OESTERREICHISCHE NATIONALBANK
EUROSYSTEM

WORKSHOPS

Proceedings of OeNB Workshops

International Trade & Domestic Growth: Determinants, Linkages and Challenges

September 27, 2007

Stability and Security.

No. 14

Estimates of Gains from Further Multilateral Trade Liberalisation: Should They Differ?

Przemyslaw Kowalski[1]

Organisation for Economic Co-operation and Development

The multilateral trade negotiation process can be portrayed as having three phases or components: conceptual, technical and political (Meilke *et al*., 1996). Positive economic analysis strives to be objective and, as such, does not directly deal with political aspects of negotiations although, certainly, it is often conducted in a political context or focuses on questions where political stakes are highest. In the context of multilateral trade negotiations positive economic analysis can undoubtedly help to deliver information on the stakes involved in order to help frame the negotiations and to highlight the distribution of costs and benefits of various options. At the same time, however, the analysis can be conducted in a tendentious manner (McDougal, 1993) or the findings can be used selectively by politicians, journalists or economists themselves to support certain predetermined positions or arguments.

Continuing enhancements in economic theory, modelling approaches and data quality are helping analysts to provide ever more integrated views of the implications of changes in the world trading system and levels of trade protection. At the same time the modelling frameworks become more complex and less readily accessible to non-specialists. This and the growing abundance of alternative modelling approaches are important factors underlying the recent concerns about the usefulness of quantitative analysis for policy making (see e.g. Piermartini and Teh, 2005).

[1] This paper presents work in progress. The author is an economist at the Organisation for Economic Co-operation and Development (Przemyslaw.Kowalski@oecd.org) and the material presented here draws on work carried out within the OECD Secretariat, in particular on OECD (2003), Kowalski (2006), Kowalski (2006b), Nordas, Miroduot and Kowalski (2006) as well as on other material. The views presented are strictly those of the author and do not necessarily represent the views of the OECD or its member countries or co-authors of the aforementioned papers. Useful comments by participants of the presentation at the WIIW/OeNB/WKO Workshop "International Trade & Domestic Growth, Vienna, 27. September 2007.

It is argued in the current paper that the richness of these approaches and alternative estimates of gains from further liberalisation is not necessarily undesirable and can in fact be seen as a part of an organic analytical process. The differences in results from alternative modelling approaches can be very often linked to diverging views about economic realities (e.g. the likelihoods of alternative negotiation outcomes) or assumptions about specific economic mechanisms (e.g. model closures) or estimates of behavioural parameters (such as trade elasticities). Also, naturally, the differences can sometimes be traced back to data quality. However, in a limited number of instances the differences in existing results can be artefacts of the employed methodology with, for instance, different regional or sectoral aggregations of the same model generating quantitatively, and occasionally qualitatively, different predictions.

The reminder of this paper first elaborates on various sources of gains from trade in trade theory and the applied general equilibrium models. Next, it discusses a number of recent sets of estimates of gains from the Doha Round and broadly discusses the differences in their underlying economic assumptions, starting with certain specificities of the Doha Round negotiations that contribute to the uncertainty with respect to the likely negotiating outcomes. The paper does not attempt a systematic reconciliation of similarities and differences of specific assumptions, model structures and differences in results but rather identifies certain broad types of differences with a view to help in their interpretation.

2. Sources of Gains from Trade in Theory and in Applied Trade Models

Chart 1 below reproduces a graphical representation of a textbook trade model (see e.g. Caves, Frankel and Jones, 2002) that can be used to illustrate what types of gains from trade are represented well or less well in the currently used applied general equilibrium models. It describes an economy that produces two goods (*X* and *Y*) and has internal terms of trade represented by the *TT* line, the slope of which is determined by tangency to the production possibility frontier (PPF) and the highest aggregate utility curve achievable in autarky (y_0). In autarky the country will produce and consume at point *A* achieving utility y_0. What international trade offers to this country is a possibility to trade goods *X* and *Y* at a relative price that is different form *TT*, for instance TT_1. No matter which good becomes more expensive relative to autarky the country as a whole can benefit from pure exchange at external terms of trade by producing the same bundle *A* as in autarky, trading it at the external terms of trade TT_1 and consuming a bundle *B* that is ranked higher on the preference map (at y_1). In the particular case presented in chart 1 the country imports good *Y* and exports *X*. The difference between y_1 and y_0 represents the so called "gains from pure exchange" since the welfare increase does

not involve a change in production structure of the country, just the trading activity.

It is clear that the country can gain even more by specializing more in the good *Y* that became more expensive with opening up to trade. In such a case utility maximization would take this country to production bundle *C* and consumption bundle *D* characterized by the yet higher utility level y_2. The country would export even more of *Y* and import more of *X* which would require shifting of production factors across sectors.[2] In this case the difference in utility levels (y_2–y_1) represents the additional "gains from specialization" or "allocative efficiency" gains. The latter term refers to an allocation of production factors that is more efficient at locus *C*, than for instance at locus *A*, according to the world terms of trade TT_1. It is also possible to use the same diagram to illustrate the so-called terms of trade effects that can be either positive or negative. On the one hand, if the terms of trade change so that Y becomes even more expensive relative to *X* the country that produces momentarily at point *C* will enjoy even higher level of welfare. On the other hand, if the terms of trade of *Y* fall, the country will be affected negatively.

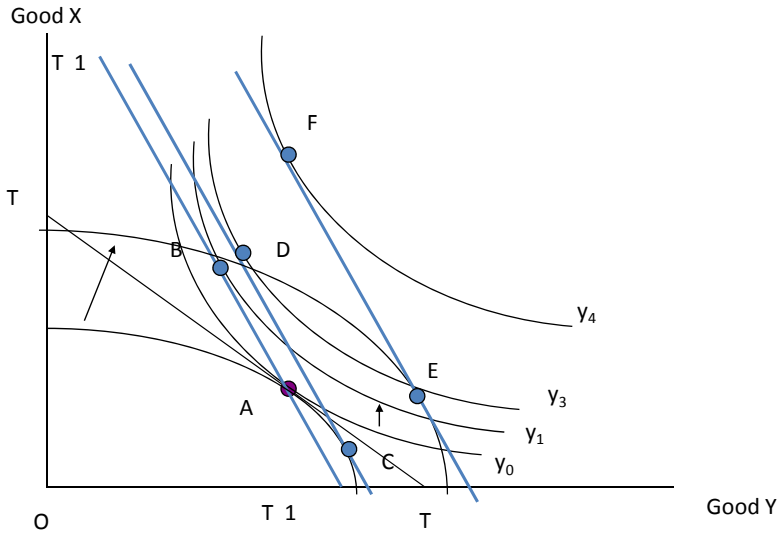
Yet, the situation of trade can lead to further changes in the production possibility frontier of the country. This can happen for many reasons, for instance if a process of learning-by-doing related to exports of good *Y* leads to improvements in the technique of production or if trade related investment triggers accumulation of one or both production factors. Such a change can be represented graphically as an outward shift in the production possibility frontier which at terms of trade TT_1 would lead to production of bundle *E* and consumption of *F* at the utility level y_4.

This very simple graphical model is capable of illustrating the various effects the quantification of which is attempted in applied general equilibrium models used in simulations of potential DDA outcomes. What is captured relatively well are the combined gains from exchange, gains from specialisation or allocative efficiency gains and the terms of trade effects. Of course, how the terms of trade change with the considered trade policy reforms and to what extent economies adjust their production and consumption depends on the chosen functional forms and a large set of assumed[3] elasticities but there is no disagreement with respect to the principles of these mechanisms and the welfare effects of trade shocks are calculated in a way that is similar to the presented basic exchange model.

[2] The current description assumes that full employment of production factors is maintained throughout the shift from A to C but it is possible to demonstrate that the aggregate welfare gains can be maintained even with a certain amount of unemployment.

[3] Many existing estimates have an econometric basis but these are often combined with subjectives rules of thumb such as, for example, the rule sometimes applied with the Armington assumption that substitution elasticity between varieties of products imported from different foreign countries is twice as high as the substitution between domestic and imported products.

Chart 1: Pure Exchange, Mobile Factors and "Dynamic" Gains



Source: Based on Caves, Frankel and Jones (2002).

What is captured less well – typically with the use of relatively crude ad hoc assumptions – is the impact of trade on production possibility frontier, or simply, trade-related productivity changes. Importantly, the estimated welfare effects of productivity changes are typically larger than the effects of the very trade policy changes on which they are predicated. Hence, any uncertainty about the causal link between trade policy and productivity is likely to be yet magnified when it comes to estimates of income effects of such trade policy changes, potentially magnifying uncertainty with respect to estimated gains from the considered trade reform. We will come back to this issue below.

3. Selected Recent Assessments of the DDA: Why Results Differ?

3.1 DDA Negotiations and "Realistic Doha Scenarios"

It can be argued that one particular lesson that modellers of multilateral trade liberalisation should have drawn out of their experience with the Uruguay Round is that they should not try to second-guess the final outcome of the negotiations, and then base their simulations (and policy conclusions) on such speculation. Most of the studies that simulated "likely outcomes" from the Uruguay Round prior to the conclusion of the negotiations missed their mark as they have excluded critical components in the Round and implemented scenarios none of which actually resembled the final Uruguay Round package.

Almost thirteen years after the conclusion of the Uruguay Round of trade negotiations and seven years into the DDA negotiations, scores of analysts and negotiators have considered various formulations and dimensions of a possible DDA accord. Yet, even at this stage it is not easy to characterise what the final modalities in agriculture and non-agricultural market access will look like nor when an accord can be realistically achieved.

The DDA was declared a development round at its birth which meant that the negotiations were expected to put emphasis on economic development of the developing WTO members. Yet, from the outset it was not very clear what this meant with respect to, for example, the extent of trade reform that was expected to be assumed by developing countries. Is it the developing countries that are to undertake the ambitious reforms and reap economic gains or should they to be given an option of reducing their trade barriers by less (or more slowly) than required by the general formula? It is quite clear that even within the developing countries group opinions on these issues are divided. This type of uncertainty largely persists to this day and is one of the reasons for co-existence of a variety of sometimes quite different sets of presumed policy changes that are portrayed as "realistic" DDA scenarios.

Both developing and developed countries' demands in the DDA negotiations are for increased access to partner markets. Their different starting points, specialisation in particular market segments and varying abilities to implement trade reforms help explain the divisions associated with the current tariff negotiations. Indeed, certain countries have expressed concerns about the loss of tariff revenue, adverse terms of trade effects, potential erosion of preferential access margins, impact of openness on certain specific sectors of economy and the overall distribution of gains from this reform.

Kowalski (2006) outlines the estimated structure of world tariffs based on information available in the World Integrated Trade Solution (WITS) database (see

table 1). In general, developing countries tend to impose higher tariffs on imports of both agricultural and non-agricultural products. Particularly high MFN rates are levied on imports in low and middle-income countries of North Africa, the Middle East, and South Asia.[4] One striking feature of post UR schedules is that tariffs on South-South trade are often higher than on North-South or North-North trade. This is particularly the case for trade in agricultural products of LDCs and low and middle-income countries. The tariff profiles of developing countries are also characterised by a higher dispersion of tariff rates and widespread incidence of international tariff peaks.[5]

In general, both in developing and developed economies, tariffs tend to be higher on imports of agricultural products as compared with industrial products.[6] The agricultural sector also suffers from a higher incidence of tariff peaks. Industrial tariffs are in general lower than agricultural ones; however, there is a considerable degree of heterogeneity across the industrial product categories with sectors such as simple textiles and clothing, leather or footwear recording significantly higher rates as compared to other sectors (see e.g. Bacchetta and Bora, 2003).

While many discussions and modelling exercises are centered around applied MFN rates as those directly affecting trade flows, it is crucial to distinguish them from bound tariffs that are at the centre of the WTO market access commitments. The distinction between applied and bound rates is important due to considerable differences between bindings and applied rates (binding overhangs) which bear implications for the trade, welfare impacts associated with any tariff reduction agreed in the WTO. As a result of the tariffication process in the Uruguay Round binding overhangs tend to be very high in the agricultural sector. In LDCs, expressed as a percentage of their applied duties, they reach 365% in agricultural products and around 290% in industrial products (Kowalski, 2006). Among lower and middle income countries, the existing overhangs expressed in relative terms are highest in Latin America and Caribbean, East Asia and Pacific and in the

[4] The gap in MFN tariff rates between developed and developing countries was reinforced by the Uruguay Round that resulted in average tariff reductions among OECD countries of 45%, as compared to 30% among non-OECD countries [OECD, 2001]. Partly, this outcome was the result of the failure or inability of some developing countries to fully engage in the negotiating process.

[5] Tariffs exceeding 15% according to the definition of an international tariff peak used commonly in the WTO context.

[6] Despite agricultural tariffs being generally higher than tariffs on industrial goods several categories of agricultural products enjoy relatively low tariff rates. These include: coffee, fibre, spices, live horticulture (WTO, 2003). Similarly, a few countries do not conform to the general pattern and levy lower import duties on agricultural products than they do on industrial goods. Among them are Australia and New Zealand and Switzerland has a zero tariff policy in both sectors.

agricultural sectors of South Asia. Developed countries maintain single digit overhangs which are, however, significant if expressed as a percentage of the corresponding applied rate.

Larger binding overhangs in developing countries require bolder tariff cuts in order to obtain reductions in applied rates. Indeed, the binding overhang is estimated at three times the average applied rate in the agricultural sectors of South Asian low and middle income countries (Kowalski, 2006); this implies that on average the bound rates would have to be cut by as much as 75% if it were to have an impact on applied rates. This highlights the need to have a robust formula in the context of the Doha round of negotiations in order to secure real market access and resulting welfare gains for participants. At the same time, large binding overhangs imply that unused protection can be significantly reduced, contributing to greater certainty about the future levels of tariff protection, without implying any losses to government tariff revenue (see Kowalski, 2006b).

The sequence of events in the negotiations have not helped analysts pin down their possible outcome with any great accuracy. In the lead up to the Cancún Ministerial, the work of the WTO Negotiating Group on Market Access (NGMA) focused on the issue of "modalities" and particularly on a harmonizing formula for tariff cuts applied on a line-by-line basis. Several countries submitted proposals outlining a range of market access priorities (WTO, 2003). In May 2003, the chairman of the NGMA released a document entitled *Draft Elements of Modalities for Negotiations on Non-Agricultural Product*s (WTO, 2003b) which was meant to bring together members' negotiating positions. Key elements of the proposal included: a distinction between developed, developing and least developed countries (LDCs); a proposed formula for tariff reductions; and proposals for sectoral tariff reductions and special and differential treatment for developing countries. Built into the formula was an element taking into account the current average level of tariffs of each country and a negotiated coefficient implying that countries with relatively high levels of average tariffs would in principle be able to maintain higher tariff rates unless they would agree in the negotiations to accept a lower value of the negotiated coefficient.

The meetings of NGMA in the run up to Cancun revealed different levels of ambition among Members with respect to how deep formula tariff cuts should be.[7] Significant North-South differences on tariff liberalisation and special and differential treatment aspects of the proposal emerged. For some developing countries, the proposal was going too far and did not sufficiently address their

[7] As far as sectoral approach (i.e. the seven sectors proposed for a complete elimination of tariffs) is concerned, positions were far apart. A number of developing countries would see a voluntary approach to participating in these sectoral tariff reductions, while developed countries showed a preference for it to be mandatory. Most Members, however, were willing to address the sectoral approach only once the overall tariff reduction formula had been approved.

concerns. For many developed countries, on the other hand, the proposal would not guarantee effective improvement in market access. A number of proposals drew attention of the negotiating group to exemptions of sensitive products in the cases of vulnerable economies. Concerns were also raised about the need to preserve the existing margins of preference for the developing country exports.[8]

The *July Framework* adopted by the WTO General Council on 1st August 2004 built on NGMA negotiations in the run-up to the Cancún Ministerial stipulating that additional negotiations would be required to reach agreement on the specifics of negotiated modalities. In particular, the July Package stipulated that the negotiations would continue to focus on a non-linear formula approach to tariff cuts applied on a line-by-line basis which shall take fully into account the special needs and interests of developing and least-developed countries, including through less than full reciprocity in reduction commitments. This was later reaffirmed in the Doha Work Programme Ministerial Declaration adopted in December 2005 in Hong Kong with an explicit reference to the *Swiss Formula* with coefficients at levels that deliver meaningful reduction in tariffs, tariff peaks and escalation while taking fully into account the special needs and interests of developing countries, including through less than full reciprocity in reduction commitments.

Agriculture has been portrayed as being at the centre of the deadlock in the DDA negotiations and their suspension in July 2006 even though the negotiations are about a package that covers the far larger economic sectors of services and non-agricultural goods, as well as a variety of other trade-related issues. The uncertainty with respect to the major parameters of a future agreement in these areas is no smaller than in agriculture. The recently revised draft "modalities" papers for agriculture and non-agricultural market access (NAMA) that were tabled by the chairs of the respective negotiating groups almost seven years into the negotiations in February 2008 were seen by many commentators as representing only a limited progress in clarifying the major parameters of a future agreement (see. e.g. ICTSD, 2008).

Reflecting those various uncertainties, which are likely to persist until the final agreement in known, the large body of existing literature on potential welfare gains from the DDA assumes a wide range of policy changes that are thought to be "realistic" DDA scenarios. table 2 describes the main features of a set of recent assessments of gains from trade liberalisation conducted in the context of DDA negotiations in period 1999–2006. Taking the example of tariff reductions in three relatively recent assessments of the DDA (Polaski, 2006, World Bank, 2006 and Fontagne et al., 2005) we can see clearly that these assumptions differ with respect to the relative depth of cuts in agricultural and non-agricultural sectors as well as the relative depth of cuts in developing and developed regions of the world.

[8] See Lippoldt and Kowalski (2006) for a detailed discussion of the preference erosion issues.

Similarly, broad assumptions with respect to the likely outcome of trade facilitation deal range from cost reduction of 1% to 3% of the value of trade. These disparities clearly reflect a different understanding of what a realistic outcome of the negotiations might be and they constitute one of the main reasons why the estimates of welfare gains from further trade liberalisation differ so widely.

It is not hard to accept that a scenario assuming a 100% cut of remaining tariffs on manufactures imports delivers estimates that are different from one assuming, for instance a 30% cut. Fortunately, many existing studies do include a 100% liberalisation scenario across all considered sectors and this scenario is often a better benchmark for comparing results across different models and data sets. Such a scenario is also a natural comparator for other, perhaps more realistic, scenarios as it captures the overall potential gains from dismantling the remaining trade barriers and bypasses the problem of whether the conjectured cuts are specified with respect to applied or bound rates.[9]

3.2 Market Structure

Table 2 identifies a number of features other than liberalisation scenarios with respect to which the selected studies differ. All of the selected studies are in the Walrasian family in the sense that they are based on the optimizing behaviour of representative agents (households, firms) in a framework of welfare economics as contrasted with models that may depart from the optimizing behaviour in favour of ad hoc assumptions designed to increase their empirical relevance (Cline, 2004). Yet, even within this family of models significant differences persist.

One such important difference refers to the assumptions about market structure. Though more than two decades have already passed since the notions of increasing returns and product differentiation have been incorporated into the trade theory (e.g. Helpman and Krugman, 1989) they are not routinely incorporated into the applied trade models. Recent exceptions in the context of DDA assessments include: Brown et al. (2003); Francois et al. (2005); Cline (2004); Fontagne et al. (2005).

[9] Among other effects, running the simulation scenarios on the basis of applied rather than bound rates implies a much deeper reduction in developing countries' protection than both developed countries' and what is actually envisaged under the DDA. In the case of developing countries, applied tariffs are on average one-third of bound duties; and in a large number of countries, applied duties are even below MFN rates. Brief analysis of protection data from the CEPII MAcMaps database suggests that in developing countries there is a lot of "water in the tariffs" or tariff overhang where the difference between bound and applied duties in agriculture can be as high as 150 percentage points as is the case in Bangladesh. With the exception of EFTA agriculture, there is no discernible difference between applied and bound duties in developed countries, whether in agriculture or in NAMA.

All these studies assume a particular, stylised and analytically tractable formulation of imperfect competition, namely, large group monopolistic competition. As its name suggests monopolistic competition combines features of perfectly and imperfectly competitive markets: average profits of firms are driven to zero by an assumption of free market entry of firms while at the same time firms are monopolists within their market niche (variety that they produce) and set prices above marginal costs. With such a market structure output and welfare effects of trade policy reforms are magnified by pro-competitive effects of market opening on price-cost margins (see Francois, 1998). This is an important feature of economic reality but one has to bear in mind that such market structure itself rests on some simplifying assumptions (such as the firms' size symmetry and the free market entry). Additionally the discussed modelling approach requires highly elusive data on the typical differences between average and marginal costs by sector. Francois (1998) points out that the engineering literature on which the used estimates of scale economies are based goes as far back as to the 1950s, 1960s and early 1970s.

The uncertainty with respect to key parameters seems to be an important concern precisely because applied trade models that do incorporate the assumption of imperfect competition tend to generate larger estimates of gains from trade liberalisation. This is illustrated by Francois (1998) who compares the welfare, output and wages results of a trade liberalisation scenario implemented in a model with five different formulations of market structure. It is, however, less clear to what extent the assumption of imperfect competition contributes to the dispersion of estimates of gains from the DDA. For example, two of the three studies based on imperfectly competitive market structures in table 2 (Francois et al., 2005 and Cline, 2004) generate results of the same magnitude as other models based on perfect competition, while estimates of welfare gains in Brown et al. (2003) are ten times the average gains from models based on the assumption of perfect competition.[10] The latter study is also unique in considering an ambitious services trade liberalisation scenario which is likely another feature that may be driving the exceptionally large gains and their attribution to developed countries.[11]

3.3 Model Closure

Variables in economic models can be categorized as endogenous (or determined within the model) and exogenous (or determined outside the model). Mathematically the list of endogenous and exogenous variables has to be chosen so that the system of equations constituting the model can be solved. Economically

[10] See chart 5 in Piermartini and Teh (2005) for a graphical comparison of model results.

[11] Developed countries' shares of services in GDP are higher and they are more open to trade in services.

this list is chosen to reflect how the modeller thinks the economy actually works. Which variables are chosen as endogenous and which as exogenous is what is called a model closure. Of course, even if two different modellers agree on the accounting system of the analysed economy and on the specification of underlying behavioural relationships (model) they do not have to agree on the model closure (see e.g. Pyatt, 1988).

A classic example is a difference between "New classical" and "Keynesian" views of the aggregate supply curve. Simplifying for the sake of exposition, according to the "new classical" view the economy is always under full employment and any demand shifts are reflected in the level of prices but not in output or employment. According to such a closure supply would be determined outside the model while the price would be determined within the model to equilibrate aggregate supply with demand. According to "Keynesian" view prices would be sticky, unemployment would be possible and aggregate output would be determined by demand shocks. Such a closure would be characterised by exogenous prices and endogenous aggregate supply that would adjust to meet aggregate demand.

A prominent example of how a model closure can affect the size and distribution of welfare gains from a trade liberalisation scenario concerns adjustment of labour markets. Consider the assumption of fixed wages of unskilled urban labour in developing countries that Polaski et al. (2006) introduce into the Carnegie model (see table 2). Contrary to the majority of CGE studies that have simulated multilateral liberalisation, the Carnegie model assumes away full employment of urban unskilled labour in developing countries. Such an approach is justified by the authors on the basis of their observation of positive unemployment rates in most developing countries, especially with respect to unskilled labour. As the authors posit, assuming this kind of unemployment is "a reasonable representation of the reality in most developing countries in the short term."

The less-than-full employment of urban unskilled labour implies that (1) any adjustment to a trade shock occurs in quantity of employed labour rather than its price and that (2) manufacturing which is likely to make a more intense use of urban unskilled labour and is an important export activity in many developing countries receives special treatment in the model. In the full employment closure of the model the supply of labour is fixed and any decrease in labour demand (*e.g.* as a result of a negative demand shock) results in an decrease in real wages so that the quantity of labour employed after the trade shock remains unchanged. In the less-than-full employment closure, real wages are fixed and employment is allowed to vary with demand. Consider a negative demand shock such as would be expected, for example, in a developing country that loses access to markets where it previously enjoyed preferential treatment. The full employment closure will result in lowering of real wages while the unemployment closure will result in lowering of employment at unchanged wages. Which of the two situations would

result in a deeper decrease of labour earnings (and thus negative impact on welfare) cannot be determined a priori as it depends on the underlying elasticities that determine the slope of labour demand. However, the evidence from the past CGE literature suggest that in some currently used models and with the available set of elasticities a less-than-full-employment closure often results in deeper welfare and income losses for countries that experience negative market access shocks.

This point can be illustrated by a simple simulation employing a standard GTAP model of the world economy and the version 6 of GTAP database to compare the effects of full removal of tariffs worldwide under the assumption of full and less-than-full employment in one of the regions. To focus the argument, Sub-Saharan Africa (SSA) is chosen to be the region subject to alternative specifications of the labour market closure. Table 3 indicates that the introduction of unemployment lowers the global welfare gains from tariff removal from around USD 41 billion to approximately USD 32 billion, the difference being entirely the differences in gains accruing to the region of SSA. Indeed, while with the full employment assumption SSA stands to gain a moderate USD 1.4 billion, the unemployment assumption changes the result into a welfare loss of around USD 7.7 billion.

The remaining panels in table provide an explanation of the mechanisms at work. While in both cases, the removal of tariffs is predicted to put SSA producers under pressure to reduce output in most sectors, the magnitude of output reduction is larger under the unemployment assumption (table 3, Panel C). This is because with fixed wages SSA producers cannot compensate the negative demand shock by lowering wages and consequently prices. Indeed, the unemployment assumption results in a more moderate reduction of export prices across all sectors. Panel B in table 3 indicates that the output reduction resulting from the analysed tariff shocks is associated with approximately 5% reduction in employment in the region.

To summarise, a low income country that faces erosion in its preference will need to enhance its productivity and cut its export price in an attempt to maintain its market share; it cannot lower its wages with the unemployment closure as assumed in the Polaski et al. (2006) study. A large labour-surplus country such as China for example, can actually move in on this country's market share without creating any upward pressure on its export price given the assumption of fixed wages for unskilled urban workers. Inevitably, the low income country loses market shares and export earnings.

This example shows that closure assumptions may determine whether a certain country or group of individuals will gain or lose out from a given liberalisation scenario. It is true that the full employment closure may be less appropriate in economies with high unemployment or low employment rates, especially if the objective of the study is to inform of potential economic effects in short or medium run. However, it may be seen as equally as questionable to use the unemployment

closure for purposes of an assessment of effects of a global trade deal that is negotiated and implemented with long-term effects in mind.

3.4 Dynamic Gains from Trade

Another element that contributes to the wide disparities in estimates of welfare gains from the DDA is treatment of the link between trade and productivity. The notion of "dynamic gains from trade" has been long present in the applied trade modelling literature concerned with the quantitative estimates of economic gains from trade policy reforms, though the number of approaches that attempt to model this link has grown in the recent decade. This was related to an intense academic debate on to what extent trade liberalization impacts upon economic growth. A recent OECD study (Nordas *et al*., 2006) analysed and summarised the various arguments of the debate. The focus on trade-productivity growth in this literature stems from the fact that productivity growth is the only long term source of growth in the neo-classical growth framework. This is due to the fact that under the assumption of diminishing marginal returns, an increase in capital while holding labour input constant increases output, but at a diminishing rate as the stock of capital per worker increases. Eventually the capital stock reaches a level where investors will only replace depreciating capital in the absence of technological progress.

It should be pointed out at the outset that the income effects derived from the conventional comparative static AGE analyses of trade liberalization already account for one-off average productivity effects that arise as a result of reallocation of economic activity across sectors with different productivity levels (i.e. allocative efficiency gains).[12] While the impact on average productivity is rarely reported as a separate summary statistic the magnitude of average productivity changes induced by reallocation of factors of production can be determined from the figures describing percentage changes to real GDP (since in the absence of factor accumulation in static models, real GDP growth can only come about through productivity changes). For example, Kowalski (2006) employing the standard GTAP model of world trade estimates that the full removal of tariff barriers (with 2001 as the base year) and associated resource reallocation across all trading partners results in an average productivity increase of 0.35%.[13]

In addition to the static effects of trade policies some existing applied studies consider supplementary increases in total factor productivity, which are most

[12] What these models really do, however, is to consider one-off changes in levels of productivity rather than an increase in productivity growth rate that is considered to be the only source of sustained long-term growth in the modern growth theory.

[13] This is a simple average across all regions that are singled out in the model. In some developing regions average productivity is reported to have increased by as much as 0.79% (see Kowalski, 2006).

frequently implemented as exogenous add-ons in "comparative static" modelling frameworks. The hypothesis of a link between openness and productivity level has been at the centre of the sizable literature on the so called export-led growth that attempts to establish the causal link between high growth rates, increasing trade shares in GDP and significant structural changes observed in a number of rapidly industrializing economies post WWII (see e.g. de Melo and Robinson, 1990).

As stressed by Ackerman (2005) the productivity effects included in the vast majority of existing modelling exercises are "off-line calculations, not part of the models per se". Because the productivity increase is not determined by the model itself its inclusion requires crucially a separate estimation of the magnitude of the impact of trade liberalization on productivity outside of the employed CGE model and its implementation as an additional exogenous shock. One example of such an approach is the study of effects of multilateral tariff liberalization and developing countries by Dessus et al. (1999) that uses a version of the LINKAGE model developed at the OECD. While in the original model productivity is exogenous (determined outside the model) Dessus et al. (1999) adopt an additional assumption that the level of TFP is linked positively to the intensity of trade. The magnitude of this effect is established with a separate econometric model that utilizes information on openness and productivity in 63 countries in the period 1961-95. The estimation results indicate that 10% rise in trade intensity (defined as the ratio of trade volume to output) leads to a 0.9% rise in the level of TFP.

As far as the results of Dessus et al. (1999) are concerned, tariff liberalization considered in separation of productivity-enhancing effects is reported to bring about total welfare gains of USD 82 billion in 1995 prices or approximately 0.2% of world GDP. When the estimated impact of trade on TFP is added to the scenario in order to calculate dynamic gains from trade, the total welfare gains increase very significantly to around USD 1200 billion or around 3% of world GDP. Additionally, the increase is most substantial for developing countries. It is clear that in Dessus et al. (1999) the assumption of an additional link between trade and productivity made a big difference in an assessment of gains from multilateral tariff liberalization; in fact this study has come up with one of the highest post-UR estimates of gains from further tariff liberalisation.

Productivity is also assumed to be influenced by changes in trade in one of the scenarios of the extensively debated World Bank study of effects of multilateral trade reform (Anderson et al., 2006) or the study by the Carnegie Endowment (Polaski, 2006). In an associated study one of the co-authors of World Bank simulations acknowledges that the approach adopted in Anderson et al. (2006) is a short-cut as compared to a genuine endogenous model in which changes in productivity could be influenced by changes in research and development, by technology embodied in imports and by pro-competitive effects of trade (van der Menbrughhe, 2006). In contrast to Dessus et al. (1999) where trade-related productivity changes are implemented at the country level, in Anderson et al

(2006) trade-related productivity increases are implemented at the sector level and their magnitude is conditioned on the increase in the export-to-output ratio with the elasticity set at one in manufacturing and one-half in agriculture.[14] As van der Menbrughhe (2006) reports the productivity assumption significantly boosts the gains from trade reform particularly for developing countries which, presumably, record more pronounced expansion of trade volumes. At the global level an inclusion of the trade-related-productivity channel in Anderson et al. (2006) almost doubles estimated total gains from full liberalization of world merchandise trade from USD 287 billion to USD 461 billion.

The marked increases in estimates of benefits of trade liberalization after addition of the productivity effect reported in Dessus et al. (1999) and Anderson et al. (2006) are an indication of a more general predisposition of this type of modelling exercises. Namely, the welfare effects of productivity changes tend to swamp the direct welfare effects of trade policy changes (e.g. tariff reforms). An implication is that results pertaining to overall gains from a trade reform are very sensitive to what one assumes about the relationship between openness and productivity.

Consequently this approach has a number of limitations that all relate to reasonableness of the productivity increase calculations. In some studies simple estimates or rules of thumb are used (e.g. the above-mentioned Anderson et al., 2006 or Polaski, 2006) while in others the relationship between openness and trade is established econometrically (e.g. Dessus et al. 1999). It is often claimed that the existing empirical evidence does not provide a definitive and robust conclusion with respect to existence of trade-related growth effects and that because of this uncertainty they should not be included in the applied trade models simulations (e.g. Hedi Bchir et al, 2002). A more positive conclusion is that there clearly is scope for better understanding and improving the existing estimates of impact of openness on productivity levels.

Even if a robust relationship between openness and productivity could be estimated econometrically and added to the CGE simulation they would usually not be consistent with other calculations performed within a CGE model simulation. For example, an econometric estimation of impact of trade on productivity that is later implemented in a CGE model is likely to already include an impact on average productivity level discussed above. If this is the case, an inclusion of an additional productivity shock may cause a problem of double counting of productivity changes. Generally, if the econometric estimation is not based on a reduced form of a structural model that is consistent with the adopted CGE approach, there is no reason why the results should be consistent with other

[14] For comparison, using the data for Thailand in period from 1980 to 1995 Rattso and Stokke (2002) estimate the short-run elasticities of productivity with respect to foreign trade to be 0.36 for agriculture and 0.55 for industry.

calculations performed within the CGE model. This may need to be more explicitly acknowledged in future econometric work identifying the productivity effects of trade.

An early attempt at preventing this kind of inconsistency can be found in de Melo and Robinson (1990) who developed a relatively simple one-country model that incorporates explicit links between exporting and productivity and importing and productivity that arise as a result of export and import externalities. The export externality in de Melo and Robinson (1990) is introduced by linking the amount of composite domestic production to exports.[15] The import externality is introduced through a link between the import ratio in heavy manufacturing and the productivity of the capital stock. De Melo and Robinson (1990) calibrate the theoretical model so that the initial equilibrium resembles early stages of export-led growth strategy in Korea and consider the optimal policy choices with respect to export subsidies in light and heavy manufacturing and an import subsidy in heavy manufacturing. They argue that models of this type provide a first step towards endogenising the major driving forces generating total factor productivity growth to mimic development paths of countries pursuing export-led growth strategies. They find that an incorporation of import and export externalities makes the model better suited to account for the stylized facts of growth and structural changes in these countries.

Unfortunately, endogenous productivity growth is largely absent from contemporary trade modelling literature.[16] This seems to result from the difficulty of unifying the concepts of specialization and structural change present in multisector comparative static trade models with the concept of balanced growth in literature on long-run economic dynamics. Indeed, Ngai and Pissarides (2004) write that "structural shifts are usually studied in models that do not satisfy the conditions for balanced aggregate growth. Conversely, balanced aggregate growth is normally studied in models that do not allow structural change."

While a number of alternative theories exist on what balanced growth is (Beirwag, 1964), this term is usually used in the modelling literature to describe, quoting Solow and Samuelson (1953), "a state of affairs in which the output of each commodity increases (or decreases) by a constant percentage per unit of time, the mutual proportions in which commodities are produced remaining constant. The economy changes only in scale, but not in composition." The condition of balanced growth, when applied to a multisector model, implies that in the dynamic

[15] This is an externality since the producers do not see the benefits of exporting beyond the competitively determined level and do not internalize this benefit in their production decision. Government on the other hand is interested in the maximization of the overall income level and internalizes the pro-growth effect of exporting.

[16] One exception is the one country model of trade and growth in Thailand by Diao et al (2002), see Annex Table 1.

equilibrium sectoral outputs and trade must grow at the same rate and that relative prices and relative factor rewards do not change.

In conventional trade models, where often different factor intensities are assumed across sectors, balanced growth conditions place constraints on productivity growth, i.e. productivity growth paths that are consistent with balanced growth are determined by factor intensities and factor supplies. This limits the possibilities of incorporation of trade-related endogenous productivity growth into applied trade models. To give an extreme example, if factor endowments are assumed to be fixed the rates of sectoral TFP growth that are consistent with the balanced growth path must be equal to each other and to the rate of growth of sectoral outputs. Some research is being pursued to determine the properties of utility and production functions that allow coexistence of differences in sectoral TFP growth, balanced aggregate growth path and structural change (e.g. Ngai and Pissarides, 2004). This could allow endogenous productivity growth become a more widespread feature of applied trade models.

Overall, the issue of inclusion of trade-related productivity gains in CGE simulations of trade policies is rather delicate. The income effects of productivity changes are of an order of a magnitude larger than the effects of the very trade policy changes on which they are predicated. Hence, any uncertainty about the causal link between trade policy and productivity is likely to be yet magnified when it comes to estimates of income effects of such trade policy changes, potentially shedding negative light on modelling approaches to trade policy analysis. Therefore, there is a need for a thorough empirical verification of links between trade and productivity and the way they are being implemented in CGE analyses.

3.5 Aggregation

Model (and database) aggregation is another reason for which the estimates of welfare gains from the DDA differ across studies. A recent paper by Decreux and Fontagné (2006) of CEPII includes a comparison of results of two liberalisation scenarios using different sector and region aggregations. Scenario 1 in table 4 resembles "Central Doha Scenario" of Polaski et al. (2006): in NAMA, tariffs are cut by 36% except for the G90 countries; in Agriculture, export subsidies are eliminated, domestic support levels are halved, and tariffs are cut by 36% on average except for sensitive products whose tariffs are cut by 25%, and the G-90 are exempt from any liberalisation. In scenario 2, tariffs on NAMA products get cut using the Swiss formula with a coefficient of 10, with the exception of the G-90; in agriculture, the policy experiment is exactly the same as in scenario 1 except that no separate treatment is accorded to sensitive products. Aggregation choice clearly affects the results of the simulation.

While the GTAP database that is most widely used in the modelling profession contains a total of 57 sectors (20 agricultural, 22 manufacturing and 15 services sectors) and 111 countries or regions it has to be aggregated up so that the model can be solved with currently available computer hardware and software in a reasonable time. There is no standard sector and region aggregation and the aggregations are very often tailored to the specific needs of studies in question. For example in OECD (2005) where one level of analysis included household impacts of agricultural policy reforms the aggregation used for a CGE simulation reflected the choice of countries on which the analysis of household level impacts was to be based (Brazil, Italy, Malawi, Mexico and the USA) and the choice of sectors for which the detailed information on agricultural policies was available. Kowalski and Shepherd (2006) who addressed a host of issues pertaining to South-South trade chose an aggregation the allowed a rich representation of individual developing countries.

The two studies, despite using a relatively similar modelling approach[17] and tariff cuts scenarios, generated quantitatively and qualitatively different results. For example, the two sets of results implied different shares of gains accruing to developing countries. OECD (2005) estimated that around 30% of total welfare gains would accrue to developing countries while in Kowalski and Shepherd (2006) this share was more than 50%. Upon additional analysis of both sets of simulation results, this discrepancy was later attributed to differences in model aggregations. Kowalski and Shepherd (2006) considered 44 separate regions of which the majority were developing countries while the OECD countries were relatively aggregated. OECD (2005) considered 18 separate regions with a number of major developing and OECD countries treated separately and the rest aggregated to the rest of the world category.

These alternative aggregation approaches caused differences in results because aggregating regions with relatively different levels and patterns of tariff protection removes some of the potential sources of gains from trade liberalisation. To give an extreme example, aggregating two otherwise similar countries, one with a positive rate of effective protection in a certain sector and one with a negative effective rate of protection in the same sector, yields an artificial region where, after averaging, the effective protection in the sector is close to zero, implying much smaller gains from trade liberalisation than would be obtained if the two countries were treated separately. As discussed above the highest and most dispersed tariff rates are observed in developing countries and this is a why parsimonious aggregation of developing country regions is going to result in smaller world gains and a smaller share of gains accruing to this country grouping. A similar reasoning can be

[17] OECD (2005) used the GTAPEM model which is a version of GTAP model and Kowalski and Shepherd (2006) used the standard GTAP model.

conducted in the context of aggregating sectors with contrasting protection structures.

3.6 Zero Flow Data

The final set of qualifications that need to be born in mind when interpreting the estimates of gains from the Doha Round using CGE models relates to model structure and the so-called "small shares" problem. The small shares problem is particularly relevant in the context of quantitative assessments of the DDA because it puts developing countries, and more particularly the least developed among them, at a critical disadvantage. CGE models assume a certain structure of the economy with functional forms and parameter values, calibrate the initial equilibrium around a base year and then change the trade policy parameters to solve for the change the model implies. Thus, only the data from the base year are used to calibrate the model. With the Constant Elasticity of Substitution (CES) preferences predominantly adopted in the considered set of DDA assessments the implication is that if in the initial equilibrium there is no trade between country A and country B, no "new" trade will be created following the policy shock. This biases the results concerning particularly the least developed countries that have a limited number of trading partners and a narrow export base. Table 5 provides an idea of the extent of such a problem; for example, some 82% of Bangladesh's export are destined to the EU+EFTA and the US markets; it has limited or no trade with the majority of GTAP individual countries or groups. It is thus unsurprising to see, for example, that Polaski et al. (2006) find net losses for Bangladesh given the country's overwhelming dependence on markets where in the baseline scenario it enjoyed preferential access. A similar story applies across the majority of LDCs.

In a recent paper Komorowska et al. (2007) explain that the continued use of CES preferences in modelling studies, despite their unfitness for dealing with the small shares problem, had been determined by their analytical tractability and the limited set of estimated parameters it requires. They also describe some existing approaches to dealing with the small shares problem as well as propose a new such approach of their own.

In fact, this problem is not unique to any one CGE study as it affects the majority of recent estimates of multilateral trade liberalisation. What one should note here though is that authors should acknowledge it as a shortcoming and caution the reader on its implications.

4. Conclusions

In the context of multilateral trade negotiations positive economic analysis can undoubtedly help to deliver information on the stakes involved in order to help frame the negotiations and to highlight the distribution of costs and benefits of

various options. Continuing enhancements in economic theory, modelling approaches and data quality are helping analysts to provide ever more integrated views of the implications of various policy changes. At the same time the modelling frameworks become more complex and less readily accessible to non-specialists which opens avenues for the analysis to be conducted in a tendentious manner, or selectively, to support certain predetermined positions or arguments.

It is argued in the current paper that, on balance, the richness of approaches and alternative estimates of gains from further trade liberalisation is not necessarily undesirable and can in fact be seen as a part of an organic analytical process. The sequence of events in the DDA negotiations have not helped analysts pin down their possible outcome with any great accuracy. The differences in results from alternative modelling approaches can be very often linked to diverging views about the likelihoods of alternative negotiating outcomes. Also, diverging assumptions about specific economic mechanisms such as the market structure, smoothness of adjustment of factor markets or the nature of relationship between openness and productivity growth are at the heart of differences in results. Also, naturally, the differences can sometimes be traced back to data quality, which, however undoubtedly improves with time. However, in a limited number of instances the differences in existing results can be artefacts of the employed methodology with, for instance, different regional or sectoral aggregations of the same model generating quantitatively, and occasionally qualitatively, different predictions. Similarly, in computable general equilibrium analysis only the data from the base year are used to calibrate the model with the implication that where trade did not exist in the initial period no "new" trade will be created following the policy shock.

Overall, we are light years away from creating the perfect computable model that will be capable of accurately replicating all the linkages between economies through international flows of goods and services as well as through movements in labour, capital and the allocation of investment across the globe. Thus, all applied trade models should always start by explicitly acknowledging the limitations of their results and the assumptions that have been made. It is also critical that all modelling approaches are transparent to allow interested researchers to examine all their aspects, replicate their results and learn from their approaches.

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Appendix

Table 1a: Simple Tariff Averages

	Agricultural products		Non-agricultural products	
	Bound	Applied	Bound	Applied
Reporter:				
Developed countries (DEV)	22.3	7.5	8.5	3.8
Low and middle income countries	58.9	22.6	30.7	11.1
of which:				
East Asian & Pacific countries	40.0	14.9	28.8	13.5
Europe	35.0	28.1	10.2	7.0
Latin America and Caribbean	63.4	16.4	39.1	10.4
Middle East and North Africa	59.4	32.1	34.0	21.3
South Asian countries	98.6	24.6	33.7	18.8
Least Developed Countries	77.4	16.6	51.5	13.2

Source: WITS.

Table 1b: Trade-Weighted Averages of MFN Applied Rates on Agricultural Products

	Country source of imports							
	DEV	LDC	LMEAP	LM Europe	LMLAC	LMMNA	LMSAsia	LM
Reporter:								
Developed countries (DEV)	5.6	10.1	6.7	11.8	5.1	4.9	2.6	5.9
Least Developed Countries (LDC)	11.5	18.9	13.5	12.5	13.5	16.5	10.3	13.3
Low and middle income countries (LM)	19.6	24.0	28.8	22.5	15.9	18.9	15.5	20.3
of which:								
East Asian & Pacific (LMEAP)	11.9	17.3	17.3	15.4	12.6	16.4	12.6	15.1
Europe (LMEurope)	20.7	18.7	15.8	22.2	24.3	19.5	12.6	20.5
Latin America and Caribbean (LMLAC)	23.2	15.9	11.8	34.2	14.6	13.2	9.3	14.8
Middle East and North Africa (LMMNA)	28.8	19.3	28.3	23.4	11.6	17.6	10.7	17.8
South Asian countries (LMSAsia)	19.9	30.6	69.1	23.4	35.9	21.1	22.6	48.3

Source : WITS.

Table 1c: Trade-Weighted Averages of MFN Bound Rates on Agricultural Products

	Country source of imports							
	DEV	LDC	LMEAP	LM Europe	LMLAC	LMMNA	LMSAsia	LM
Reporter:								
Developed countries (DEV)	8.3	14.0	7.2	21.1	6.8	8.7	3.2	7.6
Least Developed Countries (LDC)	66.5	106.1	107.3	72.8	153.1	48.1	149.0	121.3
Low and middle income countries (LM)	39.4	79.2	80.0	37.0	43.7	43.6	68.1	54.6
of which:								
East Asian & Pacific (LMEAP)	25.9	18.4	27.4	30.0	17.3	17.5	27.6	23.1
Europe (LMEurope)	28.0	19.6	23.9	32.2	28.9	26.4	22.4	28.7
Latin America and Caribbean (LMLAC)	45.3	64.2	38.6	32.3	47.7	39.2	35.5	46.8
Middle East and North Africa (LMMNA)	41.0	29.4	27.2	60.6	49.6	23.8	16.4	42.0
South Asian countries (LMSAsia)	79.2	118.0	205.7	86.0	102.5	96.5	132.7	160.2

Source: WITS

Table 1d: Trade-Weighted Averages of MFN Applied Rates on Industrial Products

	Country source of imports							
	DEV	LDC	LMEAP	LM Europe	LMLAC	LMMNA	LMSAsia	LM
Reporter:								
Developed countries (DEV)	2.2	9.8	3.5	3.1	4.0	1.9	6.4	3.7
Least Developed Countries (LDC)	10.8	8.8	17.5	7.5	8.6	8.7	18.7	14.0
Low and middle income countries (LM)	11.0	7.6	10.5	6.4	10.4	6.4	11.4	8.9
of which:								
East Asian & Pacific (LMEAP)	9.6	5.4	8.9	6.2	5.1	6.7	9.0	7.5
Europe (LMEurope)	7.1	6.5	6.6	5.2	4.4	1.0	6.9	5.2
Latin America and Caribbean (LMLAC)	12.8	10.0	12.8	7.6	11.5	2.8	13.0	11.1
Middle East and North Africa (LMMNA)	20.9	18.9	25.9	24.1	21.0	14.7	19.9	20.6
South Asian countries (LMSAsia)	24.3	22.0	19.7	26.7	16.7	17.4	17.8	20.9

Source: WITS.

Table 1e: Trade-Weighted Averages of MFN Bound Rates on Industrial Products

	Country source of imports							
	DEV	LDC	LMEAP	LM Europe	LMLAC	LMMNA	LMSAsia	LM
Reporter:								
Developed countries (DEV)	2.9	10.2	3.7	3.5	3.9	3.4	6.6	3.9
Least Developed Countries (LDC)	28.7	20.3	32.9	28.2	29.4	27.0	33.6	31.2
Low and middle income countries (LM)	19.2	7.3	14.9	9.2	27.4	13.3	14.9	16.5
of which:								
East Asian & Pacific (LMEAP)	8.3	1.7	7.7	7.0	5.2	2.6	6.2	6.4
Europe (LMEurope)	9.1	12.3	7.5	6.9	7.2	7.3	11.8	7.1
Latin America and Caribbean (LMLAC)	33.4	32.7	33.2	26.7	31.9	33.2	32.1	32.1
Middle East and North Africa (LMMNA)	28.8	27.8	31.2	30.5	23.0	28.0	22.1	28.4
South Asian countries (LMSAsia)	31.6	33.2	25.3	33.4	33.7	35.2	26.6	30.4

Source : WITS.

Table 1f: Differences between Bound and Applied Rates

	Agricultural products		Non-agricultural products	
	absolute	as % of applied rate	absolute	as % of applied rate
Reporter:				
Developed countries (DEV)	14.9	199.3%	4.7	124.1%
Low and middle income economies	36.4	161.3%	19.6	176.4%
of which				
East Asian & Pacific countries	25.1	168.7%	15.3	113.6%
Europe	6.9	24.5%	3.2	45.8%
Latin America and Caribbean	47.0	287.3%	28.7	275.2%
Middle East and North Africa	27.4	85.5%	12.7	59.6%
South Asian countries	74.0	300.1%	14.9	79.5%
Least Developed Countries	60.8	365.6%	38.4	291.0%

Source: WITS.

Table 1g: Coefficients of Variation

	Agricultural products		Non-agricultural products	
	Bound	Applied	Bound	Applied
Reporter:				
Developed countries (DEV)	2.0	2.9	1.3	1.7
Low and middle income economies of which	1.0	2.4	0.7	1.1
East Asian & Pacific countries	1.1	17.7	0.8	1.3
Europe	1.4	1.3	1.0	1.1
Latin America and Caribbean	0.6	1.4	0.4	0.9
Middle East and North Africa	2.7	4.3	0.5	0.9
South Asian countries	0.7	0.9	0.8	0.7
Least Developed Countries	0.7	0.7	0.6	0.8

Source: WITS.

Table 1h: Incidence of International Tariff Peaks (% of Total Number of Lines)

	Agricultural products		Non-agricultural products	
	Bound	Applied	Bound	Applied
Reporter:				
Developed countries (DEV)	21.0%	18.7%	4.8%	8.0%
Low and middle income economies of which	72.6%	81.0%	24.1%	36.9%
East Asian & Pacific countries	69.2%	70.2%	25.5%	24.4%
Europe	22.5%	55.1%	9.0%	35.5%
Latin America and Caribbean	94.9%	96.2%	26.5%	33.3%
Middle East and North Africa	86.3%	59.7%	49.8%	47.5%
South Asian countries	86.7%	97.3%	52.5%	59.9%
Least Developed Countries	88.3%	96.7%	35.0%	41.9%

Source: WITS.

Table 2: Selected Studies of Trade Liberalization, Their Treatment of Trade-Related Productivity and Other Dynamic Effects

Study	Scope	Model	Data	Data aggregation	Dynamic features	Productivity treatment	Selected key findings
Anderson et al. (2006)	Agriculture (tariffs and subsidies) Manufacturing	World Bank LINKAGE Model, perfect competition recursive dynamic multicountry multisector	GTAP 6, baseline year 2001, adjusted for recent developments in trade policy and projected to 2015 supplemented by World Bank growth projections	Not specified	endogenous capital accumulation exogenous population and labor supply exogenous labor-augmenting technological change	exogenous levels assumed to increase in proportion to export-to-output ratio 10% increase in this ratio results in 10% increase in TFP for agricultural sectors and 5% in manufacturing sectors	Assuming trade has no impact on productivity: - the benefits of moving to global free trade: USD 287 billion in 2015 - gains higher for developed countries in nominal terms but higher for developing countries in relative terms (as % of GDP) -complete removal of protection in agriculture is responsible for two thirds of global welfare gains Assuming trade has an impact on productivity: - the benefits of moving to global free trade: USD 461 billion in 2015 - the gains for developing countries more than double

Study	Scope	Model	Data	Data aggregation	Dynamic features	Productivity treatment	Selected key findings
Kowalski (2006)	Agriculture (tariffs) Manufacturing Trade facilitation	GTAP, standard, perfect competition comparative static multicountry multisector	GTAP 6, baseline year 2001,adjusted for tariff bindings from WITS	12 regions, 10 sectors	none	exogenous levels not affected by liberalization scenarios	- full removal of tariffs worldwide: USD 42 billion - 1% reduction of trading costs worldwide: USD 120 billion - developing countries: comparatively large proportional effects: on average 0.54% of GDP; developed countries on average 0.08% - results for cuts according to Swiss formula with a coefficient of 5% for developed regions and coefficient of 30% for developing regions: USD 22 billion
Polaski (2006)	Agriculture (tariffs and subsidies) Manufacturing	Modified version of Wang (2003), perfect competition comparative static particular treatment of clearing in labor market	GTAP 6, baseline year 2001, plus additional data from national and intergovernmental resources	13 regions, 27 sectors,	none	exogenous levels assumed to increase in proportion to imports of capital goods 10% increase in real imports of capital goods – increase of 1% (or less in developed countries) in TFP in given sector	- the benefits of moving to global free trade: USD 168 billion approximately equivalent to 0.5% of world GDP - the benefits of so-called 'plausible Doha scenario': USD 59 billion or 0.2 of world GDP with 10% of these gains attributed to liberalization in agriculture - developing countries account for approximately 45% of global gains; most developing countries gain from manufacturing liberalization; many poor countries lose from agricultural liberalization

Study	Scope	Model	Data	Data aggregation	Dynamic features	Productivity treatment	Selected key findings
OECD (2005)	Agriculture (tariffs export subsidies and domestic support) Manufacturing	GTAPEM (modified version of GTAP with a more detailed treatment of agricultural factor specificity and substitution)	GTAP 6, baseline year 2001, plus additional OECD data on export subsidies and domestic support	18 countries 20 sectors (of which 18 within the agricultural sector)	none	exogenous levels not affected by liberalization scenarios	- the benefits of combined 50% reduction 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 amount to USD 44.3 billion or 0.14% of world GDP. - policy changes implemented by the OECD contribute 67% of the global gain - 29% of global gains accrue to non-OECD countries - 60% of global welfare gains originate from agricultural policy reforms
Francois et al. (2005)	Agriculture (tariffs) Manufacturing Services Trade facilitation	Modified version of GTAP, imperfect competition comparative static	GTAP 5, baseline year 1997, with tariff data from WTO integrated database supplemented by UNCTAD/ World Bank WITS data, original services protection estimates		endogenous capital accumulation in certain sectors	exogenous levels not affected by liberalization scenarios	- the benefits of 100% reduction in agricultural and industrial tariffs, export subsidies, domestic support for agriculture and tariff-equivalent services barriers; reduction in trading costs of 3% of the value of trade: USD 367,- 50% reduction in agricultural and industrial tariffs and export subsidies, 50% reduction in domestic support for agriculture, 50% reduction of tariff-equivalent services barriers, reduction in trading costs of 1.5% of the value of trade: USD 240

Study	Scope	Model	Data	Data aggregation	Dynamic features	Productivity treatment	Selected key findings
CEPII (2006)	Agriculture (tariffs) Manufacturing Services Trade facilitation	MIRAGE Perfect competition in agricultural sectors and imperfect competition in industry and services Recursive dynamic	GTAP 6 , baseline year 2001, additional estimates of services trade barriers	Two aggregation variants: 24 regions, 35 sectors and 18 regions, 23 sectors	endogenous capital accumulation	exogenous levels not affected by liberalization scenarios	- free trade in goods: USD 232 billion - 25% reduction in services trade barriers brings higher welfare gains than a 70% cut in agriculture by industrialised countries and a 50% by developing countries -liberalisation restricted to agriculture would not benefit developing country regions to a great extent, liberalisation of industrial trade offers larger gains to developing countries than to developed countries
Cline (2004)	Agriculture (tariffs export subsidies and domestic support) Manufacturing	Harrison, Rutherford and Tarr (1997), perfect or imperfect competition variants Comparative static	GTAP 5, baseline year 1997, only selected preferential trading agreements reflected in protection data	22 sectors (of which 8 agricultural), two variants of country aggregation: one with 25 countries with emphasis on big traders and one with 26 countries with emphasis on countries with most poverty	none	exogenous levels not affected by liberalisation scenarios	Under constant returns to scale variant of simulation: -full removal of trade protection worldwide: USD 85.5 billion or 0.35% of world GDP -55% of global welfare gains originate from agricultural policy reforms -combined gains from global free trade accruing to developing countries amount to 1.4% of their GDP as compared to 0.78% of GDP for industrial countries

Study	Scope	Model	Data	Data aggregation	Dynamic features	Productivity treatment	Selected key findings
Fernandez de Cordoba et al. (2004)	Manufacturing	GTAP, standard, perfect competition comparative static	GTAP 5, baseline year 1997, including data on preferential agreements from UNCTAD TRAINS database, additional information on tariff bindings	Not specified	none	exogenous levels not affected by liberalization scenarios	-free trade scenario: USD 42 billion - results for cuts according to so-called Girard formula range, depending on the ambition, from USD 32 USD 41 billion - linear tariff cut of 50% for developed regions and 36% for developing regions: USD 28 billion
Brown, Deardorff and Stern (2003)	Agriculture Manufacturing Services	Michigan Model Perfect competition in agriculture Increasing returns to scale, monopolistic competition in all other sectors	GTAP 4, baseline year 1995, supplemented with UN data on market structure, UNIDO and WB data on employment structure Scaling up of database for 2005 to account for the UR implementation	20 regions, 18 sectors	none	exogenous levels not affected by liberalization scenarios	- 33% reduction in the post-UR agricultural import tariffs, export subsidies, domestic support, tariffs on manufacturing imports and estimated post-UR services barriers results in global welfare gain of USD 574 billion - the net effect of the above reductions in the agricultural sector is negative while the net and individual developing and developed country effects of manufactures liberalisation are positive, increases in welfare due to services liberalisation were substantially greater than increases due to manufactures liberalisation -combined effects were sizable in both absolute and percentage terms for both

Study	Scope	Model	Data	Data aggregation	Dynamic features	Productivity treatment	Selected key findings
							developing and developed regions, the largest absolute gains were for developed countries
Dessus et al. (1999)	Welfare effects of complete elimination of agricultural and industrial tariffs on developing countries	Version of LINKAGE Model developed at OECD, perfect competition, comparative static multicountry multisector	GTAP 4, baseline year 1995, projection year 2010; supplemented by World Bank growth projections and statistics on national savings	16 regions, 4 sectors	exogenous TFP increases	exogenous levels assumed to increase in proportion to trade intensity (ratio of trade volume to output) 10% rise in trade intensity leads to a 0.9% rise in the level of TFP	- complete elimination of agricultural and industrial tariffs in all regions: USD 82 billion without TFP increase and USD 212 billion with trade-related TFP increase -Tariff rates reduced by 50% for non-OECD countries and full liberalisation maintained for OECD countries: USD 74 billion without TFP increase and USD 912 with trade-related TFP increase

Table 3: Comparison of Trade Liberalisation Effects under the Full Employment and Unemployment Assumptions

	Fixed employment assumption for SSA	Fixed real wage assumption for SSA
Panel A. Welfare (equivalent variation)		
Oceania	2,408	2,383
Rest of world	958	961
Asian NICs	18,585	18,539
North & East Asia	8,536	8,644
South East Asia	1,315	1,297
North America	-3,945	-3,812
Latin America	3,215	3,167
Western Europe	3,240	3,205
Rest of Europe	-297	-280
Former Soviet Union	2,147	2,085
Middle East and North Africa	3,894	3,747
Sub-Saharan Africa	**1,389**	**-7,682**
Total	41,444	32,251
Panel B. % change in the use of production factors in Sub Saharan Africa		
Land	0	0
Labour	0	-5.35
Capital	0	0
Panel C. % change in output in Sub Saharan Africa by broad sector		
Natural resources	1.1	2.1
Primary agriculture	0.8	-2.3
Processed agriculture	-1.0	-4.6
Textiles & clothing	-16.8	-20.5
Chemical products	-5.3	-8.7
Wood products	-6.3	-10.0
Motor vehicles & parts	-2.0	-5.2
Other machinery	-7.1	-12.5
Other manufacturing	-1.5	-4.6

Table continued 3: Comparison of Trade Liberalisation Effects under the Full Employment and Unemployment Assumptions

Panel D. % change in export price in Sub Saharan Africa by broad sector

Natural resources	0.6	0.2
Primary agriculture	0.0	0.4
Processed agriculture	-1.2	-0.9
Textiles & clothing	-5.0	-4.6
Chemical products	-2.0	-1.8
Wood products	-1.5	-1.0
Motor vehicles & parts	-3.9	-3.7
Other machinery	-1.9	-1.2
Other manufacturing	-1.6	-1.4

Source: Author's calculations.

Table 4: Welfare Estimates of Two Liberalisation Scenarios Using Different Aggregations

Sectors	Regions	Scenario 1	Scenario 2
35	24	0.09	0.18
25	18	0.07	0.14

Source: Decreux and Fontagné (2006).

Table 5: Export Shares of Four Selected LDCs as Reported in the GTAP 6.0 Database

	Bangladesh		Malawi
EU+EFTA	44.8	EU+EFTA	30.9
United States of America	37.4	United States of America	19.9
Rest of Middle East	2.8	Japan	8.5
Japan	1.9	South Africa	7.4
Canada	1.8	Rest of North Africa	4.3
Singapore	1.1	Mozambique	3.6
Hong Kong	1.1	Rest of Sub Saharan	3.0
India	0.8	Russian Federation	1.8
Iran	0.7	Zambia	1.7
Republic of Korea	0.5	Poland	1.7
Pakistan	0.5	Rest of Former Soviet Union	1.3
Taiwan	0.5	Mexico	1.3
Thailand	0.5	Philippines	1.2
Turkey	0.4	Australia	1.1
Australia	0.4	Hungary	1.0
Brazil	0.4	Zimbabwe	0.8
Mexico	0.4	Croatia	0.7
Rest of Sub Saharan	0.3	Tanzania	0.7
Rest of FTAA	0.3	Taiwan	0.7
Indonesia	0.2	Turkey	0.6
China	0.2	India	0.6
Viet Nam	0.2	Czech Republic	0.6
Malaysia	0.2	Rest of Middle East	0.5
Rest of North Africa	0.2	China	0.5
Poland	0.2	Romania	0.5
Philippines	0.2	Brazil	0.5
Russian Federation	0.2	Canada	0.4
Czech Republic	0.1	New Zealand	0.4
South Africa	0.1	Singapore	0.3
Rest of South Asia	0.1	Argentina	0.3
Hungary	0.1	Bulgaria	0.3
Rest of Former Soviet Union	0.1	Malaysia	0.3
Argentina	0.1	Rest of FTAA	0.3
New Zealand	0.1	Pakistan	0.2
Rest of the Caribbean	0.1	Mauritius	0.2
Sri Lanka	0.1	Rest of Oceania	0.2
Morocco	0.1	Republic of Korea	0.2
Central America	0.1	Botswana	0.2
Rest of SADC	0.1	Morocco	0.2
Rest of East Asia	0.0	Bangladesh	0.1
Zimbabwe	0.0	Central America	0.1
Chile	0.0	Tunisia	0.1
Nigeria	0.0	Slovenia	0.1
Rest of Oceania	0.0	Thailand	0.1
Estonia	0.0	Peru	0.1
Slovenia	0.0	Hong Kong	0.1
Rest of Europe	0.0	Indonesia	0.1
Venezuela	0.0	Slovakia	0.1

Table 5 Continued: Export Shares of Four Selected LDCs as Reported in the GTAP 6.0 Database

	Bangladesh		**Malawi**
Tunisia	0.0	Iran	0.1
Rest of Southeast Asia	0.0	Rest of the Caribbean	0.1
Romania	0.0	Rest of Europe	0.1
Tanzania	0.0	Uganda	0.1
Peru	0.0	Venezuela	0.0
Cyprus	0.0	Nigeria	0.0
Croatia	0.0	Rest of Southeast Asia	0.0
Slovakia	0.0	Colombia	0.0
Uruguay	0.0	Chile	0.0
Bulgaria	0.0	Rest of SACU	0.0
Madagascar	0.0	Latvia	0.0
Colombia	0.0	Viet Nam	0.0
Rest of South America	0.0	Sri Lanka	0.0
Latvia	0.0	Rest of South Asia	0.0
Malta	0.0	Rest of East Asia	0.0
Rest of SACU	0.0	Ecuador	0.0
Uganda	0.0	Uruguay	0.0
Ecuador	0.0	Rest of SADC	0.0
Mauritius	0.0	Rest of South America	0.0
Mozambique	0.0	Lithuania	0.0
Lithuania	0.0	Cyprus	0.0
Zambia	0.0	Estonia	0.0
Rest of North America	0.0	Bolivia	0.0
Bolivia	0.0	Rest of North America	0.0
Albania	0.0	Malta	0.0
Botswana	0.0	Madagascar	0.0
Malawi	0.0	Albania	0.0
Bangladesh	0.0	Malawi	0.0

Table 5 Continued: Export Shares of Four Selected LDCs as Reported in the GTAP 6.0 Database

	Mozambique		Zambia
EU+EFTA	53.0	EU+EFTA	49.5
South Africa	22.0	South Africa	10.9
Zimbabwe	7.3	Rest of Middle East	6.6
United States of America	4.1	Thailand	4.8
Japan	2.9	Japan	4.4
China	1.2	Rest of Sub Saharan	4.1
Malawi	1.1	Taiwan	4.0
Hong Kong	1.0	China	3.2
Russian Federation	0.8	Rest of North Africa	2.9
India	0.7	USA	1.6
Republic of Korea	0.6	India	1.1
Rest of Middle East	0.5	Zimbabwe	1.1
Canada	0.4	Rest of SACU	1.0
Singapore	0.3	Malaysia	0.9
Malaysia	0.3	Malawi	0.7
Rest of SACU	0.3	Pakistan	0.4
Brazil	0.3	Singapore	0.3
Rest of North Africa	0.3	Tanzania	0.2
Rest of Sub Saharan	0.2	Botswana	0.2
Indonesia	0.2	Mauritius	0.2
Thailand	0.2	Republic of Korea	0.2
Rest of Former Soviet Union	0.2	Mexico	0.2
Taiwan	0.2	Canada	0.1
Philippines	0.1	Australia	0.1
Australia	0.1	Russian Federation	0.1
Poland	0.1	Slovenia	0.1
Czech Republic	0.1	Uganda	0.1
Viet Nam	0.1	Hong Kong	0.1
Rest of FTAA	0.1	Brazil	0.1
Turkey	0.1	Cyprus	0.1
Mauritius	0.1	Bangladesh	0.1
Hungary	0.1	Poland	0.1

Table 5 Continued: Export Shares of Four Selected LDCs as Reported in the GTAP 6.0 Database

			Mozambique
Mexico	0.1	Turkey	0.1
Argentina	0.1	Rest of the Caribbean	0.1
Chile	0.1	Central America	0.1
Nigeria	0.1	New Zealand	0.0
Croatia	0.1	Rest of Former Soviet Union	0.0
New Zealand	0.0	Czech Republic	0.0
Rest of SADC	0.0	Argentina	0.0
Venezuela	0.0	Indonesia	0.0
Romania	0.0	Viet Nam	0.0
Zambia	0.0	Rest of FTAA	0.0
Tanzania	0.0	Hungary	0.0
Rest of the Caribbean	0.0	Mozambique	0.0
Central America	0.0	Bulgaria	0.0
Rest of Oceania	0.0	Venezuela	0.0
Peru	0.0	Rest of East Asia	0.0
Slovakia	0.0	Rest of Europe	0.0
Bangladesh	0.0	Nigeria	0.0
Colombia	0.0	Colombia	0.0
Rest of Europe	0.0	Philippines	0.0
Slovenia	0.0	Rest of South Asia	0.0
Iran	0.0	Chile	0.0
Bulgaria	0.0	Rest of SADC	0.0
Morocco	0.0	Lithuania	0.0
Rest of East Asia	0.0	Romania	0.0
Rest of South Asia	0.0	Croatia	0.0
Rest of Southeast Asia	0.0	Slovakia	0.0
Sri Lanka	0.0	Iran	0.0
Uruguay	0.0	Rest of Oceania	0.0
Tunisia	0.0	Peru	0.0
Malta	0.0	Morocco	0.0
Lithuania	0.0	Rest of Southeast Asia	0.0
Pakistan	0.0	Sri Lanka	0.0
Estonia	0.0	Estonia	0.0
Latvia	0.0	Albania	0.0
Uganda	0.0	Uruguay	0.0
Cyprus	0.0	Tunisia	0.0
Botswana	0.0	Rest of South America	0.0
Ecuador	0.0	Latvia	0.0
Rest of South America	0.0	Ecuador	0.0
Bolivia	0.0	Rest of North America	0.0
Albania	0.0	Malta	0.0
Madagascar	0.0	Madagascar	0.0
Rest of North America	0.0	Bolivia	0.0
Mozambique	0.0	Zambia	0.0