IS TRADE PESSIMISM JUSTIFIED?
OPENING THE "BLACK BOX" OF TRADE MODELING

by

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GLOSSARY OF ABBREVIATIONS

AGOA	African Growth Opportunity Act
CEPII	Centre d'Etudes Prospectives et d'Informations Internationales
CGE	Computable General Equilibrium
EFTA	European Free Trade Area
EU	European Union
GDP	Gross Domestic Product
GEP	Global Economic Prospects
GTAP	Global Trade Analysis Project
HRT	Harrison, Rutherford, Tarr
HS	Harmonized Commodity Description and Coding System
LDC	Least Developed Countries
MENA	Middle East and North Africa
MIRAGE	Modeling International Relations under Applied General Equilibrium
NAFTA	North America Free Trade Agreement
OECD	Organization for Economic Cooperation and Development
RD	Research and Development
SACU	Southern Africa Custom Union
TRQ	Tariff Rate Quota
UN	United Nations
USA	United States of America
WTO	World Trade Organization

1. INTRODUCTION

Development and poverty alleviation have become a high priority for the international community. Among many proposed remedies to these problems, trade liberalization is expected to play a positive role both in reducing poverty and generating economic growth in developing countries. This explains why numerous analysts have attempted to assess the expected benefits of trade liberalization. The main empirical tool for these assessments has been the use of multi-country Computable General Equilibrium (CGE) models. These models, however, have produced divergent results. According to the recent studies, the associated increase in world welfare from full trade liberalization may range anywhere from 0.2% to 3.1% — results that differ by a factor of 15 to 1! The impact on poverty headcount also varies widely, with the number of people that would be lifted out of poverty projected anywhere from 72 million to 446 million.

Taken together, therefore, the models present a rather contrasting picture of the effects of trade liberalization on poverty. They give the impression that with global trade modeling, lack of agreement is the rule. Moreover, as a sophisticated and complex tool of analysis, a CGE model often seems to be a "black box", the results of which are difficult to understand.

There are several reasons for these differences, many of which have to do with the CGE model's capacity to account for essential information in a way that was not possible previously. The objective of this paper, which draws on a more in-depth analysis (Bouët, 2006), is to explain how the main global trade models currently in use capture the benefits from trade liberalization. In doing so, a new study was carried out using the MIRAGE[1] model — a CGE model capable of testing different scenarios and assumptions — and the results compared with those obtained in other studies.

[1] The MIRAGE model was developed at the *Centre d'Etudes Prospectives et d'Informations Internationales* (CEPII) in Paris. A full description of the model is available at the CEPII's web site (www.cepii.fr).

The paper also provides four key explanations as to why CGE-based studies have produced such great diverging results, as well as discusses important convergent conclusions. Finally, the study provides results from a sensitivity analysis which was carried out to determine the relative importance of the four explanations.

2. HOW TRADE IS MODELED

Single and multi-country CGE models are complex as they have to take into account the fundamental effects of policy change, such as income effects and interdependencies among various sectors. The key difference between a single-country and multi-country CGE model is that the former is unable to measure bilateral trade flows and cannot capture discriminatory trade policies, such as those associated with regional agreements or preferential schemes, whereas the latter is able to do so. For this reason, the multi-country CGE model has become the instrument of choice for assessing the impact of multilateral trade liberalization.

A multi-country CGE model is founded on a theoretical representation of the world economy. Computable means that the model is calibrated so that it represents the world economy at the initial period of time. General equilibrium means that the demand and supply inall markets is ballanced. Models based on general equilibrium treat all markets as interdependent; they account for real income effects. For example, in a partial equilibrium model, the impact of liberalizing the domestic market of textile and apparels will be studied only by looking at the direct effect that removing trade barriers to these goods will have on the demand and supply in this particular sector. On the other hand, a general equilibrium analysis would consider the impact of reduced consumer prices on consumers' real income and their demand for each product, the impact of expanded activity in this sector on intermediate and capital consumption, the impact of diminished public receipts on the fiscal deficit, and so forth.

In CGE modeling, the modeler must mathematically describe the behavioral representations of consumers, producers, governments, and other related factors. One of the major drawbacks of CGE models, however, is that they require a considerable amount of information on economic variables, which greatly reduces their tractability.

For assessing the impact of trade liberalization, a multi-country CGE model is the most comprehensive, but not the only, analytical tool available. Spatial and non-spatial partial-equilibrium models and gravity models sometimes yield sufficiently robust results. However, in general, partial equilibrium models are suitable only when analyzing small sectors of single economies. They do not account for the interdependence of markets. Therefore, instead of considering equilibrium across all markets, as CGE models do, they model equilibrium in only one market. In short, partial equilibrium models do not seek to describe the entire economic system, but focus on modeling a particular sector or commodity. Nevertheless, this kind of analysis gives the modeler more freedom to study a specific aspect of trade liberalization and is quite relevant for incorporating richer and more realistic details than a CGE model.

Models using a gravity equation are based on econometrics (i.e., statistical techniques applied to economics) and founded on multi-country general equilibrium. They can be employed to evaluate the effects on trade flows caused by changes in border measures, such as tariffs or quotas, either at the multilateral or regional level. The advantage of the gravity equation is its extreme tractability. Furthermore, it yields very robust econometric results. But, it can model only changes in exports and not in gross domestic product, welfare, or the remuneration of productive factors.

Though these models may not be perfect, they represent important analytical tools for the assessment of trade impacts. They are complementary tools, not substitutes: for example, multi-country trade models can evaluate the impact of regional agreements at a macroeconomic level, while a single-country trade model, with greater detail on household incomes, can use this macro-economic shock (specifically, a change in world commodity prices following liberalization) to evaluate the distributional impacts.

3. MODELING TRADE LIBERALIZATION AND DEVELOPMENT UNDER CGE MODELS: A SURVEY

The advanced capacity of CGE models to assess the impact of trade liberalization is a result of several developments: increases in the availability and quality of economic data, improvements in the calculation speed of computers, and the development of the

GTAP (Global Trade Analysis Project) network, among others. What is most surprising, however, is the degree to which the quantitative results of CGE models differ. This section of the paper provides a review of the divergent as well as convergent conclusions from studies of impact of trade liberalization.

At last count, more than 20 CGE model assessments of the impact of full trade liberalization on the world have been produced since the beginning of 2000[2], and nine assessments of the impact of a potential Doha Round multilateral trade agreement. These models suggest that, with full trade liberalization, the increase in world welfare could range from 0.2 to 3.1%, depending on the model and assumptions used. The number of people that would be lifted out from poverty ranges from 72 million to 440 million, with an average of 219 mln.[3] These widely contrasting results paint a rather jumbled picture of the effects of trade liberalization.

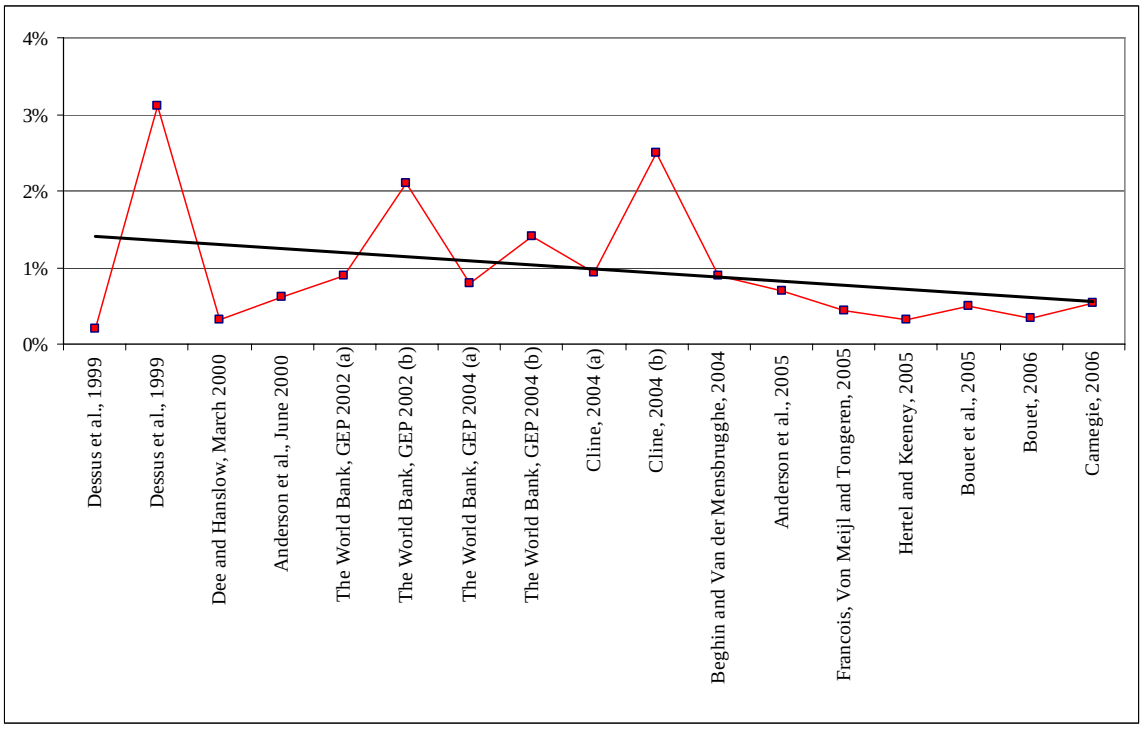
Figure 1 ranks the estimations of world benefits from full trade liberalization in chronological order.[4] Though results from recent CGE models differ, they reveal a continuous downward revision in the expected world welfare gains from full trade liberalization. For example, from an average world welfare increase of 1.7% in 1999, the average estimate is 1.5% in 2002, 1.3% in 2004, and 0.5% in 2005. This trend in results has been interpreted by some NGOs, and by some reports in the press, as indicative of an increasing pessimism regarding the expected benefits from trade liberalization. The assessments of impact on poverty headcount (with the exception of Cline's optimistic estimation in 2004) have reinforced the impression of trade pessimism.

[2] The Appendix contains the results from one such assessment of full trade liberalization, using the MIRAGE model.

[3] In 2003, the number of people in poverty (US$ 2 per day definition) is estimated at 2.8 billion (World Development Indicators, 2004). It means that full trade liberalization could decrease world poverty by between 2.9% and 19.1%, with an average [of 9.4%.

[4] This graph does not include the study by the USDA's Economic Research Service entitled "Agricultural Policy Reform in the WTO: The Road Ahead", 2001, which only focused on the liberalization of agricultural trade.

Figure 1. Trade pessimism? The impact of full trade liberalization on world welfare
(Percentage increase in real GDP)



Source: Bouët, 2006.

Until 2000, most studies concluded that there would be no losers from trade liberalization, at least not at the national level — a vision of the world that one French newspaper reporter dubbed "*Mondialisation heureuse*".[5] Starting with the study by Philippa Dee and Kevin Hanslow (2000), however, more and more analysts have found that full trade liberalization would lead to welfare losses for some countries. Worryingly, the losers would nearly all be developing countries.[6]

The range of welfare gains resulting from a likely new agricultural agreement under the Doha Round varies from 0.08% (Bouet, Bureau, Decreux and Jean, 2005) to 0.18% (Anderson, Martin and Van der Mensbrugghe, 2005a) and from 0.17% (Bouet, Mevel and Orden, 2005) to 0.51% for the complete Round (Fontagne, Guerin and Jean, 2005).

Nevertheless, these studies have also led to similar conclusions about the impact of trade liberalization. They agree on the following important aspects:

[5] This French expression means "fortunate globalization"; the term became famous in France with the publication of an article by Alain Minc in the *Le Monde* in August 2001. It was a tentative description of globalization as a wonderful process giving benefits to everybody in all countries throughout the world.

[6] The sole exception, in one assessment conducted in 2000, would be Canada.

(i) Full liberalization is beneficial as it increases welfare at the world level. Though it does not mean that all countries are equal beneficiaries, if efficient redistribution mechanisms are put in place, all agents could see their welfare increase.

(ii) Liberalizing agriculture is the main source of expected gains, accounting for about two-thirds of global gains. It stems from the fact that this sector contains a major part of current trade barriers. Furthermore, nearly all export subsidies and domestic support goes to agriculture.[7]

(iii) Tariffs are by far the main source of distortions. They account for more than 90% of expected benefits in the case of full liberalization. This major political issue is confirmed by the assessment of the Doha Round, which prioritizes the elimination of export subsidies and a cut in domestic support, while pursuing modest objectives in terms of market access.

(iv) Developing countries could be large beneficiaries of these reforms. Considering that their GDP is lower, even a smaller absolute welfare gain for developing countries could entail a higher rate of increase in their real income. In this sense, trade reform would be progressive inasmuch as it increased the real income of poor countries.

(v) Liberalizing the trade policies of developing countries is a major stake. It contributes for about half of expected benefits. This is of course one supplementary criticism addressed to the Doha Agenda as Special and Differentiated Treatment could allow developing countries to liberalize less and Least Developed countries to keep their trade policies unchanged.

These convergent conclusions are extremely important. Even if the picture drawn by these models is not as favorable as the one that emerged a few years ago, it remains that the global net expected effect is positive. Agriculture and market access are where the largest gains are to be made. For the maximum benefits to be achieved, developing countries need to reform their own economies too, though that may require

[7] Large gains in world welfare are expected from liberalization in services, but these estimates must be interpreted with caution.

that parallel policies, such as structural-adjustment programs, be already in place or implemented simultaneously.

Nevertheless, divergences among these assessments and increased trade pessimism require further examination. Four explanations that address the sources of diverging results from CGEM studies are: *(i)* the experiments differ; *(ii)* the economic data differ; *(iii)* the behavioral parameters differ; and *(iv)* the theoretical features of the models differ.

3.1. Different experiments

Almost all studies use the GTAP database. When studying trade liberalization, the reviewed studies usually suppose that it takes place in 2005 or 2006, implying an 8 to 9-year delay under GTAP-5 version (for 1997) and a 4 to 5-year delay in GTAP-6 (for 2001). Whatever the effective date of liberalization, it is undeniable that trade barriers have been reduced since 1997 and 2000. Signal events have been the implementation of the Uruguay Round, the accession of China to the WTO, and the enforcement of some preferential schemes, such as Europe's "Everything but Arms" initiative and the United States' African Growth Opportunity Act (AGOA). Thus, applying a trade shock on a dataset that does not include all this information overstates the impact of further trade liberalization on trade flows, economic activity, and welfare.

This is the reason why most — but not all — studies (e.g., Beghin and Van der Mensbrugghe, 2004; Bchir, Fontagne and Jean, 2005; and Anderson, Martin and Van der Mensbrugghe, 2005; Hertel and Keeney, 2005) conduct a "pre-experiment". This involves simulating the implementation of those trade agreements that will go into force during the period under analysis, and applying the results to the initial database. Trade liberalization (complete, or a likely Doha Round outcome) is then simulated using the modified database. In effect, what the models measure, therefore, are the additional welfare gains that can be expected from trade liberalization, *assuming that all the trade-liberalization initiatives already agreed to are also fully implemented*.

In addition to trade reforms, the assessment of liberalization needs to include fiscal reforms, as the fiscal issue is a major concern in developing countries, where corruption and tax evasion are often present. As income and sale taxes do not yield sufficient public receipts, taxing imports has become a key source of revenues for the

public sector in developing countries, representing a range from 0.4% of the domestic GDP in Botswana up to 4.3% in Tunisia. As a result, liberalizing trade may reduce fiscal receipts in developing countries, which in turn, would affect the fiscal deficit of such countries.

3.2. Different data

The utilization of different data leads logically to different assessments. Nearly all assessments nowadays use the GTAP database for consumption, production, and international trade. But divergences still arise from modelers using different databases for information on tariffs and domestic support.

Data relating to market access have greatly evolved over the past few years. This development may be one of the main sources of declining optimism about the expected benefits from further trade liberalization. Three improvements in recent assessments are significant: (*i*) the main databases take into account trade preferences and regional agreements; (*ii*) *ad* v*alorem* equivalents of specific tariffs and tariff rate quotas are calculated; and (*iii*) the simulation of multilateral trade negotiation can now account for the interaction of bound and applied duties.

The MacMap_HS6 database[8] has become the main reference for measuring market access in general equilibrium analysis. The use of this database has resulted in a downwards assessment of the current levels of protection throughout the world as it includes all preferential schemes and regional agreements, instead of basing border protection uniquely on MFN (most-favored nation) tariffs. Such use has been subject to criticism, as it implies that preferential schemes are being fully utilized. However, contrary to previous empirical assessments, new methodologies and studies have recently demonstrated that these preferences are, in fact, rather well utilized by exporters from developing countries, especially in agriculture (Wainio and Gibson, 2003; Candau, Fontagne and Jean, 2004; Candau and Jean, 2005).

The primary objective of market-access negotiations at the multilateral level are the reduction of bound duties. Thus, an accurate assessment of the impact of a multilateral trade reform must take into account the interplay between bound, MFN

[8] For a complete presentation of the MacMap-HS6 database, see Bouet, Decreux, Fontagne, Jean, and Laborde, 2005a and 2005b.

applied, and preferential duties. This consideration results in a downwards estimation of the expected benefits of liberalization. Jean, Laborde, and Martin (2005) calculate that taking into account applied tariffs instead of MFN tariffs in agriculture lowers border protection by 30% (= [24%-17%]/24%), while at the world level and in agriculture also the binding overhang—the amount by which maximum tariffs under WTO law are greater than MFN applied tariffs—is greater than 13 percentage points (37% and 24%).

On the other hand, data on domestic support can also greatly differ across studies. This support can act on production for intermediate consumption; it can be bound or not. Almost all modelers use the GTAP-6 database for domestic support data. These data have been calculated from the OECD Producer Support Estimate (PSE), which consists of market price support arising largely from border measures and budgetary payments. The former represents indirect transfers to producers and is not included in the GTAP-6 database, whereas the latter are grouped in the GTAP-6 database according to four classifications: output payments, intermediate input payments, land-based payments, and capital-based payments. Data on domestic support can be improved further and certain studies have made progress in that aspect. For example, Bouët, Bureau, Decreux, and Jean (2005) integrate fully decoupled payments — treated as the return to self-employed labor — as well as land set-aside programs, which are modeled as a reduction in the productivity of farmland.

Finally, CGE modeling of consumption, production, and trade of several products in several trading zones requires solving a very large system of equations. Thus, it is necessary to identify a limited number of sectors and trading zones. It means that two studies assessing the impact of the same trade reform with the same model and the same data, but with different product and geographic decomposition, will produce different estimates of changes in welfare.

3.3. Different behavioral parameters

Welfare effects created by liberalization depend crucially on trade elasticities, or more precisely the price elasticities of exports. The Armington[9] hypothesis precisely means that products are differentiated by their country of origin. Determining the level of Armington elasticities (i.e., the degree of substitution between domestically produced

[9] See Armington, 1969.

and imported goods as their relative prices diverge[10]) is a key parametrical choice of a modeler as it determines how much imports will increase when tariffs are eliminated. With higher Armington elasticities, liberalization creates more trade and higher real incomes, as a result.

Unfortunately, there is no consensus on the value of Armington elasticities; they vary with the level of product disaggregation. On average, the GTAP network provides relatively low trade elasticities, even though recent developments have provided higher estimation of these parameters (see Hertel, Hummels, Ivanic and Keeney, 2004). On the contrary, Harrison, Rutherford and Tarr (henceforth the HRT model, see for example Harrison, Rutherford and Tarr, 1997 and 2001) utilize much higher trade elasticities than the GTAP (see for example Tarr *et al.* 2001) while the World Bank's LINKAGE elasticities are intermediate: on average they are 35% higher than the GTAP ones, but 75% higher in agriculture. This point is a direct and important explanation for the divergences of assessments of trade liberalization.

One of the reasons, for example, why Cline's study is more optimistic about the impact of liberalization is its usage of the HRT model, which leads to higher welfare effects from full trade liberalization. Anderson, Martin and Van der Mensbrugghe (2005a and 2005b) obtain intermediate results; using elasticities contained in the GTAP database, they even demonstrate that this is the main explanation for differences in assessing welfare effects.

3.4. Different theoretical assumptions

The final source of divergence concerns theoretical features of models. It is nearly impossible to be exhaustive on this topic as modelers have to make numerous theoretical choices. Some of the most important theoretical assumptions in assessing the impact of trade liberalization have to do with whether the modeler assumes perfect or imperfect competition, whether the modeling is static or dynamic, and assumptions made on factor markets.

[10] A few years ago, Gallaway, McDaniel and Rivera (2003) derived a comprehensive and detailed sets of Armington elasticity estimates, providing them for 309 industries (at the 4-digit SIC level) over the period 1989 to 1995. Their significant long-run estimates ranged from 0.52 to 4.83. The higher figure means that a 1% increase in the relative price of a good produced in a country compared with the price of imported goods will decrease the ratio of consumed domestic goods on imported goods by 5%. Armington elasticities are sensitive to the level of commodity aggregation at which the estimates were derived. Generally, the more precisely the commodity described, the greater its substitutability (Reinert and Roland-Holst, 2002).

Adopting specific theoretical assumptions can lead to very specific results. The Carnegie model (Polaski, 2006) assumes that in developing countries' industrial sectors, real unskilled labor remuneration is fixed (due to unemployment) while the agricultural wage is perfectly flexible and assures full employment. A migration function describes rural and urban reallocation of this productive factor and its intensity depends on the difference between agricultural and urban wages.

For example, when a developing country enters a liberalization agreement its industry can be negatively shocked due to increased openness. Less demand for domestic industrial products leads to less demand for labor in this sector. This causes labor migration to rural areas, therefore, increasing labor supply in agriculture, which means — all things held equal — a reduction in the equilibrium wage. Thus, in a case like this, trade liberalization would lead to lower employment in the industrial sector and lower wages in agriculture.

On the other hand, in the case that the industrial sector expands due to an increase in exports, demand for labor in this sector increases, resulting in labor migration from rural to urban areas; this means a decrease in the labor supply in agriculture and, consequently, an increase in agricultural wages. Therefore, for a country undergoing a similar experience, trade liberalization would entail more industrial employment and higher agricultural wages.

This causes very contrasting outcomes for developing countries, depending on whether the impact of trade reform is positive or negative on their industrial sector. Furthermore, there is no equilibrating force as the model is calibrated in order to maintain fixed real wages in industry. In a flexible wage model, however, competitiveness in the industrial sector is progressively eroded as industrial wages are increased.

3.4.1. Perfect vs. imperfect competition

An analyst using a CGE model can adopt either a perfect or imperfect competition framework for all productive sectors, or vary the assumptions among the different sectors. In the latter case, industry and services are very often characterized by imperfect competition while the agricultural market is characterized as perfect.

In perfect competition there is no fixed cost and, as all producers are price-takers (i.e., no individual seller can significantly influence the market price), the equilibrium

price is equal to the marginal cost of production. When competition is imperfect, there is a fixed cost so that average costs fall with increased output. In most models under imperfect competition, products are differentiated into "varieties". Imperfect competition brings new sources of welfare: economies of scale, which decreases prices when output expands, and horizontal differentiation. It is generally supposed that consumers love variety, and that expanding the size of the market implies they will have more varieties to choose from. Though it is clearly more realistic than perfect competition, this feature is not systematically adopted in all CGE model assessments as it requires a lot of detailed information about the economic structure in a multi-country multi-product model. Thus, results obtained from studies that incorporate this feature depend on the assumption choices that the modeler makes.

3.4.2. Modeling the factor market

A key feature of CGE models are the assumptions about the productive factor markets. For example, it can be supposed that labor is either perfectly mobile (labor receives only one wage across the entire economy) or perfectly immobile (wages differ across sectors in the economy), or that there is an imperfect mobility of labor between agricultural and non-agricultural activities[11] but that mobility is perfect within each of these activities. Some primary factors (e.g., land, or water for irrigation) are naturally less mobile than others, but even in this respect assumptions can differ across studies as one can assume, at one extreme, that land in agriculture cannot be shifted from one product to another, or at the other, that land is fully mobile across all agricultural activities. So, studies with different assumptions on productive factor markets offer different results on welfare and real income.

3.4.3. Static vs. dynamic modeling

CGE models are typically distinguished by whether they are static or dynamic in nature. Static modeling explains economic change at a single interval of time; it does not describe the process of change. On the other hand, dynamic modeling attempts to explain the process in which change occurs. For example, trade liberalization might affect simultaneously income, saving and investment, and capital (or other primary

[11] In order to represent this imperfect immobility, a constant elasticity of transformation is often assumed between these different types of activities. This means that labor is allocated among the different activities according to the ratio of remunerations.

factors, such as skilled labor and land), all of which are accounted for by dynamic models. Elements of the MIRAGE model that reflect its dynamic modeling capacity, for example, include: investment, land supply, share of skilled and unskilled labor, economies of scale, and the emergence or closure of firms in certain sectors.

Another key assumption explaining the divergence across studies certainly comes from the relationship between total factor productivity and trade openness. For example, when the World Bank produced its 2004 *Global Economic Prospects* report, it assumed that trade openness explains 40% of the growth in total factor productivity growth within countries, on average. The reasoning behind this assumption is that, as firms export more, they are supposed to learn about new technologies, to compete [?] with foreign producers and bring their production process up to international standards. Moreover, firms can react to more competition by increasing investment in research and development (RD), which affects positively all factor productivity.

Trade openness should, therefore, increase factor productivity. But, the way in which this relation has been introduced in CGE models may be criticized for several reasons. First, the equation describing a positive relationship between trade openness and a sector's productivity can be considered as an *ad hoc* element introduced into CGE models used to study the impact of trade liberalization; it has no microeconomic foundation. Obviously, introducing such a function amplifies the positive effects on efficiency associated with opening up trade. Second, this *ad hoc* relationship provides no clue as to which countries, sectors or productive factors would be the first beneficiaries, as its influence is not equally strong in all countries, across all sectors and for all factors.

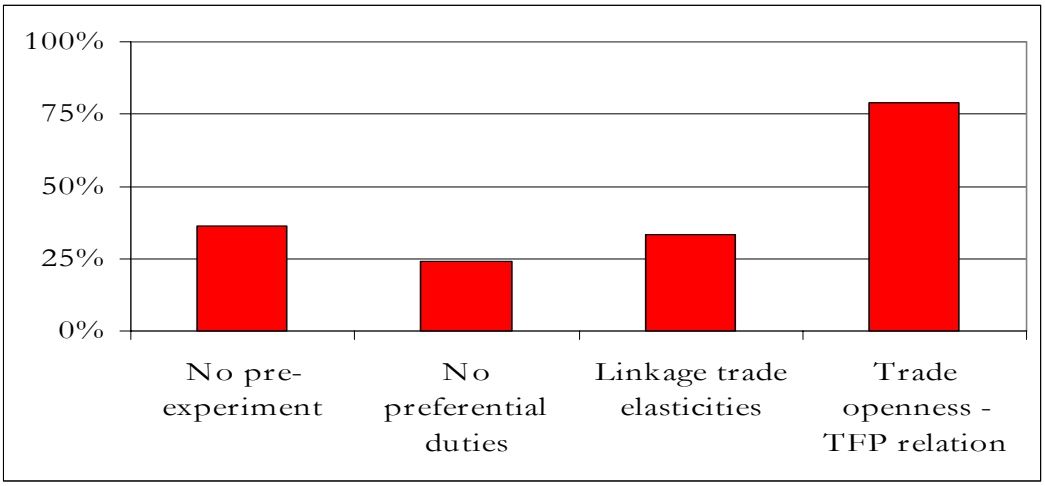
4. SENSITIVITY ANALYSIS

In order to test these explanations for the diverging results, a sensitivity analysis was carried out using the CGE modeling framework described in the Appendix. Figure 2 provides the main conclusion of this sensitivity analysis. The assessment carried out under the MIRAGE model (see Appendix) concluded that full trade liberalization would entail a 0.33% increase in world real income. If the pre–experiment had not been

accounted for (that is, if the trade liberalization that occurred from 2001 to 2005 had not been taken into account before testing the impact of full trade liberalization), this rate of change would have been raised by 36%, to 0.45%.

The utilization of trade elasticities from the World Banks' LINKAGE model would have yielded approximately the same results (33% increase). If the simulations were based on a database with no preferential schemes, the result would have suggested a 24% higher increase in the world welfare. Finally, including a positive relationship between trade openness and total factor productivity would have given a rate of change in the world welfare 79% higher. Though other theoretical features (exogenous or endogenous land supply, imperfect or perfect competition) or empirical choices (different database on distortions, different product and sector disaggregations) may also have an impact, these four explanations obviously play a major role.

Figure 2— Why do global trade models differ so much? The rate of change in world welfare compared with the central experiment



Source: Bouët, 2006.

5. CONCLUSION

This paper sets out to explain the reasons for divergent results among studies of the welfare effects of trade liberalization. The first explanation comes from different assessments of the current level of trade distortions: it is now widely recognized that these assessments have to take into account preferential schemes and regional agreements. This implies that assessments have now converged, but not fully.

Today, the main source of divergences is the modeler's choice of the level of trade elasticities and the implementation of dynamic relations. There is no consensus yet on the impact of behavioral parameters. Moreover, the link between openness and factor productivity might be strong, but it is not fully understood and precisely estimated.

When considering divergences in CGE model assessments, it could be argued that all CGE models are structurally identical (all are so-called Walrassian models[12]), and that therefore their duplication is wasteful and confusing. However, from the methodological conclusions outlined here (convergence on market access data and divergence on trade elasticities, dynamic relations, understanding of trade in services, and non-tariff barriers), it appears that, on the contrary, there remains some value in CGE models continuing to compete. If the data characterizing actual market access have recently been improved, it is largely thanks to competition among research teams. In this respect, one can expect future progress in the understanding of dynamic relations, trade in services, the impact of non-tariff barriers, and so forth.

Recent studies have lowered expectations regarding the potential impact of trade liberalization on poverty reduction. This is due to improved assessments of existing trade distortions. Previous assessments provided a more optimistic view of trade liberalization's impact on poverty, primarily because they were not able to account for regional agreements, preferential schemes and recent policy changes in trade and agricultural policies, all of which make for a more globalized world than it was previously thought. Furthermore, lesser benefits stemming from a potential Doha Round multilateral trade agreement are expected, as the assessments take into account the interplay between distortions associated with bound and applied tariffs and domestic support.

Nevertheless, most trade modelers expect that the effects from further trade liberalization are likely to be positive. There is agreement that world welfare would increase, mainly as a result of elimination of agricultural distortions. This welfare gain could be amplified by up to 80% if openness increases factor productivity. At the same time, liberalization should generally contribute to poverty alleviation as remuneration of unskilled labor is expected to rise in numerous developing countries, especially in South

[12] Named after the French economist, Marie-Ésprit Léon Walras (1834-1910), widely regarded as the father of general-equilibrium theory.

America, Sub-Saharan Africa, and Developing Asia. However, liberalization could only marginally reduce world inequality.

There are always winners and losers from trade liberalization. In some countries (Mexico, Zambia), poverty may increase as liberalization leads to decreased remuneration of unskilled labor. This is not an uncommon impact as several studies (see Hertel, Ivanic, Preckel, and Cranfield, 2000) have already obtained such results. Model-based assessments, however, may underestimate the positive impacts of trade liberalization on world welfare for two reasons: *(i)* most of them do not include liberalization in services, and *(ii)* they do not include trade facilitation and elimination of some non-tariff barriers (technical, sanitary and phyto-sanitary norms).

The Doha Agenda will not entail an implementation of full trade liberalization. On the contrary, it will lead to a more or less ambitious package; recent assessments of trade liberalization scenarios by CGE models have been successful in showing that "*the devil could be in the details*", implying that CGE models have been able to account for more information and details that may be crucial in determining the impact of trade liberalization than they have in the past.

Several policy recommendations emerge clearly from the literature:

Tariff cuts have to be large and "progressive" (higher rates of reduction on higher tariffs). On the tariff issue, a sensitive products clause could have very negative consequences on the extent of liberalization even if it concerns a limited number of products. Furthermore, implementing a cap on tariffs, even at a relatively high level (200%) could be a measure fostering liberalization.

Agriculture is the main area where distortions are greatest and need to be reduced.

Developing countries have would benefit from liberalizing their own economies. On this topic, the Special and Differentiated Treatment that the WTO offers gives them flexibility, but it may have negative consequences on these countries.

From recent modeling exercises, and studies in the literature, expected benefits from trade liberalization are surprisingly low. The Asian miracle, Chile's experience, Chinese and Indian liberalization all brought high annual growth rates, yet the CGE

models show a less than 3% increase in total real income. It could mean either that dynamic gains are not well captured by the global trade models or that these gains come from the domestic reform accompanying trade liberalization. Nevertheless, it implies that the relationship between trade and domestic reforms is not well understood.

CGE models nonetheless can help in understanding the economic impacts of trade liberalization. To make them more useful, research needs to be focused on four priorities:

A better understanding and inclusion of non-tariff barriers, administrative controls, and lack of infrastructure.

A better understanding of dynamic relations and the way in which trade liberalization affects factor productivity and capital accumulation.

Knowledge of the nature and the exact content of domestic reforms that could amplify expected benefits from trade liberalization.

A detailed examination of the link between trade and poverty.

The fourth priority has been the object of important progress in the recent years. This is all the more positive as poverty alleviation remains the ultimate objective of this debate.

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APPENDIX

A new assessment of the impact of trade liberalization using MIRAGE

This appendix presents the results obtained from a recent study of trade liberalization using the the MIRAGE model (Bouët, 2006). Before considering the results, however, it is important to understand the key technical features of the model. MIRAGE (Modeling International Relationships in Applied General Equilibrium) is a multi-sector, multi-region CGEM devoted to trade policy analysis. It is a very tractable model as sensitivity analysis is easy to implement; it proposes original features like vertical differentiation of products and foreign direct investment; it is founded on econometrically justified levels of Armington elasticities and micro-economically based relations. Consequently, it provides realistic assessments of benefits from trade liberalization.

In MIRAGE, substitutability between two intermediate goods exists, depending on the relative prices of these goods. Factor endowments are fully employed. The only factor for which the supply is constant is natural resources. Skilled labor is the only factor perfectly mobile. There is full employment of labor, and both perfect and imperfect competition are considered.

The MIRAGE model has two features that influence geographical decomposition. First, it distinguishes countries with an abundant supply of land from those for which land is scarce. Second, it differentiates products according to whether they have been produced in northern or tropical climates. The geographical decomposition presented in Table 1 reflects specific characteristics of various countries and regions. It emphasizes the heterogeneity of developing countries according to forces that *could* contribute to successful stories for some countries (Brazil, China, India), but also to great loses for others (Bangladesh, Mexico, Tunisia, Zambia). Four developing zones have been distinguished due to the specificity of their geographic trade composition: the “Rest of Developing Asia”, the “Rest of Middle East and North Africa (MENA)”, the “Rest of America (excluding OECD countries)”, and the “Rest of Sub–Saharan Africa”.

Table 1— Geographical decomposition

#	Abbrev	Zone	North/South	Land = scarce facto.
1	AUNZ	*Australia/New Zealand*	North	No
2	Cana	*Canada*	North	No
3	DvdA	*Developed Asia*	North	Yes
4	EU25	*European Union - 25*	North	Yes
5	USAm	*USA*	North	No
6	Roec	*Rest of OECD*	North	Yes
7	Arge	*Argentina*	South	No
8	Bgld	*Bangladesh*	South	Yes
9	Braz	*Brazil*	South	No
10	Chin	*China*	South	Yes
11	DvgA	*Developing Asia*	South	Yes
12	Indi	*India*	South	Yes
13	Mexi	*Mexico*	South	Yes
14	SACU	*Southern Africa Custom Union*	South	Yes
15	Tuni	*Tunisia*	South	Yes
16	Zamb	*Zambia*	South	Yes
17	Rame	*Rest of America*	South	Yes
18	Rmen	*Rest of Middle East and North Africa*	South	Yes
19	RSSA	*Rest of SubSaharan Africa*	South	Yes
20	RofW	*Rest of the World*	South	Yes

Source: Bouët, 2006.

Similar to this study's geographic decomposition, product decomposition represents specific characteristics of various products. It emphasizes the existence of key sectors where distortions are high and numerous; which means that the impact of liberalization is likely to be greater in such sectors. Distortions are particularly high in the agricultural sector, where tariffs above 15% are commonplace for wheat, sugar, meat, rice, and milk. (In the case of sugar, rice and milk, the model treats processed goods separately, as only small quantities of paddy rice, raw milk, sugar cane, and sugar beet are traded internationally). Vegetables and fruits are also treated separately by MIRAGE and are characterized in detail as they constitute a key agricultural output for numerous developing countries. Finally, product decomposition reflects that textile and clothing sectors are still highly protected compared with other industrial goods produced in developed countries.

Expected benefits from trade liberalization

In order to account for trade reforms that occurred between 2001 and 2005, a pre-experiment is conducted: data on market access are changed in order to include the last implementation of the Uruguay Round, the elimination of the Multi-Fibre Arrangement, enlargement of the European Union, implementation of the "Everything But Arms" initiative, the African Growth Opportunity Act, and finally, the accession of China to the WTO. For a better understanding of the MIRAGE study, the results obtained here will be explored by looking at liberalization impact at the world level, country level, impact on income distribution, and decomposition by region (North and South), activity (agriculture and industry), and instrument of intervention (tariffs, domestic support, and export subsidies).

Impact of full liberalization at the world level

Compared with the baseline situation, full trade liberalization increases world welfare (real income) by 0.33%, or just under USD 100 billion[13] (Table 2). When focusing on the rate of increase in real income, if the reference for comparison is the last group of assessments based on recent data on market access and domestic support, this result is close to those obtained by Hertel and Keeney (2005), and Francois, Von Meijl and Tongeren (2005). But it is smaller than the figure obtained by Anderson, Martin and Van der Mensbrugghe (2005). The differences are much larger in comparison with Cline's results (2003) or with the Global Economic Prospects' assessment (2002 and 2004).

Table 2. Impact of full trade liberalization: world indicators for 2015
(Rate of change in %)

World agricultural trade	33.67
World Merchandise Trade	5.25
World Welfare	0.33

Source: Bouët, 2006.

[13] This version of MIRAGE does not include exogenous change in factor productivity. Thus, when looking at the assessment results, it is better to adopt reasoning in relative terms.

This welfare increase is associated with a world trade growth of 5.25%. As trade barriers are numerous in the agricultural sector, world agricultural trade increases by 6.5 times more. With regard to world prices, their increase is uneven: while they are only minor in industry and services, they are large in agriculture, especially for wheat, plant-based fibers, and other agricultural products. These increases in agricultural world prices are quite similar to those obtained by other studies.[14]

Impact of full liberalization at the country level

The impact of the trade reform on the country level is progressive: the increase in welfare is proportionally higher for developing countries, and especially for LDCs (Table 3), although their share of the overall world welfare increase might be smaller. The rate of change in welfare is two times greater for LDCs than for middle income countries and more than two times greater than for rich countries. In this sense, full liberalization is development friendly.

The welfare gains, however, are unequally distributed among developing countries. There are several sources of welfare variations. First, distortions are reduced and productive factors are re-allocated in sectors where they are more efficient.

Table 3. Distribution of welfare gains among beneficiary zones and the rate of change in welfare

	Share of total welfare gain	**Increase in welfare**
Rich countries	73.8%	+0.3%
Middle income countries	24.1%	+0.4%
LDCs	2.2%	+0.8%

Source: Bouët, 2006.

[14] See, for example, Diao, Somwaru, and Roe, (2001).

Second, terms of trade are modified. A better access to foreign markets increases export prices while, on the contrary, erosion of preferences implies more competition on export markets and lower export prices. Furthermore, as distortions are numerous in agricultural sectors, full trade liberalization entails an increase in the relative world price of these commodities. Agricultural exporters are generally benefiting from an improvement in their terms of trade while net food importing countries are penalized.

Nevertheless, specialization of each country is not evenly distributed in all agricultural sectors. For example, agricultural exports of India, the "Rest of America" zone and the "Developing Asia" zone are highly concentrated in sectors where distortions are low. They are also net exporters of industrial products the world price of which remains almost constant. As a result, these three zones lose from a deterioration of their terms of trade even if they were initially net food-exporting countries (Table 4).

Table 4. Impact of full trade liberalization: macroeconomic indicators for 2015
(Rate of change in %)

	Welfare	Allocation efficiency gains	Terms of trade gains
Australia/New Zealand	0.9	0.1	1.4
Canada	-0.1	0.6	0.2
Developed Asia	1.4	2.3	0.1
European Union - 25	-0.1	0.2	-0.1
Rest of OECD	1.0	1.0	0.1
USA	0.1	0.0	0.1
Argentina	-0.1	0.3	0.3
Brazil	0.2	0.1	0.4
China	0.6	0.8	0.1
Developing Asia	0.4	0.7	-0.1
India	0.7	1.5	-0.9
Mexico	-0.3	1.3	-0.5
Rest of America	0.0	0.8	-0.2
Rest of Middle East and North Africa	0.9	1.2	-0.5
Rest of the World	0.1	0.9	0.0
Southern Africa Custom Union	-0.2	0.3	0.6
Tunisia	0.4	0.4	-0.4
Bangladesh	1.5	1.8	-1.1
Rest of SubSaharan Africa	0.6	1.3	-0.6
Zambia	0.3	1.6	-2.4

Source: Bouët, 2006.

In rich countries, the impact of full liberalization is positive, except in the case of Europe and Canada, where it is negative, even if this welfare loss is marginal. In developing countries, efficiency gains are large where distortions are initially high: India, Bangladesh, and Sub-Saharan Africa. As Brazil, Argentina, and SACU are large net food exporters, the rise in agricultural world prices implies an improvement in their terms of trade. The zone "Rest of Sub-Saharan Africa" is initially a net food exporter, nevertheless, its terms of trade are worsened as its EU preferential access is eroded: its export prices decrease. Furthermore, in the cases of Bangladesh and "Rest of MENA", preferences are eroded and prices of imported goods are raised: these two negative effects are cumulative.

The adverse effect of agricultural specialization on welfare gains which comes from economies of scale and product differentiation, explains global welfare losses of Argentina, Canada and SACU.[15] Allocating more productive factors in sectors under perfect competition reduces the gain from multilateral liberalization in the case of Australia-New Zealand, Brazil, and "Rest of America". Conversely, full trade liberalization expands the industrial sector and increases associated welfare gains in Bangladesh, Tunisia, and Zambia.

What is the potential impact of trade liberalization on poverty? While this work is primarily focused on the issue of poverty, it does not provide an estimation of the extent to which full trade liberalization could alleviate poverty. Such an assessment would require utilization of numerous household surveys in developing countries, which goes beyond the technical feasibilities of this study. But this assessment points out that full trade liberalization could have a very positive impact on poverty through an increase of the unskilled labor remuneration in South America, SACU, Bangladesh, "Developing Asia", Tunisia and "Rest of Sub-Saharan Africa". It has clearly a contrasting effect on urban and rural poverty in China, India, Mexico, "Rest of Middle East" and North Africa,

[15] In the sensitivity analysis it can be seen that if the same model is conducted under perfect competition in all sectors, Argentina, for example, gets a large increase in welfare.

where it increases remuneration of urban households and decreases that of rural households. Finally, it has an unambiguously negative effect in the case of Zambia.

As far as income distribution is concerned, the Gini coefficient is reduced slightly, from 0.73993 to 0.73981.[16] Globally, free trade means less inequality in the world (with the above limitations) but the impact is minor: this trade reform does not change the fact that 63% of the world's population gets only 8% of the world income. Trade reform implies a redistribution of the world agricultural production. The USA, Brazil, Australia, New Zealand, "Developing Asia", Argentina, and SACU increase their net trade balance in these commodities while the trade deficit in agricultural and food products of "Developed Asia", the European Union, North Africa and Middle East, India and the EFTA worsens.

Decomposing trade reform

Decomposing trade reform by *(i)* liberalizing region (North and South), *(ii)* liberalized activities (agriculture and industry), and *(iii)* instruments (tariffs, domestic support and export subsidies) allows for a better understanding of the underlying mechanisms in trade liberalization. In doing so, conclusions that emerge from the literature are confirmed. First, developing countries' own trade reform matters a lot; second, agriculture provides the greatest welfare gains; third, tariffs, by far, are the main source of distortions.

When looking at the liberalizing region, in general trade reforms in both North and South matter for developing countries, but while on average Northern trade reform implies improvement of foreign market access and increased export prices, Southern trade reform is beneficial as it entails a reallocation of productive factors to competitive sectors. Nevertheless, Northern trade liberalization can generate welfare losses for developing countries due to deterioration of terms of trade where some countries experience erosion of their preferential access (e.g. Tunisia and Mexico), and others (net food importing countries) are affected by increased world agricultural prices.

[16] These Gini coefficients were obtained using the results on real income from the above modeling exercise calculating real income per capita, with and without full trade liberalization, using population data from the World Development Indicators.

In terms of liberalized activity, in general, welfare of developing countries increases with full agricultural-trade liberalization, whereas liberalized trade in industry has much more contrasting effects. Decomposing trade reform by instrument of intervention reveals that tariffs are by far the main sources of distortions. Complete elimination of tariffs increases world welfare by 0.23%. Elimination of domestic support and export subsidies has a small negative effect on world welfare.[17] Eliminating tariffs creates positive efficiency gains in countries where protection is initially high (India, Bangladesh, "Rest of Sub-Saharan Africa") or exhibits peaks ("Developed Asia", rest of OECD).

In a nutshell, the results from the MIRAGE assessment conclude that full trade liberalization is welfare–improving and development–friendly as welfare augmentations are greater for developing countries and especially for Least Developed Countries. Nevertheless, some topics require further consideration: *(i)* full liberalization can have adverse effects on individual countries because of terms-of-trade losses; *(ii)* agricultural specialization entails a smaller expansion of industrial activity, which means less economies of scale and fewer varieties.

This study might have led to a slight underestimation of expected benefits. At least three reasons justify this statement. First, it is founded on a database on market access that fully includes regional agreements and preferential schemes. This assumes a full utilization of preferential access, which in reality may not always be the case. This means that expected benefits for countries receiving preferences, which are mostly developing countries, may be underestimated. Second, simulation is based on low trade elasticities. This choice can be justified. Recent econometric work by Hertel, Ivanic, Preckel, and Cranfield (2000), gives a scientific basis for using these behavioral parameters. But this element must be kept in mind.

Third, the estimation here is based on 17 sectors in 20 geographic zones. This is a quite representative choice compared with the previous literature and is also justified by theoretical features. The model used here accounts for imperfect competition, horizontal

[17] This conclusion resonates with a similar issue raised by Panagarya (2005).

and vertical differentiation, imperfect mobility of unskilled labor between agricultural and non–agricultural activities, and it is dynamic. Thus, increasing the number of products and regions would have also increased the number of equations and the calculation time. Finally, this disaggregation inevitably underestimates the distortions created by protection as tariffs are unevenly distributed across products and regions.