new bound rates that are below the pre-existing applied rates, there will be no effective requirement for a reduction in protection. In many cases import access at lower than maximum allowable tariffs is extended to all WTO members under what is called the Most Favoured Nation (MFN) principle of the WTO. In order to distinguish this from other kinds of applied tariffs to be discussed below, for the remainder of this paper it will be referred to as MFN-applied. According to that principle, if a lower tariff rate is scheduled for one trading partner, the same rate must be offered to all partners. The difference between the bound and the MFN-applied rate has been termed binding-overhang, a term also to be used subsequently (Francois and Martin, 2004).

There are two main types of trade agreements under which at least one of the trading partners may receive better-than-MFN treatment: those resulting from regional and bilateral trade agreements and those under which developed countries provide preferential market access to developing countries. The special tariff treatments afforded under the first of these two schemes are referred to as reciprocal preferences to indicate that each and every partner to the agreement charges all of the others the same tariff. Correspondingly, the favourable treatment developed countries afford developed countries are one-way and are thus referred to as non-reciprocal preferences.

The distinctions between bound, MFN-applied and preferential-applied tariffs confound generalisation about the likely distributional effects of multilateral tariff reductions and all the more so when tariff cutting formulae themselves call for reductions that may differ for different countries, commodities and initial tariff levels. Fully understanding the economic implications of such distinctions is an enormously complicated task, one far beyond the scope of the present analysis. Fortunately, as new data has become available for studying the issues, the subject has

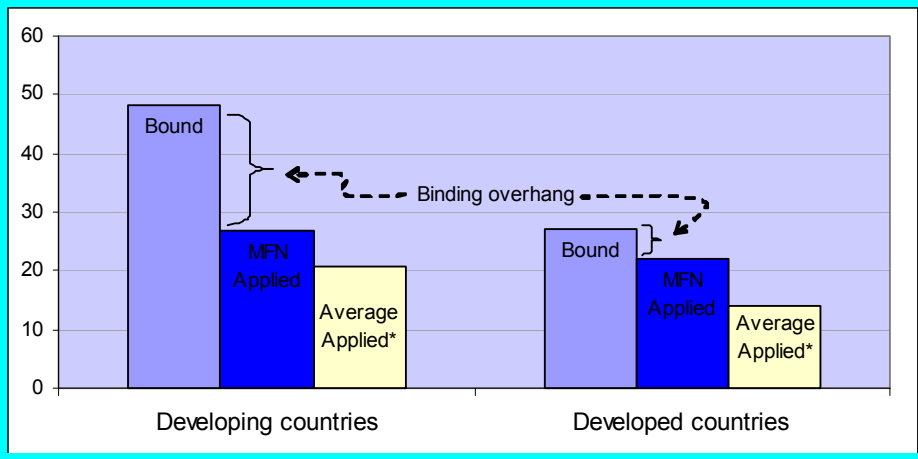
received considerable recent attention from others (OECD 2004; OECD 2005b; Bouet *et al* 2005; Bchir *et al* 2005). The main purpose in raising the issue here is to highlight some of the potential implications for the between country distributional effects of trade policy reforms.

Trade negotiations focus on reducing bound tariff rates. A negotiated agreement to reduce tariff bindings will lead to reductions in MFN-applied rates only if the agreed reduction in bound rates is greater than the initial binding overhang. Jean *et al*. (2005) compare bound and applied agricultural tariff rates in an analysis of the implications of different kinds of tariff cutting formulas. The figure below summarises some of their data. (Notice that the country and product aggregations used in this figure are different from those used in Figure I.3 in the text.)

The figure compares averages of bound, MFN-applied and preferential-applied tariffs for developing and developed country regions separately. The data shown are averages of the *ad valorem* equivalent of tariffs observed in the 2001 base year. The procedures used in developing these estimates, including key details such as the basis used in converting specific and mixed tariffs to ad valorem equivalents, are fully developed in Bouet *et al* (2004) and Decreux *et al*. (2004). The averages in the figure naturally conceal considerable variation across both commodities and countries.

As explained above the difference between the bound and the MFN-applied averages reflect the importance of binding overhang – here to be interpreted as the difference between the regional averages of bound tariffs and that of the lower applied rates offered all trading partners under the MFN principle. Likewise, the difference between the regional averages of the MFN-applied rates and that of the preferential applied rates reflects the importance of preferential margins. The findings reported in the figure reveal that binding overhang tends to be quite small on average in developed countries, where the average gap between bound and MFN-applied tariffs is just 3.6%. This gap is much higher for developing countries. The implication is that any trade agreement calling for proportional reductions in bound tariff rates could well lead to substantial reductions in the MFN-applied tariffs in developed countries but perhaps not in developing countries.

Differences between bound, MFN-applied and preferential-applied tariffs for agricultural products (2001)



* The average applied rate incorporates the effects of both MFN applied and preferential rates.
Source: Jean *et al*. (2005).

Having now established some intuition for what reducing MFN bound tariff rates might mean for the associated MFN applied tariffs there remains the uncertainty about implications for preferential applied tariffs. Widespread reductions in MFN-applied tariff rates could lead to reductions in preferential rates in some countries, but no change in many others. There are three possibilities. First, as discussed above, a given cut in the bound might not engender a cut in the MFN-applied, in which case there would be no implication for the still lower preferential rate. Second, in many cases the preferential treatment being given to the trade partner is in fact duty free access, which obviously closes the door on any further downward adjustment in tariff rates as

part of global tariff reductions. Finally, preferential tariff rates would be automatically reduced under frequently encountered arrangements whereby the preferential rate is a fixed proportion of the MFN-applied rate (Bouet *et al.*, 2005)

In reality whether reducing bound tariff rates leads to reductions in the associated preferential tariff rates may be for most preference receiving countries largely beside the point. The main concern for them is not with the preferential rate but with the preferential margin – the difference between the tariff they have to pay, which is often zero, and what competing export suppliers have to pay. This margin will be reduced and the associated economic benefits conferred by preferential tariff treatment eroded, any time the MFN applied rates are cut, unless the preferential tariff is also reduced by the same absolute margin. Looking at the third column in each of the two triplets of columns in the figure will give some idea of the importance of preferential tariffs in reducing the average applied tariff below the associated averages of MFN rates. Bear in mind, however, that these comparisons are of averages of tariff rates across broad groupings of commodities and countries. In this particular case that averaging masks almost all the important detail.

The nature and significance of preferential trading arrangements has also received a great deal of attention in recent trade analyses. See in particular: OECD (2005a,b,c); Bouet *et al.* (2005); Jean *et al.* (2005); and Bchir *et al.* (2005). In each of these studies, the authors report findings from original quantitative analysis as well as extensive reviews of related studies. The consensus emerging from all these studies is that the erosion of the economic value of preferences is potentially a significant problem for some developing countries now receiving preferential access for a short list of commodities among which: sugar, bananas, meat products, textiles and clothing.

Recent OECD work aimed at quantifying the potential economic impacts of preference erosion (OECD, 2005b) found a negative correlation between the welfare gain a country might experience from global tariff reductions and the size of that country's preferential margin. In other words, some countries now benefiting from preferential tariff treatment stand to lose economic welfare with global trade reform. However, the study notes that a few countries now benefiting from preferential access in some of their export markets could still gain overall from multilateral tariff reductions. This could happen if the benefits from lower tariffs in non-preference granting countries amount to more than they stand to lose from erosion of the economic benefits of preferential tariff treatment in preference granting markets.

Budgetary payments

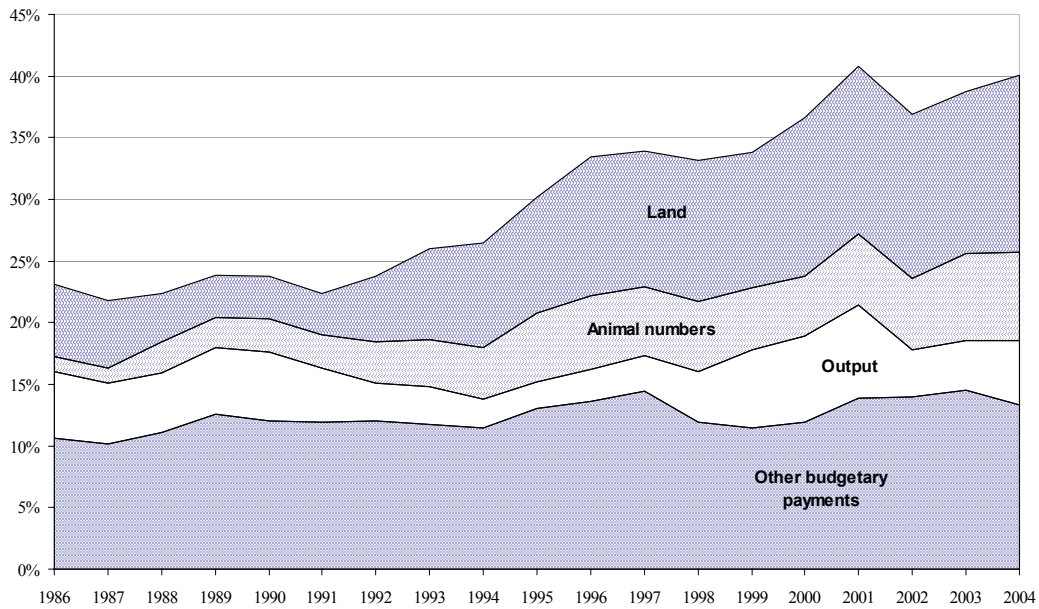
The data in Figures I.1 and I.2 above show a growing share of budgetary payments in the total PSE (from less than 25% in 1986 to just over 40% in 2004), a share that is growing much faster for the crop than for the livestock sectors of OECD countries. The system used in classifying support measures for the PSE distinguishes quite a large number of categories and sub-categories of budgetary payments. However, for present purposes the most important distinctions are captured by focusing on just four broad groupings of payments based respectively on: *a)* land, *b)* animal numbers, *c)* output, and *d)* other payments. Land payments here include both payments made per hectare of current plantings as well as those made under the various programs of payments based on historical entitlements. Payments based on animal numbers are dominated by headage payments made to livestock producers in the EU and other European countries. Payments based on output include the US crop loan deficiency payments and those made under similar programs in other OECD countries. The 'other' category includes payments based on variable and fixed input use as well as the headage payments made to livestock producers. Figure I.4 plots the evolution of the PSE shares for each of these three types of support over the period 1986 to 2004.

Currently, area based payments account for around one third of total budgetary payments made to farmers OECD-wide, a share which has risen from only about one-

fourth in 1986-88. There are two main kinds of area payments in the PSE — those which require planting of some one or another of eligible crops and those which, though perhaps based on historical plantings of specific crops, do not require planting them as a condition for payment. Naturally, payments that require planting, especially those made per unit area of current plantings of a specific crop, lead to greater production distortions than area payments not requiring planting.

On the other hand, even supposing they come with a planting requirement, for an equivalent amount of money spent on them, area payments have been shown to be less production distorting than market price support and some other forms of budgetary payments. Moreover, area payments allowing producers broad flexibility in choosing the use to which the land benefiting from the payment is to be put may be much less production distorting than those with narrowly defined eligibility criterion. This is because the supply of land tends to be highly price inelastic compared with other factors of production and especially so for broad categories of land uses, *e.g.* all cropland or all pastureland. There may be some shifts at the margin from cropland to pastureland and vice versa, but the substitution possibilities are typically less than between, for example, wheat and coarse grains within the cropland total (OECD, 2001a).

Figure I.4. Contribution of land, output and other budgetary payments to the total %PSE 1986 to 2004



The upward trend in the share of budgetary payments based on animal numbers follows that of the increasing share of area based payments and mainly reflects the same evolution of agricultural support policy in the EU. In the policy simulation analysis to be discussed later payments based on animal numbers are treated as subsidies to farm capital. The model used in doing that analysis considers resource adjustments that might occur over the medium run (five to ten years) and so assumes that livestock capital will adjust in responses to changes in relative prices. Accordingly, simulated reductions in payments based on animal numbers will have a negative impact on livestock production.

The most important kind of policy measure classified in the 'payments based on output' category is a deficiency payment — one which is made to cover the difference between a policy-determined administered or target price and a market price. The expected production impacts of payment based on output are analogous to those of market price support. Expected impacts on trade are less because, unlike market price support, consumers are not directly impacted by an associated price distortion. However, because of generally low price elasticities of demand for food and other agricultural products, this distinction may not be especially important quantitavely.

The third category of budgetary payments adds together a quite diverse mix of subsidies to intermediate inputs and capital, none of which individually accounts for a significant share of the total. This includes support measures aimed at reducing the farm costs of: fuel, fertiliser and livestock feed as well as measures targeted to reduce the cost of buying and holding agricultural capital items: capital grants, debt write-offs, interest concessions on long term credit.

Chapter 2.

Global Market, National and Sectoral Impacts

A large number of recent studies examine the economic and market effects of global agricultural policy reform. See for recent examples and extensive references see Bouet *et al* (2004) and Anderson *et al* (2005). These two studies, as well as most other recent studies, are oriented to quantifying the potential consequences of a multilateral trade agreement negotiated within the framework of the Doha Development Agenda and focus particularly on comparing the effects of different assumptions about tariff cutting formulas and other modalities of an agreement. The general conclusion emerging from findings reported in these various studies is that the potential gains from reducing agricultural trade protection and domestic support are substantial, but only if those cuts are deep and widespread.

The main analytical goal in the present study is to measure economic incidence of policy interventions in a more general sense and without regard to any specific package of trade reform proposals. In discussing the potential economic consequences of trade and agricultural policy reform two kinds of questions dominate: what will it mean for world commodity markets? and what will it mean for incomes and consumer prices? This last question is equally relevant whether assessing the economy-wide impacts, which are the focus of this chapter, or the household level impacts that that will be taken up in the next chapter.

The AGLINK model was adapted and used to simulate global commodity market consequences of a hypothetical 50% reduction in agricultural trade protection and domestic support. Independently, the GTAPEM model was used to gauge economic costs and benefits of similar policy reform for selected national and regional economies. GTAPEM estimates welfare impacts using an 'income-equivalent' indicator that ignores non-monetary costs and benefits of policy reform. The results from policy simulation models such as AGLINK and GTAPEM are significantly affected by the whole range of assumptions on which they are based. Findings obtained need to be interpreted with due regard to the degree to which such assumptions correspond with the realties of the situations studied.

Global commodity market effects

AGLINK Model

AGLINK[1] is a partial equilibrium model of agricultural supply, demand and trade. An extended description of its main characteristics as well as an explanation of the way it was implemented in doing analysis such as that presented in this study can be found in

OECD (2002a). A comprehensive report of findings from the policy simulation analysis summarised below is in a companion document. AGLINK's commodity coverage stresses temperate-zone crop and livestock products. Its country coverage concentrates on major OECD countries and regions but also includes some larger non-OECD countries that are important trading partners in one or more of the OECD's main farm commodities. Coverage of both agricultural trade policy and domestic programs is extensive in AGLINK. Trade policy coverage includes tariffs and export subsidies that drive a wedge between domestic and world market prices as well as tariff rate quotas that regulate quantities imported. Domestic policy coverage includes those interventions requiring complementary trade measures, *e.g.* programs of administered prices as well as programs of direct budgetary support to farmers.

In the model domestic producer and market prices in each country are linked to their corresponding world market prices using price transmission equations. Sometimes the domestic price and the world price of a given commodity are separated by a margin, expressed either as linearly additive or percentage mark-ups on the world price. In part, the margins represent cost factors, *e.g.* transportation, insurance, storage and handling that create a wedge between domestic and world prices. Furthermore, and more importantly for present purposes, the margins between domestic and world prices in AGLINK price transmission equations will also reflect the influence of trade and domestic policy interventions. Price transmission equations constitute one of the ways by which trade and domestic policy scenarios are introduced into AGLINK. In those cases where the trade intervention comprises a simple tariff the corresponding price transmission equation will contain a wedge measuring its *ad valorem* equivalent. If, in reality, the tariff is additive (specific) the model will automatically re-calculate its ad valorem equivalent when world market prices change in policy reform scenarios. In those cases where the trade intervention comprises an export subsidy AGLINK endogenously determines export volumes based on the relationship between domestic and world prices.

Incorporating tariff rate quotas requires taking into account three distinct trade policy instruments: the quantity constraint embodied in the TRQ, the in-quota tariff rate which may itself be high enough to restrict trade flows to below the TRQ limit and the out of quota tariff rate which may be in fact be low enough to permit some trade to occur. All three policy instruments are explicit in AGLINK thus enabling policy experiments wherein each one can be adjusted independently of the other two.

There are a large number of programs of domestic agricultural support that receive specific treatment in AGLINK. However, two broad types: output price support and area payments, together account for most of the direct financial support OECD farmers receive under programs represented in the model. In turn most output price support in the model is that given under just one program, the US marketing loan program. This program constitutes an especially important consideration in the AGLINK context because deficiency payments made under that program may or may not be triggered during one or more years of a given baseline projection or policy scenario.

AGLINK policy scenario and results

Policy scenario analysis with AGLINK develops in two sequential steps. First, the model is used to generate a baseline projection of annual commodity supply, demand and prices for projection horizons typically extending for up to ten years into the future. This baseline embodies assumed values for a wide range of exogenous variables, including those relating to the settings of key agricultural trade and domestic policy parameters. An

AGLINK policy scenario is then constructed by introducing an alternative set of policy assumptions and then comparing simulated market outcomes obtained under baseline assumptions with those obtained under the alternative. Here, the alternative features an assumed 50% increase in tariff rate quotas combined with 50% decreases: in tariffs (bound, in-quota and out of quota), in export subsidy limits and in domestic support afforded farmers under main domestic farm programs.

As explained above, cuts to bound tariffs may result in smaller cuts in applied rates where there is some initial difference between the two (binding overhang). Likewise, there can be slippage as cuts in export subsidies are also from bound not necessarily actual levels. (No consideration is given however to differences between bound and actual levels of domestic support.) The projections cover the ten-year period 2004-13. However, because of slight differences in the implementation periods adopted for the various reforms the discussion here will focus on comparisons of 'baseline versus alternative' results only for the terminal year of the projection period of 2013.

The four columns of Table I.1 contain simulated world market prices for the baseline and the policy scenario as well as the numerical and the percent differences between them. Since trade protection and budgetary payments for farmers increase commodity surpluses on world markets, it is natural to expect that reducing them should lead to higher world prices. Results in Table I.1 are generally consistent with that line of reasoning. Generally speaking, world market prices increase most for those commodities that benefit from the highest rates of initial protection (Figure I.2).

Table I.1. World market price impacts of policy reform*

	Baseline	Alternative	Difference	% Difference
	USD/100 kg			
Dairy products				
Butter	151.7	171.4	19.7	13.0
Cheese	211.7	240.7	29.0	13.7
Skim milk powder	177.6	188.3	10.7	6.0
Whole milk powder	187.9	212.5	24.6	13.1
Meat				
Beef and veal (Pacific market)	283.2	288.5	5.3	1.9
Beef and veal (Atlantic market)	54.3	56.1	1.8	3.2
Pig meat (Pacific market)	123.1	125.2	2.1	1.7
	USD/t			
Cereals				
Coarse grains	115.6	118.1	2.5	2.2
Rice	315.3	321.5	6.2	2.0
Wheat	153.5	152.9	-0.6	-0.4
Oilseeds and products				
Oilseeds	252.4	251.1	-1.3	-0.5
Oilmeals	184.9	178.9	-6.0	-3.3
Vegetable oils	596.2	612.7	16.6	2.8

* Simulated levels of prices in the baseline and the alternative are for the terminal year of a ten year (2004 to 2013) projection.

Dairy product prices increase significantly more than any of the other AGLINK commodities affected by the reform, with cheese, butter and whole milk powder prices showing average percentage increases of 13% or more. None of the other simulated price increases make it into this double-digit range. Fabiosa *et al.* (2005) use an agricultural commodity supply-demand model with commodity and policy coverage similar to AGLINK to simulate world market price impacts of complete removal of agricultural support. The pattern of estimated world price impacts they obtain — relatively large simulated increases in dairy product prices, modest crop price increases — is roughly the same as that shown in Table I.1.

Interestingly, and perhaps contrary to what one might expect, the simulated price changes for some of the commodities, oilseeds and oil meals in particular, are negative – a finding also reported by Fabiosa *et al*.(2005). There is both a supply and a demand explanation for this. On the supply side, although OECD oilseeds producers benefit from trade protection and support they are relatively less supported than other crop producers. (Figure I.2) Consequently, the supply of oilseeds may increase with widespread reductions in trade protection and support as reform leads to resources shifting out of cereals and into oilseeds. On the demand side, reductions in support and protection afforded OECD livestock producers can have a knock-on negative impact on the demand for feedstuffs, including demand for high protein oil meals and the oilseeds from which they are made. The combination of increased OECD supply and reduced OECD demand increases excess supply that must be cleared on world markets at lower world prices. The simulated small negative world market price result for wheat may be explained similarly. As results in Figure I.2 show, OECD wheat producers are less supported compared to some other commodities competing for some of the same resources. Accordingly, although widespread reduction in support and protection may lead to falls in wheat producer returns measured in absolute terms, such returns could still remain above those for competing crops in *relative* terms.

Regional, national and sectoral impacts

GTAPEM Model and Policy Representation

The analysis reported in this part of the report was based on policy simulations using a specially modified version of GTAP, a multi-sector and multi-region computable general equilibrium model widely used for trade policy analysis. The basic structure of GTAP is described in Hertel (1997). Full documentation of modifications to the model made subsequent to publication of Hertel (1997) can be found at the GTAP web site (www.gtap.org). The standard version of that model was adapted to better meet present purposes by introducing the same representation of agricultural factor demand, supply and policy as that contained in the Secretariat's Policy Evaluation Model (PEM). OECD (2001) As compared to the standard GTAP model these enhancements result in a representation of agricultural supply that features a more considered treatment of agricultural factor specificity and substitution. Key technical characteristics of this modified version of GTAP, called GTAPEM, are described in the Annex to Part I. A comprehensive reporting of its base data, economic parameters, and simulated results is available for public access at www.oecd.org/agr/reform/gtapem.

The GTAP database contains all the information that would be needed to construct highly detailed CGE models for a long list of individual countries, regions, economic sectors and commodities. The coverage of agricultural commodities is especially rich.

However, the specificity of objectives and a host of practical considerations require choices that limit the size of the model created for any particular application. The choice of country coverage for GTAPEM was dictated to some degree by the need for information to feed into the five individual case study countries on which the analysis of household level impacts was to be based (Brazil, Italy, Malawi, Mexico and the US).

It was also considered important to include a variety of larger OECD and non-OECD countries. Some countries were added to the list to achieve a better geographical and stage of economic development balance. In addition to the five case study countries the final list included the following OECD countries and regions: Australia/New Zealand (as one region), Canada, EU15 (also as one region), Japan and Turkey. Individual non-OECD countries or regions treated individually were: China, India, Indonesia, Russia, Thailand, South Africa, Sub-Saharan Africa (all countries except South Africa treated as one region).

Because the main focus of the analysis is on assessing agricultural trade and domestic policy reforms, commodity coverage in GTAPEM is biased heavily toward individual agricultural commodities (Table A.I.1.2 contains the list). All of non-agriculture is represented in just three aggregated sectors: textiles and clothing, other manufacturing, and services. Finally, factor coverage focuses on distinctions between agricultural factors: land, skilled and unskilled labour and capital and their non-agricultural counterparts.

Policy analysis with GTAPEM is based on comparisons of data for the 2001 base year with the results of model solutions obtained when key policy assumptions, *e.g.* import tariffs and domestic support rates, are changed experimentally. The model and the simulation procedure are both called comparative static to signal that comparisons between base year and simulated prices and quantities will give some idea of policy effects that might be observed after allowing for a 'medium term' period of adjustment — generally interpreted to mean after five to ten years. Implicitly this assumes that world commodity markets are stable in the sense that prices, quantities demanded and supplied will all adjust smoothly to their new market equilibrium levels following policy reform. This assumption of stable world commodity markets has been questioned in recent analysis by Gérard *et al* (2003).

Because GTAPEM represents determination of an economy-wide equilibrium its equations constitute a complete system of theoretically consistent supply and demand relationships. Among its key assumptions on the demand side is that domestically produced commodities and imported products are viewed by buyers as different products. This assumption, commonly referred to as the Armington assumption, carries with it some important consequences that can affect policy simulation results in sometimes surprising ways. First, since products are assumed to differ according to country of origin, each country has, in effect, the potential to gain welfare by imposing an optimal export tax or import tariff, even if the country in question might be considered in the usual economic sense of the term too small to have any influence on the market prices of products it sells or buys on world markets (Tokarick, 2005). Second, because of the way the assumption is implemented in the model, there is no possibility that a country can switch from being an importer to an exporter in consequence of a policy change (nor can trade occur if there is zero trade in the base period). That is to say, changes in relative prices may change the share of a given market supplied through domestic production versus imports but there is no possibility that the direction of the trade flow can change.

Key assumptions on the supply side are that production techniques are characterised by constant returns to scale and that producers confront a market for their output that is

perfectly competitive. Additionally, producers are assumed to behave as if there were no uncertainty even though, in reality, policy change will carry with it changes in exposure to risk, an issue that has been explored in recent OECD analyses of the effects of risk in the context of decoupling. Moreover, the model does not address implementation and adjustment costs which may accompany policy change, especially policy change in a developing country context (Charlton and Stiglitz, 2005).

Policy reform is often assumed, including in the present study, to occur in a situation of full employment. In such circumstances the pattern of wage rates and sectoral employment may change but not the total number of people employed. In the presence of unemployment, a particularly common situation in developing countries, trade reform may change the total number of people employed (or the number of total hours they work) with little influence on wage rates. Even if the total welfare change were the same between these two situations, the distributional effects can be radically different (Charlton and Stiglitz, 2005).

Most trade and domestic policy interventions appear in GTAPEM as tax or subsidy wedges in price equations. An important exception occurs in modelling production quotas — an issue discussed further below. Tariff and export subsidy data are used to calculate the price wedges distinguishing domestic from border prices; PSE estimates of domestic support are used in calculating the corresponding wedges to distinguish domestic producer and consumer incentive prices from the corresponding market prices for commodities and inputs. Estimates of bilateral tariffs are available for most agriculture and manufacturing products traded internationally, for most developed and developing countries. Domestic support estimates are however available only for primary agriculture in individual OECD and a few non-OECD countries.[2]

…Tariffs and export subsidies

The analysis is based on tariff information contained in the most recent version (6.0) of the GTAP database.[3] Two features of this new database have significant implications for results of trade policy analysis using it. First, the base year has been updated from 1997 to 2001, a change that is important because both the profile and level of tariffs have changed over the intervening years. Especially important in the present study is that agricultural tariffs in particular, are generally less in 2001 than they were in 1997. Second, the new version contains tariffs based on averages of applied rather than bound tariff rates. As already discussed, in general applied tariffs are lower than the corresponding bound rates, and substantially so in many important cases. Additionally, switching to applied rates allows incorporation of the still lower preferential tariff rates applying to some important trade flows between selected developed and developing countries. Taken altogether the apparent rates of trade protection in the new database are much lower on average than those in the old database. Accordingly, market and welfare impacts of proportional reductions in tariff rates would also be expected to be more modest with the new than with the old data.

Estimated tariffs in the GTAP database come from calculations done as part of a joint effort by the *Centre d'Etudes Prospectives et d'Informations Internationales* (CEPII) and the International Trade Centre (WTO/ITC) (Bouet *et al.,* 2004). This database (Market Access Map, or MAcMap) converts tariffs applying to trade in products measured at a very disaggregate level (HS6) into their *ad valorem* equivalent at the GTAP commodity level of aggregation. The import protection measures include *ad valorem* tariffs, specific tariffs and tariff rate quota regimes. Specific tariffs are converted into *ad valorem*

equivalents using a procedure that begins by assigning each country to a reference group of similar countries. The import unit value used in converting a country's specific tariffs into their *ad valorem* equivalents is the median unit value of world-wide exports originating from its reference group. Products subject to tariff rate quotas carry both a within-quota and outside-quota tariff and decisions have to be made about which one of these to use. (Unlike AGLINK, GTAPEM does not model TRQ's explicitly.) In constructing the GTAP tariff estimates, the in-quota tariff rate was used if the fill rate on the TRQ was less than 90%, a simple average of the in and out of quota rates was used where the fill rate was between 90% and 100% and the out of quota tariff rate was used for those cases where the TRQ was 100% filled.

In calculating regional, sectoral and commodity averages of tariffs the results depend critically on the choice of weighting scheme (as, for example, was done for Figure I.3 and for the data in Box I.1). In the data used here, individual tariff line tariffs were weighted by the associated value shares in trade. This kind of weighting has an inherent downward bias arising from the fact that, in general, the higher the tariff the lower the volume of trade. In the worst case, prohibitively high tariffs receive a zero weight and thus have no impact whatsoever on the average for the aggregated commodity. Taking a simple average would avoid this 'prohibitive tariff' problem but, in effect, this means all tariffs receive equal weight. This will certainly not correspond to the reality of trade protection, as products that are more important (in trade volume terms) should in principle receive a higher weight.

Data measuring export subsidies are assembled from information Member countries provide to the WTO for tracking adherence to the volume and value commitments made as part of the Uruguay Round trade agreement. Despite some concerns related to late reporting by Member countries as well as omissions made apparent in WTO panel or appellate body rulings, these data are generally agreed to provide a sound basis for analysing the distortionary effects of explicit export subsidisation. However, some kinds of government intervention in agricultural trade such as officially supported export credits, state trading and food aid may distort trade in a manner analogous to export subsidies. Lacking appropriate data and modelling tools, no attempt was made to consider these forms of interventions for this analysis.

...Domestic policy

The classification of domestic subsidies and taxes in the GTAP database is not exactly the same as that done in classifying budgetary payments for the PSE. Furthermore there are fewer categories of support measures distinguished in GTAP database than there are in the PSE. Table I.2 shows how the various categories of PSE budgetary payments are allocated to the various categories of domestic subsidies in the GTAP database.

The general procedure for introducing budgetary payments into GTAPEM is similar to that used for AGLINK, *i.e.* as wedges in price transmission equations. However, GTAPEM allows a more specific treatment of input and land payments than does AGLINK. For example, if a particular payment alters the incentive price for an input or category of land use, then a price wedge is introduced into a GTAPEM equation linking the demand and supply price for that particular input or land category. In the policy reform scenario these price wedges are halved leading ultimately, through simulated market clearing processes, to reductions in the supply price and increases in demand price of the associated input or category of land. Whether it is the demand price or the supply

price that adjusts the most depends of course on the assumed values of relevant supply and demand elasticities.

Table I.2. Assignment of PSE budgetary payments to GTAP subsidy categories*

GTAP subsidy category	PSE budgetary payment category	Assignment made for	
		Crop commodities	Livestock commodities
Output Subsidies	Payments based on output	✓	✓
	Miscellaneous payments	✓	✓
Intermediate Input Subsidies	Payments based on input use: variable inputs	✓	✓
	Payments based on input use: on-farm services	✓	✓
Land Subsidies	Payments based on area planted	✓	
	Payments based on historical entitlements	✓	✓
	Payments based on input constraints: variable inputs	✓	✓
	Payments based on input constraints: fixed inputs	✓	✓
	Payments based on input constraints: set of inputs	✓	✓
	Payments based on overall farming income	✓	✓
Capital Based Payments	Payments based on animal numbers		✓
	Payments based on input use: fixed inputs	✓	✓
	Payments based on input constraints: fixed inputs		✓

There are two features of the way area payments are treated in the PSE and in the model that have implications for policy simulation results obtained.[4] First, area payments in the PSE are allocated on a crop by crop basis and that crop specificity is carried over into the model's database. Secondly, in the PSE, but not in the model database, there are distinctions among categories of area payments that signal whether the payment basis is current or historical and thus whether planting the crop is a condition for receiving the payment. In the model all area payments are treated as based on current area. An alternative treatment correctly acknowledging the basis for payment and precisely distinguishing between those payments requiring and not requiring production would show smaller production distortions attributable to area payments.[5] Note, however, that the policy scenario considers a uniform 50% reduction in all forms of support — including all area payments. Given that land supply in the model is highly price inelastic, a smooth pattern of reductions in such payments will not have much of an effect either on total plantings or on the allocation of land amongst alternative uses.

Production quotas applying to milk (in Canada and the EU) and sugar (in the EU) constitute another important category of domestic policy instruments incorporated in the

model. Quotas mitigate the supply inducing effects of a given level of trade protection and domestic support. In the context of the present analysis this means marginal reductions in tariffs, export subsidies or budgetary payments may have little or no impact on quantities produced, though they would normally be expected to lead to some increases in quantities demanded. As it turns out, even the 50% reduction scenario evaluated here did not cause production of any one of the quota-restricted commodities to be reduced below its quota level.

Policy simulation results

The GTAPEM simulation experiment combined 50% reductions in all rates of agricultural budgetary payments and trade protection (tariffs and export subsidies) with a 50% reduction in rates of import protection applying to non-agriculture. In making these cuts, no consideration was given to whether countries may have 'room to manoeuvre' either with respect to binding overhang in tariffs, export subsidies or domestic support. The policy reforms yield simulated changes in virtually every producer, consumer, import, export and factor price in every country and region in the model. Here, we focus initially on the implications for factor markets. As Hertel and Reimer (2004) note there is an increasing recognition of the overriding importance in trade policy analysis of factor market effects, in particular the impacts of trade reform on earnings and employment. That is to say, the biggest impacts are a consequence of changes in factor allocations and supply side adjustments, not changes in demand. Consumption effects are dampened by the combination of low pass-through of farm price effects into retail food prices and by typically low elasticities of demand for food.

... Returns to land

The economic return a landowner earns per unit area of land used in farming[6] — the implicit rental rate — can usefully be viewed here as the sum of two payments: a factor payment reflecting what land would earn with production valued at producer prices and a budgetary payment based on area. Government interventions that boost producer prices — trade protection or payments per unit of output — automatically increase factor payments, including those to land. Area payments may be made instead of or perhaps in addition to price support. In classifying support for the PSE, area payments that require planting a particular crop are distinguished from those that only require that the land be retained in agriculture. Here, all types of area payments are assumed to be made on a commodity specific basis and subject to a planting requirement. The implications of this assumption for the estimated income and welfare impacts of policy reform will be discussed in a later section of the paper.

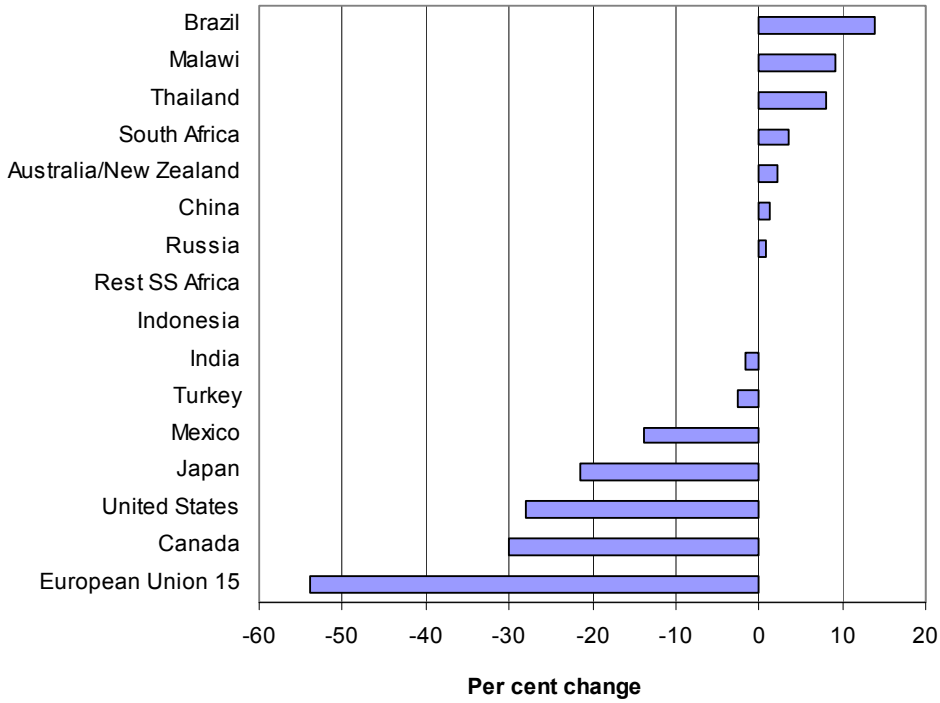
When trade protection and domestic support are reduced landowners may experience declines in returns to land due both to the induced reductions in the total value of production to be distributed amongst the factors and to the imposed reductions in area payments. Correspondingly, landowners in countries where government provides no or relatively little price support and area payments may experience increased returns to land from reform induced increases in world market prices.

Figure I.5 shows the estimated pass-through effect of the policy reform shock on the implicit rental rate of land. The magnitude of these effects is substantially greater than corresponding effects on unit wage rates or returns to capital (shown in Figure I.6). This is especially so for OECD countries currently providing high levels of support and trade

protection for agriculture. Reform induced reductions in monetary returns to land, capital and labour used in farm production must be accommodated via a combination of reductions on one hand in factor prices and rents and on the other by reductions in factor use.

Which type of adjustment: price or quantity turns out to be the most important, depends on the ease with which factors can be shifted among alternative uses in agriculture and between agriculture and non-agricultural uses. Most of the human and physical capital used in farming is highly sector-specific and cannot readily be converted to non-farm uses in the short to medium run. In the longer term though, the number of people employed in the sector and the stock of physical capital will be adjusted in line with changes in relative rates of return in agriculture as compared to other sectors of the economy.

Figure I.5. Simulated impacts on land rental rates



Source: GTAPEM simulation results.

Results shown in Figure I.5 indicate the percent increase or decrease in the annual flow of land rents earned by a landowner. The model does not calculate the implications of changes in this rental flow for the price of land as an asset. The capitalization of the economic benefits of farm support into asset prices — land especially, constitutes an enduring topic of applied economic analysis [see Gardner (1998) for an extended discussion and additional references]. Additional empirical study is necessary before drawing definitive conclusions about the asset value implications of the particular kinds of area payments studied here. There is, however, one general finding that emerges from past studies devoted to the topic. It is that a given percentage change in the annual rental

rate would be fully reflected in the selling price of land only under quite restrictive assumptions about expectations (including about future government policy) and the functioning of land markets (Burfisher and Hopkins, 2003).

Results shown in Figure I.5 are nevertheless generally consistent with the widely-held view that much of the benefits of government interventions in agriculture show up in higher rental rates and selling prices of land. This applies especially in the present case as a significant share of domestic support to agriculture in some of the OECD countries featured (United States, EU, Mexico, Canada) comes in the form of direct payments per unit area of land. Reducing these payments directly reduces the (subsidy-inclusive) factor payments to land. Since the quantity of land in agricultural use does not change very much with changes in economic returns, virtually all of the adjustment must come through the unit returns side of the factor payment equation. If area payments were made with no requirement to plant then the pass through of reform induced changes to land rental rates could be even greater than shown in Figure I.5. (See Table I.3 below.)

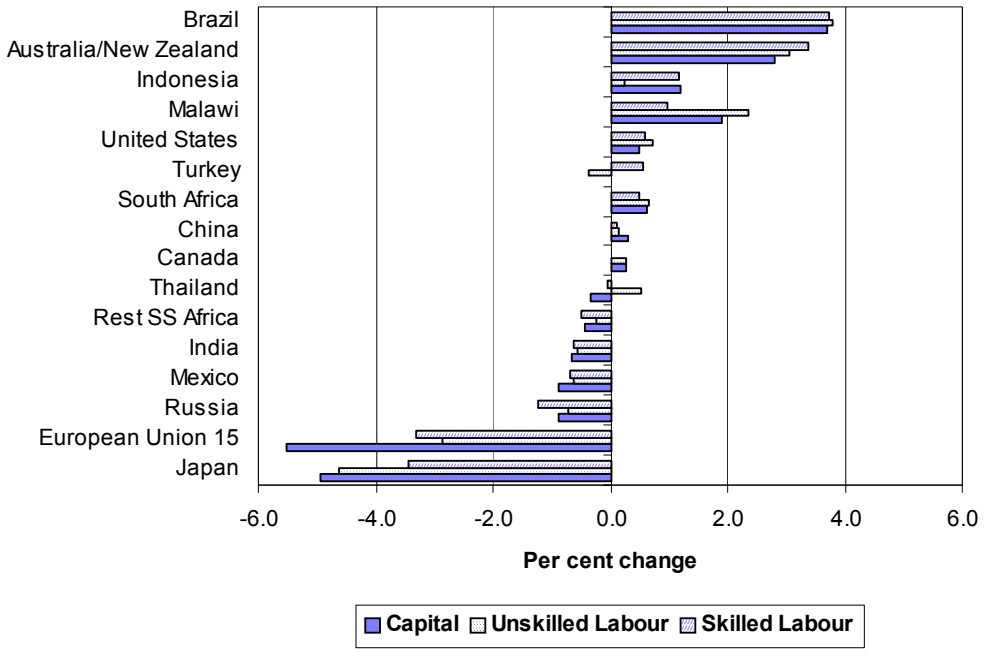
… Labour and capital

Figure I.6 shows the change in real unit returns to agricultural labour and to capital used in agriculture versus outside agriculture. These changes are substantially smaller than those for land shown in Figure I.5. The reason of course is that, unlike in the case of land, quantities of agricultural labour and capital also adjust with changes in relative sector returns. Indeed, as it turns out, the country pattern and magnitude of the factor quantity changes is more or less identical to those for unit returns (and so have been omitted here to simplify the presentation). As expected, when support is reduced, in most countries offering high support and protection to agriculture the factor returns in the sector evolve unfavourably relative to the returns that can be gained in non-agricultural activities.

The numbers shown in Figure I.6 compare differences in the percent changes in unit factor returns in agriculture versus non-agriculture uses. Hence, what they indicate is not whether unit returns to labour and capital used in, for example, agriculture go up or down in an absolute sense but the magnitude of such changes relative to corresponding unit returns in non-agriculture.

The region experiencing the second greatest increase in relative returns to agriculture — Australia/New Zealand — and the region experiencing the greatest decrease in such returns — Japan — are both in the OECD. Among non-OECD countries, Brazil and Malawi also see unit returns to labour and capital employed in agriculture rising significantly more than the corresponding rise in returns to labour and capital employed in non-agriculture. The reverse is true for India and Russia.

Figure I.6. Simulated impacts on *relative* per unit returns to labour and capital used in agriculture



Source: GTAPEM simulation results.

... Agriculture value added

Agricultural value added, also known as agricultural GDP, is defined as the real value of output produced minus the costs of goods and services purchased as farm inputs. It is often used as an indicator of the economic performance of the agricultural sector because it combines the net economic returns to farmland, labour and capital invested in farms. Simulated changes thus reflect the combined or net effects of estimated impacts on all factor prices and quantities. A closely related and perhaps more familiar indicator is farm sector income. Agriculture GDP differs from farm sector income because it includes the value added by hired farm workers and by people who own farm land or who supply capital to farming but who do not farm. For example, averaging across countries, about half the land farmed in OECD countries is rented. Nevertheless, directional changes in agricultural value added should provide a good indication of directional changes in farm sector income.

Another, perhaps more important, distinction to bear in mind however is that neither changes in agricultural GDP nor changes in farm sector returns will provide a good indicator of the potential effects of the support reductions on farm household incomes. Farm households will not bear the full brunt of the reductions in factor returns as some other people, *e.g.* absentee landlords will share part of the burden. Moreover, in those countries where farm sector income is shown to go down, farm households will adjust their on-farm and off-farm activities in ways that will minimize the negative impacts on farm household income. Indeed, there may be cases where reform-induced increases in returns to their labour and capital employed off the farm more than off-set reduced farm

incomes. Chapter III explores some of these questions in some more depth, looking at the multiple sources of impacts on farm household incomes across a broad range of representative farm household types.

Estimated reform impacts on agricultural value added in different countries/regions, broken out by broad category of support measure: land payments, other budgetary payments and trade measures (tariffs and export subsidies combined) are shown in Table I.3. Unsurprisingly, agricultural value added falls most in those countries providing their farmers the highest levels of support and protection. Among the OECD countries listed in the table, only the combined Australia/New Zealand region and Turkey show increases. There is a mix of increases and decreases in agricultural GDP among the non-OECD group. Brazil, Malawi and Thailand all show gains of more than 3% but China, India, Sub-Saharan Africa and Russia are estimated to suffer some loss in economic returns to agriculture with widespread policy reform.

Reductions in land based payments account for a large share of the loss in agricultural GDP in most countries experiencing such losses. On the other hand, in those countries expected to experience gains in agriculture GDP, hardly any of those gains come from reducing land payments. Even in the case of Australia/New Zealand, where agricultural GDP increases overall, the effect of reducing OECD land subsidies is negative (but outweighed by gains from reducing other kinds of budgetary payments and trade policy). For trade measures though, it is the other way around. For those countries where agricultural GDP increases, most of the gains are attributable to the effects of reducing tariffs and export subsidies while such reductions contribute little to the income losses in those countries experiencing them.

Table I.3. Changes in agriculture value added due to support reductions by policy category, % change from base

	All support	Land payments	Other payments*	Agricultural trade policy**
OECD				
Australia / New Zealand	2.4	-0.3	0.4	2.3
Canada	-4.3	-5.2	0.6	0.4
European Union 15	-8.2	-5.7	-0.9	-1.6
Japan	-4.4	-0.4	-0.1	-3.9
Mexico	-2.2	-1.3	-0.2	-0.6
Turkey	0.3	-0.1	0.0	0.4
United States	-3.2	-3.3	-0.5	0.6
Rest OECD	-6.3	-1.7	-0.5	-4.1
Non-OECD				
Brazil	5.5	-0.4	1.1	4.8
China	-0.1	0.0	0.4	-0.5
India	-1.1	0.0	0.5	-1.7
Indonesia	0.9	-0.1	0.5	0.5
Malawi	3.5	-0.7	1.6	2.6
Russia	-0.7	0.2	0.4	-1.2
Thailand	4.3	-0.1	0.7	3.6
South Africa	1.0	0.0	0.5	0.5
Rest SS Africa	-0.9	-0.2	0.6	-1.4
Rest of World	0.5	0.0	0.7	-0.2

* Other payments = capital payments + intermediate input payments + output payments.
** Import tariffs and export subsidies.

Source: GTAPEM simulation results.

Table I.4 compares findings obtained when all forms of area based payments are assumed to require planting (column 1) with those obtained when assuming all forms of payments based on area would be provided with no restrictions whatsoever on the use to which payment-eligible land could be put (column 2). Area payments not requiring production exhibit higher income transfer efficiency than do payments that require planting. Accordingly, when they are reduced the associated income loss is, as shown in the table, slightly greater. The planting requirement means that some land that would not otherwise be used in producing supported crops is diverted to their production. Thus, when these coupled payments are reduced some of the adjustment comes from reductions in area planted with corresponding reductions in cost of production thereby easing some of the loss in net income caused by support reductions.

Table I.4. Changes in agriculture value added due to area payment reductions, assuming no planting requirement, % change from base

	Planting requirement	No planting requirement
OECD		
Australia / New Zealand	-0.3	-0.3
Canada	-5.2	-5.8
European Union 15	-5.7	-6.3
Japan	-0.4	-0.5
Mexico	-1.3	-1.4
Turkey	-0.1	-0.1
United States	-3.3	-3.5
Rest OECD	-1.7	-1.9
Non-OECD		
Brazil	-0.4	0.0
China	0.0	0.0
India	0.0	0.0
Indonesia	-0.1	0.0
Malawi	-0.7	0.0
Russia	0.2	0.0
Thailand	-0.1	0.0
South Africa	0.0	0.0
Rest SS Africa	-0.2	0.0
Rest of World	0.0	0.0

Source : GTAPEM simulation results.

...Economic welfare: regions, sectors and policy instruments

Table I.5 gives the breakdown of estimated global welfare gains by policy instrument and by broad country group implementing the policy change. Column-wise comparisons show how much of the estimated global welfare gain from widespread agriculture and trade reform can be attributed to reforms in OECD and non-OECD countries respectively. Row-wise comparisons show how much of the change in global welfare is attributable to each category of policy.

Table I.5. Decomposition of global welfare gains by support category and region implementing the policy change, million USD

	OECD	Non-OECD	Total
Import tariffs agriculture	17 549	3 120	20 670
Capital payment	3 969	—	3 969
Land payment	765	—	765
Export payment	573	-3	570
Intermediate input payment	185	—	185
Output payments	134	—	134
Subtotal agriculture	23 176	3 117	26 293
Import tariffs non-agriculture	6 695	11 338	18 033
Total	29 872	14 455	44 327

Elements do not equal exactly to the total due to errors in approximation.

Agriculture includes primary and processed food.

Source: GTAPEM simulation results.

In general terms, those benefiting economically from policy reform may do so because the prices they pay as consumers go down and/or because the money income they earn goes up. The measure of welfare change used in Table I.5 and subsequent tables to sum up the net economic benefit of these price and money income changes is Equivalent Variation (EV). Technically, the EV is the minimum amount of money an individual would be willing to accept in exchange for the economic benefits accompanying a given package of policy changes. Symmetrically, for those who lose, the EV indicates the maximum an individual would be willing to pay to avoid the economic pain imposed by a given package of policy changes (Varian, 1992).

The EV results reported in Table I.5 reveal an estimated global welfare gain totalling to USD 44.3 billion or 0.14% of world GDP in 2001. The policy changes implemented by OECD countries would contribute the lion's share (67%) of the global gain. But the reductions of import tariffs by non-OECD countries also yield a significant contribution. Agricultural policy reforms in OECD countries would yield a gain of USD 23 billion or 78% of the total potential contribution from all OECD reforms.

Within agriculture, over 75% of the estimated welfare gains come from reducing import protection. Implicit in this result is the assumption that where tariffs constitute only one component of a package of mutually re-enforcing price support instruments, tariff reductions would be accompanied by complementary reductions in all related policy instruments in the package. In other recent studies aimed at measuring the welfare effects of reducing agricultural support and protection (Hertel and Keeney, 2005; Anderson *et al*., 2005; and Tokarick, 2005), the dominance of benefits from improved market access was found to be even greater than that obtained here. Among the various categories of subsidy payments considered, the greatest simulated gains in welfare come from reducing those given to capital. In the PSE this category includes capital grants, interest concessions and headage payments given to livestock producers.

Although they constituted nearly 15% of the OECD-wide total PSE in the 2001 base year, the estimated welfare impact of reducing land-related payments (all the various kinds of area payments tracked for the PSE taken together) is relatively quite small — amounting to only 3% of the estimated total of global welfare gains resulting from policy change implemented in the OECD area.[7]. Recall in this connection the results reported in Table I.4 showing that most all of the *loss* in farm income occurring in most of those countries experiencing farm income losses due to policy reforms was caused by the reduction in land payments. The importance of export subsidies has declined in recent years, and this is reflected in their very limited contribution to the global welfare result. Moreover, export subsidies in GTAPEM include only the explicit budgetary expenditures and no attempt has been made to calculate and take into account the 'export subsidy equivalent' of other types of intervention such as export credits or food aid.

Reducing import tariffs applied to industrial products boosts estimated global welfare gains by USD 18 billion, a figure that accounts for over 40% of the total of those gains. Notice especially that while almost all the welfare gain from reducing agricultural support and protection comes from OECD reforms, most of the gains from reducing non-agricultural tariffs come from reforms implemented in the non-OECD region. Note that this holds despite the fact that agricultural tariffs are higher than tariffs on industrial goods in developing countries and despite the fact that agriculture is relatively more important in the economies of developing as compared with developed countries.

Table I.6 documents potential welfare impacts of policy reform for the OECD and the non-OECD region and for selected countries. Row-wise comparisons of the results in the table reveal how much of the global welfare change goes to each of the various OECD and non-OECD countries and regions. Column-wise comparisons give an idea of whether it is agriculture support and protection or the protection afforded other sectors which is most important. The first two columns show total impacts in USD million and as a per cent of national GDP respectively. The dollar figures correspond largely to the size of country or region so that the percent figures actually give a better indication of the incidence of reform impacts.

The per cent GDP estimates reveal that developing countries seem likely to experience a somewhat greater economic boost from the policy reforms than developed countries. Notice, however, that Australia/New Zealand and the rest of OECD regions show increases in percent GDP terms that are considerably higher than the average for non-OECD countries. Among developing countries, Brazil, China and India all show above average gains in both dollar and per cent terms. Only one region, sub-Saharan Africa, is shown to lose due to the multi-sector, multilateral reforms. However, in regional aggregates such as the 'rest of world' group there are undoubtedly some individual countries that lose, even when the outcome for the region overall is shown to be positive.

Findings reported in the last four columns of Table I.6 show that while most of the estimated reform benefits for OECD countries come from the simulated reductions in OECD agricultural trade protection and support, for non-OECD countries most of the gains come mostly from simulated reduction in trade protection afforded OECD producers of non-agricultural merchandise (gains 3 to 4 times greater). Note also that nearly half of the total simulated gains for the non-OECD region coming from reduction in OECD tariffs on non-agricultural merchandise flow to China.

Table I.6. Decomposition of welfare effects by broad policy category, region and country implementing the reforms, million USD

	Total welfare	%of GDP	OECD agriculture	Non-OECD agriculture	OECD non-agriculture	Non-OECD non-agriculture
World	44 327	0.1	23 173	3 120	6 695	11 338
OECD	33 686	0.1	21 396	1 873	-252	10 669
Non-OECD	10 641	0.2	1 777	1 247	6 948	669
OECD						
Australia-New Zealand	1 011	0.2	855	98	50	8
Canada	195	0.0	669	31	-375	-129
European Union 15	11 953	0.2	7 998	708	-1 520	4 766
Japan	9 824	0.2	5 560	-22	2 091	2 196
Mexico	503	0.1	85	-31	464	-15
Turkey	636	0.4	160	95	47	334
United States	2 245	0.0	2 305	706	-2 223	1 457
Rest of OECD	7 319	0.6	3 764	288	1 214	2 054
Non-OECD						
Brazil	1 622	0.3	1 068	91	367	96
China	3 894	0.3	78	-197	3 378	635
India	1 698	0.4	46	546	379	727
Indonesia	488	0.3	-29	80	309	128
Malawi	25	1.4	18	-1	1	6
Russia	-31	0.0	-169	166	55	-83
Thailand	1 205	1.0	192	225	238	551
South Africa	249	0.2	64	24	23	137
Rest of SS Africa	-248	-0.1	43	66	-136	-221
Rest of World	1 739	0.1	466	248	2 334	-1 309

Agriculture includes primary and processed food.

Source: GTAPEM simulation results.

...Economic welfare: OECD agriculture-only reforms

The question of whether individual developing countries or regions stand to gain or lose from OECD agricultural policy reform has been the subject of intense debate recently. Bhagwati (2005) labels as "*dangerous nonsense*" the idea that agricultural subsidies in OECD countries are keeping the developing world poor. Panagariya (2004) concludes *"...there are compelling reasons to reject the view that developed-country subsidies and protection hurt the poorest countries."* Generally speaking, developing country farmers would benefit from reduction of OECD agricultural trade protection and support, although some could lose through erosion of the benefits of preferential access. On the other hand, the same increases in world market prices that benefit developing country farmers also increase costs for developing country consumers.

The third column of Table I.6 contains results showing the distribution of welfare changes deriving from OECD agriculture-only reforms. These figures add together the estimated welfare impacts for all the various categories of agricultural trade protection and budgetary payments. (A decomposition of this aggregated result by policy category (not shown) reveals that, with very few exceptions, the gains for individual non-OECD countries from OECD agriculture-only reforms derive almost entirely from reductions in OECD agricultural tariffs.)

In line with results reported by Tokarick most of the estimated benefits coming from reform of OECD agricultural policies (over 90%) go to the OECD countries themselves. Note moreover, that more than half of the estimated total USD 1.8 billion benefits for the entire non-OECD region accrues to just one country – Brazil. Indeed, as might be expected for countries that are net importers of OECD agricultural products, some countries would lose welfare from reform confined just to reductions in OECD agriculture protection and support.

Most individual non-OECD countries singled out in the GTAPEM analysis are shown to gain. However, apart from Brazil, the welfare changes attributed to OECD agricultural policy reforms are, whether positive or negative, relatively small. Notice that in contrast to the result obtained from multi-sectoral reform, the sub-Saharan Africa region is shown to gain slightly when OECD agriculture trade protection and support is reduced.

Whether there are net gains or losses for any particular country depends on its net trade position in those commodities whose prices change with policy reform as well as the magnitude and direction of those price changes. It is impossible to provide a general answer, this question relying solely on economic theory and knowledge of a country's status as a net importer or net exporter. The commodity mix of production, consumption and trade varies greatly from one country to another. Most countries export some kinds of agricultural and food products and import other kinds. Because agricultural policy reform would generate a complex pattern of world price changes for different commodities and countries it could well turn out that a country that is a net importer in aggregate terms, both before and after widespread policy reform, could still gain overall if the world market price increases on the products it exports more than offset the price increases it has to pay as an importer. Similarly, a country could lose more if the world market price for the products it imports increases more than the price of the products it exports (Tangermann, 2005).

…Economic welfare: results from other studies

Table I.7 presents results showing a wide range of estimates of the potential global welfare gains from trade liberalization reported in some earlier studies. The estimates obtained in the present analysis are well toward the lower end of the range of estimated results obtained in previous analyses. This is especially evident in comparing the estimated USD 24 billion of welfare gain from agricultural liberalization estimated in the present study with the estimated USD 193 billion (static) and USD 358 billion (dynamic) welfare gains reported in an earlier study by the World Bank.

Table I.7. Results obtained in other CGE studies of trade liberalisation

Study	Model and Database	Liberalisation scenario	Notes	Global welfare gains USD billion		
				Agri-culture	Other	Total
This study	GTAPEM GTAP database 2001 base year	50% cut in domestic agricultural support and 50% cut in applied tariffs - all sectors and regions		26	18	44
Anderson, *et al.* (2005)	LINKAGE, dynamic GTAP database 2001 base year data	Elimination of domestic agricultural support and trade protection in all sectors	Dynamic version	173	105	278
Beghin *et al.* (2002)	LINKAGE, dynamic GTAP database 1997 base year data	Elimination of agriculture support and protection in high-income OECD countries		108	n/a	n/a
François *et al.* (2003)	GTAP 1997 base year data	Elimination of tariffs, all sectors, all regions	increasing returns to scale, med. run increasing returns to scale, long run	109	107	*367.1 *670
Hertel and Keeney (2005)	GTAP 2001 base year data	Elimination of domestic agricultural support and tariffs — all sectors and regions		56	28	84
OECD (2003c)	GTAP 1997 base year data	Elimination of trade protection, all sectors		34	63	**174
Tokarick (2005)	GTAP 1997 base year data	Elimination of domestic agricultural support and trade protection		128	n/a	n/a
UNCTAD (2003)	GTAP 1997 base year data	50% cut in applied agricultural tariffs	Incorporates tariff preferences	20	n/a	n/a
USDA (2001)	CGE, dynamic	Elimination of domestic agricultural support and tariffs, all sectors	Static version Dynamic, productivity gains	31 56	n/a n/a	n/a n/a
World Bank (2003)	LINKAGE, dynamic 1997 base year data	Near 100% reduction in domestic agricultural support and applied tariffs	Static version Dynamic version	193 358	98 156	291 518

* Includes gains from services liberalisation.
** Includes gains from trade facilitation.

In comparing results obtained here with those from other studies, several factors need to be kept in mind. One obvious difference among the studies is in the nature of the policy simulation experiment itself. Here, all rates of trade protection and support are reduced by half, while in some of the studies the scenario involved near or complete elimination. Another potentially important source of difference is in the assumptions concerning incidence of domestic agricultural support measures — especially the assumptions regarding incidence of area payments. Here and in most other recent versions of the GTAP model such payments have their initial incidence on area allocation decisions. In earlier analyses however they were frequently treated as output support, a category of support measures having considerably greater impact on production than land based payments.

Recall also that the base year used for this study is 2001 while earlier work was based on data from either 1995 or 1997. The actual rates of tariffs applied are substantially lower in 2001 than in those earlier years reflecting scheduled reductions under the Uruguay Round agreements. More importantly perhaps, is the fact that the 2001 GTAP tariff averages used in the present study are based on the rates actually applied, including those applying under preferential arrangements, whereas in earlier analyses the much higher, bound, rates were used (and assumed to be the rates importers actually applied).

A final key distinction to note is that the present analysis is 'comparative static'. Estimated welfare gains result either from cost savings made in optimally reallocating domestic resources following trade liberalisation or because of terms of trade gains (cheaper imports, higher prices for exports). Other studies factor in some other kinds of welfare gains. For example, the OECD (2003c) study includes gains from reducing trading costs (trade facilitation). Francois *et al.* (2001) include gains from services liberalization as well as some gains that result from assuming increasing returns to scale. Additionally, both the World Bank and the USDA studies listed in Table I.7 factor in some gains attributable to the impact of trade liberalisation and openness on productivity and economic growth. Finally, the World Bank (2003) and the Anderson *et al. (2005)* study produces larger apparent benefits from trade reform because the projected impacts refer to a future year, 2015, by which time the projected size of the world economy will have grown considerably.

Summary of findings from analyses of global, national and sectoral impacts

This section of the paper has presented results of policy simulation analyses aimed at measuring the impact of further multilateral trade liberalisation. The world market effects of OECD agricultural policy reforms are highest for dairy product markets where butter, cheese and milk powder prices are all expected to rise by more than 10%. The projected impacts in other commodity markets average less than 4% and are slightly negative -3% in the case of oilseeds and oil meals. These estimated effects were obtained by comparing an AGLINK ten-year baseline projection of agricultural supply, demand and prices with an alternative projection embodying a 50% expansion in tariff rate quotas and a 50% reduction in all tariffs, export subsidies and domestic support. The estimated results obtained depend to some degree on the particular assumptions that underlie the baseline.

Estimated welfare gains obtained from simulations undertaken with the GTAPEM model (0.1% of GDP), though substantially less than shown in some other studies, are nevertheless significant. Static welfare gains at the global level are estimated at USD 44.3 billion. These can be decomposed into the impact of the various categories of

policy reformed and, according to the region implementing the reforms, yielding the following:

- The incidence of multi-sector reform benefits, as measured by the percentage increment in GDP, is higher for the non-OECD than for the OECD region.
- About 50% of global gains are the result of reform in OECD agricultural policies. Reductions in OECD agricultural tariffs account for more than three-fourths of these total gains from agricultural policy reforms.
- The gains from OECD agricultural policy reform accrue largely (over 90%) to the OECD countries themselves.
- OECD countries gain more from global agricultural policy reforms than from global non-agricultural policy reforms.
- Non-OECD countries generally gain more from OECD reform than from own reforms (in both agriculture and non-agriculture).
- Developing countries gain substantially more from reductions in OECD tariffs on non-agricultural products than from OECD agriculture reforms, a finding that reflects the relatively greater importance of the manufacturing sector in the economies of many developing countries.
- Over 75% of global gains from agricultural policy reform come from cutting import tariffs.

Net economic returns to land, labour and capital employed in agriculture (value added) fall in most OECD countries implementing the assumed policy reforms but increase in some OECD countries where current levels of trade protection and domestic support are relatively low. Likewise agricultural sector returns rise in some, but not all developing countries.

The most important contributor to the estimated falls in farm value added in OECD countries are losses in returns to land, due mainly to the assumed cuts in area payments. An important consideration in this regard is the pattern of land ownership, *i.e.* the share of land that is owned by farm households as opposed to land that farmers have rented. Household-level analysis of adjustment needs and processes should permit taking this issue more fully into account.

Reductions in trade protection contribute only marginally to farm income losses in OECD countries. Strikingly, however, the knock-on effects on world market prices caused by those same reductions in trade protection explain most of the income gains experienced in countries where farm sector returns rise.

Among the developing countries further trade reform may add to ongoing downsizing of the agricultural work force in some of them, *e.g.* India, but may offset some of that pressure in others, *e.g.* Brazil. However, where pressures for downward employment adjustment in the sector are created by trade liberalisation, they may not add greatly to those associated with ongoing processes of economic development and growth. Undoubtedly, however some people currently working in agriculture in some of the affected countries will experience a reduced demand for their services. This may happen in both some OECD and some developing countries, though overall farmers in developing countries are more likely to gain from multilateral policy reform.

Note that these results are comparative static and do not reflect longer term dynamic influences that might arise through, *e.g.* induced economic growth, technology spill-overs, or innovation (Duncan and Quang, 2003) or risk related price volatility (Gérard *et al,* 2003). Furthermore, no account has been taken of the effects of accompanying policy measures (compensation, adjustment, transitory support, etc.). Reality would be different, and to the extent that measures could be targeted to the real needs of households, negative impacts could be muted.

Notes

1. Please note that the AGLINK and GTAPEM models have not been formally linked.
2. The list includes: Brazil, China, Bulgaria, Romania, Slovenia, Estonia, Latvia, Lithuania, and Russia.
3. This is a publicly available database but access to it is free only for institutions and individuals who are members the GTAP consortium. The particular combination of data used for the analysis reported in this paper is available at www.oecd.org/agr/gtapem.
4. The Secretariat, in collaboration with experts from Member countries, is developing a revised version of the system used to classify various kinds of budgetary payments, especially area based payments, for the PSE. The outcome of that ongoing process may have implications for the way the data is interpreted for modelling purposes.

5 Payments that do not depend at all on current production, factor use, or commodity prices may be viewed as lump-sum income transfers. These kinds of payments produce their effects not so much through their influence on decisions about factor use and production but rather on consumption decisions. In their purest form lump-sum income transfers can improve the economic well-being of farm households, enabling them to increase consumption, savings and leisure but with only minimal distortion to production and trade (Burfisher and Hopkins, 2003).

6. The terms land rents or land rental rates are used here and throughout the remainder of the text to refer to the economic returns to land without regard to whether land is in reality farmed by the landowner or by someone else.
7. Moreover, the estimated global welfare gain from reducing area payments is obtained assuming a planting requirement. Under an alternative assumption that there is no planting requirement the estimated welfare gain derived from reducing them would be zero. There are of course welfare costs incurred in making any kind of budgetary payment due to, for example, deadweight costs of taxation. These costs were ignored in this analysis.

Chapter 3.

Household Level Impacts

Scope and purpose of applications

The country case studies for Brazil, Italy, Malawi, Mexico and the United States, each measure the distributional effects of agricultural and trade policy reforms undertaken at the national and multilateral level. The overall objective of these studies is to learn more about the ways in which policy reforms affect different types of household in a diverse group of developed and developing countries. The aim is not simply to generate one off results, or to extrapolate from a small set of applications, but rather to explore the degree of within-country divergence associated with the aggregate impacts described in the previous chapter, demonstrate the kinds of policy insights that can be obtained, and suggest ways in which such insights can assist in the design of appropriate policy responses for those adversely affected by policy reforms. The case study approach makes it possible to compare and contrast methods for measuring distributional effects and to suggest some principles for constructing applications with the maximum policy relevance. A more ambitious goal, relevant in the three developing country case studies, is to provide some insight into agriculture's role in economic development and poverty reduction, acknowledging the dangers inherent in generalising from such a small sample of countries.

The sample of countries for which it was possible to undertake analysis was necessarily limited and reflected resource constraints, the willingness of countries to participate, data availability, and the availability of the necessary expertise for developing models in the macro-to-micro mould, either within academic institutions or government ministries. The scope for applying the broad approach to a much wider range of countries was recognised by experts and policymakers at the OECD Global Forum on Agriculture in December 2003, although is was recognised that any such model developments would need to take account of each country's unique aspects (for example, in determining the domain of the household as a decision making unit). Some of these specificities are evident in the three developing country studies, where economic structures differ substantially, but there are likely to be many more. Recall in this connection that the main motivation for doing the country case studies was to study within country distributional implications of the hypothesised agricultural policy reforms. Importantly, the choice of countries was not driven by interest in what might happen to broad national or sectoral aggregates as these aspects were the focus of the global market and welfare analysis covered in the introduction.

This synthesis of the case studies starts with a discussion of the sorts of impacts that need to be considered and the main channels through which global and national policy reforms feed down to the household level. Having identified these channels there is a discussion of the modelling options for capturing each of the impacts. This is followed by a summary of the particular methodological approach adopted in each case. For each case study, the impacts of a set of global and national reforms are considered. The common and specific elements of the reform scenarios are summarised and the main results of each case study reported, along with a distillation of the main findings. Finally, there is a discussion of the analytical lessons to be learned from the case studies and a discussion of the scope for making use of such types of analysis in designing policy responses.

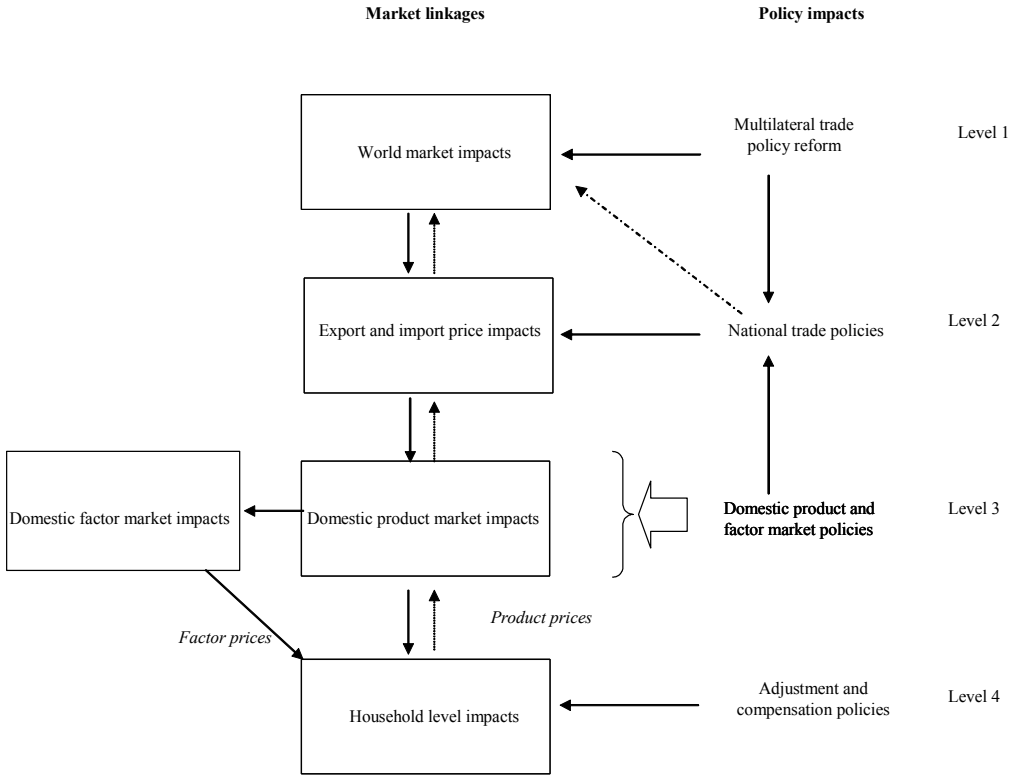
The case studies for Brazil, Italy, Malawi and Mexico were each done by consulting experts contracted for the purpose by the OECD. The US case study was done for the OECD by colleagues from the Economic Research Service (ERS) of the United States Department of Agriculture (USDA-ERS). Extended summaries of each of the case studies are presented in Part II of this report.

Analyzing policy incidence

What kinds of policy effects need to be measured? The ultimate interest of the case studies lies in what multilateral and national policy reforms imply for the level and distribution of household incomes. The household forms the essential building block of the analysis, being the basic institution governing decisions on production, consumption and labour allocation, and corresponding to the level at which relevant data are collected. An instructive way of viewing the various ways in which reforms and other policy measures can affect households is provided in Figure I.7.

Under this schema, market based impacts (levels 1, 2 and 3) feed down to the household level (level 4). First, multilateral trade reform has a global effect on international markets, as resources are reallocated in response to the existing pattern of comparative advantage (level 1). Second, these changes on world markets, together with own-country policy changes, are associated with changes in the prices paid by importers and received by exporters in individual countries (level 2). Third, changes in prices paid and received at the border lead to changes on local domestic markets (level 3). Fourth, changes in these prices affect the incomes and expenditures of households, with consequent effects on the incidence of poverty (level 4). As the right hand column illustrates, policies can have a direct impact at each stage. Not all policies are independent. For example, both multilateral rules and domestic policies can affect national trade policies. In the case of a large country, national trade policies may have a measurable effect on world markets (dotted arrow). Alternative schemas with a similar orientation are contained in McCulloch *et al.* (2001) and Diaz Bonilla *et al.* (2003).

Figure I.7. A simplified schema of market, household and policy linkages



This representation of trade reform impacts is, of course, an oversimplification. First, the causality can run both ways. For example, structural changes at the household level can affect local markets, while changes in local markets can affect the relative prices of tradables and non-tradables, which, in the case of a large country, can alter the conditions on world markets. Second, there are general equilibrium impacts at each stage. For example, households may receive incomes from agricultural production in the form of wages or profit, which they then spend on a variety of agricultural and non-agricultural goods according to the structure of their demands. The overall pattern of demand will in turn have a bearing on the structure of production. Similarly, tariffs may affect government revenues, which can be spent in a variety of ways. Finally, there is a range of dynamic impacts, including the complex linkages between trade, economic growth and poverty. These dynamic effects are potentially important, because they could counteract the static impacts, and possibly overwhelm them in the long-run. A basic dilemma confronted by these studies is how to build tractable models that address this complexity.

The GTAPEM policy simulations of the market and welfare effects of reform discussed in the previous chapter provide results that essentially links levels 1 to 3 across countries. The case studies here focus in greater detail on what happens at the national level, *i.e.* at levels 3 and 4. They take changes on global markets, in the form of shocks to export and import prices, as exogenous. In principle, disaggregated national models, with household level detail, could be nested in a global model, so that the connections are all made seamlessly. In practise, however, national models can provide more specific detail

at levels 3 and 4, and a pragmatic approach (adopted in the case studies) is to link the global and national models less formally (but checking for consistency in terms of the predicted impacts on domestic markets).

Characteristics of case study models

Each model is constructed somewhat differently, according to the economic characteristics of the country, data availability, specific policy questions that need to be addressed and related judgements on the appropriate methodology. The studies nevertheless share two core characteristics. First, they contain groups of representative households that collectively represent the totality of household types in the economy. Second, they embed those households in a macro (region or economy wide) behavioural model. Policy and/or non policy shocks are applied to these models in order to trace out the effects of reform on different types of households.

The detailed categorisation of households differs in each study. However, there is a broad distinction between commercial and non commercial farm households (with one or more sub categories in each case). The former tend to behave more like firms, consuming little of their own output and supplying few of their own inputs. This group tends to be better integrated with formal markets. The non-commercial category differs considerably between developing and developed countries. In poorer countries, this category corresponds to subsistence or semi subsistence households, which both produce and consume food, and possibly sell their own labour or hire some from outside. In richer countries, the non commercial category typically equates to lifestyle or retirement farm households, which are characterised by high levels of off farm income. Non commercial farm households allocate their time between farm and off farm work or leisure, and allocate their income from those activities between consumption of home production (notably food) and external purchases.

Two further broad categories of household are agricultural wage earners and urban (consumer) households. These groups may be particularly important in developing countries, where there tend to be more landless workers and the urban population spends a substantial share of its income on food. Note that the stylised categories referred to above are merely broader groupings. In each study, households are further subdivided, according to either structural characteristics that determine behavioural differences (*e.g.* commodity specialisation) or socio-economic variables, which provide a useful way of viewing the results (*e.g.* income level, gender of head of household). The specific typologies in each case are as follows:

- In the Brazil study there are ten household accounts, comprising four categories of family farm (non-commercial) households ordered by economic size; one category of commercial farm households; one category of wage-earning agricultural employees; and four categories of urban household ordered by income quartile. These ten groupings account for all households in the economy and are embedded within a CGE model.

- The Italy application also comprises ten household types. There are three types of non-commercial farm households (limited resource, retired, and residential) and four types of commercial farm households (professional farmers with low sales, professional farmers with large sales, large family farms and very large family farms). In addition, there are three categories of urban households, ordered by income, and a separately specified group of rural non-farm households. The CGE analysis is complemented by a

micro analysis of farm household behaviour, for which all agricultural households are grouped into two broad types: professional and non-professional.

- In the Malawi application, households are differentiated first with respect to three agro-ecological zones and second with regard to socio-economic characteristics within each zone. The latter characteristics include off-farm employment income, remittances, value of assets, retained maize stocks, holding size, access to credit and gender of household head. These data were used to define seven household types: larger farmers, medium sized farmers with assets, borrowers, poor male headed households, poor female headed households, employees and remittance earners. The model allows each household type to behave differently, depending on the resource constraints that it faces.

- For Mexico, the household types are: commercial farms on large landholdings, which behave more like firms than like households;net-surplus producing family farms on medium and small holdings, typical of small owner-operated farms of medium productivity; subsistence and infra-subsistence household farms, typical of small-scale, low productivity agriculture, frequently operating under marginal conditions and incomplete markets; and landless rural households. For each household type, The Mexico case study estimates four separate farm household models for each of Mexico's five census regions (*i.e.* 20 models in total), and these household models are embedded in a separate CGE for each region.

- The United States study includes seven representative types of farm household, and two types of non-farm household (low-income and high-income) within a CGE. In addition, the macro results for each household type are linked to a micro-simulation model, so that the impacts on the overall group can be distributed across individual households. The effects on an individual household depend on its adjustment capacity, which is linked to two variables: the probability of working off farm, and managerial adjustment capacity. The former is estimated econometrically on the basis of household characteristics such as age, education and race; the latter is linked to financial performance.

As noted in Box II.1, there is an implicit trade-off between the completeness of the economy-wide specification and hence the comprehensiveness with which the distributional effects of reform are described, and the amount of household-specific behavioural detail and depth of related insight. This trade-off is resolved differently in each of the studies. The Malawi and Mexico studies each contain farm household models that account for market failures and the resulting interdependence of households' decisions on production, consumption and labour supply. The Malawi farm household model takes account of seasonal constraints, varied activities among households and heterogeneity in resource endowments. By allowing for different maize prices in the harvest and post-harvest periods, the model allows for some embedded risk. Farm households are nested in a model of the rural economy, whereby households interact with each other and with external markets for output (maize and tobacco) and wage labour. The model of the rural economy is in turn loosely nested in a CGE.

Box II.1. Methodological approaches to measuring household level impacts

There is a central dilemma when attempting to measure the disaggregated impacts of policy reform. On the one hand, it is possible to adopt a bottom up approach, focusing on household behaviour, and then trying to round out the economy wide picture. Alternatively, one can develop a disaggregated CGE model with household accounts that exhaust national aggregates, but where behavioural responses are not differentiated across structurally distinct types of household.

The former approach, specifically the construction of farm household models, can account for the fact that farm households may behave in structurally distinct ways. For example, commercial farms may operate as profit maximising firms; but in both developed and developing countries there are farm households with diversified income sources that both produce and consume food, and whose production and consumption decisions are inter-related.

The key issue is market failure. In the absence of market failure, traded prices correspond to opportunity costs and it should not matter whether the household consumes its own food or sells it and then buys food on the market. Similarly, if the market wage corresponds to the opportunity cost of hiring labour, it should not matter whether the household supplies its own labour to the farm or works off-farm and hires in labour. Under such circumstances, the farm household's behaviour can be modelled as that of a profit maximising firm, which then consumes on the basis of an income constraint determined by maximum profits. However, there are several potential sources of market failure that may drive a wedge between market prices and opportunity costs and which necessitate a simultaneous (as opposed to separable) modelling of production, consumption and labour supply decisions. Insofar as some farm households are more susceptible to these market failures than others, these differential impacts can determine the distributional impacts of reform.

Some specific sources of market failure that may need to be taken into account are:

- *Transactions costs* — These include poor infrastructure, which may raise the opportunity cost of obtaining off-farm inputs and supplying goods to the market; the costs of obtaining information on output and input prices; and squeezes on margins by merchants with local market power. Other transactions costs include the costs of monitoring hired labour, whose objectives differ from those of household members.
- *Price risks and risk aversion* — Households discount sale prices and mark up purchase prices according to the degree of risk in the market and the extent of their risk aversion. The greater the risk and the degree of risk aversion, the larger the difference between the market price and the opportunity cost to the household.
- *Limited availability of credit* — Credit deficiencies restrict production and consumption choices and introduce a similar wedge between market prices and the households' decision prices. For example, the decision prices of goods that relax the credit constraint are marked up, so increasing their production and sale.

Given suitable survey data, household models can be built with considerable detail. For example, the producer side can account for output responses to changes in the relative prices of different crops. Similarly, off-farm income can be accommodated in order to demonstrate the relative effects of changes in the relative prices of crops (via production and consumption decisions) and in off-farm wages (via the on-farm versus off-farm labour decision). The importance of specific sources of market failure can also be gauged empirically. All this information may be valuable in tracing out the differential impacts of reform across households.

The chief limitation of such models derives from the difficulty of extending such a disaggregated level of detail to the national level, in order to obtain an economy-wide representation of the effect of policies. Although the household approach can be retained at the national level, with the breakdown of households into different structural categories, there will necessarily be a loss of detail in the way that policy effects and behavioural responses are captured.

The six case studies each attempt to resolve this dilemma by focusing on the linkages that are deemed to be most important. No model succeeds in fully integrating detailed farm household models into a highly disaggregated CGE, and in most cases this would not be possible. However, each study provides important insights that derive from the relative strengths of the approach adopted, be that bottom-up or top-down.

In the case of Mexico, for each of five regions (Northwest, Northeast, West-Centre, Centre and South-Southeast), there are four farm households nested within a rural CGE. The household models are estimated separately, to capture the fact that the same household category is comprised somewhat differently from one region to another. The CGE model determines the (net) marketed surplus of tradable commodities as the difference between supply and demand. Prices for 'village' tradables are exogenous, determined by markets outside the village or by policy. Prices of village non tradables (land and hired labour) are endogenous, with local supply equal to demand, and individual households price takers. For households that do not participate in local markets, prices are unobserved shadow prices, and the marketed surplus is zero.

The Brazil, Italy and United States studies each embed the representative household groups into a national CGE. The CGE models all follow a standard form in which households groups respond to reforms by varying their consumption decisions, while production responses are determined at the market level and passed through to the household via changes in factor incomes. A benefit of this approach is that each study provides substantial sectoral detail. In the Brazil study there are 30 activities, of which 9 are in primary agriculture and 15 are in agribusiness; and 40 products, of which 17 are agricultural and 19 of the remaining 23 are agribusiness or strongly agriculture related. In the Italy study, there are 41 sectors, of which 23 are in agriculture, 9 are in agribusiness, 7 are in industry and 2 in services. Unlike the Brazil case, each sector produces a unique output.

The United States model contains 59 sectors, of which 10 farm sectors and 12 are food processing. Trade and transportation are treated explicitly, so that household consumer behaviour responds to the retail price, while producer decisions respond to the producer price. The United States study links the macro results for each household type to a micro simulation model, so that the impacts on the overall group can be distributed across individual households. The effects on an individual household depend on its adjustment capacity, which is linked to two variables: the probability of working off farm and managerial adjustment capacity. The former is estimated econometrically on the basis of household characteristics such as age, education and race; the latter is linked to financial performance.

Case study results

This section describes the policy shocks applied in each case study, summarises the household level impacts for each country and distils the main findings across the five studies. For further details on what underpins the results for each country, the reader is referred to the individual country summaries in Part II. Where possible, an effort is made to link the aggregate national effects described in Chapter 4 to the disaggregated (household level) effects obtained using national models. This is done by having each country (excepting the US) adopt the same reforms as required in the GTAPEM experiment, namely 50% tariff cuts and for OECD countries a 50% reduction in domestic support, and by introducing changes in export and import prices obtained from the GTAPEM simulation. The US study of household effects was based on simulations of a national model based on an assumed elimination of all forms of price support and payments except those judged to be non-distorting. Recall that each country reaps overall welfare gains from reform. However, there are considerable differences in how farm households will be affected, with net gains to commercial farm households in Brazil and

Malawi, but net losses as a result of own-reform to farmers in Italy, Mexico and the United States. The specific scenarios are as follows:

- Brazil reduces its own tariffs by 50% and faces a vector of price changes (to export and import prices) obtained from the GTAPEM simulation.
- Italy implements the same scenario. In addition, a CAP reform scenario is considered, under which area and headage payments are replaced with a system of decoupled payments.
- For Malawi, the GTAPEM simulation suggests price increases of less than 5% for the main cash crop (tobacco). A range of changes to tobacco and maize prices are simulated, along with a non-policy shock in the form of increased openness of the rural economy to purchases of tradable goods and services.
- Mexico takes the changes to food (maize) prices, cash crop prices and urban wages that GTAPEM predicts would result from a the 50% liberalisation scenario. In addition, a series of stylised policy and market shocks are applied in order to demonstrate the value of the modelling approach. These include price shocks (to maize and cash crops), migration experiments (urban wage increases and peso devaluation) and government transfers (PROCAMPO and PROGRESA payments).
- The United States study considers the effects of a scenario featuring full global trade reform comprising complete elimination of border protection and domestic support that is deemed to be trade distorting but excluding payments not linked to production of specific crops, *e.g.* the US Production Flexibility Contract payments.

Brazil

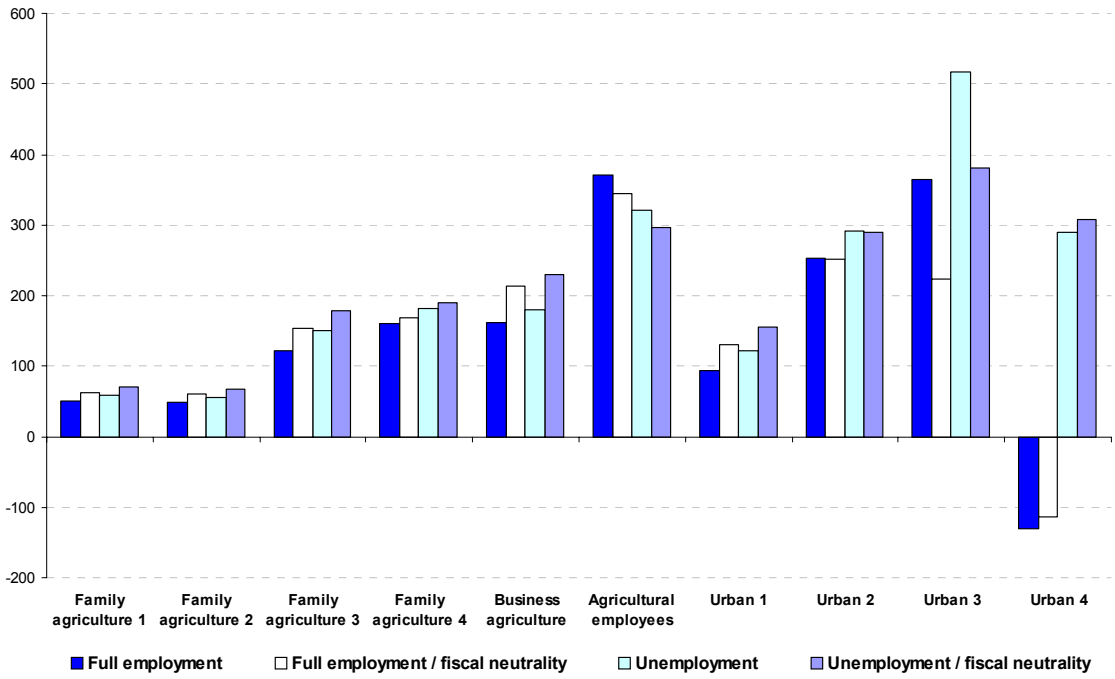
The aggregate welfare gains from reform vary from USD 1.5 billion with full employment to USD 2.2 billion under the more realistic assumption of unemployed unskilled labour. (These two estimates bridge Brazil's estimated national welfare gain of USD 1.73 billion obtained in the GTAPEM simulation.) These impacts are ultimately distributed across households, via changes in factor returns. Figure I.8 shows the changes in welfare for each household group under alternative closure rules. The following patterns are evident:

- In general, the welfare gains are widespread across household types. With the poorer categories of both urban and rural household better off, the incidence of poverty falls.
- Inequality among agricultural producer households increases, with larger (and richer) family farm households gaining more than smaller ones. This is because larger farms tend to be more specialised in export products, for which price increases are relatively large.
- At the same time, the total gains to agricultural employees are more than for any other type of agricultural household. The benefits to this group derive from the increased demand for farm labour from commercial farm households. Because agricultural employees are relatively poor, this impact counteracts the increase in inequality among agricultural producers.
- Urban households also gain, and their benefits generally increase with income level. For these households, the benefits attributable to increased redistributed profits and wage earnings from the agro-food sector outweigh the costs of food price increases. An

exception is the richest quartile, whose gains are less than those of the second richest group, and in fact loses when there is full employment (because they end up paying more for goods that use unskilled labour).

- The tax burden, while assumed to remain constant globally is shared among the household types differently following reform. Higher tax cost fall disproportionately by the third urban quartile. This reflects a relatively flat income tax structure for the richest 50% of urban households and greater cost of living increases for the second richest group.

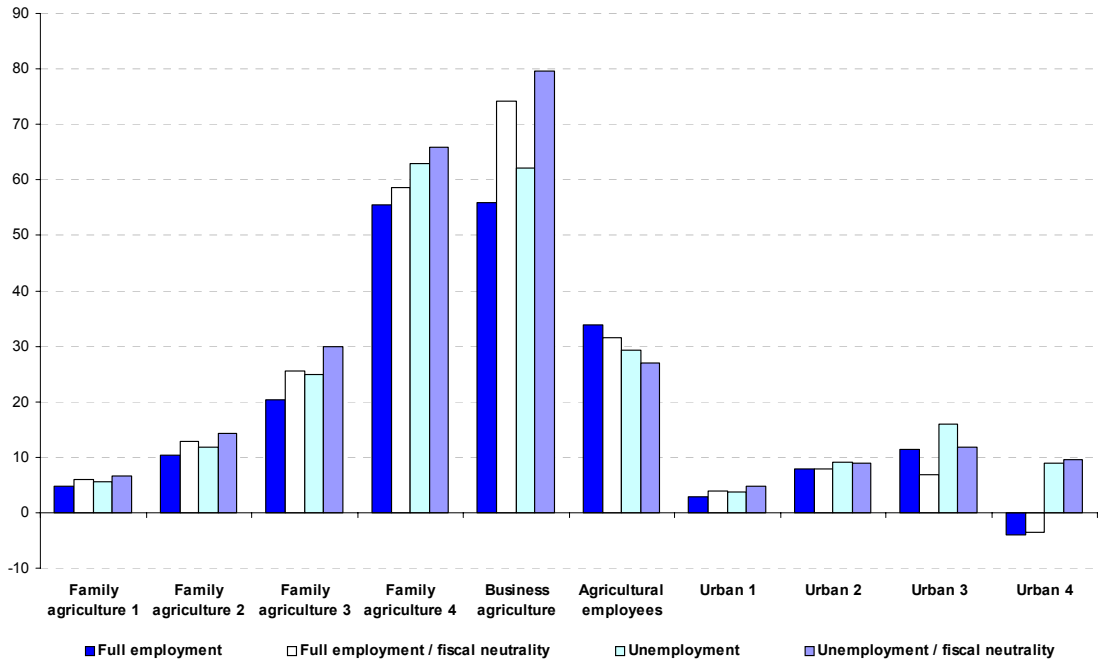
Figure I.8. Distributional effects of global policy reform in Brazil — Equivalent Variation in total Household Welfare (USD million)



Source: Simulation results.

Given that the above categories contain different numbers of households and persons, further insight can be obtained from the annual changes in welfare per 'person' that are reported in Figure I.9. These estimates confirm that, for agricultural households, the welfare gains increase with income and that the benefits to agricultural households are generally greater than for urban households.[1]

Figure I.9. Distributional effects of global policy reform in Brazil
Equivalent Variation per Person (USD)



Source: Simulation results.

In overall terms, real incomes are expected to rise by between 2% and 4% for agricultural producers, by around 3% for agricultural employees, and by about 1% for urban households. These income gains lead to a modest decline in the incidence of poverty. Because commercial farmers gain more than smallholders, inequality among producers is expected to increase. But the wider gains to agricultural employees and urban households (who account for about 80% of the population) imply that the overall impact on income inequality is likely to be broadly neutral.

Malawi

The vast majority of Malawian households are poor. Commercial producers of the dominant cash crop, tobacco, who are less poor, gain from higher prices. GTAPEM suggests price increases of less than 5% for the principal cash crop (tobacco) from a 50% global reform scenario, which will raise tobacco farmers' incomes by less than 1%. The resulting increase in tobacco farmers' demand for labour benefits poor non-commercial households who cannot grow tobacco, but lowers the incomes of poor farm households that hire in labour. In contrast, the domestic price of maize, the main staple, may be only weakly linked to international market prices. Moreover, the effects of maize price increases/decreases are very context specific, depending on the range over which price increases occur, whether the household has a net surplus or deficit, and the relationship between maize prices, wages and fertiliser prices.

The effects of policy reforms in Malawi depend fundamentally on the extent of interactions that are considered, and the original values for which the model is calibrated.

Under the simplest farm household model (with no outside market interactions), all households lose from increases in maize prices from a very low base where all households are net buyers of maize. At higher prices, however, some households gain and some lose from price increases, depending on whether they are, or have the scope to become, net sellers. Poorer households lose because cash and land constraints prevent them moving to a profitable net surplus. In this case, higher maize prices can actually induce a perverse supply response. This occurs because an increase in the maize price raises the cost of food expenditures, which tightens the cash constraint, reducing households' ability to buy inputs with which to grow maize, and, for the poorest households, requiring them to allocate labour from maize production to wage employment which delivers immediate (if lower) income. Similarly, increases in wages can cause these households to supply less labour to the market. In the case of tobacco, the benefits of higher prices accrue to larger smallholder farms, owners of more assets, borrowers, non-agricultural wage earners and remittance earners. The poorest households do not benefit, as they do not grow the crop due to lack of cash to buy inputs.

But even a relatively limited extension to the basic household model to accommodate wage changes can fundamentally alter (and in some cases even reverse) estimates of how the poor will be affected by policy reform. In response to small increases in maize prices, wages fall, but with larger maize price increases wages rise, with the extent of the response depending on changes in on-farm labour use, total labour supply, and the demand for non-tradable goods and services (and hence for non-farm labour used in their production). Very low maize prices lead to larger areas under tobacco which requires more farm labour than maize. As maize prices rise, real incomes fall (increasing total labour supply, and decreasing demand for non-tradable goods and services), and farm labour is also released by the transfer of land from tobacco to maize. Larger maize price rises lead to less poor households finding it worthwhile to become surplus maize producers, so their incomes begin to rise again (reducing their family labour supply and increasing demand for labour to produce non-tradables). They also begin to adopt more intensive maize technologies, which demand more on-farm labour. This tightening of the labour market leads to increased wages, which may offset some of the losses to the poorest households which lose from higher maize prices.

The introduction of inter-sectoral and international linkages, together with some dynamic considerations, further complicates the results. For example, higher international maize prices can stimulate technological change and drive up productivity, which then serves to drive down domestic prices. Higher international tobacco prices also induce competing effects on maize prices. On the one hand, higher tobacco earnings lead farmers to switch crops, the reduction in maize supply tending to raise prices. On the other hand, higher tobacco prices improve the balance of payments, strengthen the currency and effectively lower the prices of imported maize. In both the extended farm household model and the most sophisticated development with economy-wide and some dynamic linkages, it is the poorest households (agricultural wage earners) who gain most from reform. But in each formulation the complexity of effects is such that there are always both winners and losers within the overall population of poor rural households.

Mexico[2]

Feeding in results from the GTAPEM reform scenario, *i.e.* declining prices for cash crops and livestock, and lower urban wages — the estimated real incomes of all agricultural households fall, but the declines are greatest for producers with more than 5 ha of land (-0.4%). There are similar, but much smaller impacts for landless households and smaller producers with less than 5 ha (-0.1%). There are two principal reasons why larger farmers lose more: first, they tend to consume a smaller share of their own output, so declining output prices have a bigger impact on net cash income; second, larger scale producers on balance rent land out to smaller farmers and lose out from declining land rents. The results are summarised in Table I.8. It is important to note that these are average impacts for Mexico and could mask significant regional differences. Some of these differences are explored by stylised policy experiments, including those simulating the effects of changes to maize and cash crop prices.

Table I.8. Percentage effects of price shocks resulting from multilateral trade reform

Variable	Landless households	Households <2 ha	Households 2-5 ha	Households >5ha
Production				
Maize	0.15	0.20	0.24	1.22
Cash crops	-1.14	-0.28	-0.28	-0.30
Livestock	-0.14	0.01	-0.13	-0.14
Nonag	0.63	0.48	0.13	0.44
Factors				
Wages, urban		***-0.20***		
Wages, rural		-0.26		
Land rents		-1.01		
Prices				
Maize	-0.60	-0.57	-0.52	-0.40
Cash crops	***-0.80***	***-0.80***	***-0.80***	***-0.80***
Livestock	***-0.70***	***-0.70***	***-0.70***	***-0.70***
Incomes				
Nominal	-0.16	-0.24	-0.22	-0.33
Real	-0.13	-0.15	-0.13	-0.40
Migration				
Domestic		0.002		
International		0.03		

Exogenous changes, taken from GTAPEM simulations, are in bold.

Source: Taylor and Yunez (2004).

The maize price shock compares the implications of reducing maize price supports by 10% in Central Mexico, where most households do not produce a marketed maize surplus, with the North-West, where maize is dominated by commercial producers operating on irrigated land. In both regions, the production of maize by commercial households contracts sharply in response to the price decrease. This leads to a significant drop in maize output in the North-West, where commercial production dominates. The contraction in commercial maize production decreases the demand for land and labour, causing rents and wages to decline and reducing the incomes of subsistence households. This, in turn, reduces subsistence households' demand for maize and with it the shadow

price of maize. In the North West this effect causes production to fall. But land and labour are also inputs, and lower rents and wages stimulate production. In Central Mexico this effect dominates, with the subsistence production of maize rising in response to a price fall, as well as the production of other goods that benefit from cheaper inputs, including livestock. These changes are reflected in diverse effects on income distribution. Commercial households lose or gain according to their net surplus or deficit. Net sellers in the North-West therefore lose significantly. Non-commercial households are worse off in the North-West, but are largely unaffected in Central Mexico.

The effects of a 10% increase in the price of cash crops are compared between Central Mexico and the North East. On the relatively low productivity farms of Central Mexico, cash crop production increase moderately – between 3% and 4% – for most producers, be they large or small. As a consequence, incomes rise across the board. In the North East, however, cash crop production increases sharply for large farmers and landless households. This drives up wages and, even more so, land rents. In the two smaller groups of producers, cash crop production falls as land is bid away by more efficient producers. As a result, incomes of larger farm households rise by nearly 5%, while those of smaller farm households are virtually unchanged.

Italy

Figure I.10 shows distributional effects for Italy obtained when findings from GTAPEM simulations of the effects of global agriculture and trade policy reforms are fed into the disaggregated CGE model for Italy. While all categories of farms post losses, the medium to larger family farms lose relatively more than the small, limited resource and retirement farms. The higher losses for the larger farm categories stem from simulated falls in land rental rates due to support reductions under the GTAPEM global reform scenario. All categories of urban households gain from the reduced tax burden that comes with reductions in budgetary payments that are part of the GTAPEM policy reform scenario. Moreover, although not shown here, national welfare improves in net terms under this policy reform scenario (Magnani and Perali, 2005).

The findings from a policy simulation experiment aimed at measuring the distributional impacts in Italy of the recent switch to the single farm payment under EU farm policy are featured in Figure I.11. This policy change favours middle to large size and residential lifestyle farms over limited resource, retirement and small farms. Larger households receive substantial benefits especially from the income support through the lump sum transfer. The gains to the larger and more commercially oriented farms flow mainly through the significantly positive effects of the policy change on land rental rates (agricultural land rents in Italy are shown in the analysis to rise by nearly 20% with the switch to the single farm payment). The negative impacts on retirement and limited resource farms stem largely from simulated reductions in returns to farm labour and agricultural capital accompanying the policy change. Urban households are little affected by the policy switch since neither simulated consumer prices nor the tax bill changes much under the single farm payment scenario.

Figure I.10. Household distributional effects from global policy reform

Welfare change as % of base income

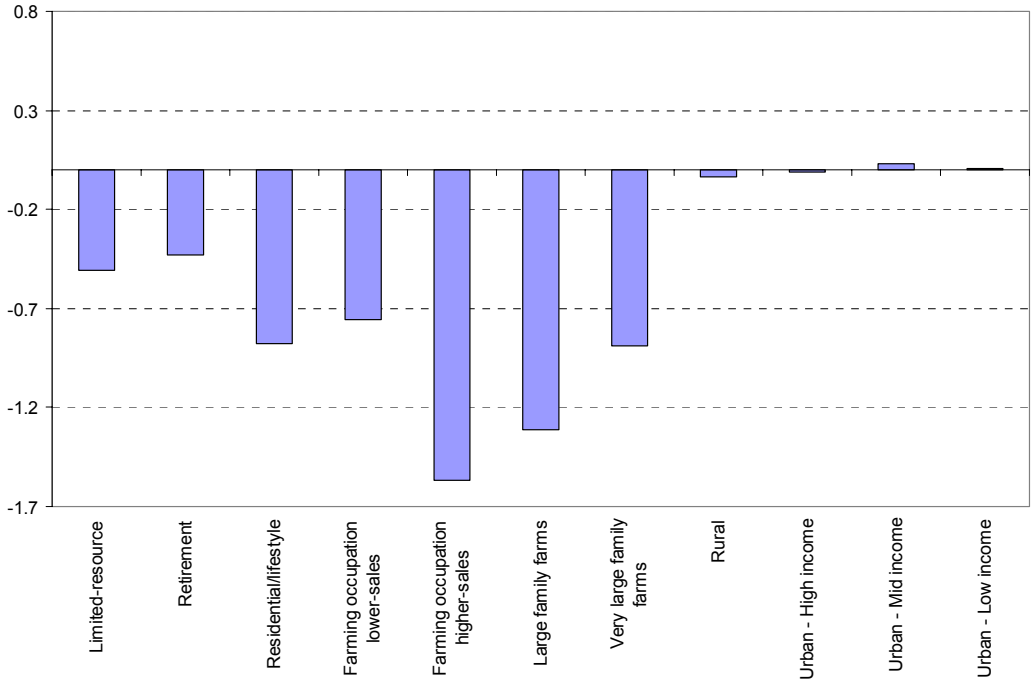
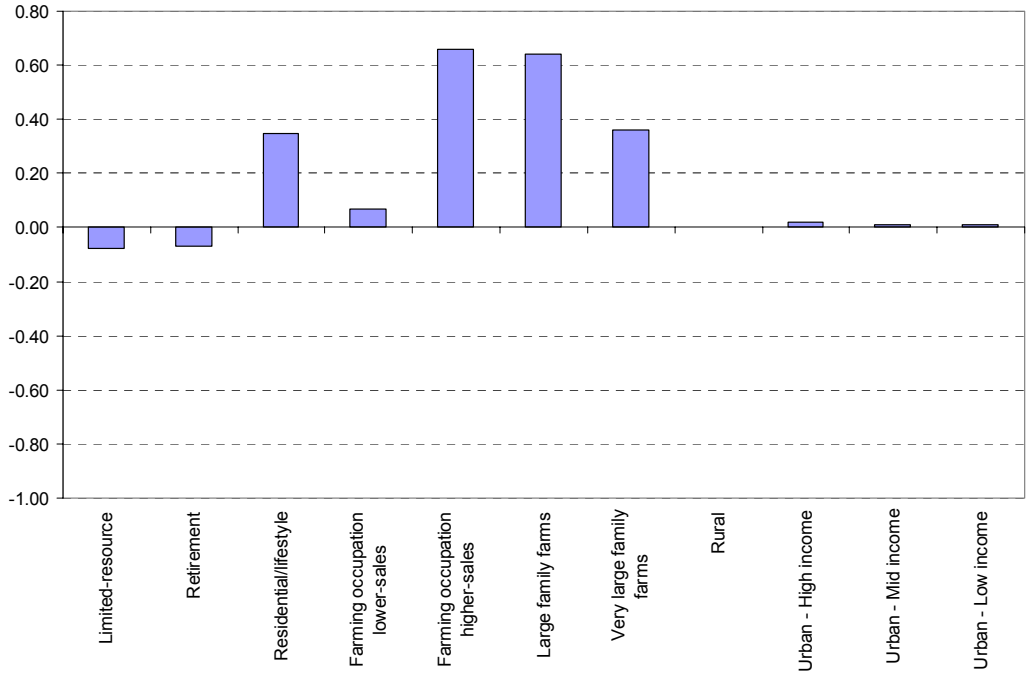


Figure I.11. Household distributional effects of switch to single farm payment

Welfare change as % of base income



Source: Secretariat calculations using results from analysis in Magnani and Perali (2005).

United States

The United States study finds that the global trade policy reform will affect the incomes of the seven U.S. farm household types differently, depending on their reliance on support, and their production mix as well as the role of farm and non-farm activities in households' income and asset portfolio. Table I.9 describes the incidence of *payment* loss across the seven farm household types, while Table I.10 shows what happens to farm household incomes once the higher simulated world market prices and induced resource adjustments occur. Very large farms receive more payments than other types of farms, and as the numbers in Table I.9 show, this stylized reform would result in an average loss of payments for this farm type of roughly USD 6 000, compared to an average loss of USD 50 on retirement farms. However, relative to the value of production, the payment reduction is largest for residential and farm occupation farm types.

Table I.9. Incidence of Payment Loss by US Farm Type from a Stylized Trade Policy Reform

Farm type	Number of farms	Total payment loss by farm type	Average payment loss per farm	Average loss in cents per dollar of production
	Thousands	USD million	USD	US cents
Limited resource	127	9	69	0.57
Retirement	298	14	46	0.83
Residential/lifestyle	931	75	81	1.00
Farm occupation/low sales	480	161	336	1.17
Farm occupation/high sales	175	343	1 955	1.20
Large	77	309	4 000	0.45
Very large	58	341	5 833	0.79
All	2 147	1 252	583	0.79

Source: Burfisher *et al. (2005).*

The changes in farm household income reported in Table I.10 take into account the households' compensating adjustments to the policy reform. The net effect of a stylized-type of trade reform on incomes is composed of changes in farm and off-farm wages, returns to assets, farm program payments, and taxes that would have been paid to fund these payments, as well as the impact of price changes on the cost of household food purchases. Overall, US farm household income increases by nearly USD 500 million due to the global reform, with net gains for every representative farm type. Incomes rise across all household groups because the loss of subsidies is outweighed by the benefits arising from stronger international prices, notably higher wages and improved returns to assets.

The greatest income gains accrue to residential and lifestyle farms. These are the farms with the most part-time spousal employment. They therefore have the greatest capacity for labour substitution in the macro model, and the largest on-farm labour supply response. They also tend to specialize in beef production, for which market prices rise. Despite over-all net gains for each representative farm type, some net losses are likely to be experienced at the individual farm level. The seven farm types are too aggregated to reflect the specialization that characterizes most farms, and that can be expected to result

in gains (losses) for individual farms that specialize in commodities whose prices increase (decrease) following global reform.

Table I.10. Changes in U.S. farm household impacts from a stylized-type global agricultural policy reform (USD million)

	Program payments	Farm labour Income	Returns to farm assets	Off-farm labour income	Other non-farm income	Tax expend-iture	Total household Income
Limited resources	-9	6	9	-1	0	-1	4
Retirement	-14	46	17	-5	3	-6	41
Residential/lifestyle	-75	148	96	-21	3	-10	141
Farm occupation low sales	-161	87	179	-11	3	-10	87
Farm occupation high sales	-343	59	376	-8	0	-6	78
Large	-309	42	338	-6	0	-4	61
Very large	-341	84	338	-9	0	-4	68
All farms	-1 252	471	1,353	-58	10	-40	484

Source: ARMS, 1999 and ERS-USDA CGE model.

Within each household group, those households with higher adjustment capacity earn a greater share of the group's overall benefits. Adjustment capacity is predicted to depend on two factors: the probability of finding off-farm employment and managerial skills. The former is estimated on the basis of household characteristics such as age, education, household size, the level of off-farm investments, and spouses' off-farm employment, while the latter is proxied on the basis of the cost of production relative to the value of output. Non-commercial farm households are in general found to have superior adjustment capacity.

Summary of findings from case study analyses of household distributional effects

The within-country distributional effects of agricultural policy reforms, whether undertaken nationally or as part of a broad multilateral and multi-sector agreement, need to be seen in the context of aggregate effects described in the previous chapter on market and welfare impacts. In general terms, the redistributive effects of reforms are considerably larger than the aggregate efficiency gains, at least over the short to medium term. The intuition here is that policy reform is a reversal of interventions which distort the allocation of resources in order to redistribute money from one group and entail an efficiency loss which is smaller than the size of the policy transfer.

However, the effects are still small, at no more than a few percentage points of current welfare, even for those households most affected by reform. This result is consistent with the aggregate findings from the GTAPEM analysis and not surprising given that a large share of world non-agricultural trade is already relatively liberalised and that trade accounts for a minor share of economic activity in each country. In the

three developing countries, the direct effects of global trade reforms are further muted by the fact that many farmers operate on a subsistence or semi-subsistence basis.

The incidence of reforms on individual households will depend on the net effect of reforms in the home country and reforms undertaken by other countries. At the global level, agricultural trade liberalisation is expected to raise most world farm commodity prices relative to what they would otherwise be. Among the five country studies, there are some cases where farmers receive little or no protection and on balance stand to gain from this impact. In other instances, reduced protection at home may dominate, with farmers standing to lose from lower domestic prices. Consistent with the GTAPEM findings, the case study analyses suggests net gains from global reforms to commercial farm households in Brazil, Malawi and the United States, but net losses in Italy and Mexico. However, the net effect varies considerably by commodity and, by extension, among farm households according to their specialisation.

The impact of agricultural policies on the distribution of income in OECD countries has been explored in previous OECD studies. One element of this work examines the distribution of incomes in OECD countries and finds no evidence that farm households have systematically lower incomes than other households in society, although there is some evidence of a higher incidence of low incomes within the farm sector (OECD 1994, 2001b). Another element considers the distribution of support within the farm sector in OECD countries and finds no evidence that that support improves the distribution of income. The main reason for this is that upwards of two thirds of total assistance to producers is provided through policies that keep producers' prices above levels that would otherwise prevail. A feature of such policies is that they cannot be targeted to individual households. In the case of open-ended price support, the size of transfer is directly proportional to the level of output. This means that the majority of support that gets through to the household — itself limited by a low transfer efficiency — accrues to larger farmers, many of whom have higher incomes anyway (OECD, 1999, 2003b). For these reasons there are *a priori* reasons to believe that a reduction in support should improve the distribution of income in OECD countries.

Comprehensive information on the distribution of agricultural incomes, or the distribution of farm support, is not available for developing countries. There is widespread evidence that rural areas are, on balance, poorer than urban areas, but there is less evidence on the extent to which the incomes of farm households are higher or lower than the incomes of non-farm households within rural areas. There is also the potential for complex trade offs in developing counties. In Brazil, for instance, recent OECD analysis has confirmed that the incidence and depth of poverty is higher in rural areas, but the total number of poor people is higher in urban areas (OECD, 2005c).

Despite the difficulty of making strict comparisons between the country case studies, there are some common threads running through the results. In all cases, the biggest immediate impacts of reform tend to be on commercial producers. When domestic protection is low and prices received rise as a result of other countries' reforms, commercial farm households gain the most. Similarly they lose most when confronted with the loss of domestic protection. This result holds in both absolute terms and relative to other types of household.

The reasons that this result holds in relative, not just absolute, terms are threefold. In the first place non-commercial farm households tend to have more diversified income sources, with a greater share of income coming from non-farm activities. This tends to limit the impact of sector-specific reforms. Second, non-commercial farm households

(notably subsistence households in developing countries) tend to have significant self-consumption of farm products, which dampens or even reverses the benefits of price increases. Indeed, many poor farm households in developing countries are net consumers of commodities they produce, which means they are likely to lose from higher prices. Third, non-commercial households are likely to incur higher transaction costs than their commercial counterparts. This can further dampen the beneficial effects of price increases, and can lead to factor market impacts (such as higher land rents) dominating, as described above. In many cases, therefore, it appears that reforms that benefit commercial producers are likely to have mixed effects within the overall category of non-commercial farm households.

One caveat, emerging from the United States study, is that commercial farm households may have more or less adjustment capacity than non-commercial farm households, depending on the circumstances. For example, commercial farmers may have better access to credit and therefore be more able to respond to improved market opportunities. They may also have better management skills. On the other hand, non-commercial farmers may have less specific skills that enable them to find off-farm employment more easily and so shift labour out of (into) farm activities as prices fall (rise). In short, the adjustment capacity of different household types is context-specific and could in some cases reverse the general result that commercial farmers have more to win or lose than their non-commercial counterparts.

Across the economy, the distributional effects of reform are further complicated by what happens to the incomes of non-farm households, notably agricultural wage earners and consumers in general. These impacts are often important in developing countries, given relatively large numbers of agricultural labourers and the fact that the poorest households often spend a large share of their incomes on food (40% or more).

The impacts of reform on agricultural employees depend fundamentally on the hiring decisions of commercial farm households. In many cases, farm workers are relatively poor, even compared with non-commercial households. A rise in wages, or expansion in employment, thus mitigates the rise in inequality from commercial farm households becoming richer. These effects are important in the three developing country applications. Moreover, wage increases may also benefit semi-subsistence households to the extent that they obtain income from off-farm work.

In developing countries, food price changes can have large impacts on the real incomes of consumers. That said, consumers are less specialised in their consumption patterns than producers are specialised in their income sources, and can switch more quickly to cheaper foodstuffs than producers can adjust their supplies. Hence the effects of any particular price increase will be less acute. For net agricultural exporters with low protection, domestic consumers would be expected to lose from higher food prices. In the case of Brazil however, the agro-food industry is sufficiently important that the losses to urban households from higher food prices are on balance outweighed by higher redistributed profits and labour income originating from increased agro-food exports. In this particular study, therefore, the income gains are spread across all groups, and while inequality among agricultural producers increases, poverty declines and there is little economy-wide impact on inequality.

Analytical lessons from the case studies

For developed OECD countries, the data on incomes and the structure of support alone suggest that own agricultural reforms should typically improve the distribution of income (OECD, 1994; OECD, 1999; OECD, 2003b). This basic result is unlikely to be altered significantly by an accommodation of behavioural responses into the analytical framework, as undertaken for these case studies. On the other hand, where both own reforms and reforms in other countries are undertaken as part of a multilateral reform package, the results will depend very much on the net impact on domestic prices and on how different commodities are affected. For developing countries, the results are complex and context-specific. Where there are poor producers and consumers, there may be net changes in inequality, but it is typically impossible to ensure that no poor household is made even worse off.

Each of the case studies describes differential impacts across household types, contrasts the effects once varying degrees of adjustment are taken into account, and provides some insight into adjustment capabilities (and what constrains them). The broad approach can be applied to countries at widely different levels of development and with varying structural characteristics, depending, of course, on data availability.

A major strength of the farm household model derives from its ability to accommodate market failures, notably those that are the consequence of transactions costs. The accommodation of market failures can lead to non-standard supply responses among farm households. Thus, in the Malawi study, higher wages can ease farmers' liquidity constraints, causing them to increase agricultural output and engage in less off-farm work. Market failures can also lead to non-linear policy effects. For example, farm households that are net buyers of food may lose from a small price increase, but gain from a larger one if that enables them to become net sellers. Thus, the amount of reform matters, not just the direction. Similar results hold in the Mexico case. For example, poor farm households in some regions benefit from higher maize prices, but similar households in other regions lose as they are less integrated with output markets, yet pay higher land rents as the expansion in commercial output increases the demand for land.

The distributional impacts of reform depend significantly on factor market impacts and inter-sectoral allocations. The important insight here is that even households that are unaffected directly may nevertheless be affected significantly through second round interactions (such as wage rate and land rent changes). Again, the direction of the expected impact could even be reversed. Each of the case studies accommodates such impacts.

No model can capture all the effects of potential importance. For example, an emphasis on household level detail may make it difficult to round out the national picture with similar sophistication (the difficulty in the case of Malawi and Mexico). Conversely, with a strong emphasis on economy-wide interactions, it can be difficult to discern what makes one group behave differently from another (as in Brazil). Essentially, there are two ways around this problem. One is further model development, with each application building highly disaggregated household models within a CGE. Another complementary approach is to use these models in conjunction with other analyses that can fill in the weak spots.

The priorities for model development depend on which policy questions are most urgent. Thus the need for household level detail is paramount when the priority is to understand how farmers adjust to policy reform, and how their options are constrained by

market failures. On the other hand, the economy-wide picture is more important when the concern is with how rural households are affected compared with urban households, and how resources will be reallocated between sectors.

Even when the models include some dynamics, such as investment and productivity linkages, there are important aspects of structural adjustment that they cannot accommodate. The results therefore need to be interpreted carefully. In the Brazil study, for example, rising farm prices benefit commercial producers, who expand their output and hire more labour. But this impact needs to be considered in the context of a progressive shedding of labour from agriculture, which is outside the scope of the model. Similarly, the structural tendency for large-scale commercial operations to displace smaller family farms is not captured.

Using distributional analysis in policy design

There are several ways in which information on the distributional impacts of reform may be useful to policymakers. In the first place, policymakers need to know which constituencies are likely to lose out from reform over the short to medium term. Such information can help identify the need or otherwise for targeted policy measures that might usefully accompany the policy process. It is therefore crucial that the categorisation of households be sufficiently refined to capture the main determinants of differential impacts. Disaggregated models can also be used to compare the effects of alternative reform scenarios, and — beyond quantitative estimates — provide a useful framework for understanding the economic linkages that determine distributional impacts.

The second benefit of disaggregated information on the distributional effects of reform is that it can help in the actual design of suitably targeted policy measures. The types of measures that policymakers may wish to employ fall into two categories: adjustment policies that help households adapt to changed economic circumstances, and compensation policies that (temporarily) soften the impacts of reform.

It is important to recognise that there is a potential for conflict between adjustment and compensation policies. Indeed, with full and permanent compensation there would be no adjustment at all. Accordingly, there is a strong case for adjustment policies taking precedence, with compensation (for example in the form of safety nets) more appropriate for households without the potential to adjust. In developed OECD countries, income safety nets come into force *ex post*, *i.e.* after the impacts of reform have been realised. But in developing countries, where the resources for income support may be more difficult to mobilise, *ex ante* policies to cushion and phase in reforms may be more appropriate, making quantitative and qualitative assessments of the impacts of reform particularly useful.

The key to designing effective adjustment policies is information on the factors that constrain and facilitate household adjustment, for example in terms households' ability to substitute between agricultural products, or between farm and off-farm income. Some of the case studies in this report provide rich insights into how differences in adjustment capacity (reflected in elasticity measures) can fundamentally determine the impacts of reform. But the actual determinants of adjustment capacity are likely to be outside the model, in areas such as education, training and skills development. Other complementary forms of analysis are therefore likely to be necessary for such policies to be designed effectively.

The impacts of policy reform also depend on the extent to which households are confronted by market failures in output and input markets. To the extent that these market failures are captured in the models, the results can highlight the need for corrective policies, such as investments that lower transport and marketing costs, or improve the functioning of land and credit markets.

Finally, the impacts of reform on households depend very much on the scope and extent of those reforms. Studies such as these may help policymakers gauge the differing distributional implications of alternative reform scenarios. It is possible, for example, that farm households could lose from a reduction in agricultural protection, but that those losses could be substantially offset by reforms in other sectors. Similarly, farm households that are net buyers of food (often the case in developing countries) could lose from a small price increase, but gain from a larger one that enables them to become net sellers.

Notes

1. The number of members per household tends to decline as income increases. Hence, the tendency for richer individuals to gain more than poorer ones (in both rural and urban categories) is more pronounced than the tendency for richer households to benefit more than poorer households.

2. In the summary of the case study presented in the annex, an increase in the price of cash crops is simulated. In this section, the results are inverted to represent price reductions in order to be consistent with the other studies.

Chapter 4.

Conclusions and Policy Inferences

Trade protection and direct budgetary payments increase significantly what OECD farmers would otherwise earn from selling their output at world market prices. In both developed and developing countries (though not nearly so much) trade and domestic agricultural policy tends to favour farmers over other economic agents in society. However, the level, and even more so the degree of trade distortiveness, of farm support in OECD countries have diminished over the past fifteen years.

Likewise, while agricultural tariffs in both developed and developing countries are higher than those in industrial goods sectors, the gap has narrowed with the implementation of the Uruguay Round agreements. These developments should not reduce the priority accorded further reform efforts as the potential gains still exist for many OECD and a few non-OECD countries and are positive for the overwhelming majority of all countries and regions covered by this analysis.

Of special interest to policymakers in OECD and non-OECD countries alike is the potential harm done by OECD farm subsidies in developing countries and especially to poor farmers in developing countries. Although there is some controversy surrounding the magnitude of these effects, most economic studies find that developing countries as a group would gain in aggregate terms from reform of OECD agricultural policy. Less controversially, most studies show that developing country farmers stand to gain from such reform.

The estimated welfare benefits from global agriculture and trade policy reform obtained in this study are at the lower end of the range of such estimates obtained in similar studies, partly because the analysis is based on more recent and more precise data but also because other studies factor in benefits from policy reform that might come through, *e.g.* induced improvements in productivity or complementary reductions in transactions costs.

Results obtained here show that when grouped as one region, non-OECD countries do gain overall from the hypothetical halving of OECD farm support – but not nearly so much as OECD countries themselves gain from such reform. Likewise, agricultural value added for the non-OECD region increases. These gains are concentrated in a comparatively small number of middle-income agricultural exporting countries. In fact, findings show much larger potential gains for developing countries from reduction in the trade protection that OECD countries afford their producers of textiles and other industrial products than from reduction in OECD agricultural support.

Welfare gains from agricultural trade and domestic policy reform are dominated by the effects of tariff cuts (assuming all related instruments in the same policy bundle would be cut at the same time). Results show relatively little net welfare gain from reducing other forms of support, especially those types of support such as land based budgetary payments whose main effects are to boost the rental prices of land. Such findings suggest that a package of reforms that emphasizes first of all cuts in trade

measures might yield a substantial share of potential reductions in trade distortions while minimizing negative impacts on farm returns in countries implementing the reforms. Indeed, the findings point to possibilities for achieving a high proportion of the economic benefits from reform by shifting the policy mix from more to less distorting forms of support.

Policy reform would lead to increases in agriculture value added and incomes of commercial farm households in relatively less protected OECD and non-OECD countries but falls in countries whose farmers now benefit from relatively high support levels. Policy implications emerging from these findings must however be carefully considered. In some cases, the fact that farm sector incomes decline with reforms may not be a cause for policy concern. This would be true, for example, when the affected households are able to adjust to farm income losses with offsetting income gains induced by non-agricultural policy reforms. Another potentially important policy consideration in this context relates to the fact that some of those who lose because returns to land fall with reform may not farm at all. In other cases, pressures on farm incomes may be only a transitory policy issue if economic growth is stimulated by trade and domestic policy reforms.

The case study findings provide some insights into the effects of the policy reform on poverty and the inequality of income distribution. In general, the welfare gains are widespread across household types, while welfare losses tend to fall more heavily on protected commercial farmers. In the Brazil case, poorer categories of both urban and rural household are better off with reforms, and the incidence of absolute poverty falls. Inequality among agricultural producer households increases, with larger (and richer) family farm households gaining more than smaller ones. At the same time, the total gains to agricultural employees that come with increased demand for farm labour from commercial farm households are more than for any other type of agricultural household, counteracting the increase in inequality among agricultural producers.

Within any given population of farm households there will be winners and losers depending on their output and factor mix and their off-farm earning possibilities. Indeed, even where policy responses may be justified, as for example in the design of appropriate compensation or adjustment policy for those negatively affected, the policy answer may fall outside the domain of agricultural policy being more properly within the domain of broader social and development policy. Measures to improve adjustment capacity include public investments in area such as education and training, research and extension and health (notably in poor countries). Such policies may be targeted regionally, or at the household level.

In both developed and developing countries, the immediate effects of reforms on commercial farmers tend to be greater than the incidence on non-commercial farm households. If a commodity sector stands to gain on aggregate from multilateral reform, say due to higher export prices, then commercial producers in that sector will reap the majority of those gains. Similarly, if the sector stands to lose, because lower domestic protection is not sufficiently offset by higher world prices, then commercial farmers will incur the majority of those losses. This observation typically holds not just in absolute terms, but also relative to existing income. Non-commercial farms tend to have higher off-farm income, which dampens the effect of price changes on total income, and in developing countries they also consume a significant share of what they produce, which has a similar effect. In some cases, non-commercial (subsistence) producers may consume more than they produce, in which case the incidence of reform is reversed. One caveat is that non-commercial farm households in richer countries may have more

flexible skills which enable them to transfer labour into and out of agricultural production more easily.

The ultimate impacts of reforms will depend not just on their immediate incidence, but on what happens once markets and households have had time to adjust. Such adjustments can fundamentally alter the distributional impacts of reform. For example, non-commercial households are likely to face higher transactions costs than commercial households. If transactions costs restrict non-commercial households from engaging with markets, they may not benefit at all from commodity price increases. They may still benefit indirectly from higher off-farm wages, as commercial producers hire more labour, but they could also lose from higher land rents. In both the Malawi and Mexico studies there are winners and losers within the category of non-commercial (and in both cases poor) farm households. On balance, transactions costs tend to reinforce the tendency for commercial households to benefit most from price increases and lose most from price declines. Policies aimed at reducing transactions costs, especially those facing poorer households, are possibly a highly cost-effective means of ensuring the widest possible distribution of benefits from policy reform for developing countries.

The case studies demonstrate the inherent difficulty of achieving aggregate efficiency gains without making some households worse off in terms of the immediate effect of policy change, though adjustment and compensation policies can change that outcome significantly. In OECD countries with high support, uncompensated reforms will inevitably reduce the incomes of protected farm households. In many developing countries, it is probably impossible to change price policies and accompanying border measures without making some poor households even poorer.

Households that have greater adjustment flexibility are in a better position to exploit new market opportunities, or to cushion the effects of exposure to increased competition. In the United States, non-commercial — residential and lifestyle — farms tend to be more flexible in varying their proportions of farm and off-farm income, and in changing their production levels. However, such insights may not generalise across countries, and adjustment flexibility is in any case likely to vary considerably within structurally similar farm household groups, on the basis of factors such as age, education, management skills and health. In short, it is very difficult to provide comprehensive yet precise information on what reform implies for the incomes of specific households once individual adjustments, with collective implications for markets, are accounted for.

Moreover, it is unlikely that all households will have the potential to adjust, or to respond effectively to adjustment assistance. For these households, there is a need for effective safety nets. In designing such programmes, there is a need to establish criteria of eligibility, and a registry system which enables all households to establish whether or not they qualify. Insofar as these models, and their accompanying datasets, have relevant socio-economic information, they can assist in the design and specification of criteria of eligibility.

Applications such as these case studies can be helpful in identifying the pressure points of reform, the varying capacities of households for adjustment, and the need or otherwise for supporting policy measures. They also provide valuable information on the effects of changes in the policy mix. For example, if agricultural protection is to be significantly reduced, the adjustment stresses to farm households may be reduced significantly by ensuring that non-agricultural reforms proceed concurrently. More hopefully, if the distributional impacts of reform are made clear to all interests; it may be easier to build political support for those reforms.

Annex I.1

Overview of the GTAPEM Model

GTAPEM is a version of the basic GTAP model most of whose equations, parameters and base data are identical to those in the parent model. GTAP includes equations representing demand for goods for: final consumption, intermediate use and government consumption; demands for factor inputs, supplies of factors and goods, and international trade in goods and services. In the model, a representative regional household allocates regional income across three categories of final demand: private consumption, government expenditure, and savings. Private consumption is represented using a Constant Difference of Elasticities (CDE) functional form.

The two global sectors in GTAP are transportation and banking. The transportation sector accounts for international trade and transport activity. The banking sector allocates investment across regions to equate expected rates of return. This ensures that in equilibrium, global savings equal global investment. Taxes are included in the model at several levels. Production taxes are placed on intermediate inputs, primary inputs, or on output. Some trade taxes are modelled at the border. Additional internal taxes can be placed on domestic or imported intermediate inputs, and may be applied at differential rates that discriminate against imports. Trade policy instruments are represented as import or export taxes/subsidies. Welfare changes in the model are measured using the concept of equivalent variation.

The macro-economic closure of the model specifies savings-driven investment at the regional level, and global savings are allocated to individual regions to equalize expected rates of return to capital. Consequently, the model allows for regional trade balances to adjust. The numeraire of the model is global average price of primary production factors. GTAP, like most CGE models, utilizes a number of important structural assumptions. These assumptions and the associated limitations should be kept in mind when interpreting the simulation results obtained. Key assumptions include:

- the economy operates under constant returns to scale and perfect competition;
- all actors are rational, with consistent preferences, and producers choose factor and output combinations in order to maximize profits;
- all factors, including labour are assumed fully employed in the economy and resources are always used in the most competitive sector; and
- there are no transactions costs or costs related to information gathering.

Although the great majority of equations and parameters used in GTAPEM are taken directly from the standard GTAP model, some changes were made to improve the representation of factor substitution and land supply. These changes are discussed below.

More comprehensive reporting of model parameters, base data and simulation results can be found at the website www.oecd.org/agr/reform/gtapem.

... Elasticities of factor substitution and transformation

The elasticity of substitution determines the conditional price responsiveness of the nested Constant Elasticity of Substitution (CES) production functions. Specifically, the elasticity of substitution for value added, determines the ability of the economy to alter its output mix in response to changes in relative commodity prices. GTAP substitution elasticities are adopted from an extensive review of the literature and original empirical work undertaken for the SALTER Project (Jomini *et al.* 1991). The elasticities are partially commodity-specific. Agriculture has a different value than other sectors, but individual agricultural commodities have the same value (Table A.I.1.1).

The substitution elasticities reported in Table A.I.1.1 and all subsequent tables are the so-called Allen elasticities of substitution — the ones usually estimated in econometric analyses of production relationships and reported in the literature. (Abler) In standard GTAP these parameters are region-generic. Moreover, standard GTAP imposes the restriction of non-substitution between primary factors and intermediates — an assumption that is revealed in the zero values reported in the last two columns of Table A.I.1.1.

Table A.I.1.1. Standard GTAP elasticities of factor substitution

	Among Primary Inputs	Between Primary and Purchased inputs	Among* Purchased inputs
Primary Agriculture	0.23	0.00	0.00
Processed Agriculture	1.12	0.00	0.00
Other Food	1.11	0.00	0.00
Manufactures	1.14	0.00	0.00
Textiles, Wearing Apparel	1.26	0.00	0.00
Services	1.38	0.00	0.00
Capital Goods	1.00	0.00	0.00

* Implicitly zero in GTAP.

The elasticity of substitution plays an important role in determining sectoral supply response, particularly in the presence of sector-specific factors of production, such as land for agriculture. Moreover, because standard GTAP uses region-generic elasticities, important country differences may not be fully captured. This is why this study has adopted an alternative set of elasticities that recognizes country specific elasticities of substitution based on PEM elasticities for OECD countries (Table A.I.1.2). Note that the GTAPEM specification introduces substitutability between primary and purchased inputs, and among purchased intermediates.

Table A.I.1.2. GTAPEM elasticities of factor substitution for OECD countries

	Australia and New Zealand	Canada	European Union	Japan	Mexico	Turkey	United States	Rest of OECD
Among Value Added Inputs								
Primary Agriculture*	0.40	0.10	0.40	0.30	0.50	0.40	0.30	0.40
Processed Agriculture	←	←	←	1.12	→	→	→	
Other Food	←	←	←	1.11	→	→	→	
Manufactures	←	←	←	1.14	→	→	→	
Textiles, Wearing Apparel	←	←	←	1.26	→	→	→	
Services	←	←	←	1.38	→	→	→	
Capital Goods	←	←	←	1.00	→	→	→	
Between Primary and Purchased								
Primary Agriculture*	0.90	0.90	0.90	0.40	0.50	0.90	0.80	0.90
Processed Agriculture	←	←	←	0.00	→	→	→	
Other Food	←	←	←	0.00	→	→	→	
Manufactures	←	←	←	0.00	→	→	→	
Textiles, Wearing Apparel	←	←	←	0.00	→	→	→	
Services	←	←	←	0.00	→	→	→	
Capital Goods	←	←	←	0.00	→	→	→	
Among Purchased								
Primary Agriculture*	0.50	0.10	0.50	0.30	0.15	0.50	0.15	0.50
Processed Agriculture	←	←	←	0.00	→	→	→	
Other Food	←	←	←	0.00	→	→	→	
Manufactures	←	←	←	0.00	→	→	→	
Textiles, Wearing Apparel	←	←	←	0.00	→	→	→	
Services	←	←	←	0.00	→	→	→	
Capital Goods	←	←	←	0.00	→	→	→	

*Same value for all primary agriculture commodities.

Table A.I.1.3. GTAPEM elasticities of transformation between agriculture and non-agriculture primary factors

	Australia and New Zealand	Canada	Europe an Union	Japan	Mexico	Turkey	United States	Rest of OECD
Skilled labour	-0.50	-0.40	-0.50	-0.50	-0.60	-0.50	-0.40	-0.50
Unskilled labour	-0.50	-0.40	-0.50	-0.50	-0.60	-0.50	-0.40	-0.50
Capital	-0.50	-0.40	-0.50	-0.50	-0.60	-0.50	-0.40	-0.50

The second type of factor elasticities whose values are different in GTAPEM as compared to the standard GTAP are those gauging primary factor specificity. For each region, the model distinguishes between primary factors that are perfectly mobile across production sectors (labour and capital) and factors that are sluggish (land). These elasticities determine how much of a disparity in relative sector returns can be sustained over the simulation period. (For most CGE models, the simulation period is considered to be medium term, or about five years.)

This study has adopted a specification that distinguishes agricultural specific labour and capital from their non-agriculture counterparts. That is, capital and labour are imperfectly mobile between agriculture and non-agricultural uses. This was judged to be particularly important for analysing the situation in developing countries, where capital and labour markets may not be as efficient as those in developed countries. Mobility is determined by a constant elasticity of transformation function.

... Land supply in GTAPEM

The representation of land supply in GTAPEM is based on the way land is modelled in the OECD's PEM model. (OECD, 2001a) PEM distinguishes different types of land in a nested 3-level constant elasticity of transformation (CET) structure. The difference between the representation of land allocation in GTAPEM and that in GTAP can be seen in Figure A.I.1.1, where the GTAP structure is on the left and GTAPEM is on the right.

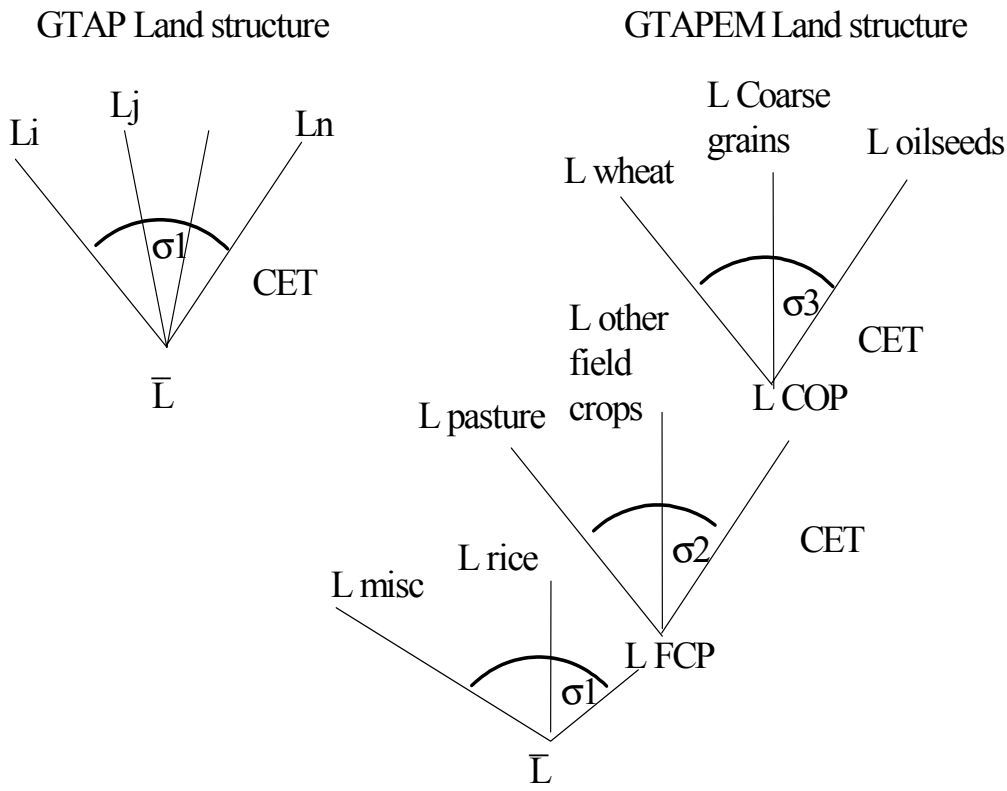
The lower nest of the GTAPEM structure assumes a constant elasticity of transformation between: "Miscellaneous agricultural land" (vegetables, orchards, etc.), "Rice" and the group "Field crops and pastures" (FCP). The transformation is governed by the elasticity of transformation σ_1. The FCP group is itself a CET aggregate of: Pastureland, the sub-group "Cereal, Oilseed and Protein cropland" (COP) and other field crops that. Here the elasticity of transformation is σ_2. Finally, the transformation of land within the upper nest — the COP group, is modelled with an elasticity σ_3.

In this way, the degree of substitutability of types of land can be varied between the nests. It captures to some extent differences in suitability of different land types for different commodities due to agronomic features. In general, it is assumed that $\sigma_3 > \sigma_2 > \sigma_1$. This means that it is relatively easier to change the allocation of land within the cereal, oilseed and protein group, while it is more difficult to move land out of this group into a lower nest, such as into vegetables.

The transformation parameters in GTAPEM have been calibrated to land supply elasticities used in the PEM model. The procedure for doing so exploits the fact that the elasticity of supply for land can be written as a function of the transformation parameter

in each nest and the share of land for each use. As land use shares are known constants, this leaves the choice of the three CET parameters as the determinant of the matrix of own and cross-price elasticity for land.

Figure A.I.1.1. Land Allocation Tree for Standard GTAP and in GTAPEM



For rice land, a member of nest 1 (the highest), its own-price elasticity is

$$\varepsilon_{rr} = \sigma_1 \cdot (1 - sr_r),$$

where sr_r represents the share of rice in all land. As this is the highest level CET function, this equation is the same as for any single CET function; the own elasticity is equal to the transformation parameter times one minus the share. The cross-price elasticity is defined as

$$\varepsilon_{rw} = -\sigma_1 \cdot sr_w,$$

the negative of share of wheat land times the transformation parameter for nest 1.

For wheat land, a member of nest 3 (the lowest), its own price elasticity is

$$\varepsilon_{ww} = \sigma_3 \cdot \left(1 - \frac{sr_w}{sr_{n3}}\right) + \frac{sr_w}{sr_{n3}} \cdot \sigma_2 \cdot \left(1 - \frac{sr_{n3}}{sr_{n2}}\right) + \frac{sr_w}{sr_{n2}} \cdot \sigma_1 \cdot (1 - sr_{n2}),$$

where sr_w is the share of wheat in all land, sr_{n3} is the share of the lowest nest in all land, and sr_{n2} is the share of the second nest in all land. The ratio sr_w/sr_{n3} is therefore the share of wheat in nest 3. This can be seen as an extension of the result for a single CET function, where to the single function formula is added a share of the impact of all the higher nests. That is, a change in the price of wheat will bring an adjustment of land for wheat within not only its nest, but between nests as well.

The cross-price elasticities for wheat, with respect to price of coarse grains (same nest), price of pasture (prior nest), and rice (top nest) are as follows

$$\varepsilon_{wc} = -\sigma_3 \cdot \frac{sr_c}{sr_{n3}} + \frac{sr_c}{sr_{n3}} \cdot \sigma_2 \cdot \left(1 - \frac{sr_{n3}}{sr_{n2}}\right) + \frac{sr_c}{sr_{n2}} \cdot \sigma_1 \cdot (1 - sr_{n2}),$$

$$\varepsilon_{wp} = -\sigma_2 \cdot \frac{sr_p}{sr_{n2}} + \frac{sr_p}{sr_{n2}} \cdot \sigma_1 \cdot (1 - sr_{n2}),$$

$$\varepsilon_{wr} = -\sigma_1 \cdot (1 - sr_r).$$

Table A.I.1.4 contains the estimated elasticities of transformation obtained following this procedure. The full matrices of own and cross-elasticities of land supply for all OECD countries identified individually in GTAPEM can be found among the tables presented at www.oecd.org/agr/reform/gtapem.

Table A.I.1.4. GTAPEM elasticities of transformation among land categories in OECD countries

	Australia and New Zealand	Canada	European Union	Japan	Mexico	Turkey	US	Rest of OECD
σ1 = Arable vs. Other Land	0.05	0.05	0.05	0.05	0.10	0.05	0.10	0.05
σ2 = Pasture vs. Crops	0.17	0.14	0.21	0.11	0.11	0.15	0.15	0.21
σ3 = Within Crops	0.59	0.58	0.23	0.20	0.59	0.35	0.55	0.23

PART. II

CASE STUDY SUMMARIES OF HOUSEHOLD LEVEL IMPACTS

Chapter 5.

Brazil

Scope and objectives

Concern over the distributional impacts of agricultural and trade policy reforms in Brazil stems from a number of factors. In the first place, Brazil has a large and diversified agriculture with a commercial export-oriented sector co-existing with an underdeveloped family farm sector. The latter is relatively more specialised in import-competing products. This dual structure raises questions about the extent to which these two constituencies will be affected by reforms, and the resulting implications for poverty and inequality. Brazil is also a highly urbanised country, with large numbers of poor consumers whose real incomes are dependent on the price of food. Hence, there are concerns about the impacts of agricultural reforms on urban as well as rural households. This study uses a Social Accounting Matrix (SAM) and a related CGE model to address such questions. In general terms it examines the link between commodity specific reforms at the national and multilateral level and income distribution in a large and structurally diverse economy. The study aims to produce results of policy relevance to Brazil, and to suggest some wider lessons in terms of the construction of such applications.

The SAM for Brazil contains a large amount of agricultural sector detail and a disaggregation of household types across both agricultural and non-agricultural occupations. It was developed specifically for this study by a research team at the University of São Paulo (USP) (Azzoni *et al*., 2004). This SAM underpins a CGE, by identifying the agents in the economy and providing the database through which the model is calibrated. The CGE follows a standard structure proposed by McDonald (2005).

The SAM contains a rich amount of information on how households earn and spend their money. This provides intuition on the likely effects of commodity-specific reforms. The CGE is used to simulate the net effects on households from multilateral trade and agricultural policy reforms once behavioural responses, including changes in output supply and consumer demand, are factored in.

Overview of the SAM

The key attribute of the SAM developed here is its rich sectoral and household level detail. There are 30 activities, of which 9 are in primary agriculture and 15 in agribusiness, and 40 products, of which 17 are agricultural and 19 of the remaining 23 are agribusiness or strongly agriculture related. There are 10 household accounts, comprising four categories of family farm household, ordered by economic size; one category of commercial farm households; one category of wage-earning agricultural employees; and four categories of urban household, ordered by income quartile. In addition, factor payments (land, labour and capital) are identified for each household according to the activities from which they derive. With government, trade and tax accounts, the end result is a large matrix (183 × 183). All totals match the national income accounts of 1999.

In order to provide this level of detail and complete the economy-wide picture, several datasets had to be combined. In particular, information on the income sources and expenditure patterns of the different household types had to be compiled from a variety of sources — a major challenge that is discussed in the USP background report.

The absence of a single source of information on incomes and expenditures means that it is not possible to identify unique observations on incomes and expenditures for each individual household within the ten aggregations. This rules out micro-simulation analysis and, even more significantly, the construction of nationally representative farm household models which can accommodate different behavioural responses across household types.

A key decision concerned the appropriate choice of household groupings. For agricultural households, we followed the stratification of a 2000 FAO/INCRA study (based on agricultural census data). The reasons for following this breakdown were twofold: first, the focus on smaller (and relatively poor) households suited the focus of this study; and second, this breakdown facilitated the combining of data from multiple sources on the basis of common information.

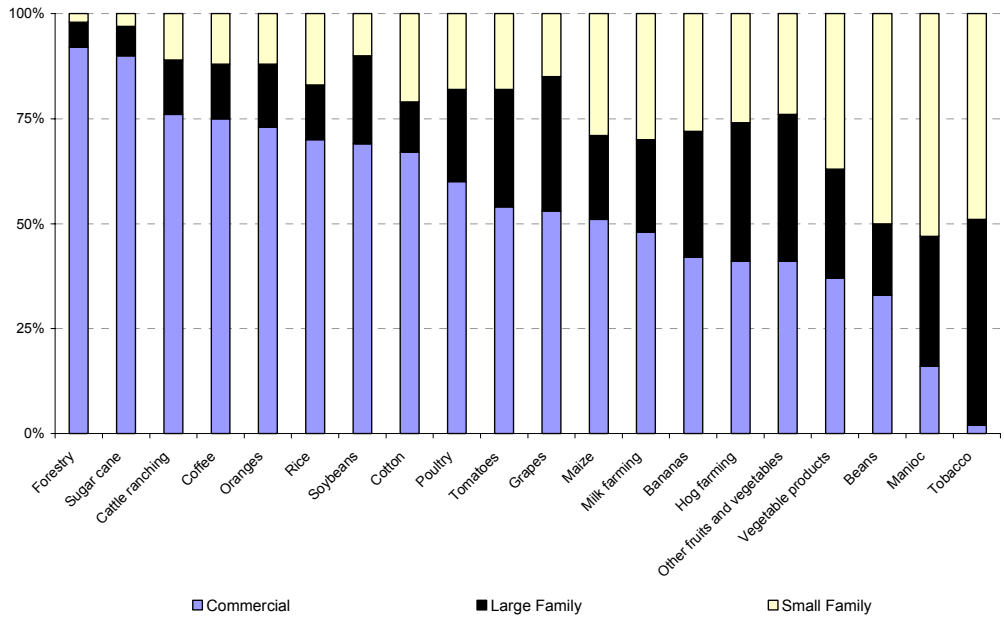
The SAM contains a large amount of structural information on the Brazilian economy. Those elements that help interpret the results from the subsequent modelling exercise are presented below. For a full discussion of the data in the SAM, readers are referred to the consultants' report. It is also possible to obtain the SAM from the OECD website.

Structural information from the SAM

A limited number of products dominate agricultural exports. These are, in order of importance, coffee (USD 2.1 billion), sugar (USD 1.6 billion), soybean oil and soybeans. Collectively, the soybean complex is most important (USD 3.4 billion). Other exports, notably poultry, beef and oranges, are considerably less important (less than USD 1 billion). On the import side, the values are much smaller, with wheat dominating (just under USD 1 billion), followed by dairy products and other foods.

In terms of the value of production, the most important sectors are cattle ranching (USD 7.1 billion), soybeans, coffee, sugar cane, milk, poultry, corn, hogs and rice. Commercial farms dominate every product category, but especially the most important to production and exports (Figure II.1). However, family farm production is important in several sectors, including poultry, milk, maize, hogs and manioc. Moreover, it is important to recognise that some family farms obtain a substantial share of their income from activities that are, in aggregate terms, dominated by commercial farms. Higher prices for products that are important to (lower income) family farmers — notably dairy products, hogs, and staples such as beans and manioc — will have a much bigger direct impact on the incomes of those households than higher prices for products such as soybeans, sugar or cattle.

Figure II.1. The composition of production value, by farm type



Source: USP SAM.

From the standpoint of distributional analysis, what matters most is how different households are affected by changes to these sectors, in terms of the resulting impacts on their income and expenditure decisions. The existing pattern of incomes and expenditures is summarised in Table II.1.

On the expenditure side, most food products account for a progressively smaller share of budgets as incomes increase. Nevertheless, food accounts for more than 40% of expenditures of the two poorest categories of farm household, and for at least 40% of the expenditures of half the urban population. This underlines the importance of examining the consumption side, and of accounting for urban as well as rural households.

In terms of total income, the poorest quartile of the urban population has an average income between that of the poorest and second poorest family farm group. However, this group accounts for 19% of the total population, compared with 9% of the population for the two poorest categories of farm households. Thus urban impacts of agricultural policy reform may be widespread across poor households, even though the impacts may be less acute than for poor farmers.

Table II.1. Income and expenditure patterns by household type

	Number of persons (1 000)	Average Income BR / month	% of income from:			% of expenditure on:		
			Raw agricultural products	Processed food products	Other activities	Raw agricultural products	Proces-sed food products	Other activities
Family Agriculture 1	10 443	38.4	45.4	1.3	53.2	20.7	44.0	35.2
Family Agriculture 2	4 686	86.9	48.1	1.8	50.1	18.0	41.5	40.5
Family Agriculture 3	6 002	159.6	63.0	1.3	35.7	15.1	37.0	47.9
Family Agriculture 4	2 883	438.5	65.4	0.7	33.9	6.0	17.7	76.2
Commercial Farms	2 882	489.3	100.0			8.2	17.9	73.9
Agricultural Employees	10 927	118.2	100.0			9.6	32.3	58.1
Urban Household 1	32 232	62.7		3.5	96.5	9.6	29.7	60.7
Urban Household 2	32 231	151.7		4.6	95.4	6.7	23.9	69.4
Urban Household 3	32 233	284.3		4.6	95.4	5.3	17.7	77.0
Urban Household 4	32 234	1 021.0		3.4	96.6	2.7	8.5	88.8
All Households	166 753	328.1	7.9	3.4	88.6	4.8	15.1	80.1

Table II.2. Relationships for the Computable General Equilibrium Model

	Commo-dities	Activities	Factors	Households	Enterprises	Government	Capital	RoW	Total	Prices
Commodities	0	Leontief Input-Output Coefficients	0	Utility Functions (Stone-Geary or CD)	Fixed in Real Terms	Fixed in Real Terms and Export Taxes	Fixed Shares of Savings	Commodity Exports (CET)	Commodity Demand	Consumer Commodity Price Prices for Exports
Activities	Domestic Production	0	0	0	0	0	0	0	Constant Elasticity of Substitution Production Functions	
Factors	0	Factor Demands (CES)	0	0	0	0	0	Factor Income from RoW	Factor Income	
Households	0	0	Fixed Shares of Factor Income	Fixed (Real) Transfers	Fixed (Real) Transfers	Fixed (Real) Transfers	0	Remittances	Household Income	
Enterprises	0	0	Fixed Shares of Factor Income	0	0	Fixed (Real) Transfers	0	Transfers	Enterprise Income	
Government	Tariff Revenue	Indirect Taxes on Activities	Fixed Shares of Factor Income	Direct Taxes on Household Income	Direct Taxes on Enterprise Income	0	0	Transfers	Government Income	
Capital	0	0	Depreciation	Household Savings	Enterprise Savings	Government Savings (Residual)	0	Current Account 'Deficit'	Total Savings	
Rest of world	Commodity Imports	0	Fixed Shares of Factor Income	0	0	0	0	0	Total 'Expenditure' Abroad	
Total	Commodity Supply (Armington)	Activity Input	Factor Expenditure	Household Expenditure	Enterprise Expenditure	Government Expenditure	Total Investment	Total 'Income' from Abroad		
	Producer Commodity Prices Domestic and World Prices for Imports	Value Added Prices								

Overview of the SAM-based CGE

The structure of the SAM-based CGE model is described in the Annex to Part I. The behavioural relationships and identities are summarised in Table II.2, which is presented in the structure of the SAM.

Policy experiments and model closure

The policy experiment takes the changes in Brazil's export and import prices that GTAPEM predicts would result from a 50% cut in all import tariffs, a 50% cut in agricultural export subsidies and a 50% reduction in agricultural budgetary payments in OECD countries. Hence, this study thus adopts the same scenario as that used to describe the aggregate market and welfare impacts of reform at the global level.

Since the commodity breakdown in the GTAPEM model and that in the Brazil SAM are not identical it was necessary to determine a mapping between them. First, each commodity account in the Brazil SAM was allocated to a commodity in the GTAPEM model. Second, the percentage changes in the export and import prices by commodity for Brazil produced by the GTAPEM model were imposed for the respective accounts in the Brazil SAM. In addition simulations were run with different degrees of (unilateral) trade liberalisation by Brazil — 25, 50, 75 and 100% reductions in Brazil's import duties and export taxes. Given that the imposed price changes are net of trade taxes, the scenario which is compatible with the GTAPEM results is the one in which Brazil also liberalises by 50%.

The selection of model closure rules was driven by the closure rules adopted in the GTAPEM simulations; namely a long run full employment scenario. Hence the basic closure rules used were the following.

Full employment of all factor types, including labour, with all factors fully mobile. In essence, this is a best case scenario since it allows the maximum adjustment of the economy to the new set of world prices subject only to the constraints imposed by the assumption of full employment.

To mirror the treatment of the demand by domestic agents for commodities used in GTAP a balanced macroeconomic closure was imposed — this fixes the (value) shares of final demand by government and investment.

All tax rates were treated as being exogenously determined and the deficit/surplus on the government budget — the internal balance — was allowed to vary to clear the government account. Note that the value of government consumption expenditure is determined by the balanced macroeconomic closure.

Savings rates by households and enterprises are flexible so that the total value of savings is equal to the value of investment. Note that the value of investment expenditure is determined by the balanced macroeconomic closure.

Brazil was assumed to be a small country, *i.e.* all import and export prices were fixed. Although Brazil may have market power in some commodities, especially coffee, the assumption of downward sloping export demand curve, which the model allows, is not appropriate since the GTAPEM model will have factored Brazil's market power into its simulations.

The model numéraire is the consumer price index.

Two of these closure rules are potentially critical — full employment and fixed tax rates — and hence simulations were run to assess the sensitivity of the results to these closure rules. Specifically

Fiscal neutrality was imposed by fixing the government budget deficit/surplus, allowing proportionate changes in the household income tax rates and maintaining the government's share of final demand expenditure.[1]

The presence of unemployed unskilled labour was accommodated by assuming that an infinitely elastic supply of unskilled labour was available at the prevailing wage rate. This means that for the unskilled labour categories the labour market adjustments take place through the volumes of employment, while for skilled labour and other factors the adjustments take place through changes in wage rates and factor returns.

Consequently 20 simulations were run — a base case plus 4 price shocks for each of 4 different sets of closure rules. These are summarised in Table II.3 below. Sim02 / cllr is the combination that is consistent with the aggregate GTAPEM analysis, and for which the results are reported below.

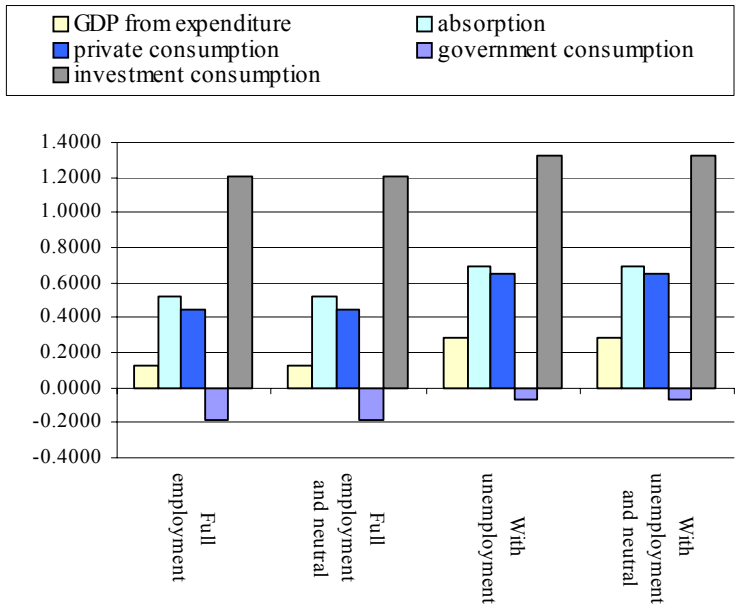
Table II.3. Model Simulations

Shocks		Closure Rules	
Name	**Description**	**Name**	**Description**
sim00	baseline for comparisons	cllr	Long run full employment
sim01	Global liberalisation with 25% cut in Brazil's trade barriers	cllr_fisn	Long run full employment with fiscal neutrality
sim02	Global liberalisation with 50% cut in Brazil's trade barriers	cllr_unemp	Long run with unemployment
sim03	Global liberalisation with 75% cut in Brazil's trade barriers	cllr_un_fisn	Long run with unemployment with fiscal neutrality
sim04	Global liberalisation with 100% cut in Brazil's trade barriers		

Model results

The real macroeconomic implications of global trade liberalisation are relatively minor: GDP rises by about 0.12% under the full employment assumption and by about 0.28% under the assumption of unemployed unskilled labour (Figure II.2). The increase in private consumption is appreciably higher, at between 0.5% and 0.7%, while there is a substantial increase in real investment, of around 1.2%, and a slight decline in real government demand. The increase in real investment is probably the most important result, since it implies that the potential 'dynamic' effects of trade liberalisation may be greater. The imposition of fiscal neutrality makes little difference. These results, although small, are not inconsistent with the magnitudes of those found for many studies of trade liberalisation. However, these macroeconomic results are likely to mask substantial variations in the price changes for different commodities following liberalisation, and hence in distributional impacts.

Figure II.2. Percentage Changes in Major Real Macroeconomic Variables[1]



1. All real values are computed at base period prices
Source: Simulation results.

The aggregate welfare impacts also vary significantly according to the closure rule. In particular, the estimated welfare gains increase from USD 1.5 billion with full employment to USD 2.2 billion under the more realistic assumption of unemployed unskilled labour. These impacts are ultimately distributed across households, via changes in factor returns. Figure II.3 shows the changes in welfare for each household group under alternative closure rules. The following patterns are evident.

- In general, the welfare gains are widespread across household types. With the poorer categories of urban and rural household better off, the incidence of poverty falls.
- Inequality among agricultural producer households increases, with larger (and richer) family farm households gaining more than smaller ones.
- At the same time, the total gains to agricultural employees are more than for any other type of agricultural household. Because this group is relatively poor, this counteracts the increase in inequality among agricultural producers.
- Urban households also gain, and their benefits generally increase with income level. The exception is the richest quartile, whose gains are less than those of the second richest group, and in fact loses when there is full employment (because they end up paying more for goods that use unskilled labour).
- The burden of fiscal neutrality is borne disproportionately by the third urban quartile. This reflects a relatively flat income tax structure for the richest 50% of urban households and greater cost of living increases for the second richest group.
- As a result of these welfare changes, there is expected to be little overall impact on income inequality.

Figure II.3. Equivalent Variation in Household Welfare (USD million)

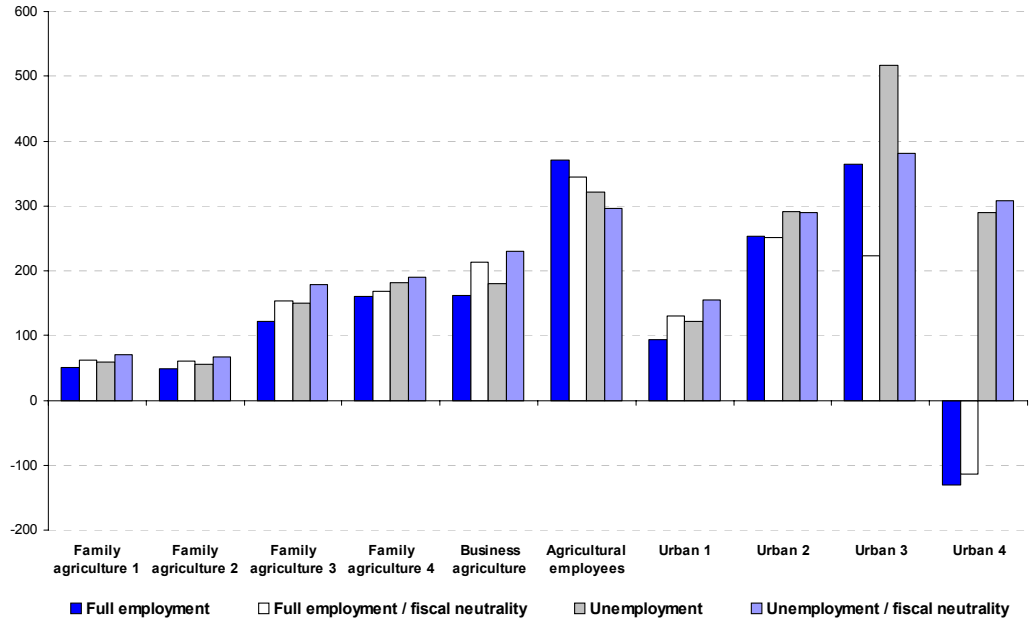
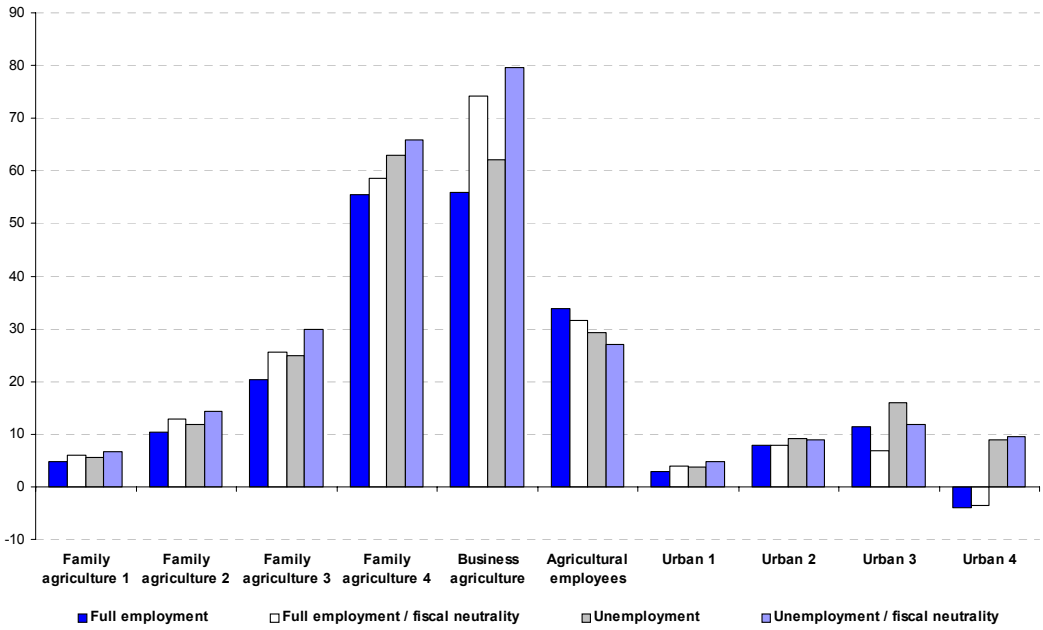


Figure II.4. Annual Changes in Welfare per Person (USD)



Source: Simulation results.

Given that the categories contain different numbers of households and persons, further insight can be obtained from the annual changes in welfare per person that are reported in Figure II.4 above. These estimates confirm that, for agricultural households, the welfare gains increase with income, and that the benefits to agricultural households are generally greater than for urban households.[2]

In order to understand the origins of these welfare gains, it is helpful to examine the underlying changes in factor incomes (which reflect supply responses to changing output prices) and expenditures (resulting from changes in purchaser prices and consumption patterns).

With regard to factor incomes, it is clear that agricultural labour and capital gain proportionally more than non-agricultural labour and capital (Table II.4). At the same time, there is a less pronounced tendency for labour and capital income in both agricultural and non-agricultural sectors to increase with the household's income level.[3] Overall, the reallocation of factor income between agricultural and non-agricultural sectors exceeds the reallocation within each sector.

The changes in household income are shown in annex Table 5.B1. The reason that richer agricultural households gain more in both relative and absolute terms from increases in land and capital income is that production (and exports) expand more rapidly for those products produced by richer farm households. However, they also gain more from increases in labour income, because the activities that expand most following liberalisation are those using skilled labour.

For urban households the proportionate changes in household income are much more even, with the only outlier being the highest income group. The primary reason for this is the relatively high proportion (15%) of this household's income that comes from transfers by the government. However, this is also a very large household group that is likely to contain substantial heterogeneity and consequently the within group variations are likely to be considerable.

Factor income changes provide only a partial explanation for the observed welfare effects. The other element comes from the expenditure patterns of households (annex Table 5.B2) and the changes in purchaser prices (annex Table 5.B3) and. In the main, agricultural prices rise, with the notable exceptions of rice, wheat, soybeans and milk.[4] Processed food prices show mixed effects, while the prices of manufactures and services decline. With lower income households spending relatively more on agricultural products than richer households, and agricultural households similarly spending more than urban households (independent of income), this dampens the overall tendency for welfare to increase more for agricultural households, and to increase with income.

The expansion of exports (annex Table 5.B4) is greater in percentage terms for agricultural commodities, although the absolute change in volumes from manufactures and services dominate. On the import side, the proportionate changes in volumes are more dispersed (annex Table 5.B5), although again the absolute changes for manufacturing and services are largest. The combined effects of these changes are incentives to reallocate factors to agricultural activities (annex Table 5.B6). The returns to factors employed in agriculture rise by around 3-4%, while for other activities returns increase by slightly over 1%.

Table II.4. Baseline Factor Incomes (USD million) and Changes in Factor Incomes (%)

	Baseline	Full employment	Full employment and neutral	With unemployment	With unemployment and neutral
Capital					
Agriculture family 1	911	3.67	3.71	3.74	3.64
Agriculture family 2	866	3.66	3.67	3.69	3.64
Agriculture family 3	2 579	3.84	3.88	3.90	3.82
Agriculture family 4	4 019	4.33	4.47	4.49	4.31
Business agriculture	8 925	4.76	4.95	4.97	4.74
Urban 1	8 114	1.05	1.30	1.30	1.05
Urban 2	17 125	0.96	1.19	1.19	0.96
Urban 3	31 277	0.93	1.16	1.16	0.93
Urban 4	18 249	0.96	1.20	1.20	0.96
Labour					
Agriculture family 1	2 254	1.57	1.47	1.47	1.58
Agriculture family 2	1 946	1.63	1.49	1.49	1.63
Agriculture family 3	3 539	1.93	2.17	2.17	1.93
Agriculture family 4	5 173	2.16	2.43	2.43	2.16
Agriculture employees	9 351	4.44	3.69	3.70	4.42
Urban 1	9 248	1.25	1.23	1.22	1.26
Urban 2	23 286	1.28	1.24	1.24	1.29
Urban 3	43 938	1.30	1.57	1.57	1.30
Urban 4	11 292	1.23	1.50	1.50	1.23
Land					
Agriculture family 1	456	3.67	3.71	3.74	3.64
Agriculture family 2	433	3.66	3.67	3.69	3.64
Agriculture family 3	1 288	3.84	3.88	3.90	3.82
Agriculture family 4	2 007	4.33	4.47	4.49	4.31
Business agriculture	4 451	4.76	4.96	4.97	4.74

Source: Simulation results.

Conclusions

This application suggests that multilateral trade reform is likely to lead to widespread but small benefits in Brazil, with poverty falling but no tangible impact on inequality. There are three main reasons for widespread gains. First, both commercial and family agriculture are net sellers of exported products whose prices will rise. Second, the potential losses to farms in import-competing sectors have in fact already been incurred by opening up trade within Mercosur, so no domestic price declines are simulated. Third, non-agricultural households will on balance gain from higher agricultural prices, as the effects of higher profits in the agro-food sector (and increased wages) will outweigh the impacts of higher food prices. There is little impact on inequality because of competing factors. Inequality rises among agricultural families, but this impact is to some extent offset by benefits to agricultural employees. Inequality also rises among urban households, except for the richest quartile, who may in fact lose. On the other hand, incomes go up more for rural households, which are on balance poorer than urban ones.

A limitation of this study is that it cannot account for variations in supply response and adjustment capacity among farm households. Hence, it sheds little light on intra-sectoral adjustment. At the methodological level, such an analysis would require an alternative modelling approach, based on a model of farm household behaviour. The data for such an approach do indeed exist in Brazil, but not at the national level. It is not possible to deliver an integrated approach that combines the economy-wide perspective of this CGE analysis with a detailed explanation of variations in competitiveness and adjustment capacity within the farm sector. However, it is important to note that in this analysis price rises are envisaged for most products produced by small farmers, so policy reform itself is unlikely to be a major source of adjustment pressure in Brazil.

Notes

1. There are two strong assumptions underpinning this closure: first, that the government has a target deficit/surplus that is constant; second, that the change in the tax burden will be spread across all household groups in proportion to their current average income tax rates. See McDonald (2005).
2. The number of members per household tends to decline as income increases. Hence, the tendency for richer individuals to gain more than poorer ones (in both rural and urban categories) is more pronounced than the tendency for richer households to benefit more than poorer households.
3. The exception is urban labour income, where the gains are lowest for the richest quartile.
4. The apparently perverse results of negative percentage changes in purchaser prices for sugar and soybean are a consequence of the large supply responses by these activities in response to increased export prices and demand, which increases supply onto domestic markets.

Annex 5.A

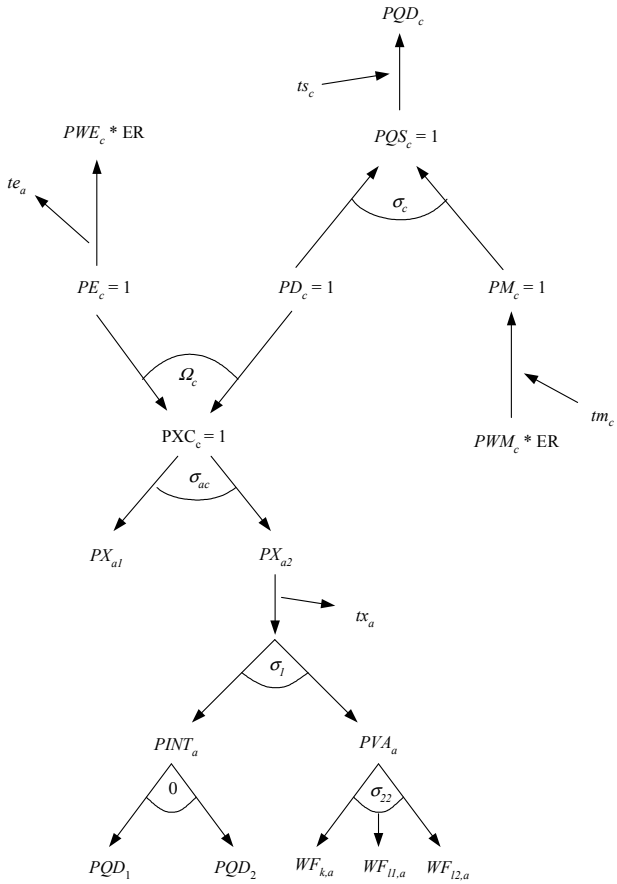
Households are assumed to choose the bundles of commodities they consume so as to maximise utility, which is defined by a Stone-Geary function that allows for subsistence consumption expenditures. Consumption bundles are chosen from a set of composite commodities that are aggregates of domestically produced and imported commodities. These 'composite' commodities are formed as Constant Elasticity of Substitution (CES) aggregates that embody the presumption that domestically produced and imported commodities are imperfect substitutes. The optimal ratios of imported and domestic commodities are determined by the relative prices of the imported and domestic commodities. This is the so-called Armington assumption (Armington, 1969) which allows for product differentiation via the assumption of imperfect substitution. In this model, the country is assumed to be a price taker for all imported commodities.

Domestic production uses a two-stage production process. In the first stage aggregate intermediate and aggregate primary inputs are combined using CES technology. Hence aggregate intermediate and primary input demands vary with the relative prices of aggregate intermediate and primary inputs. At the second stage intermediate inputs are used in fixed proportions relative to the aggregate intermediate input used by each activity. The 'residual' prices per unit of output after paying for intermediate inputs, the so-called value added prices, are the amounts available for the payment of primary inputs. Primary inputs are combined to form aggregate value-added using CES technologies, with the optimal ratios of primary inputs being determined by relative factor prices. The activities are defined as multi-product activities with the assumption that the proportionate combinations of commodity outputs produced by each activity/industry remain constant; hence for any given vector of commodities demanded there is a unique vector of activity outputs that must be produced. The vector of commodities demanded is determined by the domestic demand for domestically produced commodities and export demand for domestically produced commodities. Using the assumption of imperfect transformation between domestic demand and export demand, in the form of a Constant Elasticity of Transformation (CET) function, the optimal distribution of domestically produced commodities between the domestic and export markets is determined by the relative prices on the alternative markets. The model can be specified as a small country, *i.e.* price taker, on all export markets, or selected export commodities can be deemed to face downward sloping export demand functions, *i.e.* a large country assumption. The other behavioural relationships in the model are generally linear.

Figures 5.A1 and 5.A2 provide an overview of the interrelationships between the prices and quantities. The supply prices of the composite commodities (PQS_c) are defined as the weighted averages of the domestically produced commodities that are consumed domestically (PD_c) and the domestic prices of imported commodities (PM_c), which are defined as the products of the world prices of commodities (PWM_c) and the exchange rate (ER) uplifted by *ad valorem* import duties (tm_c). These weights are

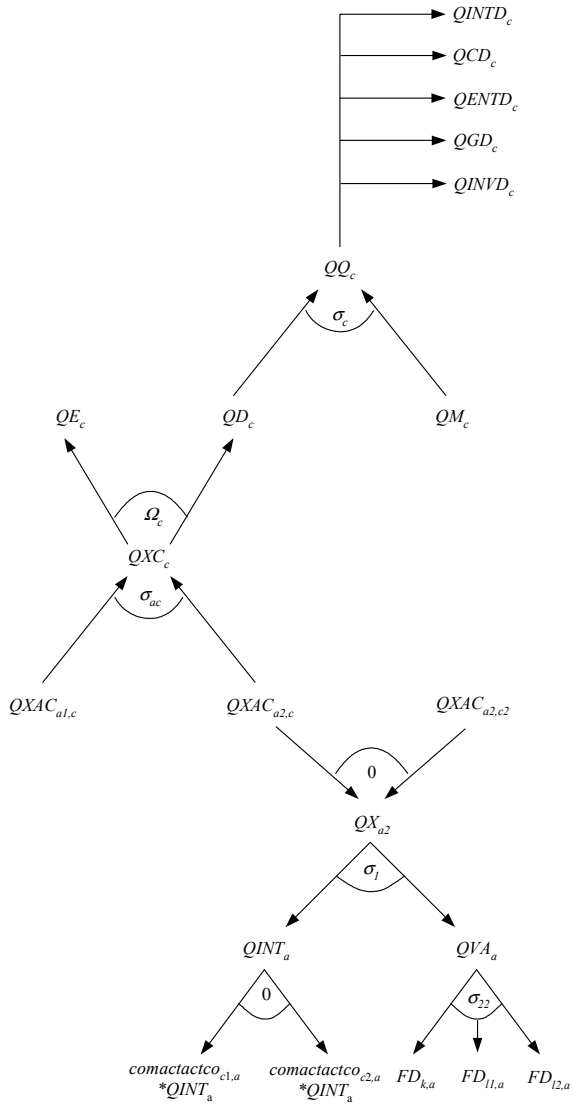
updated in the model through first order conditions for optima (*i.e.* the optimal allocation of consumption between domestic and imported commodities). The supply prices exclude sales taxes, and hence must be uplifted by (*ad valorem*) sales taxes (ts_c) to reflect the composite consumer price (PQD_c). The producer prices of commodities (PXC_c) are similarly defined as the weighted averages of the prices received for domestically produced commodities sold on domestic and export (PE_c) markets; the weights are updated in the model through first order conditions for optima. The prices received on the export market are defined as the products of the world price of exports (PWE_c) and the exchange rate (ER) less any exports duties due, which are defined by *ad valorem* export duty rates (te_c).

Figure 5.A1. Price Relationships for a Standard Model with Commodity Exports



The average price per unit of output received by an activity (PX_a) is defined as the weighted average of the domestic producer prices, where the weights are constant. After paying indirect/production/output taxes (tx_a), this is divided between payments to aggregate value added (PVA_a), *i.e.* the amount available to pay primary inputs, and aggregate intermediate inputs ($PINT_a$). Total payments for intermediate inputs per unit of aggregate intermediate input are defined as the weighted sums of the prices of the inputs (PQD_c).

Figure 5.A2. Quantity Relationships for a Standard Model



Total demands for the composite commodities, QQ_c, consist of demands for intermediate inputs, QINTDc, consumption by households, QCD_c, enterprises, $QENTD_c$, and government, QGD_c, gross fixed capital formation, $QINVD_c$, and stock changes, $dstocconst_c$. Supplies from domestic producers, QD_c, plus imports, QM_c, meet these demands; equilibrium conditions ensure that the total supplies and demands for all composite commodities equate. Commodities are delivered to both the domestic and export, QE_c, markets subject to equilibrium conditions that require all domestic commodity production, QXC_c, to be either domestically consumed or exported.

The presence of multiple product activities means that domestically produced commodities can come from multiple activities, *i.e.* the total production of a commodity is defined as the sum of the amount of that commodity produced by each activity). Hence the domestic production of a commodity (QXC_c) is a CES aggregate of the quantities of that commodity produced by a number of different activities ($QXACa,c$), which are produced by each activity in activity specific fixed proportions, *i.e.* the output of QXACa,c is a Leontief (fixed proportions) aggregate of the output of each activity (QX_a).

Production relationships by activities are defined by a series of nested Constant Elasticity of Substitution (CES) production functions. The nesting structure is illustrated in lower part of Figure 5.A2, where, for illustration purposes only, two intermediate inputs and three primary inputs ($FD_{k,a}$, $FDl_{1,a}$ and $FDl_{2,a}$) are identified. Activity output is a CES aggregate of the quantities of aggregate intermediate inputs ($QINT_a$) and value added (QVA_a), while aggregate intermediate inputs are a Leontief aggregate of the (individual) intermediate inputs and aggregate value added is a CES aggregate of the quantities of primary inputs demanded by each activity ($FD_{f,a}$). The allocation of the finite supplies of factors (FS_f) between competing activities depends upon relative factor prices via first order conditions for optima. While the base model contains the assumption that all factors are fully employed and mobile this assumption can be, and often in this study is, relaxed.

Annex 5.B

Table 5.B1. Household Incomes

Baseline Levels (USD million) and Changes (%)

Household Type	Baseline	Full employment	Full employment and neutral	With unemployment	With unemployment and neutral
Agriculture family 1	3 501	1.72	2.09	1.70	2.07
Agriculture family 2	3 568	1.54	1.89	1.52	1.86
Agriculture family 3	8 488	1.62	2.07	1.79	2.22
Agriculture family 4	11 561	1.91	2.42	2.11	2.60
Business agriculture	8 697	2.80	4.29	3.03	4.46
Agriculture employees	10 440	3.96	3.98	3.30	3.32
Urban 1	16 267	0.62	1.09	0.69	1.14
Urban 2	39 361	0.68	1.08	0.73	1.13
Urban 3	73 802	0.69	1.09	0.93	1.31
Urban 4	26 526	0.39	1.04	0.63	1.26

Source: Simulation results.

Table 5.B2. Household Consumption Expenditure Shares by Broad Commodity Group

	Agriculture	Food	Manufacturing	Services
Family agriculture 1	0.195	0.433	0.212	0.159
Family agriculture 2	0.168	0.406	0.264	0.163
Family agriculture 3	0.140	0.359	0.304	0.198
Family agriculture 4	0.056	0.173	0.281	0.489
Business agriculture	0.076	0.174	0.319	0.431
Agriculture employees	0.089	0.312	0.297	0.303
Urban 1	0.090	0.289	0.268	0.353
Urban 2	0.062	0.232	0.294	0.412
Urban 3	0.049	0.171	0.294	0.486
Urban 4	0.025	0.083	0.221	0.671

Source: Social Accounting Matrix.

Table 5.B3. Purchaser Prices (% change)

	Full employment	Full employ and neutral	With unemployment	With unemployment and neutral
Coffee	5.28	5.28	4.98	4.97
Sugar Cane	2.85	2.87	2.23	2.23
Rice	-2.65	-2.66	-1.67	-1.68
Wheat	-0.44	-0.44	-0.41	-0.41
Soybean	-0.58	-0.56	-1.34	-1.33
Corn	1.49	1.50	0.98	0.99
Beans	5.34	5.35	5.72	5.73
Cassava	4.31	4.30	4.60	4.60
Orange	2.65	2.66	1.60	1.60
Other fruits and vegetables	3.10	3.12	2.51	2.52
Cotton	11.15	11.10	11.95	11.90
Other Crops	3.15	3.18	1.69	1.71
Poultry and egg production	1.66	1.67	1.05	1.06
Cattle ranching and farming	4.20	4.21	3.54	3.54
Hog and pig farming	2.13	2.14	1.51	1.51
Milk farming	0.07	0.10	-0.90	-0.87
Other animal production	2.63	2.64	1.87	1.88
Coffee products	2.69	2.68	2.48	2.47
Alcohol	0.85	0.85	0.70	0.70
Sugar	-3.94	-3.93	-4.32	-4.31
Rice products	-3.93	-3.87	-4.23	-4.18
Wheat flour	1.21	1.18	1.20	1.17
Vegetable oil mills	-2.70	-2.69	-3.13	-3.13
Other vegetables	0.01	0.02	-0.14	-0.13
Poultry products	-0.65	-0.64	-1.05	-1.04
Beef products	2.02	2.02	1.55	1.55
Other meat products	0.84	0.84	0.41	0.42
Dairy products	-0.15	-0.14	-0.57	-0.56
Animal feed	-0.49	-0.49	-0.55	-0.55
Other food products	-0.81	-0.81	-0.96	-0.96
Beverage	-1.03	-1.03	-1.02	-1.02
Textiles	1.96	1.96	1.97	1.97
Tractors products	-3.63	-3.64	-3.47	-3.47
Fertilizers products	-0.27	-0.27	-0.17	-0.17
Agricultural defensives products	0.04	0.05	-0.10	-0.09
Resource oriented products	-0.83	-0.83	-0.69	-0.69
Other industrial products	-1.45	-1.45	-1.32	-1.32
Trade	0.26	0.26	0.33	0.32
Transport	-0.50	-0.51	-0.35	-0.35
Services and government	0.63	0.63	0.72	0.72

Source: Simulation results.

Table 5.B4. Exports – Baseline (quantity) and Percentage Changes

	Baseline	Full employment	Full employment and Neutral	With unemployment	With unemploy-ment and neutral
Soybean	13.19	27.52	27.49	30.86	30.84
Corn	0.07	12.55	12.56	13.71	13.72
Beans	0.01	-0.33	-0.33	-0.78	-0.78
Orange	0.22	8.21	8.20	10.80	10.80
Other fruits and vegetables	1.52	7.07	7.04	8.60	8.58
Other crops	0.73	8.34	8.29	11.81	11.77
Poultry and egg production	0.11	12.29	12.28	14.11	14.10
Cattle ranching and farming	0.01	13.62	13.61	15.47	15.48
Other animal production	0.97	11.54	11.53	13.53	13.53
Coffee products	21.56	3.31	3.32	4.12	4.12
Alcohol	0.72	16.07	16.05	16.73	16.72
Sugar	15.18	29.98	29.97	31.72	31.72
Rice products	0.10	25.89	25.75	27.21	27.08
Wheat flour	0.01	5.55	5.63	5.93	6.01
Vegetable oil mills	20.04	25.57	25.56	27.31	27.31
Other vegetables	19.26	12.57	12.57	13.24	13.25
Poultry products	7.24	21.62	21.62	22.93	22.93
Beef products	5.02	17.37	17.37	18.86	18.87
Other meat products	3.24	18.70	18.73	20.11	20.14
Dairy products	0.06	9.05	9.03	10.51	10.49
Animal feed	4.00	18.41	18.43	18.52	18.54
Other food products	5.45	15.27	15.28	15.96	15.97
Beverage	1.08	12.71	12.73	13.05	13.06
Textiles	3.30	5.26	5.28	5.57	5.59
Tractors products	4.14	12.19	12.19	11.80	11.81
Fertilizers products	0.33	20.24	20.26	19.65	19.68
Agricultural defensive products	0.17	9.93	9.93	10.14	10.13
Resource-oriented products	27.09	11.32	11.33	11.13	11.13
Other industrial products	245.95	10.53	10.53	10.44	10.44
Trade	41.57	12.54	12.54	12.72	12.72
Transport	22.30	14.28	14.28	14.24	14.24
Services and government	50.41	9.71	9.71	9.83	9.82

Source: Simulation results.

Table 5.B5. Imports

	Baseline	Full employment	Full employment and neutral	With unemployment	With unemployment and neutral
Rice		-0.15	-0.15	2.04	2.04
Wheat		3.27	3.29	3.24	3.26
Soybean	0.81	3.10	3.13	2.30	2.32
Corn	0.87	4.58	4.62	3.28	3.32
Beans	0.21	17.30	17.33	18.25	18.28
Cassava		14.81	14.80	15.55	15.55
Orange	0.17	9.96	9.98	7.75	7.76
Other fruits and vegetables	0.48	10.97	11.02	9.71	9.76
Other crops	2.54	12.37	12.45	9.21	9.28
Poultry and egg production	0.18	4.67	4.70	3.65	3.67
Cattle ranching and farming	0.15	4.99	5.00	3.82	3.83
Hog and pig farming		4.47	4.54	3.65	3.72
Other animal production	2.31	8.55	8.60	6.99	7.03
Coffee products	0.01	6.73	6.73	6.48	6.48
Alcohol	0.04	4.95	4.95	4.73	4.73
Sugar	0.02	-7.76	-7.74	-8.18	-8.16
Rice products	1.70	-1.00	-0.85	-1.56	-1.42
Wheat flour	0.46	5.26	5.21	5.40	5.36
Vegetable oil mills	2.71	3.57	3.61	2.87	2.90
Other vegetables	4.34	21.37	21.40	21.07	21.10
Poultry products	0.06	228.35	228.45	225.90	225.98
Beef products	0.73	5.17	5.19	4.34	4.35
Other meat products	0.72	4.59	4.64	3.82	3.87
Dairy products	4.95	3.61	3.65	2.88	2.92
Animal feed	2.20	14.02	14.03	13.60	13.61
Other food products	4.00	12.80	12.81	12.50	12.51
Beverage	4.73	35.97	35.97	36.17	36.17
Textiles	4.93	10.46	10.45	10.60	10.59
Tractors products	4.84	7.97	7.97	8.51	8.51
Fertilizers products	8.37	12.38	12.41	12.09	12.11
Agricultural defensive products	5.03	25.18	25.23	24.23	24.27
Resource-oriented products	35.18	7.13	7.13	7.48	7.49
Other industrial products	504.06	13.95	13.95	14.31	14.31
Trade	3.80	2.02	2.02	2.25	2.25
Services and government	106.19	5.90	5.89	6.17	6.16

Source: Simulation results.

Table 5.B6. Price of Value Added (% change)

	Full employment	Full employment and neutral	With unemployment	With unemployment and neutral
Sugar cane	4.41	4.43	3.48	3.49
Soybean	4.29	4.31	3.14	3.16
Corn	4.14	4.16	2.82	2.83
Fruits	4.28	4.29	3.35	3.36
Other crops	4.22	4.24	3.30	3.31
Poultry and egg production	4.24	4.26	3.14	3.15
Cattle ranching and farming	4.26	4.28	3.22	3.24
Hog and pig farming	4.17	4.19	3.09	3.11
Other animal production	4.13	4.15	3.04	3.06
Coffee industries	1.02	1.02	1.19	1.19
Alcohol	1.01	1.01	1.23	1.23
Sugar	1.17	1.17	1.17	1.17
Vegetal oil processing	1.00	1.00	1.19	1.19
Vegetal products processing	1.06	1.05	1.18	1.18
Poultry industries	1.06	1.06	1.18	1.18
Beef industries	1.10	1.10	1.18	1.18
Other meat industries	1.14	1.14	1.18	1.17
Dairy industries	1.06	1.05	1.18	1.18
Animal feed	1.08	1.08	1.18	1.18
Other food products	1.11	1.10	1.18	1.18
Beverage	1.08	1.08	1.27	1.27
Textiles	1.11	1.11	1.14	1.13
Agricultural machinery industries	1.16	1.15	1.38	1.38
Fertilizers	1.17	1.16	1.34	1.33
Other chemical elements	1.06	1.05	1.26	1.26
Resource-oriented industries	1.02	1.01	1.22	1.22
Other industries	1.05	1.05	1.21	1.21
Trade	1.14	1.14	1.20	1.20
Transport	1.15	1.14	1.33	1.33
Services and government	1.14	1.14	1.24	1.24

Source: Simulation results.

Chapter 6.

Italy

Scope and objectives

This study explores the distributional implications for farm, rural and urban households of two policy reform scenarios. This summary is based on a more comprehensive analysis reported in Magnani and Perali (2005). Potential price, quantity and welfare effects were estimated using a general equilibrium model of the Italian economy described in detail in Finizia, Magnani and Perali (2004). The model represents behavioural responses to policy change at the national level but distinguishes income and expenditure impacts among eleven separate farm and non-farm household types. The first policy scenario is based on a 50% reduction in trade protection and domestic support that is similar to that assumed for the GTAPEM analysis. Indeed, simulated price impacts for agricultural commodities produced in Italy and covered under the provisions of the Common Agricultural Policy were assumed to be the same (in per cent change terms) as obtained for the EU region in the GTAPEM global policy reform scenario.

The second policy reform scenario examines the implications for Italian farm, rural and urban households of the switch in EU agricultural policy from support payments linked to area and livestock numbers to the single farm payment. Recent changes to the EU's Common Agricultural Policy permitted member states to choose between total and partial decoupling options when implementing farm support payments. In July 2004, the Italian government decided in favour of a totally decoupled scheme. Although economic theory may provide a sound basis for anticipating the efficiency outcomes of a switch from coupled to decoupled payments, theory alone is not enough to fully anticipate the distributional consequences. A key question here is whether a totally decoupled scheme would mitigate the problem of distributive justice associated with coupled payments which, by design, benefit mainly the large producers. The answers to such questions may depend not only on the design of the policy but on initial endowments of payment recipients and the degree to which they participate in related output and factor markets.

Data and model

The analysis is based on data obtained in the ISMEA survey of the socio-economic conditions of Italian Agriculture undertaken in 1996. That survey was designed on the basis of a model of the farm-household which maximizes individual utilities. This aspect is important if the interest is in recovering individual welfare levels and understanding individual behaviour such as on and off-farm labour choices. The ISMEA data set comprises five survey types in one: *(a)* Farm budget data *(b)* Input/Output Table *(c)* Stylized Time Use Budget *(d)* Household Consumption Survey *(e)* Household Income Survey. The Input/Output information about the farm resource use is also the basis to construct both a Social Accounting Matrix (SAM) and

the Applied General Equilibrium (AGE) model of the Italian farm economy. One single source of information feeds both the micro and macro behavioural model.

Individual survey households are aggregated into socio-economic groups using both the farm and household information contained in the ISMEA data set. These farm-household types are: limited resources, retired residential, professional farmer - lower sales, professional farmer - higher sales, llarge family farms, very large family farms, rural non-farm households, and urban households (separated into three income categories: low, middle and high). Both the micro and macro level models include leisure as measured from the stylized time use budget which is a characteristic unique to the ISMEA survey. Leisure is defined as the sum of time devoted to recreational activities, personal care and rest.

The general equilibrium model developed to exploit this data includes 41 sectors and places particular emphasis on the agricultural sector. Agriculture is disaggregated into 23 agricultural sectors, agro-industry in nine sectors, other industries in seven sectors and services in two sectors. Each sector produces a single output, using intermediate goods and primary factors according to a two level CES production function.

The agricultural sectors use ten production factors: land (distinguished in three types), agricultural capital, labour (distinguished in independent farm labour and dependent labour), and animals (distinguished in four types), while the other sectors use two production factors: non agricultural capital and labour. There are two institutional sectors, the households and the government. International trade is introduced by considering two trade areas: European Union (EU) and the rest of the world (RoW).

Results from global reform scenario

The main channel through which policy reform transmits income effects is through the induced impacts on factor returns. The top row of Table II.5 contains estimates obtained in the global reform scenario. Notice first that, as was the case in the GTAPEM analysis, the overwhelmingly largest impact is on the returns to land (-19.36%). Moreover, as in that analysis, the greatest contributor to the reduction in land returns (more than 80%) is the assumed halving of payments tied to land. Induced reductions in returns to family labour employed on the farm (-0.85%) and in the rates of return to agricultural specific capital (-1.43%) are more modest but consistent with the expected result when farm support and protection levels are reduced.

The land market result signals a potentially important distributional effect of policy reform. Not all landowners in Italy are farmers so that some of the economic costs associated with the policy reform will be borne by people outside the sector. Farmers who rent their land from absentee landlords may not be affected so much from the regime switch. A full understanding of the income distributional consequences would require knowing whether those who own land but do not farm or generally poorer or richer than those who rent.

The net economic impact of global trade and agricultural policy reform on the economic well-being of farm, rural and urban households depends partly on how the reforms affect the prices they pay as consumers and partly on how the reforms affect their earnings. The two columns under the sub-heading ‘Income impacts’ in Table II.5 contain findings for farm incomes and for the equivalent variation of household

incomes respectively. Results presented in the first column reveal the policy reform impact on just that component of household income that derives from sales of farm products or from agricultural direct payments. The estimates of equivalent variation contained in the second column summarise the net effect of the whole package of reform induced price and income changes on the household budget. Both are measured in percent change terms where the denominator for farm income is initial farm income and that for equivalent variation is the initial value of full income — the sum of money income plus the money value of leisure.

Table II.5. Simulated percent changes in factor returns and income, global reform scenario

Factor Market Impacts				
Off-Farm Labour	**Farm Labour**	**Non-Agricultural Capital**	**Agricultural Capital**	**Land**
0.11	-0.85	0.27	-1.43	-19.36

Income Impacts		
	Farm Impacts	**Equivalent Variation**
Limited resource	-2.95	-0.51
Retirement	-4.13	-0.43
Residential / Lifestyle	-4.33	-0.88
Farming Occupation, Lower-Sales	-4.52	-0.76
Farming Occupation, Higher-Sales	-5.75	-1.57
Large Family Farms	-5.09	-1.31
Very Large Family Farms	-4.23	-0.89
Rural Household	0.0	-0.03
Urban Household, high income	0.0	-0.01
Urban Household, mid-income	0.0	0.03
Urban Household, low income	0.0	0.01

Source: Based on results reported in Magnani and Perali (2005).

A given package of changes in factor returns will of course affect different households differently depending on their initial endowments and how much adjustment in spending patterns and resource allocations occurs. Table II.5 shows estimated impacts for the eleven categories of farm and non-farm households distinguished in the analysis. As the findings reported in the bottom rows of the table reveal, for most households — and certainly for most farm households, the impacts of policy reform on the income side of the budget are much more important than are the induced effects on the expenditure side.

Generally speaking global trade and agricultural policy reform would not be expected to have much of an impact on the prices Italian consumers pay for food and other products at the retail level. The prices of farm commodities affected by policy

reform constitute typically only a very small share of final retail cost of the final products in which they are ingredients. Confirmation of this can be found in the present case by noting results shown for off-farm households in Table II.5. By definition, these households earn no or little farm income, the major category of revenues affected by the policy reforms examined here. Thus, if the policy reforms hold any implications at all for these households it would be those deriving from induced changes in consumer prices. The EV findings reveal that such changes are of trivial importance for non-farm households.

Estimated farm income losses associated with the simulated reductions in trade protection and support range between -3% and -6% averaging slightly higher for the farming-occupation and larger farm household types than for the limited-resource and retirement types. A much more important distinction is that between the estimated impacts on farm income versus those for the equivalent variation of household income. The political debate over farm policy reform frequently highlights potential implications for income from farming. However, as comparisons of results in Table II.5 reveals, this focus may substantially exaggerate reform impacts on the economic well-being of farm households. In this context, the implications for the equivalent variation of household income constitute a more appropriate indicator of economic costs and benefits of reform.

Results from CAP reform scenario

This simulation experiment was designed to measure the national level impacts on price, quantity and economic welfare of the move to a policy regime of fully decoupled payments. In simple terms, the model was used to answer the following hypothetical question. What if the value of CAP premiums received by farm households in the reference year, 2001-2002, were taken away and replaced by a lump sum payment designed to keep their total, payment-inclusive, farm receipts unchanged? In theory, this re-orientation of policy would be expected to directly reduce the incentive to use land and livestock formerly benefiting from the premiums. Indirect effects would include those associated with reduction in demand for the capital and labour that complement land and livestock in farm production.

Table II.6 contains the simulated changes in production (Xs) and in domestic prices (Pd), both for some individual crop and livestock commodities, as well as for aggregated products: crops, milk, beef and fruit. In broad terms these results reveal the quantity and price effects of an induced shift of productive resources from those crops formerly benefiting directly from premium payments to other crops. Some of these other crops are non-tradable whose market prices must fall in order that domestic consumption demand expands sufficiently to absorb the induced increase in production.

An example may help in understanding the results. In the centre region of Italy cereal farmers traditionally face the choice of planting either soft or durum wheat. In the pre-reform situation coupled premiums were giving durum wheat a comparative advantage over soft wheat in terms of a lower cost to returns ratio. Under a decoupled scheme, these relative incentives are inverted. Neither durum nor soft wheat would be produced by a rational farm because both crops have costs higher than gross returns. It becomes therefore more efficient to switch, for example, to low cost pasture production while receiving the lump-sum payment based on the cereal production of the reference

situation. This new configuration frees resources in surplus such as labour and other inputs available for more efficient uses in other sectors of the economy.

Table II.6. Simulated percent changes in production (Xs) and domestic prices (Pd), CAP reform scenario

	Xs Production	Pd Domestic Price	Weight	Weighted XS	Weighted Pd
Crop					
Soft wheat	-27.70	0.60	5.36%	-1.48	0.03
Durum wheat	-36.19	0.60	8.29%	-3.00	0.05
Rice	0.18	-1.05	3.20%	0.01	-0.03
Corn	-0.73	-1.14	18.81%	-0.14	-0.21
Fodder	16.32	-10.49	10.89%	1.78	-1.14
Dry hay	30.35	-15.25	7.26%	2.20	-1.11
Potatoes	1.79	-0.82	3.38%	0.06	-0.03
Tomatoes	1.85	-0.77	4.17%	0.08	-0.03
Other vegetables	-0.53	0.27	25.75%	-0.14	0.07
Sugar beet	2.48	-1.20	4.56%	0.11	-0.05
Soy beans	-80.67	0.60	1.83%	-1.48	0.01
Other industrial crops	-20.65	11.13	1.46%	-0.30	0.16
Tobacco	2.19	-0.95	5.04%	0.11	-0.05
Total			**100.00%**	**-2.19**	**-2.34**
Fruit and vegetables					
Raisins	0.17	-0.10	23.21%	0.04	-0.02
Olives	0.38	-0.39	18.68%	0.07	-0.07
Citruses, fresh and dry fruits	0.32	-0.12	30.25%	0.10	-0.04
Floriculture	2.26	-0.91	23.30	0.53	-0.21
Forestry	2.16	-0.91	4.57	0.10	-0.04
Total			**100.01%**	**0.83**	**-0.39**
Milk and milk products	0.48	-0.43		**0.48**	**-0.43**
Livestock					
Beef	1.22	-0.71	34.34%	0.42	-0.24
Sheep and goats	-2.50	0.69	9.44%	-0.24	0.07
Other livestock	2.33	-1.09	56.22%	1.31	-0.61
Total			**100.00%**	**1.49**	**-0.79**

Source: Magnani and Perali.

Table II.7 contains results for factor prices, farm income and equivalent variation presented using the same reporting framework as for Table II.5. The simulated near 20% increase in the implied rental rate of land induced by the switch to decoupled payments constitutes the most dramatic result here. Decoupled payments are assumed

to be tied to land, whether directly through the provisions of the program or indirectly through the operation of the land market. Moreover, as compared to payments based on premiums there is no leakage of benefits through requirements to use that land in producing particular crops or livestock as was the case with the former program of land and headage premiums.

Table II.7. Simulated percent changes in factor returns and income
CAP reform scenario

Farm Price Impacts				
Off-Farm Labour	**Farm Labour**	**Non-agricultueral Capital**	**Agricultural Capital**	**Land**
0.05	-0.38	0.07	-4.50	18.27

Income Impacts		
	Farm Income	**Equivalent Variation**
Limited resource	-0.32	-0.08
Retirement	-.58	-0.07
Residential / Lifestyle	1.37	0.35
Farming Occupation, Lower-Sales	0.26	0.07
Farming Occupation, Higher-Sales	1.95	0.66
Large Family Farms	2.22	0.64
Very Large Family Farms	1.62	0.36
Rural Household	0.00	0.00
Urban Household, high income	0.00	0.02
Urban Household, mid-income	0.00	0.01
Urban Household, low income	0.00	0.01

Source: Based on results reported in Magnani and Perali.

Reductions in the incentives to plant particular crops and to maintain livestock inventories that come with reduced premiums have knock-on effects on the prices of farm capital (which would include livestock capital) and on the demand for farm family labour. These induced reductions in factor demands are revealed in simulated negative price impacts for these factors presented in Table II.7.

The income implications of the CAP reform scenario are small, whether using farm income or the equivalent variation of household income to measure them. There are two factors to be kept in mind in interpreting this result. First, the CAP policy reform itself was designed to leave farm households generally as well off before as after the reforms were implemented. Secondly, incomes from farming, and especially that component of farm incomes deriving from income support programs under the CAP, constitute generally a small share of total incomes of the beneficiary households.

The pattern of income impacts for the different household types is interesting nonetheless. CAP reform is welfare decreasing for limited-resource and retirement farms but welfare improving for all other farm household types with the greatest income gains accruing to farm households belonging to the largest farm size

categories. Moreover, as was the case under the global reform scenario, non-farm households are virtually unaffected economically by the CAP reform.

Conclusions

The implications of global trade and agricultural policy reforms for Italian households depend critically on the indicator used. Factor market implications are dominated by the quite dramatic simulated reductions in returns to land. Simulated land and other factor market declines leave farm incomes 3 to 6% below pre-reform levels. However, simulated reductions in farm incomes substantially overstate the associated reductions in the 'equivalent variation' measure of household income effects.

There are two reasons why simulated farm income impacts may not give policy-makers a valid implication of the true economic costs or benefits of policy reform. First, in Italy (and generally speaking in almost all OECD countries) the share of farm income in total income of those farm households affected by policy reform is typically small. Secondly, when confronted by a changed pattern of prices and earnings farm households may adjust both their earnings and their spending portfolios.

The CAP reform analysis reveals that switching from a system of farm support based on area and headage premiums to one based on completely decoupled payments leads to efficiency gains and fractional improvements in the income benefits of support for most categories of farm households in Italy. The simulated changes in output and factor mix induced by the reforms favour less intensive agriculture. The crop mix shifts to land extensive alternatives and, in total, the share of crop output contracts while that for livestock expands.

One side-effect of the reforms that may have distributional consequences derives from the induced increase in returns to land. These distributional effects depend critically on the share of farm land owned by non-farm households and the income distributional characteristics of farm versus non-farm beneficiaries of increased land returns.

In the global trade and agricultural policy reform scenario all farm household types suffer some loss of income, losses that are substantially less when using the EV indicator than when using the farm income indicator. Although all farm household types lose income, the incidence of income loss is generally higher for households in the larger farm size categories. The incomes of non-farm households did not change perceptibly under either the global or the CAP reform scenario.

Under the CAP reform scenario most farm households gain but there are income losses for farm households in the limited-resource and retirement categories. However, whether gain or loss these income effects are small, a finding that reflects the absence of any policy design features of the new CAP aimed at achieving income redistribution. Clearly however, a system of completely decoupled payment offers possibilities for targeting income benefits which do not exist with output related measures.

Chapter 7.

Malawi

Scope and objectives

Malawi is one of the poorest countries in the world, with much of its population dependent on agriculture, either directly or indirectly. This application seeks to examine the impact that agricultural policy changes will have on different types of household within Malawi, and how different households will respond to those changes. In broader terms, it contributes to an understanding of agriculture's role in the process of development and poverty reduction. As a case study, the application sheds light on the scope for measuring differential policy impacts in a poor economy, where data are often scarce and an important share of economic activity is not recorded through market transactions. These kinds of analyses are important even in economies where the majority is poor, because most policy alternatives are likely to involve internal reallocations of income.

Overview of model development

The starting point is a model of farm household livelihoods that captures the way in which the incomes and expenditures of different categories of agricultural households are affected by reforms, and how those households respond in terms of their decisions on production of food and cash crops (maize and tobacco respectively), consumption and off-farm employment.

This model is nested within a wider model of the informal rural economy (IRE) which models the local market for maize (the dominant staple) and wage labour. This model accounts for second round effects on maize prices and wages, according to the overall labour surplus and the maize surplus/deficit obtained in the household model.

The rural economy model is in turn loosely nested within a computable general equilibrium (CGE) model, which takes account of wider commodity and factor market effects, as well as the effects of reform on the fiscal position and the exchange rate. Crucially, the CGE model incorporates dynamics, in the form of population growth, increases in the stocks of factors (land, labour and capital) over time, and an endogenous process of capital accumulation.

The purpose of this sequential development is to gauge the relative importance of direct and indirect effects of reform on various categories of poor household in Malawi. The approach also demonstrates the additional value of further modelling efforts and helps make the results transparent, by effectively decomposing the origins of the different effects that are captured within the CGE.

An innovative aspect of the modelling structure is that it allows for differential behaviour among household groups within the CGE structure. Thus it combines the strengths of two approaches: the insights into differential effects and responses that come from household models, and the economy-wide scope of standard CGEs.

For comparative purposes, the results are benchmarked against those obtained with less formal techniques, which calculate the pure incidence of reforms, and make a "back of the envelope" calculation of second round effects. The purpose of this exercise is to determine the extent to which less demanding techniques can deliver comparable policy insights.

As a further test of the structure, the household and rural economy models are adapted and applied to the Zimbabwean economy. This sheds light on the scope for adapting the modelling framework in cases where data availability and economic structures are significantly different, and helps identify some of the challenges that need to be addressed.

Challenges in modelling distributional impacts in Malawi

There are a number of difficulties that need to be overcome in modelling the distributional impact of policy reform in Malawi. Some of these are common to analysis of less developed countries in general, while others reflect the specific characteristics of the Malawian economy.

A significant problem in Malawi, as in other developing countries, is the availability and quality of data. A household survey from 1997/98 was used to construct a household typology, and while this provides good representation for regions where the majority of rural households live, there are regions where it performs less well. Moreover, the survey does not contain all the information needed to construct farm household models. For productivity and pricing coefficients information was therefore patched together from various sources, but particular difficulties were encountered in the case of labour use and markets, where information is missing on hours worked, hours dedicated to farm tasks and wages. This required pragmatic judgements, notably in gauging whether chosen estimates led to sensible predictions of the hiring in and hiring out of farm labour.

Further challenges lay in capturing the structural characteristics of Malawian smallholder agriculture, and its linkages to the wider economy. In particular, model development needed to account for the following features of household decisions: diversified household activities (including food crop production, cash crop production, off-farm work); heterogeneity of household types (by agro-ecological area, asset holdings); market imperfections in the form of transactions costs, which introduce a wedge between market prices and opportunity costs; non-separable decisions on production and consumption, and hiring/selling of household labour (as a consequence of these market imperfections); risk and uncertainty; and seasonality.

In general, price policies have been liberalised but market failures (non-price constraints) have not been addressed and Malawi remains poorly integrated with the world economy. A major focus of the model development lies in describing these non-price impediments to further market integration.

Model specification

Farm household (livelihood) model

The model of farm household livelihoods is described formally in the background paper. In this model, agents maximise their expected utility (which takes an LES form)

subject to resource constraints, which are specified over four seasons (cropping, pre-harvest, harvest and post-harvest). Those constraints allow alternative stocking, farm, market and off- farm employment strategies to be pursued under different market scenarios. The specification is capable of capturing several important aspects of Malawi's economy noted above, including seasonal constraints, varied activities among households, heterogeneity in resource endowments and market imperfections. By allowing for different maize prices in the harvest and post harvest periods, the model allows for some embedded risk.

The data used to estimate the model are obtained from the 1997/98 Integrated Household Survey. Households are differentiated first with respect to three agro-ecological zones and second with regard to socio-economic characteristics within each zone. The latter characteristics include off-farm employment income, remittances, value of assets, retained maize stocks, holding size, access to credit and gender of household head. These data were used to define seven household types: larger farmers, medium sized farmers with assets, borrowers, poor male headed households, poor female headed households, employees and remittance earners.

One way in which the model is validated is by comparing the base scenario results with other available data on crop patterns and production, fertiliser use, labour market engagement, and farm and non-farm incomes (which have implications for the structure of the rural economy). These suggest that the model performs well for the Plateau Zone (which accounts for 60% of the rural population) but not so well for other areas. Modelling of policy simulations is therefore limited to this region.

Informal rural economy (IRE) model

The IRE model (also described in the background paper) includes all households in the livelihoods model, but excludes commercial or estate agriculture. It allows for economic interactions among these households and between these households and the rest of the world (which includes all agents not in the livelihood model, be they in rural or urban areas of Malawi or abroad). The representation of these interactions is contained in what is effectively a Social Accounting Matrix.

Market interactions in the IRE are modelled as follows. The rest of the world (ROW) is assumed to have an elasticity of demand for labour supplied by households in the livelihoods model. This elasticity is set at an initial value of one, implying the value of demand stays constant. The ROW is also defined to have an elasticity of demand for and elasticity of supply of maize (the latter is assumed to be relatively elastic). Given a shock to the IRE (*e.g.* higher tobacco prices), maize prices and wages adjust so that markets clear, which requires that externally traded quantities and income flows are consistent with the specified elasticities.

These adjustments are estimated iteratively. Shocks are introduced assuming a range of different wage rates and maize prices. Those shocks, given a pair of wages and maize prices, will have effects on the labour surplus and on the maize surplus/deficit. The equilibrium wage is the one where the labour surplus equals external demand (the demand curve already being defined by the initial equilibrium for wages and labour hiring and the unit elasticity of demand from ROW). The same principle holds in the maize market, with the exception that the IRE may be in surplus or deficit with ROW.

CGE model

The CGE model for Malawi corresponds to the standard IFPRI model, which is designed to reflect the salient features of developing countries (Lofgren *et al.*, 2002). In addition, the model allows for dynamic effects through trends in the growth of population and productive factors (labour and capital), and capital accumulation (determined by new capital investment and the depreciation of existing stock) (Wobst *et al.*, 2004).

The model is based on a SAM with the following dimensions:

- 22 production activities, including eight renewable natural resource production activities: smallholder maize production, separate smallholder and large-scale tobacco production, separate smallholder and large-scale production of other crops, livestock, fishing and forestry;
- 20 commodities, including six agricultural commodities, eight from manufacturing, three from industry and three from services;
- 5 factors: smallholder and large farm land, skilled and unskilled labour, and capital;
- 8 households: 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 (one urban agricultural type and two non-agricultural types with different levels of education);
- 2 other institutions (government and rest of the world); and
- 5 tax collection accounts.

Household consumption of non-marketed (or home) commodities was included, together with an explicit treatment of transport and other marketing costs for commodities that enter the market sphere.

The major development in the model used for this study was a restructuring of the existing SAM with disaggregation of smallholder production of maize, tobacco and other crops into two different types, production by households with less than 1 ha of land, and production by other households. This then enabled the CGE model to allow for differential changes in maize productivity between poor and less poor households in their response to policy induced and other shocks, using information obtained from the IRE model. An explanation of how this was achieved is contained in the consultants' report (Dorward *et al*., 2004).

Model results

Policy shocks

The household/livelihood model and the IRE model are used to simulate the effects of changes in the domestic price of maize (the food crop) and tobacco (the cash crop) over a wide range. The IRE model is also used to estimate the effects of a non-policy shock in the form of increased openness in the rural economy to purchases of tradable goods and services. This is simulated by increasing the proportion of household non-staple expenditures on tradables from 50% to 60%, then tracing through the implications for household activities and economic welfare.

The CGE model is used to examine the effects of international maize and tobacco price increases, allowing for differential maize productivity changes in response to domestic price changes. These are estimated in the livelihood and IRE models, where higher maize prices lead to increased profitability and adoption (by less poor households) of labour demanding technological change. Domestic prices in the CGE move in line with border prices (with adjustments for transport and marketing costs), but movements are damped in line with the ratio of imports (exports) to domestic consumption (production). Reconciliation between domestic price changes in the IRE and CGE models was achieved by iterative adjustments of the domestic prices used in the IRE model and of the maize productivity changes in the CGE model.

Farm household model results

The household impacts of maize price changes are shown in Figure II.5. All households lose from increases in maize prices from a very low base where all households are net buyers of maize. At higher prices, however, some households gain and some lose from price increases, depending on whether they are, or have the scope to become, net sellers. Poorer households lose because cash and land constraints prevent them moving to a profitable net surplus. In this case, higher maize prices can actually induce a perverse supply response. This occurs because an increase in the maize price raises the cost of food expenditures, which tightens the cash constraint, reducing households' ability to buy inputs with which to grow maize, and, for the poorest households, requiring them allocate labour from maize production to wage employment which delivers immediate (if lower) income. Similarly, increases in wages can cause these households to supply less labour to the market.

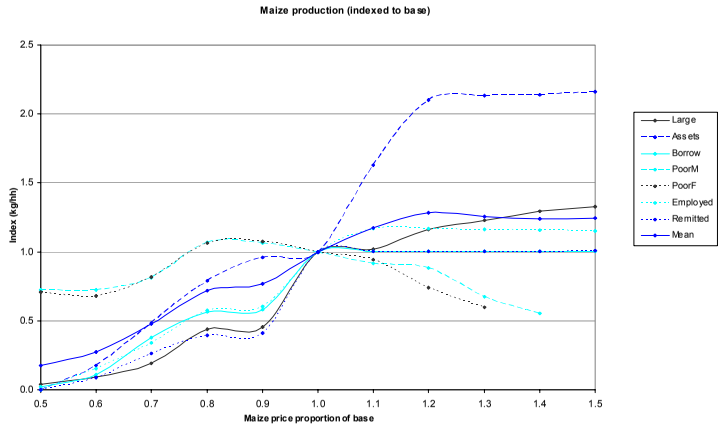
In the case of tobacco, the benefits of higher prices accrue to larger smallholder farms, owners of more assets, borrowers, non-agricultural wage earners and remittance earners (Figure II.6). The poorest households do not benefit, as they do not grow the crop due to lack of cash to buy inputs.

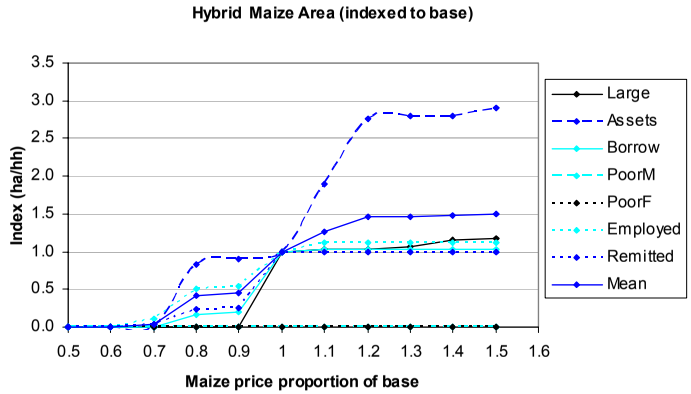
Informal rural economy model

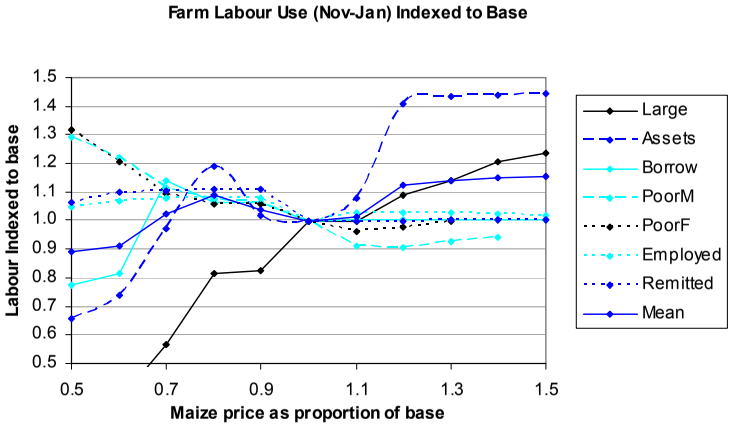
The informal rural economy model moves on from analysis of isolated household model responses by allowing wages to change on response to maize price changes.

The impacts of maize price increases are shown in Figure II.7. In response to higher maize prices, wages fall and then rise, the nature and extent of wage response depending on changes in on-farm labour use, total labour supply, and demand for non-tradable goods and services (and hence for non-farm labour used in their production). Very low maize prices lead to larger areas under tobacco which requires more farm labour than maize. As maize prices rise, real incomes fall (increasing total labour supply, and decreasing demand for non-tradable goods and services), and farm labour is also released by transfer of land from tobacco to maize. Further maize price rises lead to less poor households finding it worthwhile to become surplus maize producers and their incomes begin to rise again (reducing their family labour supply and increasing demand for labour to produce non-tradables). They also begin to adopt more intensive maize technologies, which demand more on-farm labour. This tightening of the labour market leads to increased prices so that although the poorest households lose from higher maize prices, there is the possibility that, at higher maize prices some of these effects may be offset by higher wages.

Figure II.5. Household responses to changing maize prices







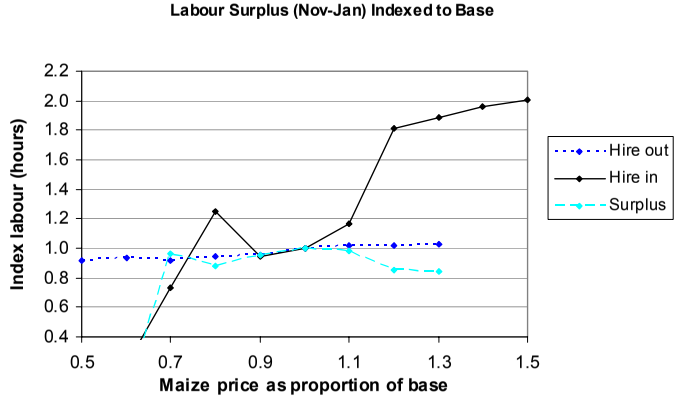
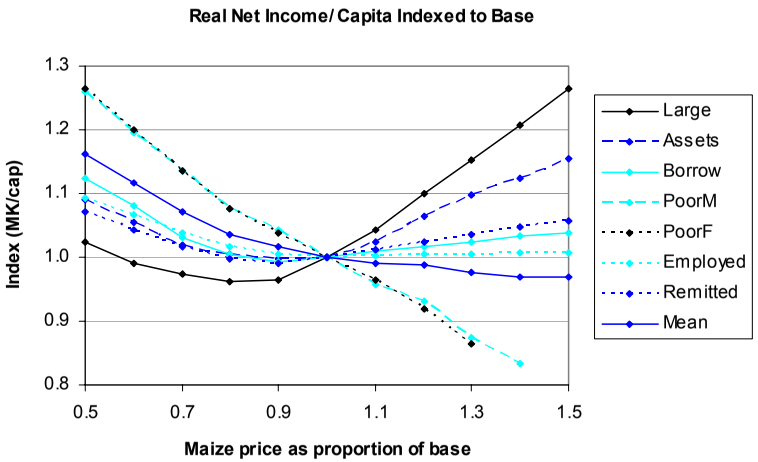


Figure II.5. Household responses to changing maize prices (*cont.*)



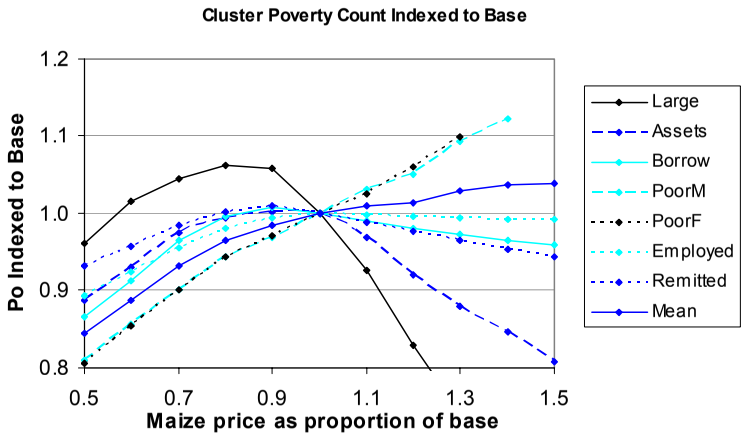
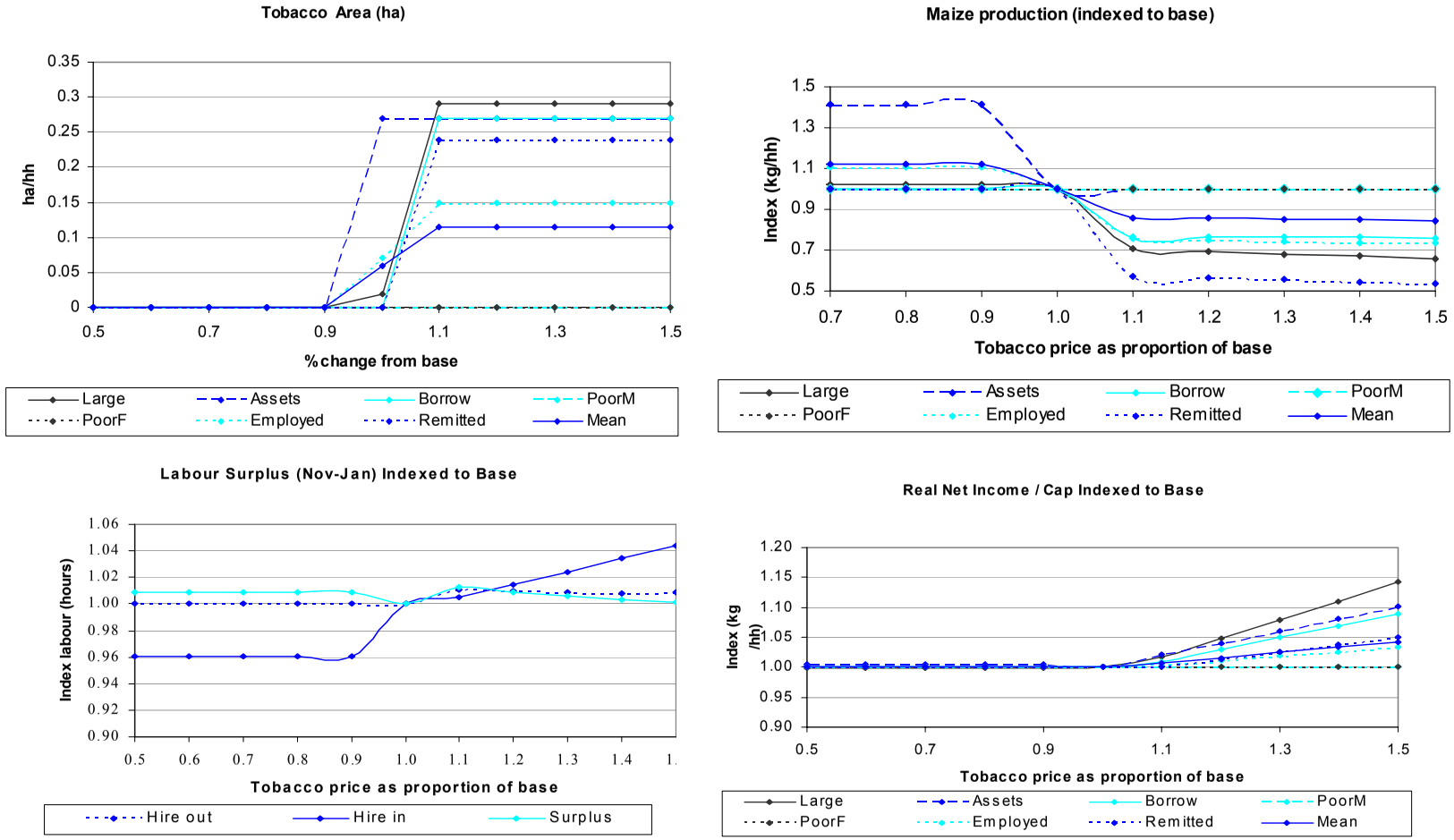
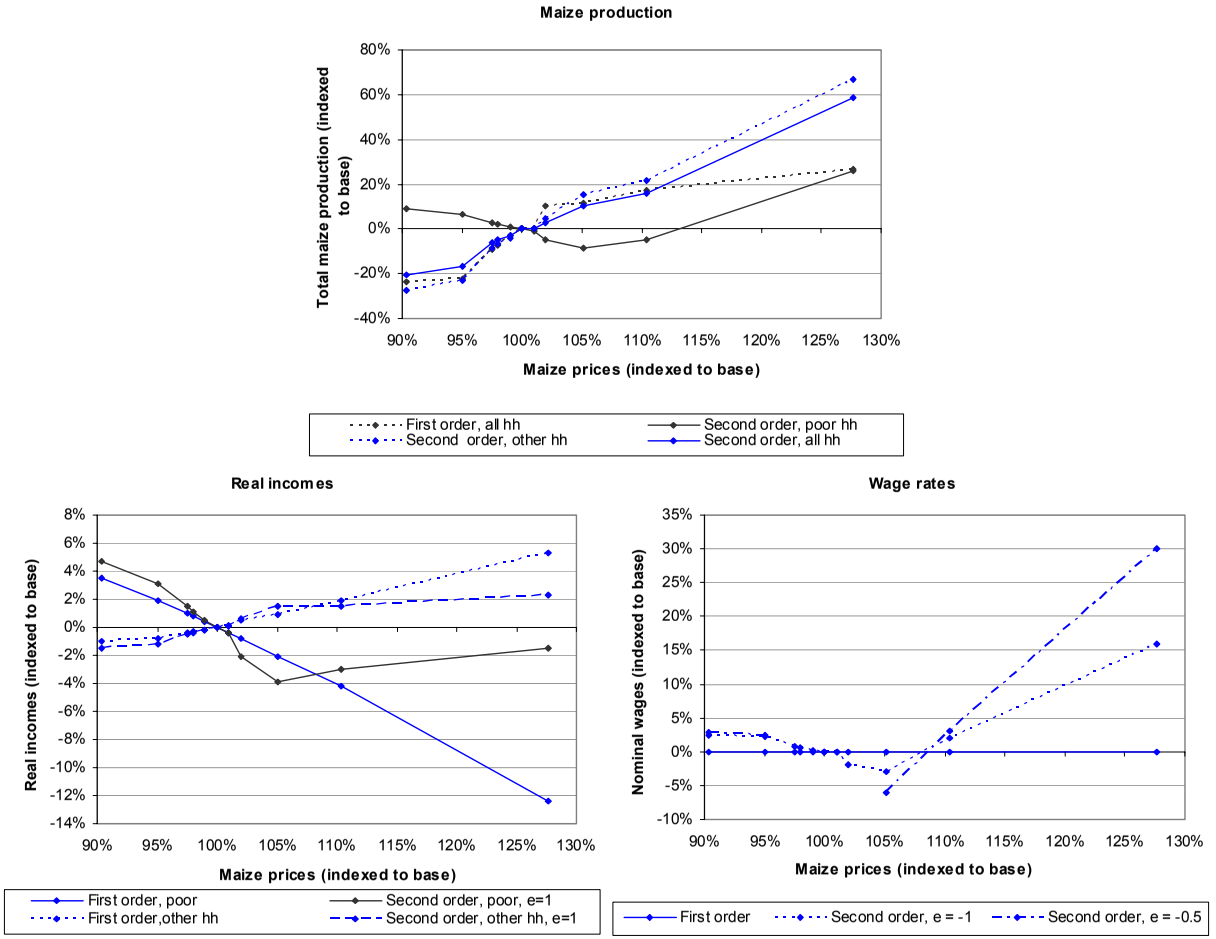


Figure II.6. Household responses to changing tobacco prices



Source: Dorward *et al.* (2004).

Figure II.7. First and second order impacts of changing maize prices



Source: Dorward *et al.* (2004).

The key insight is that even this relatively limited extension to the basic household model can fundamentally alter (and in some cases even reverse) estimates of how the poor will be affected by policy reform. Similarly, poor households can now be shown to benefit from higher tobacco prices as these tighten the labour market, thereby raising real wages (Figure II.8). But even here, the results are not always straightforward – some of these gains are lost as the switch into tradables raises maize prices and increases food expenditures by the poor.

A non-policy shock in the form of higher expenditures on tradables pushes down demand for local labour producing non-tradable goods and services and hence reduces wage rates and therefore the incomes of the poor. The regressive impact of changing the proportion of income spent on tradables from 50% to 60% is much greater than the impact of a 10% price shock in the farm household / IRE models, indicating the importance of putting policy reform impacts in context. Relative to other shocks, they may be a relatively minor determinant of the income prospects of the poor.

Economy-wide (general equilibrium) impacts

The introduction of inter-sectoral and international linkages, together with dynamics, further complicates the results. For example, higher international maize prices can stimulate technological change and drive up productivity (as in the IRE model), but that then serves to drive down domestic prices (Figure II.9). Higher international tobacco prices also induce competing effects on maize prices (Figure II.10). On the one hand, higher tobacco earnings lead farmers to switch crops, the reduction in maize supply tending to raise prices. On the other hand, higher tobacco prices improve the balance of payments, strengthen the currency and effectively lower the prices of imported maize.

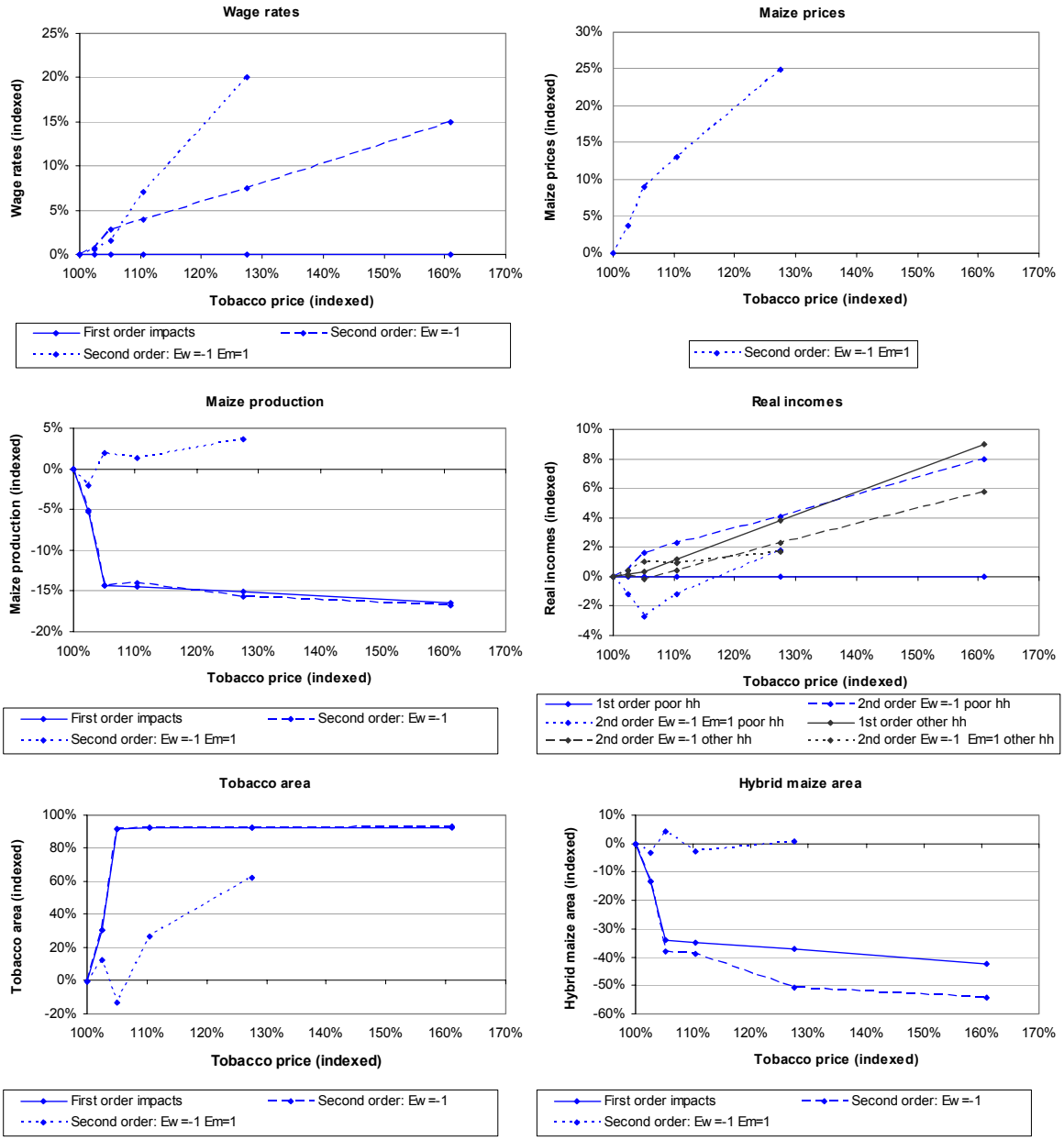
Overall, the CGE produces similar results to the IRE. The major difference is that wage impacts are smaller in the CGE, due to the assumption of labour mobility across the national economy, although some of this damping may be overstated. However, less poor households gain under the IRE and lose under the CGE due to different impacts on maize production.

The general conclusion is that poor households lose directly from higher maize prices, as they are net buyers, and are not directly affected by tobacco price increases as they do not produce it. However in both cases they may gain from higher wages as shifts into more labour demanding crops and technology cause the labour market to tighten.

Trade reform impacts

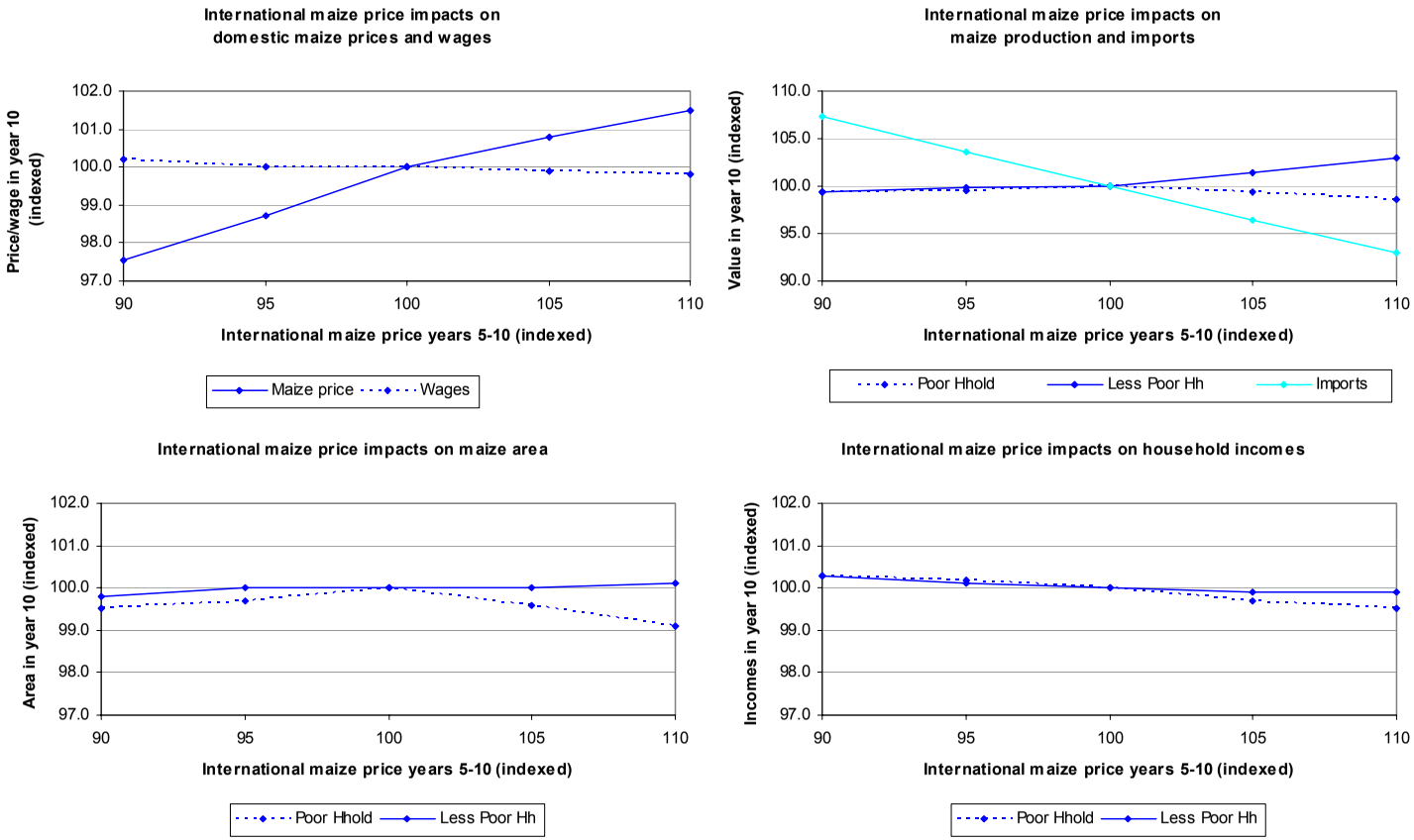
GTAPEM suggests that a 50% cut in global tariffs, and a 50% reduction in domestic agricultural support in OECD countries, will raise tobacco prices by less than 5%. The IRE and CGE suggest that higher export prices will increase wages in Malawi by less than 1%. Those less poor households with the potential to grow tobacco gain directly and increase their production accordingly, but some of the gains are passed onto poorer households in the form of higher wages, with the extent of those wage increases depending very much on the tightness of the labour market. Both poor and less poor households are expected to gain by less than 1%. Higher tobacco prices also help the country's balance of payments. If an exchange rate appreciation makes maize import cheaper then consumers gain, despite shifts out of maize and into tobacco by less poor households, and despite higher consumption. In the absence of additional maize imports, higher maize prices could lead to an intensification of maize production and further wage increases.

Figure II.8. First and second order impacts of changing tobacco prices



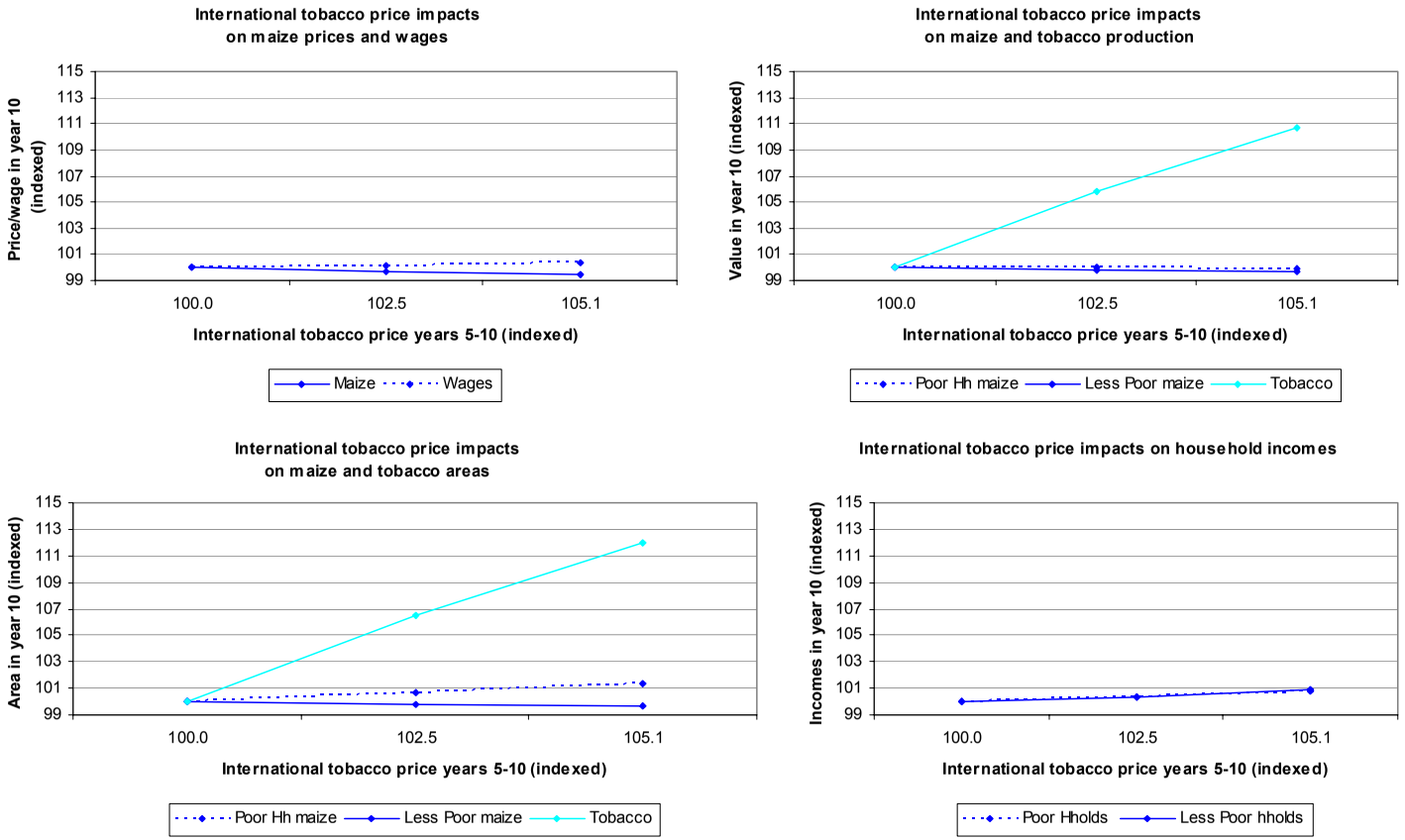
Source: Dorward *et al*. (2004).

Figure II.9. CGE results for maize price shocks



Source: Dorward *et al*. (2004).

Figure II.10. CGE results for tobacco price shocks



Source: Dorward *et al*. (2004).

Extension of the farm household and IRE model to Zimbabwe

One test of the wider applicability of the farm household / IRE model was its application to a different set of livelihood systems in Zimbabwe. This involved accommodating a number of structural differences from the Malawi model, including: a more important role for livestock, notably as a source of power; significant irrigated vegetable production; different agro-climatic conditions (especially more variable rainfall); greater off-farm income and migrant labour opportunities. In addition, the sources of available data were different, with the absence of a comparable household survey meaning that even data for the household typology had to be compiled from diverse sources. Nevertheless, the broad structure of the Malawi model was successfully applied to Zimbabwe. The model performed well in predicting production levels and patterns in the base year (see background paper).

The same logic as in Malawi also applies in terms of the farm household and IRE results, but the magnitude of the different impacts varies because of the differing structures of the two economies. For example, in more productive areas of Zimbabwe (nearer Harare) more intensive maize technologies become more profitable with higher maize prices, which stimulates both a supply response and increased demand for labour, which in turn pushes up wages. However the poor are concentrated in drier and less productive areas of southern Zimbabwe, where increased prices do not lead to an intensification of maize production. In contrast with Malawi, therefore, people living in these areas are not able to benefit much from the tightening of labour markets in the more productive areas further north, so maize price increases have an unequivocally negative impact.

Budget analysis

This part of the analysis used simpler spreadsheet methods to approximate the results of the farm household and IRE models. Standard enterprise budgets for household activities are combined into livelihood budgets for different household types, and these are then aggregated into a SAM for the informal rural economy. The impacts of exogenous change are investigated first on individual enterprises (step 1). Livelihood budgets are then adjusted to take advantage of new opportunities or to react to new constraints in the enterprise budgets (step 2), and these new livelihood budgets are then aggregated to estimate a new SAM (step 3). If the new SAM is inconsistent with expected rest of the world elasticities of demand or supply for labour and maize, then wages and/or maize prices are adjusted, and steps 1 to 3 repeated with these new prices. This process is repeated iteratively until a reasonable degree of consistency is reached.

The method yields broadly similar results to those from the farm household and IRE models. Obtaining results manually should therefore be sufficient for the non-expert user wishing to apply this modelling approach in many situations. Indeed, this form of spreadsheet analysis has the added benefit of transparency, forcing the analyst to clarify his/her awareness of the economic mechanisms at work. Furthermore, where data is of poor quality there may be little advantage in gaining more rigorous results from formal optimising models.

Conclusions

Analytical lessons

These analytical approaches are clearly viable, even in countries as poor as Malawi, where there are data deficiencies and methodological problems arising from the fact that markets are imperfect and a large share of economic activity does not occur in the form of monetary transactions. Indeed the models are particularly well suited to capture key elements of a poor, agriculture-based rural economy that differs fundamentally from economies with more developed markets and institutions. Important features include different behaviours from one group to the next, depending on the constraints which govern economic decisions, and imperfect integration with markets. In some cases this leads to perverse (*i.e.* non-standard) responses to shocks.

An important consequence of cash constraints, seasonal constraints and transactions costs (which cause market prices to differ from opportunity costs) is that policy impacts are non-linear. In other words, the amount of reform can have a fundamental bearing on the way in which households are affected. For example, some household may lose from a small increment in maize prices as this raises their food costs, but gain if the increase is sufficiently large to transfer them into net surplus producers.

Second order market interactions and dynamic impacts are also important. These can amplify the initial impact of reform, but they can also dampen or even reverse it. Thus net sellers of maize may benefit further from induced higher wages, while net buyers may see their losses reduced or (if the labour market is especially tight) offset entirely. Moreover, second round interactions mean that households that are not directly influenced by reform may nevertheless be influenced indirectly, for example through impacts on wages or cross-commodity price linkages.

However, second order effects are particularly sensitive to modelling assumptions, such as supply elasticities. It is often difficult to obtain reliable estimates of these parameters, particularly when (as the recent famine in Malawi has shown) these are likely to vary dramatically between the short and long run. This underlines the importance of sensitivity analysis.

Simple (accounting-type) models can capture the direct and immediate impacts of reform quite well, and can be tweaked to suggest plausible second round impacts. Indeed, such manual procedures are a handy device for reasoning through second round impacts that are sensitive to modelling assumptions (*i.e.* lack robustness). However, such approaches are less suited to explaining longer term adjustment and growth dynamics.

Policy lessons

In Malawi, shocks emanating from world markets are small relative to domestic shocks. This is because of the precariousness of domestic agriculture, a related lack of integration with commercial markets, and the tendency of trade to be driven by emergency demands for imports rather than commercial considerations. There is some impact through the tobacco market, but Malawi faces little external protection for this product, and gains from liberalisation in the form of higher world prices may be offset by an erosion of trade preferences, notably for sugar.

Models of the type developed in this study are generally useful for understanding the distributional implications of domestic policy reform, and can make a valuable distinction

between impacts over the short, medium and long term. In general terms, the applications provide important insights into the constraints to agricultural development, and how an alleviation of those constraints can contribute to poverty reduction in Malawi and southern Africa more generally.

They also have a more immediate practical value in describing the short to medium term impacts of agricultural policy reform and other shocks. In particular, the farm household livelihood/IRE models provide valuable insights that can be approximated by relatively simple techniques, provided that estimates are cross-checked from time to time with more formal applications.

The results from this kind of analysis should enable policy makers to identify pressure points and place a quantitative order on the scale of impacts. This should form the basis for policy interventions that can smooth the process of reform — such as adjustment assistance, help in overcoming cash constraints, the provision of incentives to adopt efficient farming practices, and emergency support where necessary.

Chapter 8.

Mexico

Scope and objectives

This study examines the effects of policy and market reforms on Mexico's agricultural and rural economy. Its purpose is to provide insights into how major policy reforms affect a diversified rural economy such as Mexico's, and to suggest a framework for exploring distributional and adjustment questions in Mexico and elsewhere.

The approach uses disaggregated modelling techniques, in order to quantify the diverse impacts of reform on different constituencies. A key feature of the analysis is that it takes into account the different responses of subsistence and commercial producers to policy changes, as well as the market linkages that transmit impacts from directly affected households to others in the rural economy.

The underlying premise of the study is that the effects of reform will vary from one rural region to another, depending on the structure of the rural economy. These diverse impacts cannot be captured by pure micro household models or by aggregate computable general equilibrium models. This application bridges across the two techniques, and acknowledges the important interactions between subsistence and commercial producers in rural Mexico.

Overview of model development

The approach adopted in this study links farm household models into 5 distinct rural economy-wide models, representing the five rural regions of Mexico: Northwest, Northeast, West-Centre, Centre and South-Southeast.

The farm household model is the basic building block for the rural economy models. These models can account for imperfect market environments, including those in which subsistence farmers operate. In these models, production and consumption decisions are linked. As producers, households decide how much of their labour and other resources will be allocated to family production, and how much to wage labour activities, including migration. As consumers, they decide how to allocate their incomes from farm profits, wages and remittances to the consumption of goods and services. By consuming all or part of its own output that could alternatively be sold at a given market price, the household implicitly purchases goods from itself. By demanding leisure or allocating its time to household production activities, it implicitly buys time, valued at the local market wage, from itself. Agricultural households stand in contrast with agribusiness-operated commercial farms, which consume a very small share, if any, of their own output and supply few, if any, of their own inputs.

In these models, prices are either exogenous, determined in outside markets, or else they are endogenous shadow prices, specific to the household. Household decisions have no cumulative effect on local prices, such as wages and land rents. This link is provided by building the farm household models into a wider rural economy model.

The rural economy models comprise four types of household, that collectively account for the entire rural population. These are: (1) commercial farms on large landholdings, which behave more like firms than like households; (2) net-surplus producing family farms on medium and small holdings, typical of small owner-operated farms of medium productivity; (3) subsistence and infra-subsistence household farms, typical of small-scale, low productivity agriculture, frequently operating under marginal conditions and incomplete markets; and (4) landless rural households.

This typology works well to describe the socioeconomic landscape of rural Mexico. However, the same household category does not look the same in all regions. For example, rural households in the northwest, a centre of irrigated commercial-export production, respond to different ecological and market conditions than households on rain fed lands in the Southeast (*e.g.* Oaxaca) or in the high emigration states of West-Central Mexico. Because of this heterogeneity, separate models are estimated not only for each household type, but also for each of the five census regions in Mexico - in total, 20 distinct household-farm models.[1]

For each region, four farm household models are nested within a rural CGE model. Given that the national rural household survey (2003) provides regionally representative data, each regional model is representative of a typical village economy in the region.

The CGE model determines the (net) marketed surplus of tradable commodities as the difference between supply and demand. Prices for village tradables are exogenous, determined by markets outside the village or by policy. Prices of village non-tradables (land and hired labour) are endogenous, with local supply equal to demand, and individual household price takers. For households that do not participate in local markets, prices are unobserved shadow prices, and the marketed surplus is zero.

The exogenous variables to the system are the prices of tradables, the peso-dollar exchange rate and government transfers. These variables are shocked in order to estimate the effects of alternative policy reform scenarios.

Results from the disaggregated rural economy model

A series of stylised policy and market shocks are applied to each of the five disaggregated regional models, corresponding to effects that have been strongly felt in Mexico. These include price shocks (to maize and cash crops), migration experiments (urban wage increases and peso devaluation) and government transfers (PROCAMPO and PROGRESA payments). The purpose of these stylised shocks is to highlight some of the key differences across regions, in order to demonstrate the value of the modelling approach. In addition a realistic global reform shock is applied, that takes price and urban wage changes for Mexico from the same GTAPEM scenario as that used to describe the aggregate market and welfare impacts of reform at the global level, namely a 50% cut in all import tariffs, a 50% cut in agricultural export subsidies and a 50% reduction in agricultural budgetary payments in OECD countries.

10% maize price decrease (Central Mexico and North-West)

This experiment compares the implications of reducing maize price supports by 10% in Central Mexico, where most households do not produce a marketed maize surplus (Table II.8), with the North-West, where maize is dominated by commercial producers operating on irrigated land (Table II.9). The latter are more directly affected by the decrease in maize prices, and have greater potential to shift land into cash crops.

Table II.8. Percentage effects of a 10% decrease in the price of maize in Central Mexico

	Landless households	Households <2 ha	Households 2-5 ha	Households >5ha
Production				
Maize	0.09	0.12	0.17	-11.76
Cash crops	2.21	0.51	0.48	0.50
Livestock	0.63	0.82	0.62	0.78
Non-agriculture	0.34	0.20	-	0.20
Factors				
Employment				
Wages		-0.19		
Land rents		-0.42		
Prices				
Maize	-0.28	-0.24	-0.22	-10.00
Cash crops	0.00	0.00	0.00	0.00
Livestock	0.00	0.00	0.00	0.00
Incomes				
Nominal	-0.02	-0.03	-0.01	-0.85
Real	-0.01	0.01	0.02	1.58
Migration				
Domestic		0.20		
International		0.22		

Table II.9. Percentage effects of a 10% decrease in the price of maize in North-western Mexico

Variable	Landless households	Households <2 ha	Households 2-5 ha	Households >5ha
Production				
Maize	-46.63	-17.43	-20.10	-52.42
Cash crops	6.01	1.16	3.97	15.13
Livestock	4.82	1.92	65.23	2.59
Non-agriculture	1.27	1.04	0.00	1.05
Factors				
Employment				
Wages		-1.03		
Land rents		-0.88		
Prices				
Maize	-10.00	-10.00	-10.00	-10.00
Cash crops	0.00	0.00	0.00	0.00
Livestock	0.00	0.00	0.00	0.00
Incomes				
Nominal	-0.12	-0.22	-4.27	-1.41
Real	-0.05	-0.19	-2.17	1.80
Migration				
Domestic		1.42		
International		1.57		

In both regions, the production of maize by commercial households contracts sharply in response to the price decrease. This leads to a significant drop in maize output in the North-West, where commercial production dominates.

The contraction in commercial maize production decreases the demand for land and labour, causing rents and wages to decline and reducing the incomes of subsistence households. This should reduce subsistence households' demand for maize, and with it the shadow price of maize, causing production to fall. This is indeed what happens in the North-West. But because land and labour are inputs, lower rents and wages also stimulate production. In Central Mexico this effect dominates, with the subsistence production of maize rising in response to a price fall, as well as the production of other goods that benefit from cheaper inputs, including livestock.

These changes are reflected in diverse effects on income distribution. Commercial households lose or gain according to their net surplus or deficit. Net sellers in the North-West therefore lose significantly. Non-commercial households are worse off in the North-West, but are largely unaffected in Central Mexico.

10% increase in the price of cash crops (Central Mexico and North-East)

On the relatively low productivity farms of Central Mexico, cash crop production increase moderately – between 3% and 4% – for most household groups (Table II.10). In the North-East, however, cash crop production increases sharply for two out of four household groups (Table II.11). This drives up wages and, even more so, land rents. In the two smaller groups of producers, cash crop production falls as land is bid away by more efficient producers. As a result, incomes of larger farm households rise by nearly 5%, while those of smaller farm households are virtually unchanged. By contrast, incomes rise across the board in Central Mexico.

Table II.10. Percentage effects of a 10% increase in the price of cash crops in Central Mexico

	Landless households	Households <2 ha	Households 2-5 ha	Households >5ha
Production				
Maize	-1.56	-2.30	-2.80	-7.93
Cash crops	17.41	4.00	3.92	4.14
Livestock	-13.69	-17.80	-13.45	-16.71
Non-agriculture	-5.51	-3.17	-	-3.17
Factors				
Employment				
Wages		3.28		
Land rents		11.87		
Prices				
Maize	7.08	6.53	5.97	0.00
Cash crops	10.00	10.00	10.00	10.00
Livestock	0.00	0.00	0.00	0.00
Incomes				
Nominal	1.99	2.45	2.24	3.93
Real	1.67	1.47	1.29	3.91
Migration				
Domestic		-3.29		
International		3.58		

Table II.11. Percentage effects of a 10% increase in the price of cash crops in North-eastern Mexico

	Landless households	Households <2 ha	Households 2-5 ha	Households >5ha
Production				
Maize	-5.26	-30.17	-24.05	-6.05
Cash crops	113.29	-5.66	-2.23	24.32
Livestock	-15.75	-14.98	-14.98	-16.13
Non-agriculture	-0.75	0.00	0.00	-0.64
Factors				
Employment				
Wages		0.65		
Land rents		16.86		
Prices				
Maize	3.81	0.00	0.00	0.00
Cash crops	10.00	10.00	10.00	10.00
Livestock	0.00	0.00	0.00	0.00
Incomes				
Nominal	0.16	0.51	-0.02	4.62
Real	0.04	0.51	-0.04	4.55
Migration				
Domestic		-1.28		
International		2.39		

10% increase in urban wages (Central Mexico and North-East)

This experiment is used to simulate the effects of an increase in the returns to internal migration. The effects of an urban wage increase are generally small (less than 1%), due to the small value of remittances sent home by the average internal migrant, and the mildly negative effect that competition with urban labour markets has on local production (Table II.12 and Table II.13). In the North-East, however, there are significant gains to smallholders with less than 2 ha. This experiment is not intended to simulate the effects of rural non-farm wages, which are playing an increasingly important role in rural household income. While remittances from internal migrants represent no more than 2% of total rural household income, rural non-farm wages represent nearly 50%. Thus, increases in rural non-farm wages and rural non-farm employment can have a significant effect on rural household incomes.

Table II.12. Percentage effects of a 10% increase in the urban wage in Central Mexico

	Landless households	Households <2 ha	Households 2-5 ha	Households >5ha
Production				
Maize	-0.05	0.00	0.39	-0.01
Cash crops	-0.05	-0.01	-0.01	-0.01
Livestock	-0.02	-0.01	-0.02	-0.02
Non-agriculture	-0.04	-0.02	0.00	-0.02
Factors				
Employment				
Wages		0.02		
Land rents		-0.01		
Prices				
Maize	0.03	0.00	0.20	0.00
Cash crops	0.00	0.00	0.00	0.00
Livestock	0.00	0.00	0.00	0.00
Incomes				
Nominal	0.19	0.00	0.69	0.27
Real	0.19	0.00	0.66	0.27
Migration				
Domestic		10.36		
International		-0.02		

Table II.13. Percentage effects of a 10% increase in the urban wage in North-eastern Mexico

	Landless households	Households <2 ha	Households 2-5 ha	Households >5ha
Production				
Maize	0.08	0.01	0.00	-0.01
Cash crops	-0.07	0.01	0.00	-0.01
Livestock	0.00	0.00	0.00	0.00
Non-agriculture	-0.01	0.00	0.00	-0.01
Factors				
Employment				
Wages		0.01		
Land rents		-0.01		
Prices				
Maize	0.09	0.00	0.00	0.00
Cash crops	0.00	0.00	0.00	0.00
Livestock	0.00	0.00	0.00	0.00
Incomes				
Nominal	0.15	8.38	0.05	0.14
Real	0.15	8.38	0.05	0.14
Migration				
Domestic		11.82		
International		-0.33		

10% peso devaluation (Central Mexico and North-West)

This experiment is used to simulate the effects of increased returns to international migration, as might result from either employment or wage increases in the United States, or a devaluation of the Mexican peso relative to the US dollar. A 10% peso devaluation raises the domestic value of US remittances and has a much stronger effect than increases in remittances from internal migrants. It increases the incomes of households that receive remittances, and of households that sell goods and services to remittance earning households. On the other hand, it lowers the incomes of cash crop producers who compete with migration for their labour supply. Incomes rise substantially in Central Mexico — by 4.7% for small farm households and 4.9 among the landless (Table II.14), while the gains are virtually negligible in the North-West, where small farmers' incomes rise by 1.4% (Table II.15).

In some cases, subsistence households increase their production of maize, as remittances stimulate consumption demand. Some of this effect is counteracted by upward pressure on local wages.

Table II.14. Percentage effects of a 10% increase in the exchange rate in Central Mexico

	Landless households	Households <2 ha	Households 2-5 ha	Households >5ha
Production				
Maize	1.35	1.93	1.86	-0.45
Cash crops	-1.94	-0.49	-0.49	-0.51
Livestock	-0.60	-0.36	-0.57	-0.66
Non-agriculture	-1.78	-1.01	-	-1.01
Factors				
Employment				
Wages		1.02		
Land rents		-0.45		
Prices				
Maize	0.77	1.68	1.21	0.00
Cash crops	0.00	0.00	0.00	0.00
Livestock	0.00	0.00	0.00	0.00
Incomes				
Nominal	4.94	4.96	3.58	2.07
Real	4.90	4.70	3.39	2.07
Migration				
Domestic		-1.05		
International		10.12		

Table II.15. Percentage effects of a 10% increase in the exchange rate in North-western Mexico

	Landless households	Households <2 ha	Households 2-5 ha	Households >5ha
Production				
Maize	0.43	-0.06	-0.08	-0.26
Cash crops	-0.21	-0.04	-0.13	-0.49
Livestock	0.59	-0.06	11.90	0.08
Non-agriculture	-0.33	-0.27	0.00	-0.27
Factors				
Employment				
Wages		0.27		
Land rents		-0.21		
Prices				
Maize	0.00	0.00	0.00	0.00
Cash crops	0.00	0.00	0.00	0.00
Livestock	0.00	0.00	0.00	0.00
Incomes				
Nominal	1.40	0.23	0.07	0.21
Real	1.40	0.23	0.07	0.21
Migration				
Domestic		-0.37		
International		14.97		

PROCAMPO (Central Mexico and North-West)

In this experiment, a 10% maize price support is introduced and PROCAMPO payments (which are linked to area cultivated) are reduced by an equivalent peso amount. The decrease in PROCAMPO payments is spread across households in proportion to their actual receipt of these payments as reported in the 2003 survey.

Maize production on commercial farms in central Mexico would have been nearly 12% higher with the price support instead of the PROCAMPO subsidy (Table II.16). Wages and land rents would also have been higher, although not by much (0.22 and 0.48% higher, respectively). However, incomes would have been slightly lower, and subsistence production would have been slightly lower, as well, because of the muted increase in received prices and higher land rents. There would have been less migration without the decoupling policy change, but only slightly. In the commercial northeast, maize production would have been substantially higher, and cash crop production slightly lower, had maize price supports not been replaced by PROCAMPO payments. The income effects would have been mixed (Table II.17). In real terms, because rural households consume maize, incomes would have been slightly lower in most cases without the decoupling policy change.

Table II.16. Counterfactual PROCAMPO decoupling experiment in Central Mexico

	Landless households	Households <2 ha	Households 2-5 ha	Households >5ha
Production				
Maize	-0.11	-0.25	-0.26	11.89
Cash crops	-2.43	-0.58	-0.54	-0.56
Livestock	-0.71	-0.91	-0.69	-0.87
Non-agriculture	-0.39	-0.22	-	-0.22
Factors				
Employment				
Wages		0.22		
Land rents		0.48		
Prices				
Maize	0.31	0.17	0.22	10.00
Cash crops	0.00	0.00	0.00	0.00
Livestock	0.00	0.00	0.00	0.00
Incomes				
Nominal	-0.03	-0.25	-0.11	-0.47
Real	-0.04	-0.28	-0.14	-2.47
Migration				
Domestic		-0.23		
International		-0.25		

Table II.17. Counterfactual PROCAMPO decoupling experiment in North-eastern Mexico

	Landless households	Households <2 ha	Households 2-5 ha	Households >5ha
Production				
Maize	-0.03	36.36	38.06	12.25
Cash crops	-0.73	-0.04	-0.02	-0.34
Livestock	-0.04	-0.04	-0.04	-0.05
Non-agriculture	0.00	0.00	0.00	0.00
Factors				
Employment				
Wages		0.01		
Land rents		0.04		
Prices				
Maize	-0.01	10.00	10.00	10.00
Cash crops	0.00	0.00	0.00	0.00
Livestock	0.00	0.00	0.00	0.00
Incomes				
Nominal	-0.02	-0.14	0.77	-0.10
Real	-0.02	-0.36	0.30	-0.36
Migration				
Domestic		0.00		
International		-0.17		

PROGRESA (Central Mexico and North-West)

PROGRESA, which is designed as a needs based programme, has a more progressive effect on income distribution than PROCAMPO. Without PROGRESA payments, incomes in landless households would be more than 7% lower, and incomes in

smallholder households would fall by more than 4%. Termination of PROGRESA would have little or no effect on commercial maize production in either region (Table II.18 and Table II.19). However, subsistence production in central Mexico would fall by between 1.3% and 2.1%. PROGRESA payments, to a much greater extent than PROCAMPO, stimulate subsistence production by raising incomes and thus maize demand in poor smallholder households.

Table II.18. Percentage effects of terminating PROGRESA in Central Mexico

	Landless households	Households <2 ha	Households 2-5 ha	Households >5ha
Production				
Maize	-2.14	-1.87	-1.33	0.10
Cash crops	0.63	0.15	0.14	0.14
Livestock	0.18	0.25	0.18	0.23
Non-agriculture	0.04	0.02	-	0.02
Factors				
Employment				
Wages		-0.02		
Land rents		-0.16		
Prices				
Maize	0.00	0.00	0.00	0.00
Cash crops	0.00	0.00	0.00	0.00
Livestock	0.00	0.00	0.00	0.00
Incomes				
Nominal	-7.42	-4.72	-2.30	-3.53
Real	-7.38	-4.48	-2.41	-3.53
Migration				
Domestic		0.00		
International		0.00		

Table II.19. Percentage effects of terminating PROGRESA in North-western Mexico

	Landless households	Households <2 ha	Households 2-5 ha	Households >5ha
Production				
Maize	0.00	0.00	0.00	0.00
Cash crops	0.00	0.00	0.00	0.00
Livestock	0.00	0.00	0.00	0.00
Non-agriculture	0.00	0.00	0.00	0.00
Factors				
Employment				
Wages		0.00		
Land rents		0.00		
Prices				
Maize	0.00	0.00	0.00	0.00
Cash crops	0.00	0.00	0.00	0.00
Livestock	0.00	0.00	0.00	0.00
Incomes				
Nominal	-4.77	-1.01	-2.31	-0.15
Real	-4.77	-1.01	-2.31	-0.15
Migration				
Domestic		0.00		
International		0.00		

Multilateral reform scenario

This policy experiment takes the changes to producer prices and urban wages that GTAPEM predicts would result from a 50% cut in all import tariffs, a 50% cut in agricultural export subsidies and a 50% reduction in agricultural budgetary payments in OECD countries. The experiment thus adopts the same scenario as that used to describe the aggregate market and welfare impacts of reform at the global level. For Mexico, the prices of livestock products are predicted to fall by 0.7%, while cash crop prices fall by 0.8%, maize prices fall by 0.4% and urban wages decline by 0.2%. It is assumed that the exogenous fall in maize prices is only felt by larger producers (with more than 5 ha) who are integrated with national markets.

Under this scenario (Table II.20), the real incomes of all agricultural households fall, but the declines are greatest for producers with more than 5 ha of land (-0.4%). There are similar, but much smaller impacts for landless households and smaller producers with less than 5 ha (-0.1%). There are two principal reasons why larger farmers lose more: first, they tend to consume a smaller share of their own output, so declining output prices have a bigger impact on net income; second, larger scale producers on balance rent land out to smaller farmers and lose out from declining land rents. It is important to note that these are average impacts for Mexico, obtained using average products and wage price impacts from GTAPEM, and could mask regional differences of the sort described in the stylised policy experiments.

Table II.20. Percentage effects of price shocks resulting from multilateral trade reform

	Landless households	Households <2 ha	Households 2-5 ha	Households >5ha
Production				
Maize	0.15	0.20	0.24	1.22
Cash crops	-1.14	-0.28	-0.28	-0.30
Livestock	-0.14	0.01	-0.13	-0.14
Non-agriculture	0.63	0.48	0.13	0.44
Factors				
Employment				
Wages, urban		***-0.20***		
Wages, rural		-0.26		
Land rents		-1.01		
Prices				
Maize	-0.60	-0.57	-0.52	-0.40
Cash crops	***-0.80***	***-0.80***	***-0.80***	***-0.80***
Livestock	***-0.70***	***-0.70***	***-0.70***	***-0.70***
Incomes				
Nominal	-0.16	-0.24	-0.22	-0.33
Real	-0.13	-0.15	-0.13	-0.40
Migration				
Domestic		0.002		
International		0.03		

Price and changes are taken from GTAPEM; exogenous changes are in bold.

Finally, it should be noted that migration and policy changes may have dynamic effects on Mexico's rural economy that are not easily captured by simulation models. For example, migrant remittances and PROCAMPO payments may loosen liquidity

constraints on production, creating an income multiplier within households in addition to the income multipliers among households that are captured by the model used in this study. This would tend to reinforce the positive effects of migration and public transfers on rural incomes.

Conclusions

The findings of this study confirm the prior expectation that when agricultural prices fall, larger scale commercial producers lose more than smaller scale farmers. In this case, the result arises because own-consumption is less important to commercial farmers who also lose from declining land rents. More generally, the stylised experiments highlight the importance of using a disaggregated approach to modelling the impacts of policy changes in rural economies; one that takes into account the heterogeneity of rural households and their activities, differences between subsistence and commercial producers, and regional variation in agricultural production and markets. Disaggregated models reveal sometimes striking differences in the impacts of policy changes on rural households and the behavioural responses of those households. Most importantly, perhaps, they may provide a basis for targeting adjustment policies to specific rural household groups, sectors and regions.

Note

1. One could imagine a still more detailed disaggregation of household types, for example, between private and *ejido*, or reform sector, farms; or between households with migrants in the United States and those without. This would add several additional household types per region, but would considerable complicate the process of estimation. In the case of *ejido* farms, distinct categorisations are often not possible, as some households have both ejido and private lands. According to the 2003 Mexico Rural National Household Survey (ENHRUM), which provided the data for this study, 49% of rural Mexican households have land and 28% have *ejido* land. Moreover, a 1992 constitutional amendment ended the special legal status and permitted the sale or rental of collectively-controlled *ejido* lands. The vast majority of *ejido* plots are farmed privately rather than collectively, and there is little difference in income sources, including the share of migrant remittances and government transfers, between households with *ejido* plots and those with private land. An advantage of the ENHRUM over data used in past studies (*e.g.* the Mexico Ejido Survey or the PROGRESA surveys) is that the ENHRUM data are nationally representative of rural households; unlike the Mexico Ejido Survey they are not limited to *ejidos*, and unlike the PROGRESA survey they are not limited to the poorest communities in Mexico.

Chapter 9.

United States[1]

Scope and objective

Global agricultural trade policy reform will lead to changing market opportunities for U.S. agriculture — stimulating demand for some commodities, but reducing demand for other U.S. products. Policy makers are often concerned about the process of adjustment, in which producers reallocate their resources in response to changing economic conditions. If agricultural producers are limited in their capacity to adjust, they may face lower returns to their farm labour and investment, at least in the short run. Conversely, when producers can readily shift their resources into sectors with expanding market opportunities, the potential efficiency-based gains from policy reform are more likely to be realized.

In this section, we develop a U.S. macro-micro model that reflects diversity in the exposure of producers to the effects of a global trade reform, and in their capacity to reallocate their resources. We use the macro model to simulate the aggregate effects of a stylized scenario of global agricultural policy reform. We use the micro model to distribute aggregate outcomes across individual U.S. farms based on differences in their capacity to adjust their resource allocations. We describe adjustment capacity using two *ex ante* measures linked to endowments of human capital: the probability of the operator working off-farm and the farm operator's managerial capacity.

The macro model

Macro model structure

Our macro analysis is based on a Computable General Equilibrium (CGE) model for the United States developed and maintained at USDA-ERS (Hanson, 2002).[2] The CGE framework allows us to capture the economy-wide impacts of a stylized trade policy scenario. Our micro-simulation model then distributes the economy-wide changes in household income, farm labour, non-farm labour, and taxes to individual farm households.

In the macro model, households receive income from three main sources: earnings from wages and salaries and from self-employment; capital income from the ownership of assets–dividends, interest, and rent; and transfer payments. Farm household income also includes program payments that are tied to the production of specific commodities, and farm transfer payments that are treated as pure transfers to household income.[3] Households use their income to consume goods and services, pay taxes, and save. Income from farm sectors accounts are also used for payments to hired labour and to non-operator owners of farm assets. Labour supply and demand are treated with occupational detail. Only farm households supply "farm operator" as an occupation, while all households, including farm households, supply labour by the operator and the spouse to a number of other occupations.

In the macro model, we divide farm households into seven representative types, and a non-farm household category. Drawing on data from the Agricultural Resource Management Survey (ARMS, USDA), we categorize farm households according to the primary occupation of the farm operator, and size of farm sales. [4] Each farm type produces its own mix of agricultural commodities, based on ARMS data. The distribution of subsidies among farm households is in proportion to their production of commodities that are supported through government programs. Farm households reallocate their resources and adjust their farm production activities in response to changes in the farm income (self-employed earnings) they generate or earn.

Adjustment to a stylized scenario of agricultural trade reform

World agricultural markets are distorted by the widespread use of import tariffs, export subsidies, and trade-distorting domestic support. We use our macro model to simulate the effects of a global agricultural trade policy scenario reported by Cooper *et al*. (2003) in which tariffs, export subsidies, and trade-distorting support are eliminated.[5] In that scenario, Cooper *et al.* find that U.S. agricultural producers realize net benefits. Global reform leads to increased world prices and higher U.S. agricultural exports, due primarily to the removal of global tariffs. Note that their model captures the effects associated with eliminating policy distortions in a very stylized fashion. The results of their scenario depend on the initial set of relative prices and on subsidy levels which, in turn, depend on market conditions in the year of the analysis and the price-effects of the global reform process. Their model also does not account for economy-wide response and adjustment.

Macro-simulation of the impacts of stylized reform

In the macro model, agricultural producers adjust to shocks through market mechanisms: by changing their production mix, the household's labour allocations, and on- and off-farm investment. To the extent possible, farmers and households will shift resources away from production, employment, or investment in sectors where returns are falling, and into sectors where returns are rising. In the macro model, farms and households that are already diversified in their production and household economic activities have greater scope for adjustment than do households that are more specialized in farm production in the short run.

We introduce the impacts reported in Cooper *et al*. as exogenous shocks to our macro model. We find that the global trade policy reform will affect the incomes of the seven U.S. farm household types differently, depending on their reliance on subsidies, and their production mix as well as the role of farm and non-farm activities in households' income and asset portfolio. In Table II.21, we describe the incidence of payment loss across the seven farm household types. Very large farms receive more farm subsidies than other types of farms, and this stylized reform would result in an average loss of subsidies for this farm type of roughly USD 6 000, compared to an average loss of USD 50 on retirement farms. However, relative to the value of production, the payment reduction is largest for residential and farm occupation farm types.

Table II.21. Incidence of Payment Loss by Farm Types from a Stylized Trade Policy Reform

Farm type	Number of farms	Total payment loss by farm type	Average payment loss per-farm	Average loss in cents per dollar of production
	Thousands	USD million	USD	US cents
Limited resource	127	9	69	0.57
Retirement	298	14	46	0.83
Residential/lifestyle	931	75	81	1.00
Farm occupation/low sales	480	161	336	1.17
Farm occupation/high sales	175	343	1 955	1.20
Large	77	309	4 000	0.45
Very large	58	341	5 833	0.79
All	2 147	1 252	583	0.79

Source: ARMS, 1999 and ERS-USDA CGE model

The changes in farm household income reported in Table II.22 take into account the households' compensating adjustments to the policy reform. The net effect of a stylized-type of trade reform on incomes is composed of changes in farm and off-farm wages, returns to assets, farm program payments, and taxes that would have been paid to fund these payments, as well as the impact of price changes on the cost of household food purchases. On net, household income of U.S. farms increases nearly USD 500 million due to the global reform, with net gains for every representative farm type. The greatest income gains accrue to residential and lifestyle farms. These are the farms with the most part-time spousal employment. They therefore have the greatest capacity for labour substitution in the macro model, and the largest on-farm labour supply response. They also tend to specialize in beef production, for which market prices rise. Despite over-all net gains for each representative farm type, some net losses are likely to be experienced at the individual farm level. Our seven farm types are too aggregated to reflect the specialization that characterizes most farms, and that can be expected to result in gains (losses) for individual farms that specialize in commodities whose prices increase (decrease) following global reform.

Table II.22. Changes in U.S. farm household impacts from a stylized-type global agricultural policy reform (USD million)

	Program payments	Farm labour income	Returns to farm assets	Off-farm labour income	Other non-farm income	Tax expen-diture	Total house-hold income
Limited resources	-9	6	9	-1	0	-1	4
Retirement	-14	46	17	-5	3	-6	41
Residential/lifestyle	-75	148	96	-21	3	-10	141
Farm occupation low sales	-161	87	179	-11	3	-10	87
Farm occupation high sales	-343	59	376	-8	0	-6	78
Large	-309	42	338	-6	0	-4	61
Very large	-341	84	338	-9	0	-4	68
All farms	-1 252	471	1 353	-58	10	-40	484

The micro model

Our micro-simulation describes variability not only within each of the seven representative groups but also among all U.S. farm households. In our micro model, we introduce two measures of adjustment capacity linked to human capital – the probability of off-farm employment, and managerial success. We describe the heterogeneity in these measures of adjustment capacity, and use them to distribute the income effects of global policy reform across the individual farm households within each typology.

Labour allocation adjustment capacity

Labour allocations to on- and off-farm work and to leisure are an important means for farm households to adjust to changes in farm-based income. For those operators and spouses who specialize in on-farm work, changes in farm wages and income will affect hours worked on the farm versus leisure or home time. Households in which farm operators already hold off-farm jobs have more flexibility to compensate for any changes in wages in one job by reallocating hours worked to others, as well as to changes in leisure and home time.

In general, what characteristics make it likely that a farm household can be successful in making adjustments through reemployment in non-farm work? Empirical research on non-farm employment has identified the importance of demographic characteristics and job tenure in determining the likelihood that an individual can successfully find reemployment following a job loss or reduction in wages. For example, Kletzer's (1998) review of recent literature on job displacement reported that higher education, younger age, low job tenure and non-minority race make reemployment more likely. Education is a critical factor; a college education is associated with significantly higher rates of reemployment compared to a high school education (Farber, 2003). Lengthy tenure tends to increase the length of unemployment. Long-term job experience creates industry-specific human capital that generates wage premiums that may not be recouped in a new industry. This can cause tenured workers to be less likely to search for jobs in new industries, or they may have a greater propensity to sit out what they perceive to be cyclical bad spells in their sector (Fallick, 1996). Gardner (1992) describes a similar labour adjustment process in agriculture in response to technological change, also focusing on the human capital and tenure aspects of adjustment. He attributes differences between farm and off-farm wages not only to the short run adjustment costs linked to job search and moving expenses, but also to the lower off-farm value placed on farm-specific skills derived from long-term experience.

The labour-force characteristics of U.S. farm operators suggest that for some, labour adjustment costs could be high, although many already work off-farm. Among the seven farm types, commercial farmers tend to be slightly younger than the average for all farms, and have fewer years experience on the farm. However, their labour is more specialized; a relatively small share of commercial farmers work any off-farm hours. Residential and lifestyle farmers are the youngest group and are relatively well educated, with the highest off-farm job participation.

Ahearn *et al.* (2002) analyze farm operators' off-farm work allocation in a study that includes labour-force and household characteristics such as age, education, household size, level of off-farm investments, and spouses' off-farm employment. Ahearn *et al*. also account for farm characteristics, including value of agricultural machinery, government

payments, and dummy variables by region of the country. Ahearn *et al.* in addition account for pull factors including labour market conditions within the farm-commuting zone, and shares of employment in different economic sectors.

We use the estimates by Ahearn *et al*. to develop an *ex ante* measure of labour reallocation capacity across farm household types that can be incorporated into our micro model. We apply the parameters described in Ahearn *et al.* to the data describing individual farms from the 1999 ARMS, allowing us to develop a measure of the probability of working off-farm for each operator in the survey. The advantage of using their results to develop a proxy for labour reallocation capacity is that it allows us to describe the probability of an individual farmer to adjust across labour markets following a shock, whether or not he or she already works off-farm. A high probability of working off-farm implies a stronger potential farm labour response to both positive and negative farm price shocks, and therefore a greater capacity to adjust resources in response to price signals.

In Table II.23, we report the aggregation of these data to the 7-way farm typology. Across the farm types, residential and lifestyle farmers are most likely to work off farm. Operators of very large farms and retirement farms are least likely to work off farm, based on their demographic, farm, and urban job environment characteristics.

Table II.23. Mean probability of operator working off-farm

	Mean probability of operator working off-farm %
Limited resource	41
Retirement	29
Residential / lifestyle	74
Farm occupation / low sales	46
Farm occupation / high sales	43
Large	36
Very large	35
Total	55

Source: ARMS, 1999 and ERS calculations based on Ahearn *et al.*, 2002.

Managerial capacity

A second measure of adjustment capacity in our micro model is the exercise of managerial human capital capacity to respond to and compensate for changing relative prices. Ideally, management capacity could be explained by the underlying characteristics of the farm and farm operator. Some recent research based on ARMS data supports the view that there are characteristics of farmers that are strongly associated with higher managerial ability. El-Osta and Morehart (1999) found that age, education, and the share of labour hours in farming were positively correlated with the adoption of management- and capital- intensive technologies in dairy production. McBride and El-Osta (2002) found that age and education were positively correlated with the adoption of genetically modified corn, while the number of years in farming was negatively correlated with adoption.

These two studies describe industries that have unique characteristics, which limits our ability to generalize their findings across U.S. agriculture. Instead, we argue that demonstrated high financial performance in farming is a likely predictor of a farmer's managerial capacity to reallocate resources due to changes in market conditions created by policy reform. This more general measure of financial performance allows potential farm adjustment to occur through a range of mechanisms, such as changes in production mix or scale of production, or the adoption of technological and managerial innovations.

We use a proxy measure for financial performance based on the total economic costs of production relative to total value of agricultural output. This proxy measure yields clear differences across farm types in financial efficiency (Table II.24).[6] Large farms are more efficient than small ones, suggesting the importance of scale in explaining farm success. Very large farms are the most efficient, with a 91% probability of high financial performance, while limited resource, lifestyle, and retirement farms are the least efficient.

Table II.24 Probability of high farm financial performance, by typology

Farm type	Percentile distribution
Limited resource	.43
Retirement	.39
Residential/lifestyle	.40
Farm occupation/low sales	.52
Farm occupation/high sales	.83
Large	.87
Very large	.91
Total	.50

Source: ARMS, 1999.

Micro simulation of global agricultural reform with heterogeneous adjustment capacity

In the micro-simulation, we combine the farm income results from the macro model, reported in Table II.22, with the characteristics of U.S. farm households described by the 1999 ARMS. The income effects from the macro model reflect adjustments to the stylized-type of global trade reform made by the seven representative farm types through changes in their production, employment and investment. The incorporation of household-level survey data in our micro-simulation allows us to describe the distribution of these changes in income across each individual farm within each typology. Our micro-simulation describes two distributional scenarios that highlight heterogeneity in both impact and adjustment. The first scenario emphasizes adjustment capacity based on the incidence of the subsidy impact. Called the payment shock index, the positive income effects of a comprehensive global reform of tariffs and subsidies are distributed proportionately to the incidence of subsidy payment removal. The second scenario emphasizes adjustment capacity based on household characteristics. Called the adjustment index, it combines information how human capital adjustment capacity varies across the farm population with information on heterogeneity in the incidence of changes in payments.

The first micro-simulation scenario simply distributes the positive income changes resulting from global removal of tariffs and subsidies within each farm typology in proportion to the share of an individual farm in the total change in payments of its typology. The behavioural assumption underlying the shock-indexed scenario is that the strength of a farm's adjustment response is proportional to the change in its payment. *Ex ante*, farms receiving a large subsidy are assumed to adjust more than farms receiving a small subsidy, and farms that did not receive a payment will not respond at all. Proportional response is likely to capture the first-order effects of the trade policy reform scenario because the type of payments removed are based on the actual level of production of specific commodities by recipient households. For example, the size of marketing loan benefits received by a farm household is proportional to its output of price-supported commodities, and translates into the removal of a per-unit price wedge that favours the production of those commodities over others. In contrast, households that do not produce the supported commodities are not directly affected by removal of the subsidy price wedge and are assumed to make minimal adjustments. A short-coming of this approach is that we do not also link a farm's adjustment response to its production specialization and the effects of global reform on commodity prices.

In the second micro-simulation, we incorporate heterogeneity in households' adjustment capacity by including our two human capital adjustment capacity indexes. We calculate an adjustment index that is calculated as the multiplicative product of the farm-specific share of the change in government payment (from the shock index), and in addition includes household-specific information on the probability of the operator working-off farm and the probability of successful farming (financial efficiency). The source of variability highlighted in this adjustment-indexed scenario describes differences among households in their opportunities to engage in alternative enterprises. Specifically, the skills and abilities held by farm operators and other household members are not identically distributed, nor do all regions of the country offer suitable farm and non-farm alternatives to households seeking to regain *ex ante* levels of well-being after a policy reform.

Box and whisker plots (Figure II.11) compare the distribution of outcomes associated with the stylized-type of global trade reform under both the shock-indexed and adjustment-indexed scenarios. The plots show the variation in impacts across households within each typology. Each box contains the range within the first and third quartile of impacts, while the whisker extends to 1.5 times the size of the box. The whisker does not extend into negative values because both farm and non-farm income increases under the global policy reform. As we mentioned earlier, an important caveat to our analysis is that when there are gains to a representative farm type in the macro model, all farms within each typology share in the gains from reform and there are no net losers.

Although the adjustment index increases the potential for variability in results, note that the results for the adjustment-indexed scenario appear to be compressed relative to the shock-indexed scenario. At first glance, this is counter-intuitive, although recall that both scenarios have the same aggregate impacts. A comparison of outliers (Figure II.12) with the box and whisker plots (Figure II.11) demonstrates the key feature of the adjustment-indexed scenario and why it actually results in greater variability in outcomes than in the shock-indexed scenario. That is, when observations outside the whisker are included (Figure II.12), two things become clear. First, it is the outlier observations that are responsible for much of the aggregate impacts in both scenarios. In three of the seven farm household types, some outliers record net income impacts of greater than USD 50 000, more than 25 times the median impact for any single group.

Figure II.11. Changes in Total Household Incomes (Excluding Outliers)

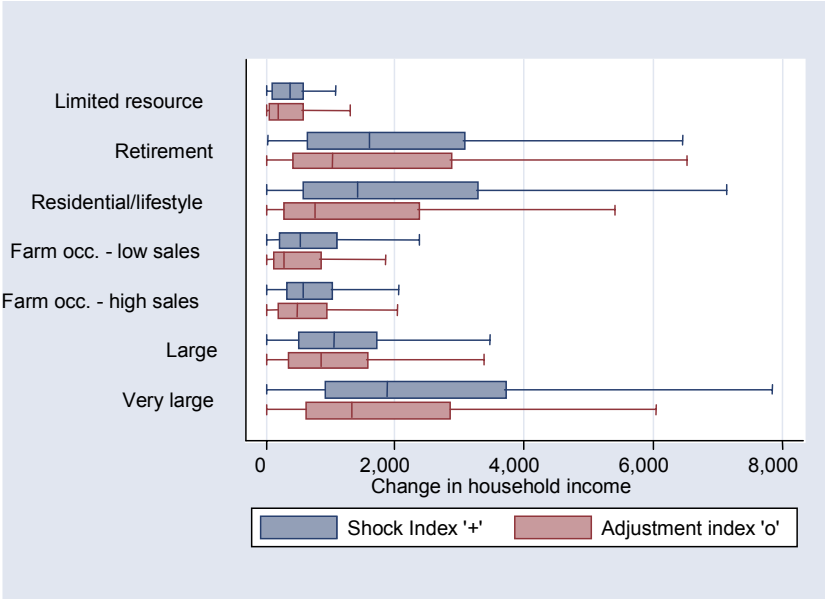
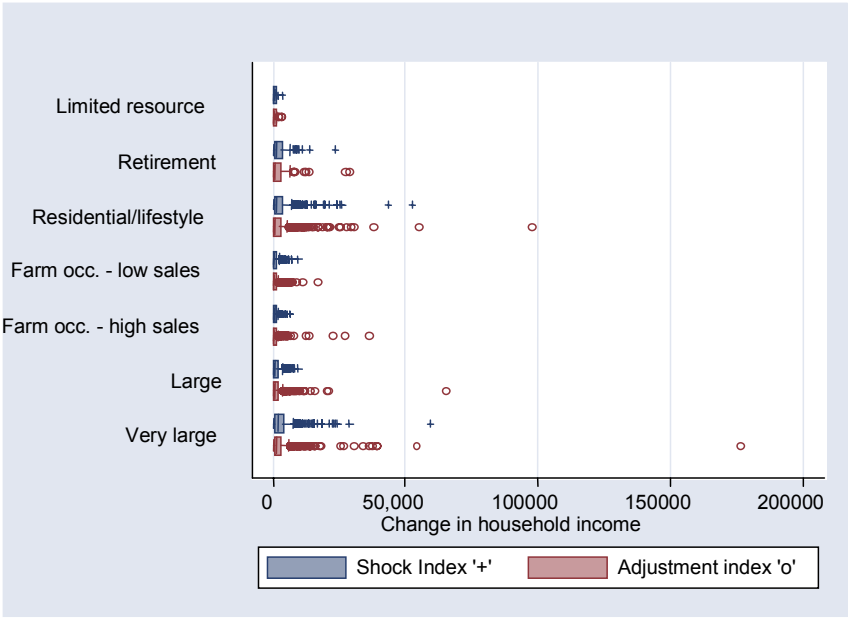


Figure II.12. Changes in Total Household Incomes (Including Outliers)

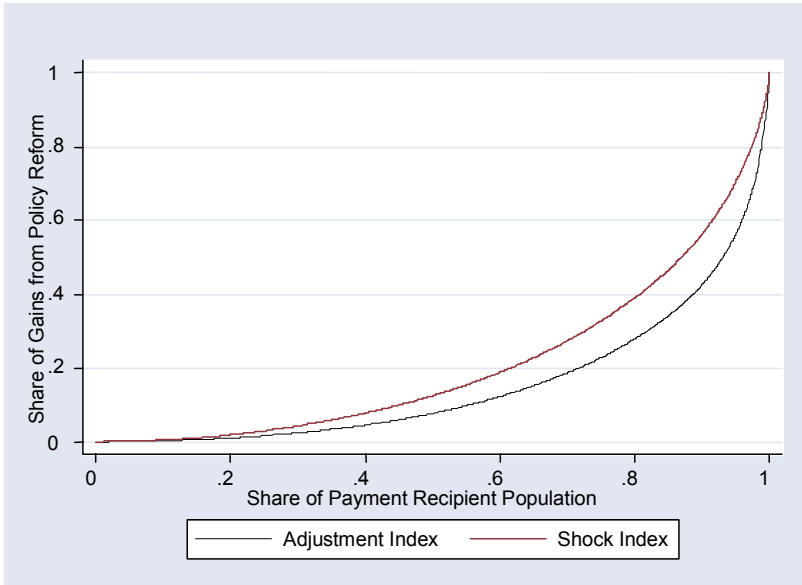


Second, the outlier impacts in the adjustment-indexed scenario are larger than the outlier impacts in the shock-indexed scenario. This is because all members of a group are measured relative to the group mean. Any farm household with an above-average adjustment index will garner more than they would have if response followed only the

size of the payments removed. In effect, households with below-average adjustment capacity give up their gains to households with above-average adjustment capacity. This "division of the spoils" functions in much the same way that later adopters give up some of their rents to early adopters when a new technology is introduced. With such large gains by a few farms within a group there remain fewer rents available for other farms also affected by the reform scenario.

A generalized Lorenz curve (Figure II.13) gives a better idea of the distributional impacts that occur, based on the differences in adjustment capacity described in the micro-simulation. For example, in the shock-indexed scenario, 40% of the gains from policy reform are shared among 80% of the farm population that received payments, meaning that 60% of the gains from policy reform were shared among only 20% of the population. In the adjustment-indexed scenario, less than 30% of the gains were shared among 80% of the farm population, and the remaining 70% of the gains were shared among 20% of the farm population. These changes in income distribution and equality within the U.S. agricultural sector based on heterogeneous adjustment capacity, present in a stylized fashion an aspect of equity issues that could enter the debate on agricultural adjustment to trade reform.

Figure II.13. Inequality in Changes in Household Income



Conclusions

Global agricultural trade policy reform will lead to changing market opportunities for U.S. agricultural producers and farm households. But adjustment to policy reform is likely to remain an important element in the trade policy debate because U.S. farm households are diverse, both in their exposure to policy reform shocks (due to their production mix and reliance on subsidies) and in their capacity to reallocate their resources as market conditions change. This chapter focuses on the heterogeneous distribution of adjustment capacity linked to human capital to describe the impacts of a stylized scenario of global reform on U.S. agriculture. We developed two measures of

human capital to describe adjustment capacity: the probability of off-farm work and farm financial management skills.

Policy makers will define the equity/distributional and/or efficiency goals to be pursued in any adjustment policy. Regardless of the balance of objectives that are set, policy design can be informed by analysis that identifies the farm households who are most likely to be impacted positively and negatively by the trade reforms, and that accounts for heterogeneity in their ability to reallocate their resources as market conditions change. The characteristics that differentiate farm households are not only their farm's production mix and current program benefits, but also household characteristics such as age, education, and managerial capacity, and access to alternative employment.

There are other aspects of trade shocks and farm and household adjustment that present important additional areas in which our research could be extended, and which could contribute to a more realistic debate on the benefits and costs of domestic and global policy reform. In addition to the adjustment capacity measures included in this analysis, farm households have other ways to adjust to and cope with change. They make dynamic adjustments by changing their savings and investment behaviour in response to changes in income, asset values, and wealth. The age of household members is linked to life-cycle considerations, and within-household dynamics also influence the way that households are likely to adjust. Incorporating adjustment mechanisms directly into the macro-simulation is another important area for further research. This will enable analysis that explicitly account for farms' commodity specialization and their adjustments to changes in relative prices due to policy reforms. Incorporating data on ownership of fixed assets, particularly of farmland, can also help to provide a more disaggregated perspective on the household distribution of income and asset shocks from policy reform.

Notes

1. This section has been contributed by Mary E. Burfisher, Kenneth Hanson, Jeffrey Hopkins and Agapi Somwaru of the U.S. Department of Agriculture, Economic Research Service. The viewpoints and conclusions expressed in this chapter are not necessarily those of ERS/USDA. Authorship is in alphabetical order. The authors thank David Skully, Karen Hamrick, and Mitch Morehart for comments on earlier drafts

2. The model is described in detail in Hanson and Somwaru (2003).

3. Model closure rules direct the impact of a policy change to take the form of a change in household real income rather than changes in the trade balance, real investment, and the government deficit. These closure rules allow the model to generate a measure of the change in household well-being.

4. The typology is described in Hoppe *et al.* (2000). The Farm Income and Costs Briefing Room (http://www.ers.usda.gov/Briefing/FarmIncome/) provides a comprehensive description of farm households in the farm typology. The distribution of farm households among these seven types, along with data for their on- and off-farm sources of income are discussed further in Hanson and Somwaru (2003).

5. Cooper *et al.* describe results from a simulation by James V. Stout, at USDA-ERS, of global agricultural policy reform using the partial equilibrium ERS-Penn State global agricultural trade model. The model, which incorporates a disaggregated treatment of commodities and policies, is documented in Stout and Abler (2004).

6. Based on ARMS, 1999. Full resource ownership costs include cash costs and non-cash costs to the farm operation, measured separately for each observation (household) in the data. Cash costs are outlays incurred by the operation to produce commodities and are dependent on production practices and the prices and quantities of inputs. Non-cash costs include opportunity costs of owned assets land, the capital recovery of machinery and equipment, and unpaid operator labor. Methods used in constructing costs and returns are endorsed by the American Agricultural Economics Association (AAEA, 2000) and can also be found on the ERS website at http://www.ers.usda.gov/Data/CostsAndReturns/. For each observation in the data, full resource ownership costs are divided by the total value of production, yielding a new variable called "financial efficiency." We used the cumulative distribution of financial performance across all farms to proxy any individual household's likely success in farming in response to changes in relative commodity prices. Values range from zero (the highest level of financial performance and the highest likelihood of success) to one (the lowest level of financial performance and the least likelihood of success).

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OECD PUBLICATIONS, 2, rue André-Pascal, 75775 PARIS CEDEX 16
PRINTED IN FRANCE
(51 2006 07 1 P) ISBN 92-64-02573-1– No. 55187 2006

Agricultural Policy and Trade Reform

POTENTIAL EFFECTS AT GLOBAL, NATIONAL AND HOUSEHOLD LEVELS

Governments of most developed and many developing countries impose tariffs on imports in order to boost domestic market prices of agricultural commodities. In some OECD countries governments may top up the financial benefits of this market price support through other means, such as direct budgetary payments, favourable tax treatment, and subsidised credit. These interventions typically lead to lower world market prices and farm incomes in countries where governments offer farmers little in the way of agricultural trade protection and support.

Widespread agricultural policy reform would undoubtedly improve global economic welfare but would also produce a complex pattern of economic winners and losers. Using a combination of global, national and household level analysis, this study examines such distributional implications focusing especially on differences in policy effects among countries and between different sectoral and household constituencies within countries.

ISBN 92-64-02573-1
51 2006 07 1 P

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