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Alternative Market Access Scenarios in the Agricultural Trade Negotiations of the Doha Round[*]

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The article explores possible outcomes of the Doha Development Agenda by simulating agricultural liberalization scenarios with a modified version of the Global Trade Analysis Project (GTAP) model and the related version 6.0 database. A 2013 baseline is employed to analyze two hypotheses in the areas of market access and export competition. Proportional cuts in tariffs are compared with a Swiss-formula approach. Welfare gains arise both in developed and developing countries, and, at least in principle, both groups should support deep reforms. Results suggest that the choice of the nature of the formula is not crucial in determining an effective increase in market access.

Keywords: commercial policy, protection, promotion, trade negotiations, agriculture in international trade

1. Introduction

The reform in the three main areas of agricultural negotiations – market access, export competition and domestic support – has formed a key element of the Doha Development Agenda since its launch in 2001. Negotiators missed the 2003 deadline for producing "modalities" (i.e., scope, methodology and numeric targets) for countries' commitments, and the ministerial meeting of the World Trade Organization, held at Cancun in Mexico in September 2003, ended in deadlock. Subsequent efforts produced at the end of July 2004 an agreement on a "Framework for Establishing Modalities in Agriculture", the so-called July package (WTO, 2004), which gave new impetus to the negotiations.

This study provides insights into the nature and magnitude of the impacts of an agricultural agreement, considering the trade-offs between different approaches to tariff cuts, such as the Swiss formula and the proportional cuts, and the interaction between developed and developing countries.

Scenarios are analyzed in a set of simulations run with a modified version of the general-equilibrium model of the Global Trade Analysis Project (GTAP) (Hertel, 1997). These are run on a 2013 baseline and aimed at isolating the effects of trade reforms from other changes. Welfare and price effects are studied for a number of countries and regions, and a game-theoretic approach is adopted to analyze the interaction between developed and developing countries. Given that the specific modalities of tariff reductions are at least as important as the overall average reduction (Bureau and Salvatici, 2004), tariff cuts are carried out at the most detailed level of existing information (Harmonized System, or HS, six digits) in the World Integrated Trade Solution (WITS) database (http://wits.worldbank.org).

2. Model and Baseline

The GTAP provides a global, perfectly competitive, comparative-static, general-equilibrium model (Hertel, 1997) based on single "regional" households. Bilateral trade flows are modeled through product differentiation on the demand side, assuming imperfect substitutability between goods produced in different countries (Armington, 1969). Transaction costs are also accounted for, as transport services are explicitly considered among economic activities. In the standard closure case, global investment adjusts to global saving, so that national balances of payments are endogenous.

The GTAP database is built starting from a set of the social accounting matrices of individual countries, and on trade data from COMTRADE. The most recent update – version 6 – refers to 2001 as a base period and employs trade policy data from the

MacMaps database (Bouët et al., 2004). Export subsidies are directly derived from countries' notifications to the WTO.

Ad valorem tariffs are the only trade policy measure explicitly represented in the model. The assessment of the impact of trade liberalization may not be accurate due to the *aggregation problem*, not to mention the conceptual difficulties related to the presence of non-tariff barriers. In fact, trade policy operates with tariff line definitions that are far more detailed than the sectoral aggregation of existing trade models. We partly overcome this limitation by calculating reduction commitments from the most detailed information available in the WITS.

Scenarios were run for 47 regions, 15 products and 5 endowments (table 1), attempting to maximize the number of WTO members considered; products were chosen with emphasis on agriculture and food.

The construction of the 2013 baseline is based on projections for a number of non-policy variables (table 2) and on policy shocks accounting for some of the most important changes that have occurred and are due to occur in agricultural and trade policies between 2001 and 2013 (table 3). Particular consideration was given to the Common Agricultural Policy (CAP), the instruments of which have been modeled extensively (Bach, Frandsen and Jensen, 2000; Brockmeier, Herok and Salamon, 2001; van Meijl and van Tongeren, 2002; Jensen and Yu, 2005). Our policy specification draws partly on these contributions.

In particular, for direct payments – which are modeled as subsidies to primary factor use – a financial stabilization element based on reference ("base") areas and on livestock inventory ceilings was added in order to allow the unit subsidy to endogenously adjust to output changes. Changes in intervention prices were approximated through changes in the corresponding import taxes, while dairy quotas were introduced by output increases. Regarding the 2003 Fischler reform of the CAP, decoupling was modeled by replacing the previous payments with a homogeneous subsidy to land use, the level of which was determined endogenously on the basis of the expenditure for crop-specific subsidies in the baseline (table 3).

EU enlargement was modeled through the removal of import tariffs between the EU and the Central and Eastern European countries (CEECs) and the alignment of domestic and trade policies. In order to introduce direct payments in the CEECs by year 2013, *ad valorem*–equivalent rates were calculated using data from both FAO and the GTAP databases. The Everything but Arms (EBA) preferential initiative was also introduced in the baseline, by eliminating tariffs on imports from least developed countries (LDCs) into the enlarged EU (table 3).

Table 1 Countries, Regions, Products and Endowments

Countries/Regions	Products	Endowments
Australia	paddy rice	land
New Zealand	cereals	skilled labour
China	vegetables, fruit and nuts	unskilled labour
Japan	oilseeds	capital
Republic of Korea (South Korea)	plant-based fibres	natural resources
Taiwan	other primary products	
Indonesia	livestock and meat	
Malaysia	raw milk	
Philippines	vegetable oils and fats	
Thailand	dairy products	
Vietnam	processed rice	
Bangladesh	sugar	
India	other food products	
Sri Lanka	manufacturing	
Rest of South Asia	services	
Canada		
United States		
Mexico		
Central America		
Colombia		
Peru		
Venezuela		
Rest of Andean Pact		
Argentina		
Brazil		
Chile		
Uruguay		
Rest of South America		
Caricom		
Rest of Caribbean countries		
European Union (EU15)		
CEEC		
Russian Federation		
Turkey		
Rest of Middle East		
Morocco		
Tunisia		
Rest of North Africa		
Malawi		
Mozambique		
Tanzania		
Madagascar		
South Africa Custom Union		
Uganda		
Rest of Southern Africa		
Rest of sub-Saharan Africa		
Rest of world		

Table 2 Sources of information for the 2013 baseline

Variable	Source
GDP	World Bank, World Development Indicators projections, adjusted by USDA/ERS with projections from the Oxford Economic Forecasting, DRI-WEFA, and the Project Link
population	United Nations projections
agricultural labour force	FAOSTAT
total factor productivity	Hertel and Martin (2000)

Table 3 Policy Shocks in the 2013 Baseline

Policy measure	Shock introduced	Sources of shock calculations
increase in the (semi-decoupled) payment per hectare to cereals producers (residual Agenda 2000 reform)	increase in the subsidy on land use	+5%, from 54 to 63 Euro/ton
reduction in the cereals intervention price (residual Agenda 2000 reform)	import tariff reduction	corresponding to market price reduction as a % of intervention price reduction in van Meijl and van Tongeren (2002)
reduction in the intervention price of butter and smp (Fischler reform)	import tariff reduction	-22% as trade weighted average of butter and smp
reduction in the intervention price of rice (Fischler reform)	import tariff reduction	-50% tariff on rice
increase in direct payment to rice producers (Fischler reform)	increases in subsidies to output and to input use	+37% in output subsidy; +96% increase in subsidy to land use
free trade between the EU15 and CEEC (enlargement)	abatement of bilateral tariff and export subsidies between the EU15 and CEEC	-100% tariffs and subsidies
extension of the PAC to CEEC (enlargement)	equalization of all input and output subsidies between EU15 and CEEC; equalization of all bilateral tariffs and export subsidies toward the rest of the world	
introduction of decoupling of direct payment in EU25 (Fischler reform)	abatement of crop-specific subsidies to land and capital use; introduction of a homogeneous subsidy to land use	
FSRI act	increase in output subsidies to cereals	weighted average of 6% for wheat and 3% for coarse grains (Bouët et al., 2004)
FSRI act	reduction in the output subsidy to soybeans	-4% (Bouët et al., 2004)
FSRI act	increase in output subsidies to dairy	3% (Bouët et al., 2004)
FSRI act	increased land set aside	-5% reduction in the productivity of land for wheat (Bouët et al., 2004)
direct payment to cereals and oilseeds in China	subsidy to land use	13% (FAO data and GTAP database)
increase in direct payment to land use in Mexico	subsidy to land use	7% (Eastwood et al., 2004)
Everything but Arms policy (EBA)	between EU25 and countries involved in the EBA	-100% tariffs

Some of the provisions of the U.S. 2002 Farm Security and Rural Investment Act (FSRI) were also considered, following Bouët et al. (2004). A reduction in land productivity was introduced to take into account the increase in the acreage conservation program. Output subsidies were increased for cereals and dairy products and decreased for soybeans. Finally, recent changes in the Mexican PROCAMPO program were considered, together with the direct payments recently granted to grains in China (FAO, 2005).

3. The Doha Agenda and the Trade Policy Reform Scenarios

Of the three main areas of agricultural negotiations, our simulation scenarios focus on two: market access and export competition. Although domestic support is also a contentious issue, it appears unlikely that the United States and the EU would accept any commitment that would disrupt their ongoing efforts towards "decoupling" agricultural support (Jensen and Yu, 2005). Moreover, there is evidence that a reduction in domestic support would account for only a small share of the potential welfare gains from a multilateral agreement (Rae and Strutt, 2003; Anderson, Martin and van der Mensbrugghe, 2005).

In the July package it was agreed that all forms of export subsidies are to be eliminated by a credible end date, while export measures that result in equivalent effects are to be disciplined. Accordingly, all our scenarios provide for the abolishment of export subsidies.

The Doha mandate commits WTO members to "substantially improve market access". Two major approaches have emerged on this matter: one which would maintain the formula employed in the Uruguay Round Agreement on Agriculture (URAA) and another which proposes "non-linear" tariff cuts. The fundamental problem with the first approach is that it provides no incentives for cutting higher tariffs ("peaks"). The other approach – which could be based, for example, on a "Swiss formula"[1] – would produce much steeper cuts on higher tariffs and could also have the effect of establishing a maximum tariff level. On the other hand, it requires the conversion of specific tariffs into *ad valorem* equivalents, which is quite a sensitive issue from the political point of view, as different conversion criteria may lead to different outcomes.

According to the July package, tariff cuts will be based on a single, tiered approach: the higher the tariff, the higher the cut. The agreement also caters to developed countries' concerns related to "sensitive products", as well as to special and differential treatment for developing countries (smaller tariff cuts) and special treatment for "special products" where there are implications for food security.

Meetings held since August 2004, however, have confirmed the difficulty of building consensus on the choice of a formula.

The actual modalities remain subject to negotiation; therefore, the number of bands, the thresholds of such bands and the tariff reductions within each band still need to be discussed. As a consequence, in designing the scenarios we decided to rely upon the Harbinson proposal (WTO, 2003a), which is the only available official proposal envisaging bands. The proposal requires larger reduction rates for the highest tiers and achieves harmonization across bands, but does not imply deeper cuts for higher tariffs *within* the bands. Building consensus on a non-linear formula is difficult, because the higher reduction in higher tariffs implies different effects in terms of each country's average tariffs: countries face different degrees of "sacrifice" depending on their initial tariffs.

In order to add realism to the simulation, we considered a proposal advanced by the chair (*Girard*) of the non-agricultural market access negotiations (WTO, 2003b), which takes into account the differences in the tariff structures by introducing a variable (and country-specific) coefficient into the Swiss formula.[2] Note also that a non-linear formula avoids the possibility that cutting a tariff in a given band results in a final tariff that is lower than the final tariff resulting from the cut required in a lower band ("overlapping").

In essence, we focused on the two following scenarios (see point A1 in the appendix for details):

1. *Harbinson approach – no export subsidies*. In the March 2003 draft modalities, the formulas in each band use the Uruguay Round approach (average cuts subject to minimums). However, since it would be arbitrary to assume a specific pattern of cut allocations, our first scenario provides for a uniform reduction in each band.

2. *Girard approach – no export subsidies*. A Swiss formula is applied in each band of the March 2003 draft modalities, using the average bound rate as the coefficient representing the maximum rate allowed within each band.

In both cases tariff cuts are implemented at six Harmonized System (HS) digits, as allowed by the WITS. We also compared bound and applied rate reductions, and calculated a reduction only where the former result was lower than the latter. Such updated tariffs were aggregated from the HS at six digit level up to the GTAP sector definition through weighted averages. The provisions for "sensitive" and "special" products reported in the July package were ignored, given the absence of credible hints about likely criteria for their identification. Concerning the *ad valorem*

equivalents of the specific tariffs, we employed those provided by the WITS database which were computed with the UNCTAD Method 1.

A third, "free trade" scenario, implying the removal of all trade policies, was also simulated as a benchmark.

4. Results

4.1 Tariff-cutting Criteria and Their Effects

Before analyzing the economic consequences of the scenarios, it is useful to explore the implications of the tariff-cutting formulas employed in each.

It should be noted, first, that the shares of tariffs included in each band for developed and developing countries are in fact quite different (figure 1). This difference is unavoidable if thresholds are homogeneous across countries, but it may create problems if a small number of members were to end up with most of their tariffs in the highest band. In the same vein, a "ghetto issue" could arise if a limited number of tariff lines were grouped in a band: political economy considerations suggest that it could be easier to accept substantial cuts if a specific industry is not cornered in the highest band. To achieve a homogeneous share of tariffs in each band, boundaries may be determined in terms of quantiles of the tariff distributions; this would be simple and objective, but would imply different thresholds for each country.
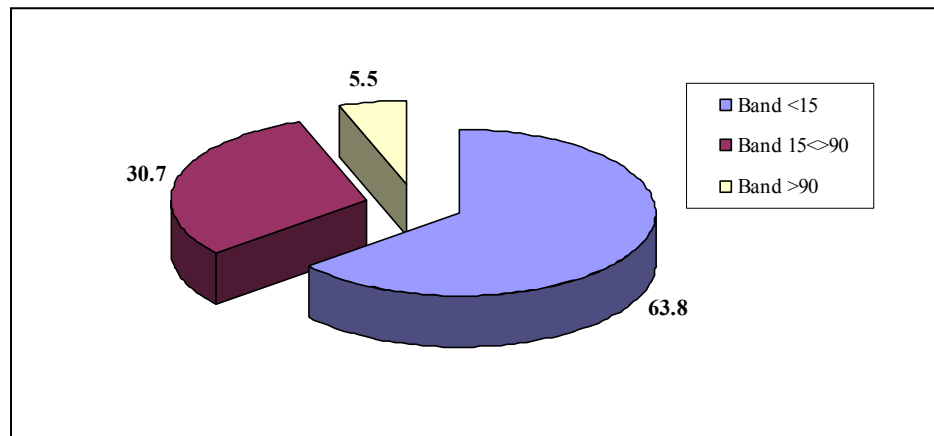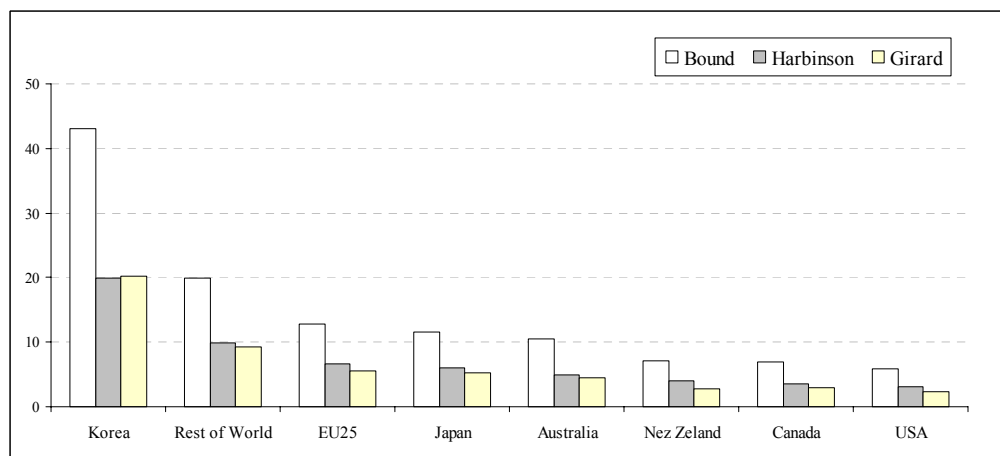

Figure 1a Developed countries: % of total tariffs in each band
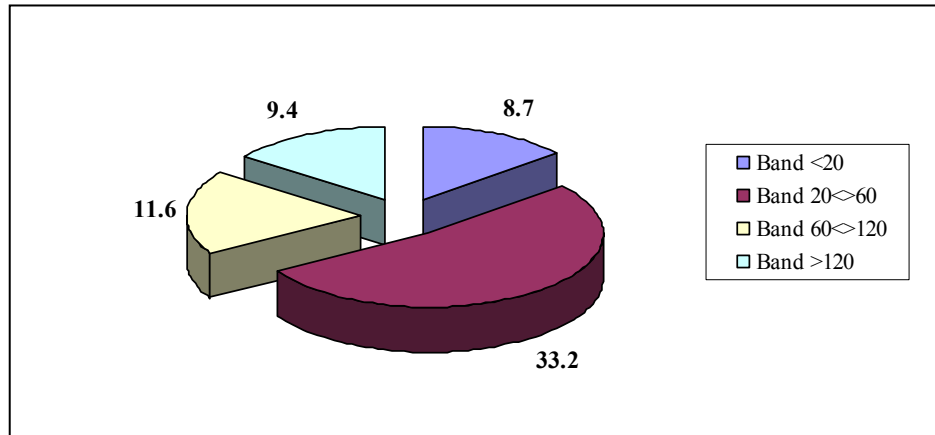
Figure 1b Developing countries: % of total tariffs in each band

Second, it should be noted that in many cases the two scenarios do not differ significantly in terms of reduction in the *average* tariffs (figures 2 and 3). To understand such an outcome, recall that "concave formulas" such as the Swiss one, reduce high tariffs more sharply, but they reduce low tariffs less sharply than do linear formulas below a "switching point". The value of the point is inversely related to the proportional reduction and directly related to the (simple) average within the band (the analytical expression is derived in equation (3) of point A1 in the appendix). As a consequence, the Harbinson scenario is more likely to result in a higher number of larger cuts in the lower bands, as well as in the case of tariff structures characterized by a few large tariffs within each band.

Figure 2   Average bound tariff and final tariff for Harbinson and Gerard cuts in selected developed countries.
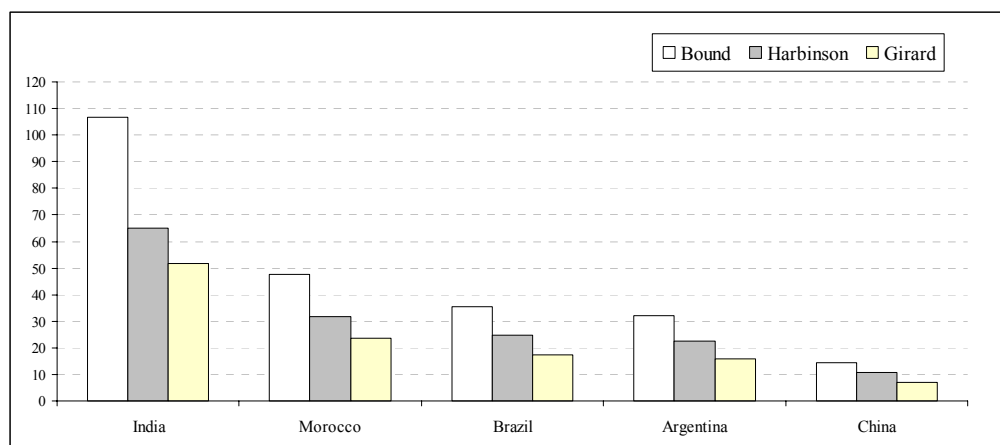
Figure 3 Average bound tariff and final tariff for Harbinson and Gerard cuts in selected developing countries

Finally, the inclusion of preferential and/or applied tariffs is one of the advantages of the version 6 GTAP database. Many developing countries apply Most-Favoured Nation (MFN) rates that are lower than their bound tariffs, due to high initial bindings and subsequent sharp waves of reductions in applied rates (Francois, Martin and Manole, 2005). The difference between bound and applied tariffs is usually referred to as "water"; the larger the amount of water in the tariffs, the less likely the reduction of the bound tariffs will result in an actual improvement in market access. Figure 4 provides information on the percentages of agricultural tariffs where the cut is effectively implemented, since the difference between the old and new bound rate is larger than the tariff overhang. The figure refers to developing countries, but it is worth recalling that the applied tariffs of developed countries also are much lower than their bound tariffs under preferential agreements.[3]
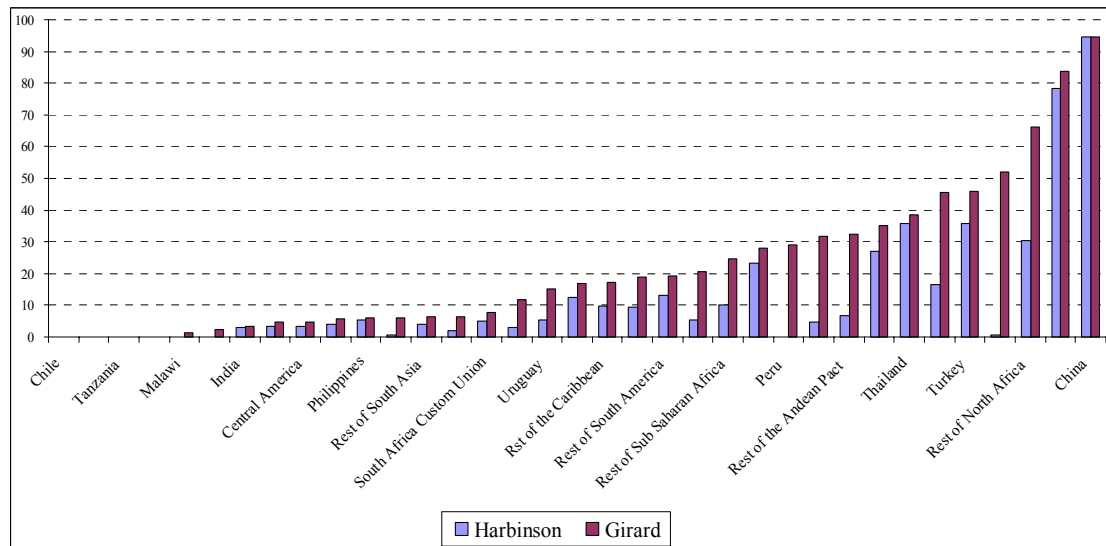
Figure 4 Developing countries. Percent of tariff lines in which cuts are effectively applied

4.2 Scenario Analysis

Simulations confirm some basic intuitions: first, the degree of tariff reduction is positively related to the potential gains in economic welfare and market price changes; second, results are similar under the Harbinson and the Girard scenarios. Hence, what follows will deal mostly with the first of these two scenarios.

Geographically, simulations show that trade policy reform leads to a decrease in market prices in the major economies of Asia, in the Mediterranean region, in sub-Saharan Africa and in Europe, whereas in Oceania and throughout the Americas prices increase in most cases. With few exceptions – Japan and South Korea – price changes range up to a maximum of 15 percent and are below 10 percent in most instances (table 4).

Prices increase in Australia and New Zealand, especially for dairy products, and prices for rice increase in Thailand. India and China experience marked changes for oilseeds, due to both the reduction in the high tariffs and increased imports from South America. Price increases are also projected for the United States, Canada and Central America – especially for rice, cereals, oilseeds, and fruits and vegetables – in Uruguay for dairy, livestock and cereals, and in Argentina and Brazil, especially for oilseeds and cereals (table 4).

Table 4 Percentage Changes in Market Prices under the "Harbinson" Reform Scenario

	Paddy	Cereals	Veg., fr., nts.	Oil-seeds	Sug. cane & bt.	Oth. prim. prods.	Live-stock	Raw milk	Veg oils & fats	Dairy prods.	Proc. rice	Plant based	Oth. foods
China	1.1	-0.7	-0.1	-5.1	-0.7	-0.4	-1.5	-1.7	-11.4	-1.0	-1.3	-0.2	-1.9
Japan	-12.7	-10.4	-6.7	-6.1	-22.3	-4.3	-7.5	-10.1	-0.8	-5.7	-36.3	-3.5	-4.7
Republic of Korea	-4.4	-13.6	-5.4	-35.7	-2.7	-1.9	-12.4	-12.4	-63.3	-6.2	-4.3	-4.1	-19.5
Taiwan	-0.5	-0.4	-0.6	2.5	-0.3	-1.6	-0.3	-0.2	0.8	-0.2	-0.4	-0.3	-0.2
Indonesia	-0.9	0.3	0.1	-0.5	-0.5	0.0	0.3	-0.1	-0.1	-0.3	-0.8	0.4	-0.2
Malaysia	10.0	1.4	2.0	1.9	-0.9	-8.5	-2.2	-7.5	0.2	-0.8	-11.2	2.1	-9.2
Philippines	-3.2	-2.5	-1.9	-1.9	-1.4	0.9	-2.4	-2.6	-0.6	-1.2	-2.4	-1.2	-1.4
Thailand	13.0	1.2	5.8	3.2	4.3	2.8	0.3	-0.6	-0.5	-2.3	10.5	2.4	-3.2
Vietnam	-3.1	-1.6	-3.2	-4.7	-1.8	-2.3	-3.0	-1.3	-1.3	0.1	-3.1	-1.3	-1.4
Bangladesh	-2.7	-2.6	-3.3	-2.9	-1.8	-2.7	-2.8	-2.8	-3.1	-2.4	-2.1	-1.7	-2.1
India	-1.4	-1.4	-2.2	-2.2	-1.0	-1.5	-2.2	-1.7	-1.8	-1.4	-0.8	-1.5	-1.1
Sri Lanka	-3.5	-0.1	-2.6	-4.2	-2.1	-0.9	-2.2	-3.1	-2.8	-2.9	-4.1	-0.8	-1.4
Rest of Asia	-3.5	-2.0	-2.1	-3.0	-2.1	-2.8	-1.7	-2.2	-3.9	-2.1	-2.2	-1.6	-1.9
USA	10.7	1.4	1.3	2.3	0.0	1.2	0.2	0.8	0.6	0.2	0.4	1.0	0.1
Mexico	1.7	0.0	-0.1	0.7	-0.5	-0.3	-0.4	-1.0	0.6	-0.6	-0.3	-0.1	-0.7
Canada	0.8	0.9	0.2	-0.2	0.2	0.1	-0.5	-0.8	-0.6	-1.5	1.3	0.1	-0.4
Colombia	1.6	0.6	4.6	1.2	0.2	1.1	0.9	1.4	-0.2	0.4	0.0	0.5	0.1
Venezuela	-0.5	-0.6	-0.2	-0.4	-0.2	-0.7	-0.5	-0.5	-0.4	-0.4	-0.3	-0.8	-0.3
Perù	9.9	7.3	8.1	9.1	5.0	7.1	7.9	9.5	3.8	0.9	0.5	7.4	2.4
Rest of Andean Pact	4.9	3.5	9.2	3.2	1.8	4.4	3.5	5.0	0.9	1.9	1.4	3.4	1.4
Argentina	4.3	3.8	5.0	5.8	2.7	5.7	3.6	6.2	4.3	3.4	3.2	2.9	2.1
Brazil	6.8	6.7	6.2	6.1	4.3	6.8	7.0	7.1	4.5	4.5	4.6	5.9	3.7
Chile	4.4	3.7	4.6	3.2	2.5	1.8	3.9	5.5	0.3	1.8	1.5	-0.2	1.3
Uruguay	7.9	8.3	7.2	5.6	5.2	5.9	8.2	13.3	4.4	10.1	4.0	3.5	5.0
Rest of South America	5.7	7.6	7.8	5.7	7.0	3.9	5.8	6.8	3.4	4.8	3.6	4.1	4.0
Central America	0.7	1.0	4.1	1.8	0.8	0.5	0.7	1.4	0.2	-0.8	-1.0	1.9	-0.2
Caricom	0.1	-0.1	0.4	-0.4	1.4	-0.5	-0.7	0.0	-0.6	-1.3	-0.9	0.3	-0.9
Rest of Caribbean	0.2	-0.3	-0.4	-0.1	0.1	-0.1	-0.7	-0.9	-0.1	-0.7	-0.4	-0.1	-0.3
EU15	0.1	0.2	-0.4	0.2	-3.1	0.0	-0.9	-0.3	-0.3	-0.5	-0.4	-0.1	-0.7
CEEC	0.1	0.3	0.2	0.3	0.2	0.1	0.0	0.8	0.0	0.1	-0.1	0.0	0.0
Turkey	0.1	-0.1	0.3	0.8	-0.1	0.8	-1.0	-0.6	0.0	-0.2	-4.9	0.3	-3.4
Russian Federation	-1.5	-1.0	-0.9	-1.5	0.8	-1.5	-0.6	-0.6	-1.0	-0.5	-0.6	-0.9	-0.4
Rest of Middle East	-0.5	-1.4	-0.8	-0.7	-2.0	-0.8	-1.5	-1.5	-0.9	-0.9	-2.7	-0.4	-1.9
Morocco	-6.3	0.7	1.0	0.4	-0.2	-0.7	1.8	0.5	-0.6	-0.4	-1.2	0.4	-0.5
Tunisia	-4.0	-8.7	2.5	-4.7	0.2	-7.1	-5.5	-1.6	-4.1	-1.8	-4.7	0.5	0.4
Rest of North Africa	-1.1	-1.1	-0.9	-0.4	-1.0	-4.0	-1.4	-1.2	-1.4	-1.1	-1.2	-1.0	-1.0
S. African Cust. Union	2.0	0.8	1.8	2.7	1.0	1.7	1.0	1.2	-0.1	0.1	0.5	1.5	0.2
Tanzania	-3.1	-2.7	-2.9	-2.9	-2.0	-2.6	-2.4	-2.8	-2.3	-2.2	-3.1	-1.6	-2.3
Mozambique	-2.4	-2.4	-2.6	-1.6	-2.1	-2.2	-3.1	-3.0	-2.3	-2.2	-2.3	-1.2	-1.8
Rest S. Africa	-7.4	-6.5	-6.6	-7.3	-8.0	-4.1	-6.0	-6.3	-5.3	-4.0	-4.1	-4.6	-4.6
Madagascar	-1.7	-1.6	-1.8	-1.7	-1.5	-1.8	-1.6	-1.6	-1.5	-1.4	-1.7	-1.4	-1.4
Uganda	-2.5	-2.3	-2.4	-2.4	-2.1	-2.1	-2.5	-2.4	-2.2	-2.7	-1.8	-1.8	-2.2
Malawi	-5.1	-4.9	-5.0	-4.4	-6.5	-3.9	-6.3	-5.9	-5.3	-5.6	-5.4	-3.4	-6.1
Rest s-S. Africa	-2.9	-2.2	-2.6	-0.4	-1.8	-1.9	-2.4	-2.4	-1.7	-4.0	-2.8	-1.3	-1.8
Australia	13.2	4.6	2.4	0.3	1.6	0.6	1.3	2.5	0.7	1.3	3.3	1.7	0.9
New Zealand	1.8	2.6	3.1	1.8	0.6	-0.4	1.5	4.7	0.8	2.9	1.0	1.9	0.7
Rest of world	-1.2	-1.5	-1.5	-1.5	-1.3	-1.6	-2.4	-1.6	-2.5	-0.9	-1.3	-0.9	-1.4

Source: Own calculation

Europe and the Russian Federation show price reductions, especially for sugar, livestock and dairy in the EU 15. The Russian Federation – where no trade policy reform applies, as the country is not a WTO member – shows a generalized marked price decrease, with the exception of sugar. The same is projected for sub-Saharan Africa, particularly for rice, livestock and dairy, while South Africa shows price improvements for many key products (table 4).

Changes in the real returns to land are consistent with the observed price behaviour. Reductions appear across East and Southeast Asia, Africa, the Middle East and Europe, while positive outcomes are found for the large producers of Latin America and Oceania. Increases are projected for a few LDCs, for example Malawi, and in South Africa (figure 5).

Changes in the returns to labour – skilled and unskilled labour behave similarly – are not directly related to the performance of the primary sector. Significant increases materialize in many countries where agricultural prices are projected to decrease, since improved resource allocation following from trade reform drives up the remuneration of this primary factor, both where the economy was distorted in the baseline and where there are benefits from improved price conditions (figure 6).
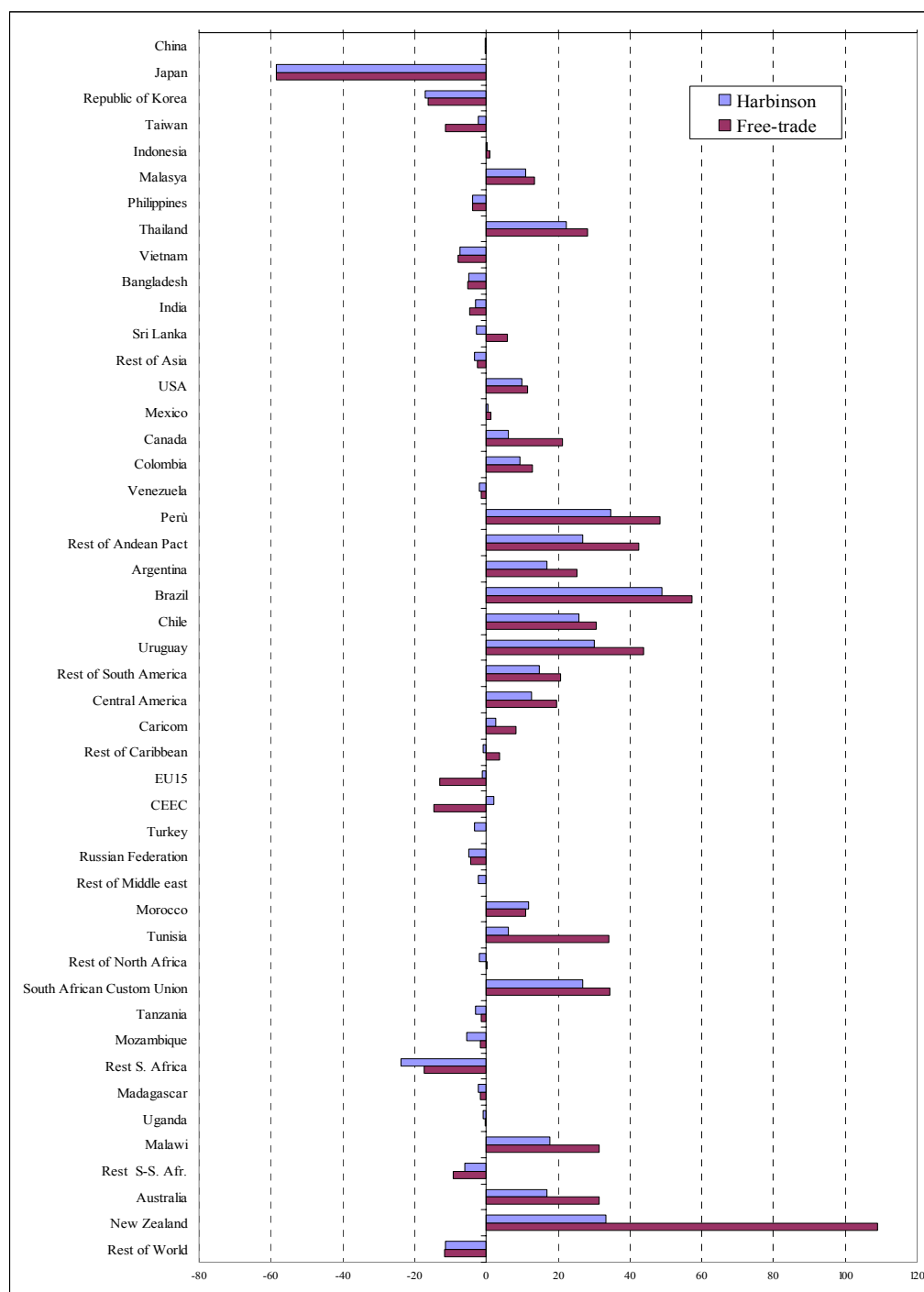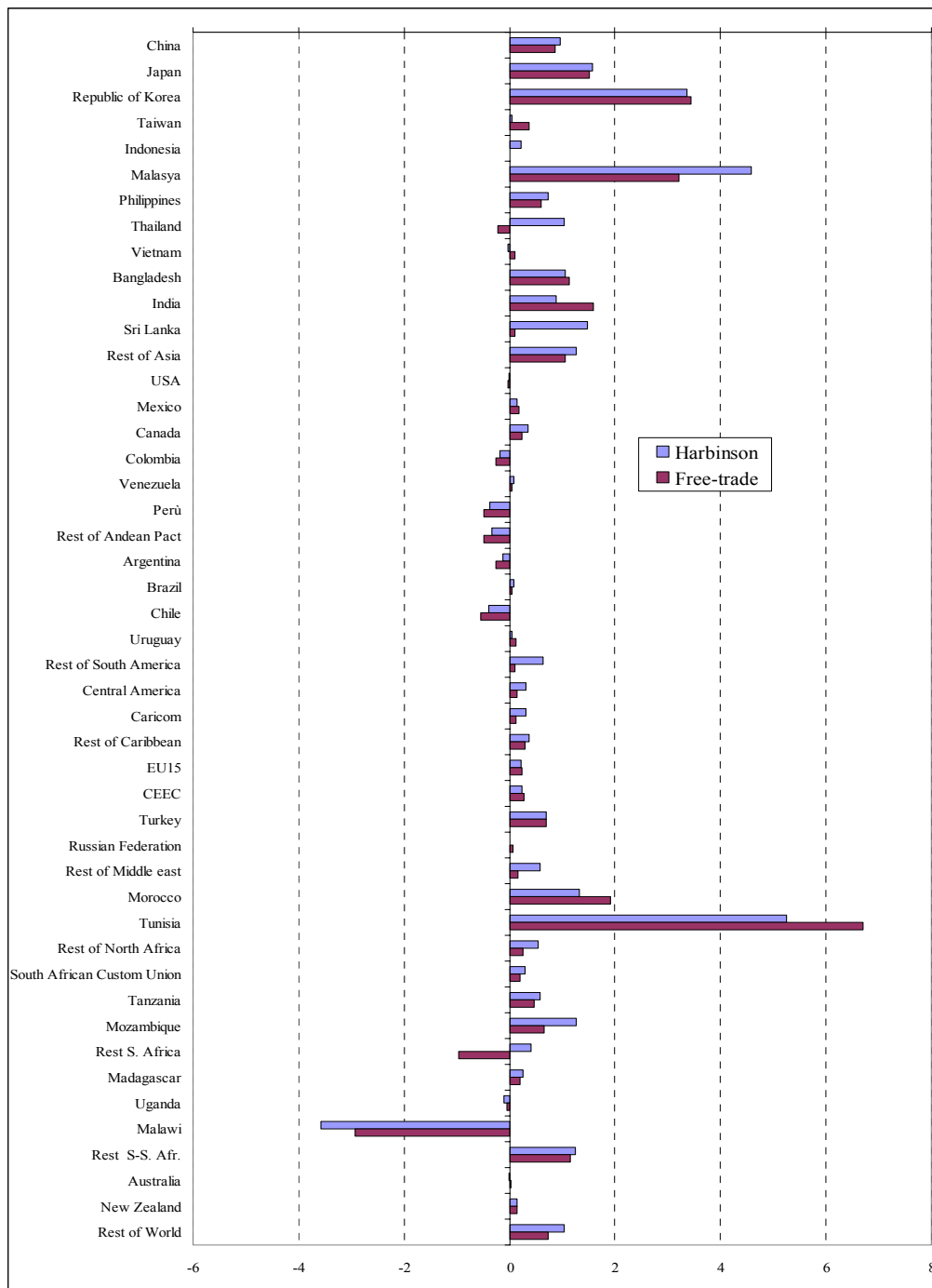
**Figure 5** Percentage change in real return to land

Figure 6 Percentage change in real return to skilled labour

The major world agricultural economies, where agricultural trade is a substantial portion of total trade, show more substantial changes in their overall terms of trade (figure 7) – an improvement in the cases of South America, Australia, New Zealand,

Morocco and Tunisia, and a worsening in South Asia and some African countries. On the other hand, smaller changes arise in some industrialized economies – the United States, Canada and the EU – due to the smaller relative importance of agricultural trade.
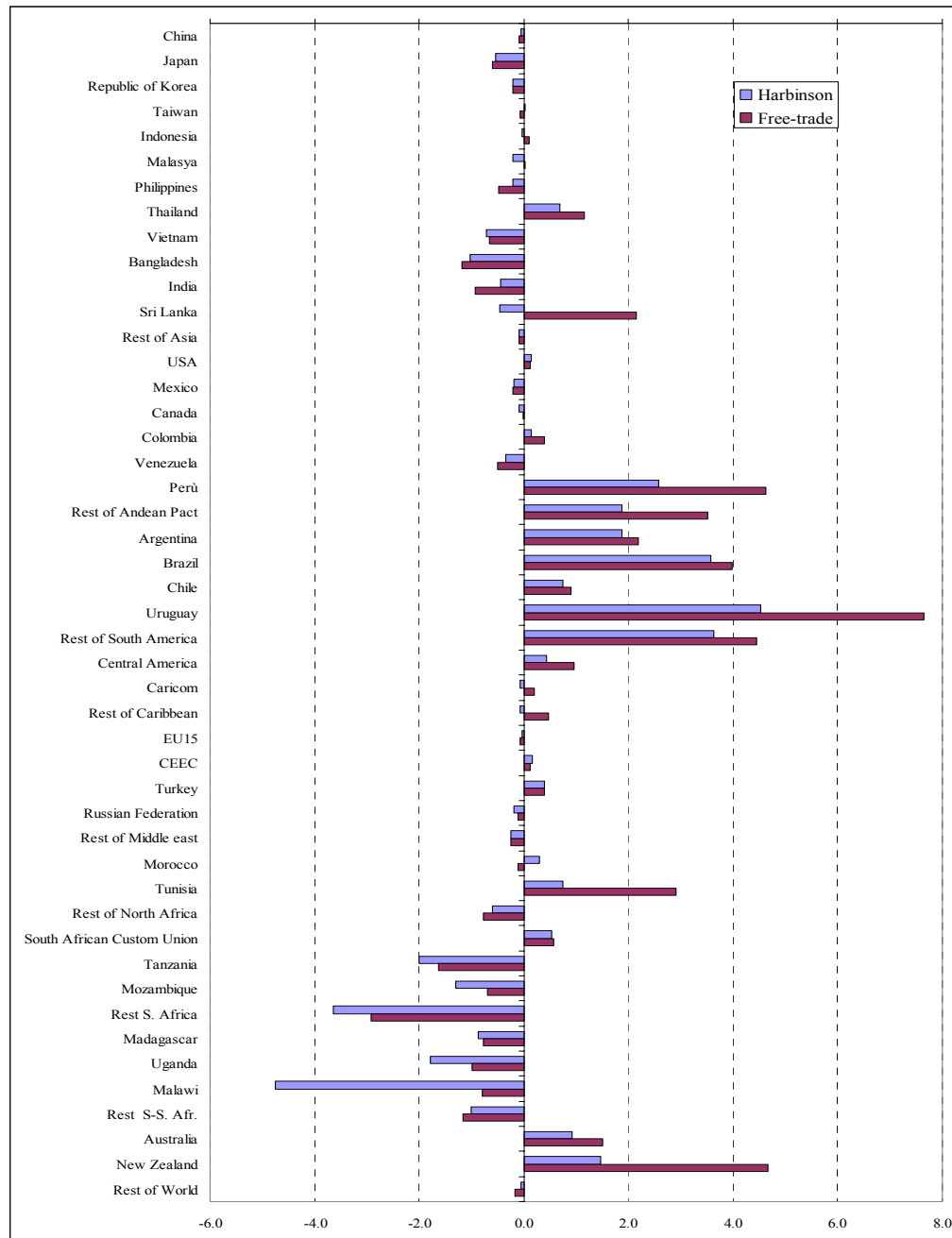
Figure 7 Percentage changes in the terms of trade

The equivalent variation (EV) – assumed as a measure of welfare change – is considered in terms of changes in its components arising from changes in the terms of trade and resource allocation, following Huff and Hertel (2000). Potential benefits increase with the extent of reform, but they appear limited in size, ranging from about 0.04 percent of world GDP to 0.12 percent in the free trade scenario.[4]

Welfare changes show few negative signs (table 5), more frequent among developing countries, especially in the sub-Saharan African region and among the LDCs; these negative changes arise mostly from small and negative allocation effects coupled with negative terms-of-trade effects. This result highlights the losses that are likely to arise in poor and less diversified economies, where there are few possibilities of recovering international competitiveness in non-agricultural activities once the border support to agriculture is reduced and the terms of trade become less favourable. Large emerging agricultural economies, on the other hand, mostly gain, either due to wide allocation effects more than offsetting negative terms-of-trade effects – as for China and India – or to wide terms-of-trade effects – as for Brazil and Argentina.

Table 5 Total Welfare Effect for (Proxies of) Countries and Region Groups ($US million)

	Allocative efficiency		Terms of trade		Total	
	Harbinson	free trade	Harbinson	free trade	Harbinson	free trade
proxy for the *G-20*						
China	2,570	2,387	-222	-382	1,947	1,779
Indonesia	55	3	-27	98	26	-1
Philippines	166	220	-76	-212	61	-36
Thailand	274	-27	706	1,180	904	1,080
India	595	1,798	-202	-604	400	1,246
Rest of South Asia	386	372	163	114	515	464
Mexico	431	425	-397	-477	3	-68
Central America	149	139	143	317	320	522
Rest of Caribbean	32	43	-16	38	17	130
Colombia	41	44	17	60	58	110
Peru	48	111	256	464	317	601
Venezuela	2	-2	-95	-131	-98	-136
Argentina	258	275	1,296	1,497	1,681	1,898
Brazil	261	263	3,377	3,736	4,557	5,006
Chile	-13	-16	278	331	198	245
Rest of Andean Pact	14	24	183	348	213	400
Tanzania	7	8	-26	-26	-35	-30
SACU	218	218	362	387	552	579
Total	*5,493*	*6,284*	*5,720*	*6,739*	*11,634*	*13,790*
proxy for the *least developed countries*						
Bangladesh	63	83	-78	-101	-47	-51
Mozambique	7	5	-16	-11	-12	-7
Tanzania	7	8	-26	-26	-35	-30
Madagascar	0	0	-4	-4	-14	-12
Malawi	-12	-4	-49	-8	-63	-13
Uganda	-1	0	-10	-8	-32	-18
Rest of S-Sahar. Africa	492	438	-563	-729	-213	-411
Rest of S. Africa	69	-87	-746	-586	-700	-690
Total	*623*	*444*	*-1,492*	*-1,474*	*-1,114*	*-1,232*

proxy for the *net-food-importing developing countries*

Sri Lanka	30	52	-26	127	4	177
Rest of South Asia	386	372	163	114	515	464
Central America	149	139	143	317	320	522
Rest of Caribbean	32	43	-16	38	17	130
Peru	48	111	256	464	317	601
Venezuela	2	-2	-95	-131	-98	-136
Morocco	294	355	51	-29	346	328
Tunisia	303	377	95	350	424	810
Rest of North Africa	194	121	-291	-463	-151	-373
Total	*1,437*	*1,568*	*281*	*787*	*1,692*	*2,524*

proxy for *developed countries*

Australia	-110	-113	777	1,238	609	1,051
New Zealand	24	48	353	1,111	336	1,050
Japan	27,076	27,071	-3,853	-4,031	23,990	23,835
South Korea	4,162	3,975	-472	-482	3,507	3,328
Canada	1,207	1,002	-304	-2	881	976
United States	-1,135	-1,079	1,816	1,394	594	247
EU-15	7,486	8,527	-1,735	-3,665	5,452	4,262
CEEC	-406	267	439	345	86	472
Total	*38,303*	*39,699*	*-2,978*	*-4,091*	*35,456*	*35,221*

proxy for the *Cairns Group*

Argentina	258	275	1,296	1,497	1,681	1,898
Australia	-110	-113	777	1,238	609	1,051
Brazil	261	263	3,377	3,736	4,557	5,006
Canada	1,207	1,002	-304	-2	881	976
Chile	-13	-16	278	331	198	245
Colombia	41	44	17	60	58	110
Indonesia	55	3	-27	98	26	-1
Malaysia	1,664	1,444	-379	70	1,145	1,331
New Zealand	24	48	353	1,111	336	1,050
Philippines	166	220	-76	-212	61	-36
SACU	218	218	362	387	552	579
Uruguay	96	138	300	488	461	727
Total	*3,866*	*3,526*	*5,974*	*8,804*	*10,563*	*12,935*

Other countries

Taiwan	-38	239	24	-162	-9	100
Vietnam	-5	-8	-102	-96	-201	-180
Rest of South America	67	71	257	312	304	359
Turkey	323	444	241	234	568	685
Russian Federation	131	109	-294	-204	-147	-65
Rest of Middle East	530	167	-883	-798	-432	-672
Rest of World	3,221	3,202	-370	-1,271	2,793	1,823
Total	*4,230*	*4,225*	*-1,126*	*-1,985*	*2,875*	*2,049*
Grand total	**53,953**	**55,745**	**6,379**	**8,779**	**61,105**	**65,286**

Results for the LDCs support the notion that these countries require *ad hoc* measures to counteract potential losses. The same applies to some of the net-food-importing developing countries (NFIDCs), for which, however, a net aggregated benefit arises from substantial benefits for certain countries within that group. OECD countries, on the other hand, appear set to reap most of the benefits, together with the so-called Cairns group.[5]

4.3 A Game Approach to the Negotiation

Welfare results have been elaborated by grouping countries into two broad entities – developed and developing countries – to study the interactions between their

respective possible strategies. A two-player, normal-form, non-cooperative, single-period game based on the model results is employed to search for a Nash equilibrium. Details on the game are in point A2 of the appendix.

In order to achieve an agreement in which both groups are at least as well off as before, the settlement must lie within the set of agreement actions (Kennedy, von Witzke and Roe, 1996). Strategies analysed are the three liberalization scenarios described in section 3, namely Harbinson (*h*), Girard (*g*) and free trade (*ft*), plus a status quo (*sq*).

Each player chooses a strategy by maximising its payoff given the strategy of the other, and the same set of strategies exists for both players. A Nash equilibrium occurs where each group chooses policies that are the best response to the choice of the other, maximising its EV given the choice of the other group.

Governments are assumed to maximize domestic welfare. The payoffs are money-metric measures of utility change from a base period. The differences in EV between the baseline and the scenarios are used to determine the amount of money available for compensation across countries within the two groups. Without compensations, the agreement action space would be empty, since in all scenarios some developing country would be worse off. Compensation is assumed to be given up to where the compensating country's EV declines or the compensated country's EV increases to status quo levels, whichever comes first.

Results are all positive (table 6); thus, within the groups it is always possible for countries to be better off than in the status quo. The number of countries reporting negative results in each case appears in parentheses. The unique Nash equilibrium occurs when both groups choose the "Girard scenario", which is a symmetric dominant strategy for both players. Hence both groups, in principle, should be willing to significantly reduce agricultural protection.

Table 6 Welfare Results from Game Simulations ($US million)

DGs/DCs*	Status quo	Harbinson	Girard	Free trade
Status quo	0; 0	7023; 50788 (17; 0)	7260; 52665 (17; 0)	7375; 50115 (17; 0)
Harbinson	4930; 230 (15; 4)	14223; 52251 (14; 0)	14463; 54104 (13; 0)	14569; 51526 (15;0)
Girard	5550; 618 (15; 3)	14847; 52648 (14; 0)	15072; 54390** (13; 0)	15194; 51925 (15; 0)
Free trade	5402; 1206 (18; 5)	14603; 53486 (15; 0)	14835; 55347 (15; 0)	14939; 52782 (15; 0)

In parentheses: the number of countries experiencing a loss in each group.
* Developed countries (DCs) include: Australia, New Zealand, Japan, Korea, US, Canada, EU-25 (including EU-15 and CEEC) and ROW; other countries and regions listed in table 1 are included in the developing countries (DGs) group.
** Nash equilibrium

Although the Girard scenario was built to represent a possible compromise, this result does not necessarily provide a realistic forecast for the final outcome of the negotiations: inter-country compensations and side payments should not be taken for granted, and economic efficiency is certainly not the only – or even main – concern of policy makers.

5. Concluding Remarks

The key parameters of the tiered approach to agricultural market access are still to be addressed within the ongoing WTO negotiations, and it is not clear yet what the result may be in terms of tiers' thresholds and tariff-cutting formulas. By examining the potential effects of a possible non-linear formula (the "Girard scenario"), we showed that there are few significant differences with respect to the Harbinson proposal, given the tariff distribution within the bands and the extent of the binding overhang. Therefore, as long as a substantial reduction in the average is met, choosing a linear approach may not greatly affect the outcome.

The analysis of the strategic interaction between developed and developing countries shows that, in principle, significant trade liberalization in agriculture should be the dominant strategy for both groups. Looking at the evolution of the actual negotiations, this result mostly highlights the extent to which the assumption of "neutral", welfare-maximizing governments is ineffective for understanding governments' behaviour.

Scenario results are consistent with orthodox expectations about the effects of a reduction in border protection: they confirm the notion that liberalization is positively related to the economic benefits arising from an increased role played by comparative advantages in determining product and factor prices. Potential benefits are likely in a number of European, American and Asian countries, which would change their agricultural production mixes and/or move labour and capital outside agriculture.

The same, however, does not apply to a number of African, to some Southern Asian, and to some Latin American countries, whose potential to benefit from relocating resources inside and outside agriculture is limited by the extent and the diversification of their economies, and whose terms of trade may deteriorate significantly. While this aspect – which appears to be correctly captured by the general-equilibrium approach – calls for ad hoc measures, such measures should be designed so as to minimize their interference with trade reform, in order not to undermine the efforts of these same countries to exploit the opportunities offered by a more liberalized trade environment.

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Endnotes

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1 . This is a type of formula implying proportionally higher cuts for higher tariffs. See the appendix for the details of the calculation.

2. To some extent, this would also take into account the differences in tariff structures between developed and developing countries, since the latter generally maintain significantly higher bound rates. In the Harbinson scenario, instead, special and differential treatment for developing countries implies different thresholds and smaller cuts.

3. It should be noted, for instance, that more than one-third of the value of EU food and agricultural imports enjoys preferential treatment, and that only nine countries export food products to the United States without enjoying some tariff preferences (Bureau and Salvatici, 2004).

4. The GDP employed in this comparison is the one reported in the GTAP database.

5. Caution should be applied in considering aggregated evidence for country groups, due to the inevitably low accuracy of group representation: Central America and the Caribbean is a single region, as is the "rest of North Africa"; also, several participants in the Cairns group are not available as individual countries in the database.

The technical annex to this paper, pages 297-298 is available as a separate document.