Model simulations of agri-food trade liberalisation

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Introduction

Assessing the impact of changes in agricultural and trade policies poses methodological challenges inherent in all policy assessment exercises. Since we are interested in the counterfactual situation with the policy change compared to a situation without the policy change, we cannot simply rely on observations that compare a pre-change state to the post-change state. Too many factors interfere to be able to isolate the effects of the policy change in question. Fortunately, the arsenal of economic research provides for a rich set of tools that facilitates policy assessment, both ex ante and ex post. As far as ex post assessment is concerned, there exist sophisticated econometric methods to disentangle the various intervening effects.¹ This paper is particularly concerned with ex ante assessment of agricultural policy changes, against the background of the ongoing Doha round of multilateral trade policy negotiations. Ex ante assessments help to identify potential winners and losers of such agreements and aim to inform the policy debate. Numerous studies have recently been published on the broad, macro-economic, assessment of further changes on agricultural (trade) policies, and this paper is an attempt to summarize the method of those studies as well as to provide a summary of results.

Modelling approaches

Since policy assessment is concerned with evaluating a situation with a proposed policy change against a situation without the policy change, economists favour structural economic models for this task. Economic models start from a portrait of an existing situation, using many assumptions on economic behaviour, and then proceed to paint a counterfactual world that includes the proposed policy changes. The most commonly used models are so-called market equilibrium models.² These contain the response (behaviour) of economic agents to changes in prices (costs), and prices adjust so as to clear markets. The objective of these models is the determination of equilibrium prices and quantities on (interrelated) sets of markets. This class of models is firmly established within mainstream economics where the

¹ For an excellent overview of recent advances see Smith and Todd (2005).
² ‘Gravity models’ are another important class of model in international trade analysis. These are less explicit about their theoretical underpinning and focus on econometric estimates. They are sometimes used in ex-ante analysis of trade policy changes.
behavioural response of suppliers and buyers is typically derived from optimising assumptions: given a description of the production technology, the supplier chooses a combination of inputs such that costs are minimised for a given level of output. Given a description of consumer preferences, the buyer determines his preferred consumption bundle such that his/her utility is maximized for a given level of his/her budget. Standard assumptions include constant returns technology, homothetic preferences, and markets characterised by perfect competition. While these basic theoretical assumptions underlie equilibrium modelling, the optimization process is usually not modelled explicitly. Rather, a reduced form approach is common, where demand and supply are specified as functions of income, prices and elasticities. Depending on assumptions made about the flexibility of production factors, equilibrium models can be classified as short term, medium term or long term. Short term (in the Marshallian sense) means that some production factors are fixed, and are not allowed to reallocate between alternative uses. The fixed factors in the short run will typically be capital, agricultural land, and perhaps agricultural labour. If the model is applied to actual data, as opposed to theoretical models, the modeller also needs to use data to estimate parameters and relationships included in the model.

Although this paper is concerned with macro-economic effects of agricultural policy changes, and hence concentrates on economy-wide models, it is worthwhile to briefly distinguish this type of analysis from partial models of agriculture. For a fuller discussion of alternative modelling approaches see Van Tongeren et al. (2001).

Partial models treat international markets for a selected set of traded goods, e.g. agricultural goods. They consider the agricultural system as a closed system without linkages with the rest of the economy. Partial models of international trade in agriculture generally focus on trade in primary commodities. They capture agricultural supply, demand and trade for unprocessed or first-stage processed agricultural products without taking into account trade in processed food products, despite the fact that the latter commodities represent an increasing share of world trade. The main area of application of partial equilibrium models is detailed trade policy analysis to specific products, which represent only a small portion of the activities of the economy in question. This (small sector) condition implies that policy-induced changes on the rest of the economy are so small that they can be ignored. While agriculture typically represents only a small portion of GDP in industrialised countries, this is certainly not true in the developing world, where
agriculture is the dominant source of income and employment. A more complete representation of these economies is required to fathom the likely impacts of trade reforms.

Economy-wide models provide such a complete representation of national economies. This is obtained when the model is closed with respect to the generation of factor income and expenditures, which requires the explicit specification of factor markets for land, labour and capital. In other words, the essential general equilibrium features are captured by including factor movements between sectors, next to allowing for demand interactions. Economy-wide models capture implications of international trade for the economy as a whole, covering the circular flow of income and expenditure and taking care of inter-industry relations.

All the estimates of potential economic gains from policy reforms considered below are obtained using a class of economy-wide models known as CGE (computable general equilibrium) or AGE (applied general equilibrium) models. This has become the dominant tool in global trade policy analysis. CGE models provide a complete representation of national economies, and a specification of trade relations between economies. CGE models are specifically concerned with resource allocation issues, that is, where the allocation of production factors over alternative uses is affected by certain policies or exogenous developments. International trade is typically an area where such induced effects are important consequences of policy choices. In the face of changing international prices, resources will move between alternative uses within the domestic economy, or even between economies if production factors are internationally mobile. The main features of CGE models can be summarized as follows, see also Kehoe and Kehoe (1994):

Within each regional economy a standard CGE model covers inter-industry linkages through an input–output structure. Demand for factors of production is derived from cost minimisation, given a sectoral production function (nested CES) that allows for substitution between inputs. Typically, substitution is allowed only between primary factors — land, labour, capital — while intermediate inputs are used in fixed proportion with output (Leontief technology). The production structure is typically constant returns to scale and perfect competition is assumed to prevail on all markets. Each sector produces one homogeneous good that is perfectly substitutable domestically but substitutes imperfectly with foreign goods (Armington assumption).
Next to the binary distinction ‘domestic versus foreign’, the multi-region nature of the model enables a distinction of traded commodities according to their region of origin.

That is, bilateral trade flows are captured. Factor markets for land, labour and capital are included, endowments for these primary factors are given and the factors are fully employed. Labour and capital are assumed to be fully mobile across domestic sectors, while land is imperfectly mobile and tied to agricultural production. Consumer demand is derived from utility maximization under a budget constraint, and consumers allocate their expenditures over domestic and foreign goods. See Figure 1 for a schematic representation of single-country CGE model.

Figure 1: The flow of production in a CGE model

A government actor levies various types of indirect taxes and subsidies including import tariffs and export subsidies. Policy measurement has converged on the concept of ad valorem price wedges, and in CGE models all policy instruments
are typically specified in this way. All factor markets and commodity markets are assumed to clear, which yields equilibrium solutions to factor- and commodity prices as well as the corresponding equilibrium quantities.

All regional economies are linked through bilateral commodity trade and through interregional investment flows. If one is willing to assume a constant current account balance in all regions, then the difference between regional savings and investments is essentially predetermined, and as a consequence the aggregate level of the savings — investment balance is also predetermined. If one wants to allow for endogenous determination of the current account balance, the model must include a mechanism to redistribute aggregate savings over regions.

Some models include a recursive sequence of temporary equilibria. Recursive models do generate time paths for endogenous variables, but there is in fact no behavioural linkage between periods. As a result, the equilibrium solution in each period can essentially be calculated without reference to earlier or later periods.

Market imperfections are typically ignored in standard CGE models. Information problems, lack of infrastructure, monopolistic market structures and similar frictions abound in agricultural markets, especially in developing countries. However, CGE models rarely include those in the analysis. Only so-called ‘second generation’ models add increasing returns and imperfect competition in some of the sectors, allowing for estimates of scale and variety effects.

The comparative static analysis performed with CGE models does not reveal adjustments processes and possible adjustment costs involved when far reaching policy changes are implemented. Policy-induced resource shifts will always entail income losses and adjustment processes for some people. The comparative static CGE analysis typically sidesteps these issues and concentrates on the features of the new equilibrium in which the system settles after the policy change has been implemented. Relatively recent methodological developments on have resulted in so-called ‘Third generation’ models that include time consistent forward looking behaviour and

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3 Instead of including the wedges that policies create between buyer’s and sellers’ prices one might attempt to explicitly model policy instruments. For example quantitative instruments such as production quota and import quota, nut also price based instruments such as intervention prices could be modelled explicitly in CGE models. For an application on the European Union’s CAP along these lines see Van Meijl and Van Tongeren (2002).
endogenous savings rates, hence allowing for the modelling of short run dynamics. While these models focus on savings-investment issues, including international capital flows, they could in principle be adapted to capture short- to medium-term real adjustment processes.

Finally a word on interpreting the oft-reported income effects from CGE model is in order. The macro economic effects of changes in policies are typically assessed by the well-established welfare economic compensation measure. The so-called equivalent variation (EV) measures what change in income would be equivalent to the proposed policy change. In other words, instead of effectuating a certain policy change how much income should be given to (or taken away from) households to achieve the same welfare. This measure always informs us about the potential welfare change and it does not inform us about distributive effects. In fact, if the EV is positive, we know that enough resources are mobilized such that the winners from the policy move can potentially compensate the losers. The EV is firmly grounded in the welfare economic literature, and provides the ultimate measure of how well an economy is doing when implementing a policy change. When CGE models report national income changes these are typically EV measures and not Gross Domestic Product (GDP) or similar national accounting indicators.

Review of recent modelling results

All the models discussed here are built around the GTAP (Global Trade Analysis Project) database. Some follow, in addition, the GTAP modelling approach, while others develop their own CGE model with special features. The GTAP database is maintained by the GTAP consortium which is based at Purdue University with funding from an international consortium of national and international agencies, universities and research centres. Development of the GTAP databases was started in the early 1990s and has since then become the prime dataset for global economic analysis.

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4 While the EV takes the new situation as a reference, the alternative measure known as Compensating Variation (CV) takes the old situation as the reference. It asks the hypothetical question: ‘what is the minimum amount of compensation after the price change in order to be as well off as before the change?’

5 See www.gtap.org for more information.
Most of the studies reported here rely on version 5 of the GTAP database, which was benchmarked to the year 1997. The two most recent studies included in this review use the most recent version 6, which is still in the pre-release phase as of early 2005, i.e. not yet publicly available. Version 6 differs in some important respects: it has more countries and regions included, it is benchmarks to the year 2001 (instead of 1997) and it has more sophisticated measurement of levels of protection. Specifically, it includes existing preferential trade agreements and the conversion of specific to ad valorem tariff equivalents. Therefore the new database captures the liberalisation efforts that have been ongoing in the wake of the Uruguay Round as well as autonomous liberalisation done by many countries, especially in Asia after the Asian financial crisis of the late 1990s.

Talking about gains from reform, one typically wants to know not only the size of the gains, but also their distribution. In addition, the sources of gains from liberalisation are important to inform the policy debate: which of the negotiation issues is most important and to whom? Tables 1 and 2 and Figure 2 attempt to summarize exactly this type of information arising from recent CGE modelling studies.

Figure 2 shows estimates of annual welfare gains from full agricultural liberalisation, i.e. a complete and multilateral removal of all border protection and domestic support. The estimates span a rather wide range, from roughly 30 billion USD (USDA, 2001; OECD, 2003) to 193 billion USD (World Bank, 2004). Table 1 and Table 2 provide further decomposition of results into the effects of broad sectors and country groupings. Since all the studies discussed use the same database, the reason for this variance of results must be found in either the modelling assumptions or the scenario design. We summarize key factors that influence the results from GTAP-based CGE models, before proceeding to discuss in the specific modelling assumptions behind these results.
Figure 2: Welfare effects from full agricultural liberalization

Source: Author’s calculation based on references cited
<table>
<thead>
<tr>
<th>Study</th>
<th>Model</th>
<th>Liberalisation scenario</th>
<th>Notes</th>
<th>Welfare gains, USD 1997 billion</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABARE (2000)</td>
<td>GTEM, dynamic GTAP database</td>
<td>50% liberalisation, all sectors, all policies, all regions</td>
<td>Base scenario</td>
<td>Agriculture: 53, Other: 41, Total: 94</td>
</tr>
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<td></td>
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</tr>
<tr>
<td>Anderson et al. (2000)</td>
<td>GTAP</td>
<td>100% liberalisation, all sectors, all tariffs, all regions</td>
<td></td>
<td>Agriculture: 165, Other: 90, Total: 254</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IMF &amp; World Bank (2002)</td>
<td>GTAP</td>
<td>100% liberalisation, agriculture only</td>
<td></td>
<td>Agriculture: 128, Other: Na, Total: na</td>
</tr>
<tr>
<td>Beghin et al. (2003)</td>
<td>LINKAGE, dynamic GTAP database</td>
<td>100% liberalisation, agriculture only, all policies in high-income countries only</td>
<td>Increasing returns to scale, med. Run</td>
<td>Agriculture: 82, Other: n/a, Total: n/a</td>
</tr>
<tr>
<td>Francois et al. (2003)</td>
<td>GTAP</td>
<td>100% liberalisation, all sectors, all tariffs, all regions</td>
<td>Increasing returns to scale, med. Run</td>
<td>Agriculture: 109, Other: 257, Total: 366</td>
</tr>
<tr>
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</tr>
<tr>
<td>Francois et al. (2005)</td>
<td>GTAP</td>
<td>50% liberalisation, all sectors, all tariffs, all regions</td>
<td>Constant returns to scale</td>
<td>Agriculture: 28, Other: 104, Total: 132</td>
</tr>
<tr>
<td>World Bank (2004)</td>
<td>LINKAGE, dynamic GTAP database</td>
<td>~100% liberalisation, all sectors, all policies, all regions</td>
<td>Standard version</td>
<td>Agriculture: 193, Other: 98, Total: 291</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>World Bank (2005)</td>
<td>LINKAGE, dynamic GTAP v6 database</td>
<td>~100% liberalisation, all sectors, all policies, all regions</td>
<td>Standard version</td>
<td>n/a</td>
</tr>
<tr>
<td>OECD (2003)</td>
<td>GTAP</td>
<td>100% liberalisation, all sectors, all tariffs</td>
<td></td>
<td>Agriculture: 34, Other: 63, Total: 174</td>
</tr>
<tr>
<td>USDA (2001)</td>
<td>CGE, dynamic</td>
<td>100% liberalisation, agriculture only, all policies</td>
<td>Standard version</td>
<td>Agriculture: 31, Other: Na, Total: na</td>
</tr>
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</tr>
</tbody>
</table>

Notes: (a) includes services, (b) includes trade facilitation, (c) in USD 2001, (d) in USD 2001

Source: Author’s calculation based on references cited
Table 2: Results from CGE studies: who shares in the benefits from agricultural reform? Billion USD, 1997

<table>
<thead>
<tr>
<th>Study</th>
<th>Benefits to low and middle income</th>
<th>Benefits to high income countries</th>
<th>Benefits to all countries</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Static</td>
<td>Dynamic</td>
<td>Static</td>
</tr>
<tr>
<td>Anderson (1999)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Developing countries liberalise</td>
<td>31</td>
<td>11</td>
<td>42</td>
</tr>
<tr>
<td>Developed countries liberalise</td>
<td>12</td>
<td>110</td>
<td>122</td>
</tr>
<tr>
<td>All countries liberalise</td>
<td>43</td>
<td>121</td>
<td>164</td>
</tr>
<tr>
<td>Diao et al. (2002) (Road Ahead)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All countries liberalise</td>
<td>3</td>
<td>35</td>
<td>28</td>
</tr>
<tr>
<td>Francois et al. (2003)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Developing countries liberalise 50%</td>
<td>6</td>
<td>28</td>
<td>5</td>
</tr>
<tr>
<td>Developed countries liberalise 50%</td>
<td>5</td>
<td>-0.7</td>
<td>12</td>
</tr>
<tr>
<td>All countries liberalise 50%</td>
<td>11</td>
<td>27</td>
<td>17</td>
</tr>
<tr>
<td>Francois et al. (2005)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Developing countries liberalise 50%</td>
<td>10</td>
<td>0.5</td>
<td>10</td>
</tr>
<tr>
<td>Developed countries liberalise 50%</td>
<td>-3</td>
<td>23</td>
<td>20</td>
</tr>
<tr>
<td>All countries liberalise 50%</td>
<td>7</td>
<td>24</td>
<td>30</td>
</tr>
<tr>
<td>World Bank GEP 2004</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Developing countries liberalise</td>
<td>80</td>
<td>167</td>
<td>23</td>
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<td>Developed countries liberalise</td>
<td>20</td>
<td>75</td>
<td>64</td>
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<tr>
<td>All countries liberalise</td>
<td>101</td>
<td>240</td>
<td>91</td>
</tr>
<tr>
<td>IMF &amp; World Bank (2002)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Developing countries liberalise</td>
<td>22</td>
<td>5</td>
<td>27</td>
</tr>
<tr>
<td>Developed countries liberalise</td>
<td>9</td>
<td>93</td>
<td>102</td>
</tr>
<tr>
<td>All countries liberalise</td>
<td>30</td>
<td>98</td>
<td>128</td>
</tr>
</tbody>
</table>

Source: Author’s calculation based on references cited
Why the results differ: a primer

There are three main sources for differing outcomes in terms of national and global welfare:

- The scenario design: the representation of existing policies in the base situation and the subsequent reform scenario makes a difference. In relation to border protection, the binding overhang (difference between bound and applied rates) makes a difference, as seen in OECD (2003) and UNECA (2004). When the scenarios reduce applied levels of tariffs, they may therefore overstate the true effect on market access. Likewise, the representation of existing trade preferences has an impact on the results, as seen in Francois et al (2005). With regard to domestic agricultural policies, the treatment of ‘decoupled’ payments appears to be important (USDA, 2001). In addition the AMSceilings agreed in the Uruguay Round have never been binding due to a variety of reasons. Again, the effects of reducing ceilings on domestic support may be overstated by this approach.

- Dynamic versus static effects: The World Bank linkage model is a recursive dynamic model that moves the database forward to the year 2015. The projected composition of the economy in the future determines to a large part where the reform gains are occurring. If agriculture occupies a large share of GDP in the future projected economy, then also will the gains from liberalisation come mainly from agriculture.

- Inclusion of non-standard features, such as increasing returns to scale, imperfect competition and trade-productivity linkages. All these tend to boost the estimates of welfare gains from reform.

Features of individual modelling studies

The Australian Bureau of Agriculture and Resource Economics (ABARE 2000) used their dynamic CGE, called GTEM, to assess the impact of trade liberalisation in all sectors. This model is designed specifically to assess economic policy issues with long term, global dimensions.
The study estimates global welfare gains of USD 94 billion. Agricultural policy liberalization accounts for USD 53 billion, of which USD 14 billion accrues to developing countries. The study further notes that these gains do not account for the “dynamic gains that arise from greater competition, innovation, improved management and greater technological advances that are known to arise from greater openness”. When these factors are included, total gains increase to USD 123 billion.

A study by Anderson et al. (2001) focuses on market access reform. The GTAP model is used to generate the welfare implications of full tariff liberalisation with particular emphasis on the two sectors with the highest remaining barriers: agriculture and textiles/clothing. The results estimate total welfare gains to be about USD 254 billion, of which USD 165 billion are accounted for by agricultural policy liberalisation. The gains to developing countries (USD 43 billion) account for 26% of total gains from agriculture.

The gains from agricultural policy liberalisation estimated in this study are among the largest of the studies reported in this review. The single most important reason for this difference lies in the input dataset that was used. This was one of the earlier studies and therefore did not have access to a comprehensive set of bound and applied tariff rates (AMAD). The study only considers reductions in bound tariff rates. These are generally higher than actual applied tariff rates, and therefore the impact of agricultural tariff reduction was overstated. The authors mention this as one of the important areas to refine in future research mentioned this data limitation.

A joint study by the IMF and the World Bank (2002) focuses on market access in agriculture and textiles. The study estimates the global static gains from a reduction of all trade barriers in agriculture at USD128 billion. About 23% of the global gains would accrue to low- and middle-income countries.

Beghin et al (2002) use a dynamic CGE to study agricultural trade liberalisation. The contribution of this paper is the focus on policies in high-income countries and how these affect developing countries. Policy reform is only introduced in high-income regions, hence this is not a true multilateral reform scenario.

The authors calculate the global welfare gains from agricultural liberalisation in high-income countries to be USD 82 billion for high-income countries and USD 26 billion in developing countries. In addition, this policy reform would be pro-poor on average, as real wages in developing countries rise across the board, and increase
more than capital returns. The authors also find that world food prices would rise significantly, leading to an important re-orientation of agricultural trade.

In a study by OECD (2003), gains from further reduction of bound tariff rates were analyzed. In particular, the study takes into account the difference between bound tariff rates and applied tariff rates (those actually used in trade). The authors note that this difference is significant. Particularly in the agriculture sector they estimate the binding overhang to amount to 33%. The GTAP model is used to consider three sets of scenarios for tariff reduction. Taking into account the binding overhang appears to explain the relatively small welfare gains from reductions of (bound) tariffs.

In the full liberalization scenario, the global welfare gains were found to be over USD 173 billion. About 52% of total gains accrue to developing countries. This is largely due to the fact that tariffs are relatively high in developing countries. If agricultural tariff liberalization is excluded, the gains amount to USD 139 billion – that is, the potential gains from further liberalization with respect to industrial goods may be even larger than gains from agriculture.

Overall, this study underscores the importance to developing countries of both greater access to developed countries’ markets as well as their own engagement in trade liberalization.

Another recent study using the GTAP model (Francois et al., 2003) considers a more comprehensive trade liberalization that includes domestic support in agriculture and trade in services. This study is noteworthy because it includes innovations in three areas: i) the services sector (often not included in quantitative analysis), ii) imperfect competition in the manufacturing and services sector, and iii) medium-run and long-run effects. The study finds global welfare gains from full liberalization of USD 360 billion, of which roughly one third are attributable to liberalization in agriculture. One reason for the high welfare estimates is simply because, in addition to tariff liberalization, the services sector and domestic support in the agricultural sector are also eliminated. However, a more important difference relates to assumptions about market structure. The authors introduce increasing returns and imperfect competition in manufacturing and services, and this introduces interactions (scale- and variety effects) that affect results in a complex way — some regions gain more, some less. This underscores the importance of dynamic impacts in the long run. Like the OECD study, a key conclusion is that trade liberalization provides maximum benefits to
developing countries when they reform their own policies. The policy reform scenario is conducted relative to a ‘baseline’ that includes China’s WTO accession, implementation of Agenda 2000 of the European Union, enlargement of the EU by 10 new members and full implementation the Uruguay Round commitments.

In a follow-up study, Francois et al (2005) use the more recent GTAP version 6 database (see discussion above). This reduces the estimated gains from reform, as this database has an improved representation of trade preferences, improved representation of domestic agricultural policies and it is benchmarked to a more recent year. The authors do not report long run dynamic results, but provide a detailed decomposition into the effects of reform by the different WTO pillars and by broad country group implementing the policy change (OECD versus non-OECD).

The World Bank (2004) uses their dynamic LINKAGE model to assess trade liberalization under two formulations. In the first version, it is assumed that trade reform has no impact on productivity —these are the static gains. The second version models dynamic gains. It is assumed that productivity is a function of the degree of openness of the economy. Measured in static terms, world income would increase by USD 291 billion in 2015. The gains resulting from liberalization of agricultural policies are USD 193 billion. In dynamic terms, these gains reach USD 358 billion, the largest estimate contained in this review (even after adjusting for time frame, as the study reports gains in 2015). In both static and dynamic simulations, agricultural reform accounts for 70% of the global gains. The study reports that for developing countries, the gains are likely to decrease poverty. Rising unskilled wages, in combination with decreasing prices for the consumption basket of poor people “could be quite substantial”.

In a recent update for the Global Economic Prospects 2005 (World bank 2005), the authors reach slightly lower estimates liberalization gains. The more recent estimate comes to USD 263 billion (instead of 291 billion) for the ‘static’ model without the openness-productivity linkage. The authors attribute the difference largely to the new GTAP version 6 database. See the discussion above.

A USDA study (USDA, 2001) uses a dynamic CGE model to look at liberalization in the agriculture sector for WTO member countries (at the time China was therefore excluded). This study is somewhat different from the others in that it seeks to go more deeply into sector detail. In particular, it focuses on decomposing the global effects of full agricultural reform by type of policy. Accordingly, separate
scenarios are run that eliminate i) import barriers, ii) export subsidies, iii) domestic support, and iv) combination of all three policies.

The study finds that using a dynamic model that assumes gains in total factor productivity (a long run formulation), the removal of agricultural policy distortions implies an annual world welfare gain of USD 56 billion. This pay-off to the liberalization process takes time. In comparison, the static welfare gains were found to be USD 31 billion, or only slightly more than half of the gains using the dynamic model. This static estimate may be lower than most of the others in this review in part because of one key assumption, that direct payments to owners of farmland (with no crop targeting, or decoupled) have little effect on production. The most striking result from this analysis arises from the distribution of gains. The static welfare gains accrue almost exclusively to developed countries, while in the long run, both developed and developing countries benefit from investment and increased productivity that is linked to more open economies. The study finds that investment growth and productivity gains due to agricultural policy reform account for 45% of total benefits from trade liberalization.

**Key lessons from the ex ante assessments**

*Who gains from agricultural reform?*

The largest part of the world welfare benefits of agricultural liberalization accrues to industrial countries. Only in the World Bank studies benefits for developing countries are higher. The higher simulated benefits for industrialized countries are a consequence of the fact that these countries tend to have higher degrees of protection.

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6 In my view this can be explained by the dynamic updating procedure used in LINKAGE. The model projects the economy into the year 2015, keeping all the ad valorem price wedges of policies constant, but taking exogenous GDP growth rates from other sources. As this rate of growth is higher for developing countries than for industrialised countries, and agriculture will grow approximately proportional to GDP the incidence of taxes and subsidies now falls on a much bigger agriculture in developing countries (an indeed a much bigger economy) than in the base year of the projection. As a result the absolute welfare gains in monetary units from removing these distortions will also be higher when calculated relative to 20015 than the same removal calculated relative to the base year. Also, since agriculture in developing countries is growing faster than agriculture in industrialised countries, the relative distribution of welfare gains from agricultural policy reform will be skewed towards developing countries.
and of subsidization. Reduction, or even removal, of these policy interventions leads to elimination of deadweight losses and to more economically efficient resource allocation, which is fully counted as a welfare gain. Developing countries, in contrast, do not typically subsidize their domestic agriculture.

Although the largest absolute gains (in dollar terms) accrue to industrialized countries, the largest relative gains in terms of GDP are obtained for developing countries. Welfare benefits for developing countries vary between $11 billion and $43 billion in the non-World Bank studies. This is equal to 0.2% and 0.7% of GDP of developing countries. In the World Bank study welfare effects vary between $101 billion (static) and $120 billion (dynamic). The most optimistic World Bank scenario adds 1.7% to the GDP of developing countries. While these estimated gains indeed raise GDP, they are nowhere sufficient to ease poverty in developing countries.

Welfare gains for developing countries from liberalizing agricultural policies in Industrial (OECD) countries vary between $5 billion and $20 billion. This is equal to 0.1% and 0.3% of GDP in developing countries. The gains from liberalization are therefore limited.

At the broad level of country grouping into low-income and high-income countries, all the studies find that the benefits from own liberalization are larger than the benefit derived from other countries liberalizing. This hides important cross-country differences. The important agricultural exporters in Latin America, Australia and New Zealand will tend to benefit most from improved market access in OECD countries.

While the empirical studies generally estimate positive welfare gains for most participating countries, there are important exceptions. For net food importing countries the negative terms of trade effects, which occur through raised world food prices in the wake of the policy changes, is not outweighed by efficiency gains from reallocating resources. Another exception is the loss of rents from preferential market access or loss of quota rents which may lead to reductions in welfare estimates for individual countries and sectors. Findings from a recent study by the United Nations Economic Commission for Africa (2004) highlights the importance of accounting for existing preferential trade arrangements. See also World Bank (2005) and Bouet et al. (2004) on this issue.

What is the contribution of agriculture?
There is a considerable variation in the contribution of agricultural liberalization to the global welfare gains. One third of the total gains represents a low-range estimate (where manufacturing and services are included), while a share of more than two thirds is estimated in other studies.

Between 70 and 85 per cent of the benefits for developing countries is the result of their own reform policies in agriculture. Because estimated own trade barriers in developing countries are higher than those in developed countries, the removal of those barriers will lead to relatively larger impact in developing countries. This sheds some doubts on the assertion that developing countries would experience high gains from removal of trade barriers by industrialized countries. A related issue is the prevalence of preferential trade agreements. Once those are taken into account, the gains for preference-receiving countries may even be smaller.

_The three pillars in the agricultural negotiations_

Effects of removing agricultural subsidies alone is likely to be negative for many individual developing countries, specifically those depending on imports of agricultural products that are currently subsidized in industrialized countries. The main positive welfare effects are found in OECD countries themselves, which are the countries where agriculture tends to be subsidized. However, as for example the USDA (2001) study highlights, once the decoupling of subsidies from production is taken into account, the welfare- and trade effects from lowering the subsidies also become smaller. Subsidies that are directly targeted at farmer’s income tend to have less side effects and the transfer efficiency of subsidization is improved.

Export subsidies have become relatively less important in recent years. Consequently the reduction of these payments alone does not yield grand effects. Of course, export subsidization cannot be viewed in isolation from domestic policies.

The single most consistent positive contribution to global welfare is derived from improved market access. This issue, therefore, should remain high on the negotiation agenda. However, an important warning must be issued here. Given high tariff barriers and other measurable import restrictions, some technical barriers may not be binding now, but may become binding if the more traditional import impediments are reduced. Indeed, recent years have seen a proliferation of import restrictions related to quality standards and to sanitary- and phytosanitary standards. None of the existing studies reviewed here has been able to consider those. The issue
is furthermore complicated by the fact that many of the quality-related trade restrictions are not the result of government intervention, but arise from private standard setting by internationally operating supply chains.

Miscellaneous issues

In many developing countries tariff revenues represent an important source for government revenue (see WDI). Revenue replacement through alternative domestic taxes seems not to be considered in any of the studies reviewed here, and consequently the gains from trade liberalization maybe overstated.

Some studies yield high estimates of effects of services liberalization, but the variance is extremely high. This area is plagued with measurement difficulties.

Some studies emphasize dynamic gains, such as gains through the enlargement of the resources base through capital accumulation, gains from improved productivity through more openness and gains from exhausting economies of scale. As a rule these dynamic gains tend to be orders of magnitude more important than the static gains from trade liberalization. While nobody will deny the importance of supplementary investments to reap the potential benefits of increased trade opportunities for developing countries, the empirical results obtained from the modeling studies should be taken with a grain of salt. The level of aggregation in these models does simply not permit an in-depth analysis on a country-by-country and sector-by-sector analysis of bottlenecks hampering agricultural development. As a consequence, the analysis of dynamic effects in the studies considered here has to rely on rather general estimates of the relationships between trade and growth.

Trade effects

So far, we have concentrated on nation income effects from policy reform. Another important dimension of the CGE modelling approach is the pattern of international trade. Indeed, some of the studies stress the importance of tapping the potential for increased south-south trade. Although trade volumes between developing countries have displayed a remarkable rising trend in recent years, especially African-Asian trade, it is still the case that developing country exports are biased towards trade with the EU and the USA. Lowering trade barriers amongst developing

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7 This section leans heavily on Francois et al. (2005)
countries would open increased opportunities for exports from low-income countries to middle-income countries.

As a typical example, we discuss here the finding reported in Francois et al. (2005). Table XXX presents the estimated changes bilateral trade flows for three regional groupings. Two scenarios are considered: a Global Trade Round scenario, wherein all countries actually engage in liberalization, and a OECD-based scenario, where only OECD countries engage in reforms, and non-OECD countries do not. Under the global trade round scenario, global trade expands by 11%. Trade growth far exceeds the income effects discussed above because increased exports also imply increased opportunity costs.

While intra-EU25 trade declines with –2 percent as a consequence of diminishing intra-EU trade preferences, suppliers from developing countries expand their exports to the EU by 16%, and realize the most impressive growth in market share on European markets. Developing countries obtain the highest overall growth in exports (21%). They are simulated to expand exports to all destinations, but the greatest surge is observed in trade amongst developing countries themselves. The lower-left part of the Table breaks out agricultural trade from the aggregate. By comparing these numbers with those for all commodities we see that developing country exports are mainly driven by agricultural exports, with the exception of exports to ‘Other OECD countries’, which sees smaller expansion in agricultural exports than in overall exports from developing countries. This is to a large extent due to the fact that the ‘Other OECD’ grouping comprises Australia and New Zealand, who are themselves important agricultural exporters.

Turning to the right panel of Table XXX we see that an OECD-based round, with developing countries not participating in reform, reduces trade growth for this group of countries substantially. First, intra-developing country South-South trade shrinks relative to the base. This points to yet more trade diversion effects in the face of OECD countries lowering their trade barriers while non-OECD barriers remain in place. Second, developing country exports to developed economies expand at a slower pace, including agricultural exports. This is because failure to engage in own reforms precludes specialization gains and insufficient resources are freed to allow
expansion in export-oriented industries. The slower export growth implies that insufficient foreign exchange is earned to finance an expansion in imports.\textsuperscript{8}

\textsuperscript{8} A technical term in trade theory, Lerner symmetry, is relevant here. Import barriers also end up, in the end, suppressing exports. This is very evident in the pattern of developing country exports.
Table 3: Bilateral trade, Percent change value in bilateral import volumes

<table>
<thead>
<tr>
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<td>21</td>
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<tr>
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<td>22</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>Total</td>
<td>4</td>
<td>22</td>
<td>11</td>
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<td>Other OECD</td>
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<tr>
<td>Total</td>
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<td>24</td>
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<tr>
<td>Total</td>
<td>6</td>
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<td>10</td>
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Source: Francois et al. (2005)
Concluding remarks

This review has looked at the results from various CGE models that have recently been used in the context of ex-ante assessments of the Doha round. The focus of the paper is on macro-economic assessment of agricultural reforms. All of the models considered here use the GTAP database, but nevertheless the results display a considerable variation. This variation can partly be explained by differences in model structures built around the same database, and partly by the scenario design that is chosen. Key differences in scenario design relate to a) the reference point of the assessment (base year with or without additional polices included; reference years updated or not), b) the representation of policies and policy shocks (binding overhang included or not; domestic support considered ‘decoupled’ or not etc.). With all the usual caveats of modeling exercises, the CGE models considered here yield some key insights:

- Agricultural liberalisation contributes about 50% of total gains from a broad multilateral reform.
- Domestic agricultural reform contributes relatively little. Gains fall mainly on OECD countries (efficiency gains)
- The most important issue on the Doha agenda is market access
- Developing countries benefit most relative to GDP (but not in absolute terms)
- Non-agricultural liberalisation is important for developing countries. This is the area where the most distortive policies in those countries are typically found.
- A country’s own policy reforms contribute most to its own potential gains: What You Give is What You Get.
- South-south trade can be an important source of growth for developing countries. Trade reform by developing countries can help to tap this possibility and can contribute to changing the existing South-North bias in trade patterns.
**References**


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