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Agricultural trade liberalization in the Doha round. Alternative scenarios and strategic interactions between developed and developing countries

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ABSTRACT

The paper explores the impact of an agricultural trade agreement, simulating alternative liberalization scenarios, and studying the outcomes of the interaction between the strategies of country groups in the negotiations. The analysis is based on the model of the Global Trade Analysis Project (GTAP), and on the related version 5.4 database. Scenarios are run on a 2013 baseline, built by taking into account a number of events that have affected (and will further affect) world agricultural markets up to that period, focusing on the effects that are specifically attributable to further trade liberalization in the Doha Round. The policy strategies analyzed are two liberalization scenarios based on the proposals made in the present round of agricultural negotiations in terms of market access and export competition, plus a free agricultural trade benchmark scenario. Simulations are employed to study the interactions between the possible strategies of two wide country groups – developed and developing countries - on the basis of game theory, and to search for mutually advantageous agreements to be compared with actual agreement hypotheses. Results indicate that welfare gains could be reaped both by developed and developing countries and the possibility of inter-country compensations would allow, at least in principle, an agreement to be reached.

Jel code: F13 (Commercial Policy; Protection; Promotion; Trade Negotiations), Q17 (Agriculture in International Trade)

RÉSUMÉ

Ce document analyse les répercussions d'un accord portant sur les échanges agricoles moyennant la simulation de scénarios possibles de libéralisation et l'étude des résultats découlant de l'interaction entre les stratégies de certains groupes de pays durant le processus de négociation. Cette étude est basée sur le modèle du Projet d'analyse des échanges mondiaux (GTAP) et la base de données correspondante, version 5.4. Les différents scénarios sont élaborés à l'horizon 2013 et sont construits en tenant compte d'une série de facteurs qui ont eu (et auront encore) des effets sur les marchés mondiaux de produits agricoles d'ici à cette date, avec une attention particulière sur les effets pouvant être attribués plus spécifiquement à l'évolution du processus de libéralisation des échanges prévu dans les négociations de Doha. Les stratégies en termes d'action sont analysées dans le cadre de deux hypothèses de libéralisation basées sur les propositions formulées durant le cycle actuel de négociations agricoles en termes d'accès aux marchés et de concurrence des exportations, ainsi que sur un scénario de référence d'échanges agricoles libéralisés. Les simulations sont utilisées pour analyser les interactions pouvant résulter des stratégies possibles de deux grands groupes de pays, les pays développés et en développement, sur la base de la théorie des jeux, ainsi que pour déterminer des accords présentant des avantages mutuels par rapport aux hypothèses effectives d'accord. Les résultats démontrent que les deux groupes, pays développés et en développement, pourraient obtenir des bénéfices en termes de bien-être et que les compensations éventuelles entre pays devraient permettre, du moins en principe, de parvenir à un accord.

RESUMEN

El presente documento analiza las repercusiones de un acuerdo sobre comercio agrícola, para lo cual simula hipótesis de liberalización y estudia los resultados de la interacción de estrategias de grupos de países que participan en la negociación. El análisis se sustenta en el modelo del Proyecto de Análisis del Comercio Mundial (GTAP, por sus siglas en inglés) y en la versión 5.4 de la base de datos relacionada. Los supuestos se plantean en una línea de base hasta el año 2013 construida tomando en consideración una cantidad de eventos que han incidido (y seguirán generando un efecto) en los mercados agrícolas mundiales hasta dicho periodo, lo que permite centrar la atención en los efectos específicamente atribuibles a una mayor liberalización del comercio en la Ronda de Doha. Las estrategias relativas a políticas sometidas a análisis corresponden a dos hipótesis de liberalización que se sustentan en las propuestas planteadas en la presente ronda de negociaciones agrícolas en términos

de acceso a los mercados y competencia de las exportaciones, además de un supuesto de referencia de comercio agrícola libre. Las simulaciones se utilizan para fines de estudiar las interacciones existentes entre las posibles estrategias de dos grupos extensos de países –países desarrollados y países en desarrollo - sobre la base de la teoría de juegos, y con el objeto de alcanzar acuerdos recíprocamente ventajosos que serán sometidos a comparación con las hipótesis de acuerdo efectivas. Los resultados arrojan que tanto los países desarrollados como las naciones en desarrollo podrían cosechar buenos resultados en materia de bienestar social y la posibilidad de compensaciones entre países que permitirían, al menos en teoría, alcanzar un acuerdo.

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1 INTRODUCTION

The November 2001 declaration of the 4th Ministerial Conference in Doha provides the mandate for negotiations on a range of subjects, including agriculture. Negotiations on this topic began in early 2000 and are to end by 1 January 2005, though such a deadline does not seem very likely after the failure of the Cancun Summit. A large number of governments have already submitted negotiating proposals and, besides aspects like special and differential treatment for developing countries and non-trade concerns, the classical themes like market access, export subsidies and domestic support are high on the agenda. This study provides insights into the nature and magnitude of the possible impacts of an agricultural agreement for international trade and the resulting welfare improvements. The analysis focuses on trade liberalization scenarios on the basis of a set of simulations run with the global general equilibrium model of the Global Trade Analysis Project (GTAP) (Hertel, 1997).

While the United States (US) and the European Union (EU) used to be the major players in the Uruguay Round, in the present round other countries are also major participants in trade negotiations, especially among the developing countries. The objective of the empirical analysis is twofold. Firstly, the effects on prices, trade flows and welfare are considered for individual countries and regions and for the main country groups. Secondly, we adopt a game-theoretic framework to simulate strategies considered during the Doha Round, searching for mutually advantageous agreements for two main groups of countries, including developed countries on the one hand, and developing countries on the other. The resulting set of optimal strategies is compared with the actual countries' positions in the negotiations.

The paper is organized as follows: section 2 briefly presents the model. Since full impact of possible WTO outcomes is expected to take place in 2013, section 3 deals with the construction of the baseline including projections based on external forecasts on macroeconomic developments. This baseline takes into account events such as the Agenda 2000 and the Mid-Term Review reforms of the EU's Common Agricultural Policy (CAP), the enlargement of the EU to new members, and the implementation of preferential agreements such as *Everything but Arms* (EBA). Despite its limitations, such efforts to develop a "realistic" baseline allow the effects that are specifically attributable only to further trade liberalization in the Doha Round to be estimated.

The contents of a possible agreement on agriculture are impossible to forecast at this stage, but the main subjects under negotiations are defined: section 4 presents two possible liberalization scenarios in terms of market access and export competition. The first of these scenarios is based on the Uruguay Round Agreement on Agriculture (URAA), and would imply a "linear" tariff reduction (i.e. the same percentage reductions no matter what the starting tariff rate is) and a further reduction of the export subsidy expenditure. The second is more radical, leading to a tariff reduction based on the "Swiss formula" initially proposed by the US (leaving a maximum tariff of 25 percent) and the removal of export subsidies. These two can be considered as rather polar cases in the negotiations, so that any compromise is likely to fall within these two scenarios. These are analyzed together with a third scenario, which is meant to constitute a benchmark, implying the elimination of all trade measures for agricultural products. It should be recalled that the specific modalities of tariff reductions are at least as important as the overall average reduction (Bureau and Salvatici, 2004). In order to take this into account, the modelling of tariff reduction scenarios is carried out for several countries at the most detailed level of existing information (Harmonized System, 8 or 6 digits).

Section 5 presents the simulation results, highlighting the impact of trade liberalization scenarios on prices, trade flows and welfare. Concluding remarks appear in section 6.

2 THE MODEL

This work is based on a modified version of the model provided by the GTAP. This is a perfectly competitive comparative static general equilibrium computable modelling framework (Hertel, 1997). The structure of demand and supply, which is homogeneous across regions and products, is built upon the Social Accounting Matrices of individual countries and regions, while parameters are mostly drawn from the literature and calibrated on the reference database period.

The model assumes the presence of representative consumers and producers together with a government sector, and all incomes are assumed to accrue to a single "regional" household. Therefore, all distributional aspects are overlooked, and all consumers are assumed to purchase all goods. By the same token, government costs and revenues do not need to balance, as it is assumed that any discrepancy accrues directly to the households (i.e. the single "regional" household). Government's consumption behaviour is endogenous, while policies are typically exogenous (Hertel, 1997).

Substitutability among primary factors and with intermediate consumption is modelled through a set of nested Constant Elasticity of Substitution (CES) systems, while the production of final goods is aggregated through a fixed coefficient function of the Leontiev type. On the demand side the representative agent allocates his income among savings, government and private consumption through a *Cobb-Douglas* utility function, while allocation within different private goods is modelled through a Constant Difference of Elasticity (CDE) demand system (Hanoch, 1975).

Bilateral trade flows are modelled through product differentiation on the demand side, with the assumption of imperfect substitutability between similar goods produced in different countries and regions (Armington, 1969). Transaction costs are also accounted for in the model, as transport services are explicitly considered among the activities in the economy.

The standard GTAP model adopts the Walrasian closure rule, by which investment at the global level is adjusted to global saving, and the balance of payments is endogenous in individual countries and regions.

The most recent publicly available database version – known as version 5.4 – includes data on 78 regions and countries, 57 industries and 5 endowments, and is referred to 1997 as a base period (Dimaranan and McDougall, 2002). Among these, land and natural resources are assumed to be employed exclusively by agricultural and food production, while capital is assumed to be fully mobile among countries and regions.

In general, there are two groups of data which are of particular relevance for global models: those on border protection, and those on bilateral trade flows. The GTAP database is built from the COMTRADE data, supplied by the United Nations Statistical Office, through an *ad hoc* reconciliation procedure based on a reliability indicator of the information supplied by each importing and exporting country (Dimaranan and McDougall, 2002). Trade policy data are retrieved from the TRAINS database of UNCTAD and from the GATT-IDB database for non agricultural products, while data on domestic support in agriculture is based on the OECD and USDA Producer Support Estimates (PSE), and on the Agricultural Market Access Database (AMAD).[1] Export subsidies are directly derived from countries' notifications to the WTO in year 1998. Agricultural tariffs are mostly those bounds after the implementation of the 1994 URAA. Where these are significantly higher than the applied tariffs – i.e. where there is significant water in the tariffs or preferential trade agreements are in place – this overstates the level of support compared to the effective level. By the same token, the calculation of the effects of a trade policy reforms may be distorted: these will be overstated to the extent to which the difference between the two rates is significant.

Furthermore, *ad valorem* tariffs are the only trade policy measure directly represented in the model, ignoring tariff rate quotas as well as several other types of measure which are still applied in agricultural markets despite the "tariffication" process brought about by the 1994 URAA. Particularly, concerning the CAP, the model does not consider the existing variability in the tariffs applied to cereals and rice, and the seasonal duties applied to imports of fruits and vegetables. Also for this reason, the assessment of the impact of trade liberalization may not be accurate.

It is also worth recalling that even if all existing trade policy measures were *ad valorem* tariffs, their modelling within a framework like the GTAP would still create conceptual problems, due to the need to aggregate tariffs across product: no model could ever include products at the level of detail at which

[1] The AMAD database (http://www.amad.org) was built on the basis of the trade policy data made available by a number of national and international institutions including, among the others, FAO, USDA/ERS, Agri-food Canada, the EU Commission, and OECD.

tariff lines are specified. For instance, the EU schedule includes 1 764 tariff lines. This work attempts to partly overcome this limitation, by calculating for some of the most important WTO member countries the result of the reduction commitment envisaged under different reform scenarios starting from the most detailed available data (see section 4).

3 THE 2013 BASELINE

Version 5.4 of the database was adjusted for this application to include 44 regions, 15 products and 4 endowments (Table 1). The attempt was made to maximize the number of WTO member countries explicitly included in the analysis.

The CEEC (Central and Eastern European Countries) aggregate includes all the ten countries which became EU members in 2004. Lack of consistent data forced to include six residual areas - namely South Asia, North Africa, the Middle East, Sub-Saharan Africa, and Southern Africa - plus a wider and even more heterogeneous "rest of the world". Products were chosen with an evident emphasis on agriculture and food, attempting also to strike a balance between those more directly of interest for the major agricultural economies and to the low and middle income countries. Products for which data is available at different processing stages were also included separately; this is the case of rice, sugar, oilseeds, and dairy (Table 1).

As mentioned, version 5.4 is referred to year 1997. Therefore, the construction of the 2013 baseline required a number of shocks. Particularly, two different types of shocks were introduced. Firstly, exogenous variables were shocked up to the levels projected for year 2013. These are

- GDP, whose projections are those of the World Bank World Development Indicators, adjusted by the USDA/ERS with the projections of the Oxford Economic Forecasting, DRI-WEFA, and of the Project Link;
- population, whose projections are retrieved from the United Nations;
- agricultural labour force, whose projections are retrieved from the FAOSTAT;
- total factor productivity, whose projections are those proposed by Hertel and Martin (2000) on the basis of a number of studies on the topic.

Secondly, a number of policy shocks were introduced, accounting for some of the most important changes occurred in the agricultural and agricultural trade policy frameworks between 1997 and today.

Particular consideration was given to the CAP, which has undergone significant modifications over this period: in 1999 the implementation of the "Agenda 2000" reform was begun, and it was deepened further in 2003, with the so-called Midterm Review (MTR). Moreover, the enlargement of the EU, and the related extension of the CAP to ten new members was taken into account. Finally, a set of shocks was introduced into the model to take into account the change in the preferential policy pursued with the EBA framework, allowing all imports from the LDC countries to access the EU market duty free from 2009.

Needless to say, these are not the only significant changes occurring in agricultural and trade policies throughout the world. For instance, the Farm Security Act adopted by the US in 2002 should certainly be mentioned (Westcott, Young and Price, 2002). However, the measures included in that policy package are difficult to deal with in a model like the one used here, given that they mostly imply changes in payments which are mostly independent from resource allocation among economic activities, though they may affect farmers' behaviour through their attitude toward risk.

For the many other countries explicitly included in the exercise, there appears to be no evidence over the last few years of major shifts in agricultural trade and policy regimes worth considering in a global setting like the one proposed (FAO, 2003).

The 2013 baseline was constructed of three separate steps, in order to avoid conflicting instructions in shocking exogenous variables. A first step was required to update exogenous variables to year 2003,

and to implement the Agenda 2000 CAP reform. The next step modelled EU enlargement to the CEECs, and other exogenous variables were updated to year 2013. Finally, a third step applied a final set of shocks aimed at representing the MTR of the CAP reform, and the EBA agreement.

Several papers have recently introduced changes in the basic GTAP model aimed at improving policy representation, with special reference to the CAP (Bach *et al*, 2000; Frandsen and Jensen, 2001; Brockmeier *et al.*, 2001; van Meijl and van Tongeren, 2002). The policy specification adopted here partly draws on these contributions (Table 2).

The CAP direct payments are modelled as *ad valorem* subsidies to factor use, particularly on land use for cereals and oilseeds, and on capital use for livestock. The level of such payments can be reduced if actual cultivation exceeds a reference ("base") area, and if the livestock inventory exceeds a maximum reference size.

In fact, there is a financial stabilization mechanism aimed at discouraging farmers from over investing in the activities for which the payments are granted, and at limiting the effects of such subsidies in terms of market distortion. In order to introduce such a mechanism into the model, we added a condition by which the expenditure in each crop specific payment is exogenously fixed to the level of the base period, while the unit (*ad valorem*) subsidy is endogenously adjusted on the basis of the changes in output. Moreover, since payments are determined in nominal terms, they were deflated at a 2 percent per year rate, in order to take into account their reduction in real terms.

Concerning intervention prices, their changes for rice, cereals, and dairy products were approximated through changes in the corresponding import taxes. Land set-aside programs, instead, were not considered, as they did not change significantly after 1997. For dairy products, output quotas were modelled by setting production exogenously at the level of the base period, and checking after each step undertaken in building the 2013 baseline, that this limit was effectively binding.[2] This simplified modelling captures one of the main objectives of this measure in the EU – preventing output growth – while it disregards the presence of the rent accruing to producers.

The EU enlargement included the removal of all import tariffs between the EU and the CEECs, and the alignment of all export, output and input subsidies and taxes reported in the database. Concerning the extension of direct payments, previous work on this topic showed that the financial provision set by the European Council in November 2002 – i.e. EUR5.8 billion for the CEECs within the EUR 36 billion total budget for the whole EU 25 – were sufficient to ensure in the new member countries an average level of direct payment comparable in percentage terms to the one granted in the current member states (Conforti *et al.*, 2003). On this basis, in building the 2013 baseline, direct payments expressed *as valorem* subsidies on factor use were simply extended to the CEECs, checking, after each step, that this would not generate increases in real expenditure.[3]

Some basic elements of the MTR of the CAP were also considered in the construction of the 2013 baseline. Given the model's characteristics, of this reform package it was possible to consider the decoupling of direct payments, i.e. their switch to non-crop-specific payments, and the change in the support to EU rice producers. Particularly, the shocks introduced refer to:

- the 50 percent reduction of intervention price of rice, which was implemented as shown in Table 2;
- the increase in direct payments to rice producers, from 63 EUR/hectare to 177 EUR/hectare;
- the decoupling of direct payments granted to cereals, oilseeds and bovine meat producers.

This last measure, which is considered the most important among those introduced by the MTR, was represented in the model through a homogeneous subsidy to land use, captured by an additional variable, whose level is determined endogenously on the basis of the expenditure arising in the

[2] This prevents the quota from acting as a minimum rather than a maximum constraint on output.

[3] It is worth recalling that at its November 2002 meeting in Brussels, the European Council decided that the overall expenditure for direct payments should not grow in nominal terms more than 1 percent per year until year 2013; this provision was assumed to correspond to zero growth of the expenditure in real terms.

baseline from the granting of crop-specific subsidies. Such subsidies are eliminated, while the expenditure that they generate in the baseline is transformed into a homogeneous subsidy to land employed solely in agricultural activities.

Moreover, given that the Commission has left member countries room to decide the extent to which some particular payments have to be de-coupled, it was assumed that

- 75 percent of payments to cereals and oilseeds were de-coupled;
- 100 percent of the beef slaughtering premium - modelled as an output subsidy - was de-coupled, and
- 75 percent of the other premiums to beef production – modelled as input subsidies – were de-coupled.

This approximation of the measures included in the CAP MTR does not take into account several important parts of this reform, particularly the modulation of direct payments, the environmental cross compliance elements introduced, and the provision for rural development. The reason for this choice is that any meaningful modelling of such measures is logically incompatible with the representative agent assumption of the GTAP model, as all of them require some differentiation among different types of farmers (Al Mekki *et al.*, 2000).

Given the intricacies of the CAP, the modelling of its instruments which is proposed here is simplified in many respects; there are three main limitations that are worth highlighting. Firstly, the modelling of changes in intervention prices assumes a one-to-one transmission of such changes on market prices. As has been shown in more than one case (van Meijl and van Tongeren, 2002) this simplification may overstate the effect of lowering intervention prices. The second is the mentioned lack of consideration of the rent generated by production quotas, particularly in the dairy sector. Thirdly, the impossibility of accounting for the exclusion of land employed for the cultivation of fruits from among those on which the decoupled payment can be claimed.

Finally, the last element required to build the 2013 baseline is the EBA agreement, which is simply introduced as the elimination of import tariffs on all products exported by the LDCs into the EU and the CEECs.

4 THE DOHA AGENDA AND THE TRADE POLICY REFORM SCENARIOS

The purpose of this section is to outline the status of WTO agricultural negotiations on market access and the scenarios that are going to be simulated. The most recent Ministerial meeting of the WTO was held at Cancun in Mexico in September 2003. That meeting was brought to a close without an agreement being reached on moving forward the Doha round of trade negotiations.

Prior to the Cancun meeting, the previous WTO ministerial level meeting was held in Doha, Qatar, in 2001. At that meeting, WTO members agreed to launch a new round of trade negotiations, encompassing the agricultural negotiations already started in 2000 according to the so-called built-in agenda. One of the key elements of the Doha round, then, is the reform of agriculture in each of the three main areas of the negotiations: market access; export competition; and domestic support. The agricultural sector, as a matter of fact, has higher tariffs on average than any other sector and it is the only sector for which the WTO rules permit the use of export subsidies.

Negotiators missed the 31 March 2003 deadline for producing “modalities” (i.e., numerical targets and formulas) for countries’ commitments. A number of proposals dealing with the main points of the negotiations were submitted and discussed between 2001 and 2003. We focus on the three main issues under negotiation separately, and particularly on the two main components of our simulation scenarios: market access and export competition. Even if domestic support has been so far one of the most contentious issues, it does not seem likely that the US and the EU will be willing to accept an agreement that would disrupt the ongoing process towards the “decoupling” of agricultural support. Moreover, there is some evidence that substantial trade expansion and welfare gains can be achieved, even when domestic support is excluded from the multilateral agreement. Rae and Strutt (2003), for instance, use the GTAP applied general equilibrium model to quantify and analyse a number of trade

reform scenarios, with and without specific changes in domestic support, concluding that improved market access makes a far greater contribution to welfare gains than do reforms to domestic policies.

The Doha mandate calls for "reductions of, with a view to phasing out all forms of export subsidies". As is well-known, the EU is the largest user of export subsidies in both value and volume terms. According to WTO notifications, the EU accounts for about 90 percent of total expenditure. It is not surprising, then, that the EU has been supporting the right to use this policy instrument, though accepting further reduction commitments in terms of value or volume constraints. Several countries, on the other hand, argue that export subsidies should be eliminated.

The Doha mandate commits WTO members to "substantially improve market access". Two major approaches have emerged for tariff reductions in general. One would copy the formula of the URAA, which used an average reduction over all products, allowing some variations for individual products provided a minimum reduction was met. The fundamental problem with this approach is that it provides no reward for cutting a high tariff rather than a low one, and hence allows policymakers to avoid dealing with tariff peaks and escalation.

The other approach envisages "non-linear" reductions on higher tariffs, for example using a "Swiss formula"[4] or similar, which would produce much steeper cuts on higher tariffs and would also have the effect of establishing a maximum tariff level. Critics say this would be too complicated, because it would require converting specific tariffs into *ad valorem* tariffs. Supporters say a Swiss formula or something similar is needed in order to deal with extra tariffs ("tariff peaks"), and to narrow the gaps between tariffs on finished products and raw materials ("tariff escalation").

We focus on two liberalization scenarios, which may be summarized as follows:

1. *Uruguay Round-bis ("weak liberalization")*. Starting from the final bound tariffs in year 2001, each tariff line is reduced by the same percentage it was reduced following the implementation of the Uruguay Round Agreement: $t_i^{new} = t_i^{2001} * (t_i^{2001} / t_i^{1995})$. This implies that each tariff line is reduced at least by 15 percent and a non-weighted average reduction around 36 percent. For those countries (EU, US, Canada, Japan, Australia, and New Zealand) for which detailed tariff data were available through the AMAD, we assume that governments would follow the same pattern of cut allocations as they did in the previous round.

   In most cases countries would reduce tariffs by only a small percentage on certain specific commodities. This is the case, for example, for olive oil, sugar, wine, selected fruits and vegetables in the EU, and sugar and dairy products in the US. Larger reductions would be concentrated on products with small tariffs, or on tropical products. Similar selectivity is evidenced in the US with large decreases in initial small tariffs. Overall, we aggregate the detailed tariff changes (at the 6 or 8-digit level of the Harmonized System classification) up to GTAP product aggregates considered in our application through simple averages. As far as the other countries are concerned, we implemented a uniform reduction of 36 percent in the case of the Republic of Korea, and 24 percent in the case of the other countries in order to take into account the possibility of a special and differential treatment for developing countries.

   In terms of export subsidies, we focus on expenditure reduction commitments, since in most cases the value constraint turned out to be the binding one in the implementation of the URAA. Specifically, it is assumed that subsidy expenditure must be reduced by 45 percent with respect to the baseline.

2. *Swiss formula - no export subsidies ("strong liberalization")*. This version of the "Swiss formula" would cut high tariffs more than low tariffs, ensuring no individual tariff exceeds 25 percent after the implementation period. We apply the proposed formula to the bound tariffs in

[4] The Swiss formula was first proposed by Switzerland in the Tokyo Round negotiations in the 1970s, and was used for negotiations on industrial tariffs.

year 2001, assuming that specific tariffs were transformed into *ad valorem* ones: $t_i^{new} = (0.25 * t_i^{1995}) / (0.25 + t_i^{1995})$.

For purposes of calculation, we converted specific tariffs into *ad valorem* equivalents, adopting the following conventions:[5]

- specific tariffs were converted into *ad valorem* equivalents by using the 1995 unit values of imports;
- for those commodities that were not imported, the 1995-98 unit values of (extra-EU) exports were used as proxies;
- when the tariff line mentioned a threshold (i.e. minimum tariffs or maximum tariffs), the highest possible tariff was considered.

Also in this case, we aggregate the detailed tariff changes for the countries (EU, US, Canada, Japan, Australia, and New Zealand) for which detailed tariff data were available up to GTAP product aggregates considered in our application through simple averages. As far as the other countries are concerned, there is no special and differential treatment for developing countries and the formula is applied to the tariff rates included in the GTAP database. In this scenario, export subsidies are abolished.

5 SIMULATION RESULTS

5.1 Scenario results for individual countries and regions

Overall, the results confirm the notion that the degree of tariff and export subsidy reduction in agricultural products is positively related to the potential gains in terms of economic welfare. As a matter of fact, the more tariff reduction scenarios imply substantial cuts, the more market price changes reflect comparative advantages.

Geographically, the simulations show that trade policy reform would imply mostly market prices decreases in Europe, in the major economies of Asia, in the Mediterranean region, and in Sub Saharan Africa; whereas in Oceania, and throughout North, Central and South America, market prices would generally increase.

Most price changes appear small in size; in the "weak" reform scenario most of them range up to a maximum of 3 percent, with few exceptions reaching 15 percent as a maximum; and in the "strong" scenario, most price changes do not exceed 5 percent, while in very few cases they reach 30 percent as a maximum.[6]

Switching from the "weak" to the "strong" scenario, and from this to the "free trade" scenario, does not alter the signs of the price changes, with the one exception of Mozambique, for which marginal increases arising under the "weak" reform scenarios turn into a widespread decrease under the "strong" and the "free trade" scenarios.

Considering specific countries, under the "strong" reform scenario prices would increase in Australia, New Zealand and Thailand (Figure 1) especially for dairy products, sugar and cereals in the first two cases, while paddy and processed rice prices would show the relatively higher increase in the case of

[5] The methodology used here differs significantly from those computed by other authors like Gibson et al. (2001), even though we use the same initial tariff data, i.e., the WTO schedules. The main difference lies in the convention for converting specific tariffs into *ad valorem* equivalents. We use a four-year average of unit values of either imports or exports (when imports are small or non-existent) at the 8-digit level, while Gibson et al. (2001) use world prices at a more aggregated level. We believe that with our computation criterion, we minimize the risk of constructing artificial tariff peaks.

[6] The detailed price results are reported in Tables A1 to A3 in the Appendix. Further details on the result can be obtained from the authors upon request.

Thailand. In Asia, both India and China would experience price changes under the "strong" scenario up to a maximum of 8 percent for the first of these two countries, in the case of vegetable oils (Figure 2); for these products, the database reports a high tariff, particularly on imports from Brazil and Argentina, that is significantly reduced in the simulations. Prices would also decrease in Bangladesh and Pakistan – the latter is by far the most important component of the "Rest of South Asia" region – reflecting mainly the reduction of high import tariffs.

For the US, Canada, and Central America prices show mostly an increase under the reform scenarios, and especially for cereals, sugar, and rice, but also for fruits and vegetables. This does not apply to dairy products for Canada, or to sugar in the case of the US (Figure 3). Agricultural prices would decrease significantly in Mexico, especially for cereals, while most of the rest of Latin America would experience significant price increases, particularly Uruguay for dairy, livestock and cereals production; together with Argentina and Brazil, especially for oilseeds (Figure 4).

Prices are generally decreasing in Europe and in the Russian Federation (Figure 5), despite the reduction in support brought about by the CAP reform process that was taken into account in the construction of the baseline. The enlarged EU would experience substantial price reductions, especially for cereals, rice and oilseeds, and their size would be even greater for the CEECs compared to the EU-15, given the higher supply and demand response of this area. The Russian Federation - for which scenarios do not imply trade reform since the country is not a member of the WTO - would only show marginal price decreases.

In the Mediterranean region, Turkey is an exception to the general behaviour, showing a marginal increase in agricultural prices, as opposed to Morocco and the "Rest of the Middle East" region, showing a decrease (Figure 6). This is due to the tariff structure reported in the database, which presents higher tariffs for the aggregated region of the "rest of the Middle East", especially for dairy products, fruits and vegetable, cereals, and livestock, while they are comparatively lower in Turkey, especially for the latter two products.

In Africa, agricultural prices mostly show a decrease under the trade reform scenarios, especially in the Sub-Saharan region (Figure 7); in the South, Zimbabwe and Malawi would experience price increases, especially for sugar, cereals, oilseeds and dairy, while all prices would diminish in the rest of the region (Figure 8). For South Africa price changes are more mixed, with marginal increases for fruits and vegetables and sugar crops, and substantial decreases for vegetable oils, and dairy products.

An interesting result is also the change that would materialize in the real returns to land, a primary factor which the model assumes to be employed exclusively in agriculture. Evidence is generally consistent with the observed behaviour of agricultural prices, and percentage changes increase with the extent of tariff and export subsidies reductions (Figure 9). Negative changes are spread across Europe, the Middle East and Asia, as shown for EU-15, the CEECs, Japan, the Republic of Korea, Taiwan, Indonesia, and China, while positive outcomes would follow, among the others, for Turkey, Thailand, Singapore and the Philippines. For many of these countries this is the direct consequence of the reduction in border protection. An opposite outcome arises for the Americas, with the exception of Mexico, and for Australia and New Zealand. Across Africa, land returns increase for some of the least developed countries (LDCs), such as Malawi, the United Republic of Tanzania and Mozambique, together with Zimbabwe, and the Southern African Customs Union (SACU) (Figure 9).

The real returns to labour, instead, appear less directly related to agriculture, and show significant increases also in many of those countries in which agricultural prices and agricultural supply decrease after the reduction hypothesised in border protection. Improved resource allocation, following from reducing import tariffs and export subsidies, drives up the remuneration of this primary factor, both where the economy was more distorted by policies in the baseline, and in the countries benefiting from improved world price conditions. Therefore, with very few exceptions changes are substantial in most countries (Figure 10), and especially in Japan and the Republic of Korea, but also in the Mediterranean regions and across Africa.

In order to understand changes in trade patterns following from policy reform, it is useful to look at the changes in the total terms of trade faced by each country and region. Simulations indicate that the major agricultural economies around the world would be those experiencing the more substantial

improvements, and that such improvements are positively related to the extent of policy reform. Therefore, Australia and New Zealand together with South American countries would see major improvements in their terms of trade (Figure 11). At the same time, changes in this variable are not so significant for some of the major industrialized economies, like the US, Canada, and the EU, due to the smaller relative importance of agricultural trade in total trade, that dampens both positive and negative effects. This same difference in weight also explains why the effect on total terms of trade is so negative for some countries and regions – like the Middle Eastern and some African countries – in which agricultural trade is a substantial portion of total trade.

Coming to actual changes in trade flows, for the major product groups these reflect the comparative advantages of the major producers, and appear consistent with the observed changes in market prices. Therefore, for cereals (excluding rice), trade liberalization would bring about improvements in the export positions of Australia, Canada, and Argentina, while the US would experience a decrease in its net exporter position (Figure 12). Under the "strong" reform scenario, China would become a net importer of cereals, whereas the country would only import marginal amounts under the "weak" one. Japan and the Republic of Korea would slightly increase their net importing position, especially under the "strong" reform scenarios.

The EU-15, which appears as a marginal net importer of cereals in the baseline – as is reasonable given the reforms introduced in the construction of the baseline – would substantially increase such a net position, while the CEECs would no longer be a net exporter. Among other countries, an increase of cereals imports would take place in the "rest of the Middle East", while a small decrease would take place in imports to India and SACU (Figure 12).

For oilseeds, the simulation of a more liberalized trade environment implies a substantive increase of exports from Argentina, Brazil and Canada, with changes positively related to the extent of liberalization, and an increase in imports into China, while other countries would show minor changes (Figure 13). The situation for vegetable oils is somewhat similar, although Indonesia and Malaysia come into the picture as major exporters and potential beneficiaries of trade reform – given their prominent role in palm oil and palm kernel oil production – while imports would increase especially into India, and the Middle East (Figure 14).

Substantial changes would take place in the trade pattern of processed sugar, particularly due to the large increase in exports from Latin America and Caribbean, from Brazil, and from Thailand and the Philippines (Figure 15). This would correspond, under all scenarios, to a substantial increase of imports into the EU-15 and the US. Competition from these countries would to some extent displace exports from the whole of Southern Africa, with the exception of Zimbabwe, and also from the CEECs and Canada (Figure 15).

For paddy rice, China, Thailand, India and the US would significantly improve their net exporting positions, and minor improvements would also take place in those of Uruguay and Argentina, while imports would increase especially into the EU, Japan, Brazil, and Central America (Figure 16), whereas the Middle East would import slightly less. Processed rice trade shows a somehow similar pattern for Thailand, India, the US and the EU-15, while China appears as a net importer in this market, and its purchases would also increase substantially with trade reform (Figure 17).

The Equivalent Variation (EV) associated in each county with the simulation scenarios as a measure of welfare change was considered here both as total variation, and in its components arising from the changes in the terms of trade and resources allocation, following the decomposition proposed by Huff and Hertel (2000). As anticipated, total potential benefits are increasing with the extent of the reform; as an order of magnitude, they range from 0.04 percent of world GDP of the "weak" policy reform scenario, to the 0.08 percent of the "strong" reform scenario, up to the 0.12 percent of world GDP in the free trade scenario.[7]

Looking at individual countries (Table 3), there are few negative signs, more frequent in Africa, in the Middle East, and in Latin America. With the exception of the "rest of the North Africa" and of

[7] The GDP employed in this comparison is the one reported in the GTAP database.

Australia, economic welfare decreases are always arising from the changes in terms of trade, outweighing that of improved resource allocation; in other words, although import tariffs and export subsidy reductions bring about in virtually all countries an improvement in resource allocation, changes in relative prices put at a disadvantage several economies, which would finally be worse off than in the baseline.[8]

The changes in the terms of trade shown before, appear as a direct consequence of a more competitive international environment, in which comparative advantages in the different agricultural production sectors play an increased role in shaping agricultural trade and prices. This being the case, losses may easily arise in countries with less diversified economies, where there are fewer possibilities of recovering international competitiveness in different production sectors when the support to those activities which are now protected is reduced. In other words, this result tells that relatively poor economies may have less comparative advantages to resort to if protection is reduced in agriculture, as they have fewer activities other than their present agricultural sectors.

Along the same lines, the grouping of countries shows that the LDCs are those less likely to benefit from trade liberalization; this supports the notion that these countries may require *ad hoc* measures to counteract potential losses. The same applies also to many of the Net Food-Importing Developing Countries (NFIDCs), in which, however there may be substantial gains in individual countries, together with a net aggregated benefit.[9] At the opposite extreme, OECD countries are those for which benefits for individual economies may be more substantial, together with the Cairns group.[10] The proxy adopted for the G-20 shows this also as a group of potential beneficiaries, with the single exception of Venezuela, for which a marginal loss is reported; therefore, this country aggregation seems to make sense from the point of view of the negotiations.

5.2 A game approach to the negotiation

In this subsection, countries are grouped into two broad entities – the developed and the developing countries – and the results of model simulations are employed to study the interactions between their respective possible strategies on the basis of game theory, and to search for mutually advantageous agreements to be compared with actual agreement hypotheses in the negotiations.

Formal representations of games are defined over a set of players, a set of strategies available to each player, and a vector of functions which map the strategies of players into a payoff for every player. We employ a two-player, normal-form, non-cooperative game nested in the model described in section 2. Our scope is limited to a single period game within which we search for the presence of a Nash equilibrium and the strategy space of possible agreements.

In the situation where two main (groups of) countries negotiate with one another, no agreement will be reached or kept unless both (groups of) countries are made at least as well off as they were prior to the agreement. Strategies satisfying the previous condition are called "agreement actions". Apparently, in order to achieve an agreement in which both countries are made at least as well off as prior to negotiations, the settlement must lie within the agreement action space, i.e. the set of all agreement actions (Kennedy, von Witzke and Roe, 1996). More in general, the successful resolution of trade negotiations requires that: (1) there must exist at least one strategy which leads to values of the payoffs

[8] In both Australia and North Africa, the negative welfare effects on resource allocation arise from the presence of (small) output subsidies reported in the database for some agricultural products, and for secondary sectors (in North Africa) and services (in Australia), whose negative welfare effect increases as prices change after the reduction in border protection.

[9] Particular caution should be applied in considering this evidence, since the accuracy in representing the group is particularly poor: Central America and the Caribbean is included as a single region, as is the "rest of North Africa".

[10] Also for this group, representation in the database is very poor, as many individual participants are not available as individual countries.

which are greater than their values at the status quo; (2) if many such strategies exist, then negotiations must ensure that just one is chosen; and (3) there must be no incentive to deviate from the terms of the agreement (Johnson, Mahé and Roe, 1990).

The policy strategies analysed are the two liberalization scenarios described in section 4, plus the agricultural free trade scenario. Each player *i* has strategy choices which are:

- the status quo of the baseline (*sq*);
- the "weak" liberalization scenario described in the previous section (*w*);
- the "strong" liberalization scenario described in the previous section (*s*);
- the "free trade" in all agricultural commodities (*ft*).

Let $S_i = \left(a_i^{sq}, a_i^{w}, a_i^{s}, a_i^{ft}\right)$ represent the set of all possible strategies, which can be employed by agent *i*. Each player *i* chooses some strategy $a_i \in S_i$ in order to maximise its payoff given the strategy of the other. A similar set of strategies, S_{i+}, exists for the other main player (denoted by *i*+). In modelling the negotiating process of interdependent (groups of) countries, a Nash equilibrium occurs where each country (or group of countries) chooses policies that maximise its (their) EV, given the policy choice of the other (group). This equilibrium is defined using a best response correspondence. For a given a_{i+}, government i chooses a_i^*, one possible best response to a_{i+}, such that $EV_i\left(a_i^*, a_{i+}\right) \geq EV_i\left(a_i, a_{i+}\right)$, for all $a_i \in S_i$. A Nash equilibrium is defined as the set of strategies (a_i^*, a_{i+}^*) where a_i^* is a best response of a_{i+}^* for country (or group) *i*, and a_{i+}^* is a best response to a_i^* for country *i*+.

We model national governments as if they focus on domestic welfare. The payoffs, as a matter of fact, are money metric measures of utility change from a base period. Our procedure is to solve the world trade model for different trade liberalization scenarios. The model allows EVs attributed to various policy scenarios to be computed. The difference in EVs under alternative scenarios versus those in the baseline are used to determine the amount of money available for compensation across countries.

The EV functions reflect changes in producer and consumer welfare and budget savings from policy changes. The base solution to the non-cooperative game is presented in Table 4.

By inspection, in Table 4 there are two possible equilibria: the combinations (a_{DC}^{s} and a_{DG}^{ft}) and (a_{DG}^{s} and a_{DC}^{ft}). However, free trade by developing countries (DGs) and strong liberalization by developed countries (DCs) stands out as the compelling solution to the game, since both groups would get higher benefits; therefore this is the unique Nash equilibrium. The fact that all the results are positive implies that within each group it is possible to make each country no worse off than in the status quo. Consequently, all strategies lie within the agreement action space.

Both the possible equilibrium points correspond to asymmetric strategies, in which the group that liberalize less gains more: each groups benefits more if it maintains some tariffs, however up to a 25 percent maximum, while the other drops all trade policy measures. However, the highest payoff is obtained when DGs liberalize more than DCs, which is exactly the opposite of the notion of special and differential treatment.

Since we are dealing with two large groups of countries, the EV results incorporate the provision of inter-country compensatory payments. Without compensations, as a matter of fact, the agreement action space would be empty, since there are always some DGs which are worse off (the number of countries/regions presenting negative results is shown in brackets). Inter-country compensation, when required, is given up to the point where the compensating country's EV declines or the compensated country's EV increases to status quo levels, whichever comes first. Although the game defined here involves, at least in principle, monetary compensation for trade liberalization, in practice

compensations might involve other forms, such as the preferential reduction (within each group) of trade obstacles in sectors different from agriculture.

The previous game shows that both groups of countries are willing to reduce trade protection, although complete free trade is not achieved by DCs. Looking at the payoff matrices for some of the most relevant actors in the negotiations (3 from the DCs group – US, EU-25, and Japan – and 3 from the DGs group – Brazil, India, and China), Table 5 shows the ranking of the strategies in terms of the welfare results. We focus on those strategies that can be ranked unambiguously, because there is no belief that a player could hold (about the strategies the other group may choose) such that it would change the ordering. The rankings confirm that most of these countries would choose the two possible Nash equilibria strategies (*free trade* and *strong liberalization*) without the need of any compensation. The only exception is the US, which would prefer to maintain agricultural trade policies at their present levels.

Apparently, these results are not consistent with the actual negotiating positions. In the case of the US, the results are driven by the fact that allocative efficiency gains from trade liberalization are not very high, given the rather low levels of present trade barriers. On the other hand, they could reap the benefits of the improvement in the terms of trade, if the other (developing) countries accepted to liberalize unilaterally.

As far as the other countries are concerned, if this game were realistic, one would expect an agreement in the present negotiations to be reached much more easily than is actually the case. The difficulty of obtaining an agreement during the Cancun Ministerial Conference provides a confirmation that economic efficiency is not the (only) criterion motivating government behaviour. The game played in the present trade negotiations, then, cannot be explained only on the basis of classical welfare analysis which would predict the implementation of free trade and/or strong liberalization strategies due to efficiency gains.

In fact, the more realistic and sophisticated analyses of trade negotiations do not assume (any more) that governments care only about aggregate social welfare, but allow them to be concerned with any number of internal or political-economy objectives. The conventional neoclassical trade analysis where alternative trade compromises are based on net social welfare gains in each country is almost surely inconsistent with the balance of political power within the countries.

Policy alternatives that are politically acceptable are typically a small or null subset of those that lead to Pareto superior outcomes. It would be useful, then, to narrow the policy set to the reforms that seems politically acceptable: trade compromises that are politically feasible need to be identified from the larger set of compromises that merely save resources.

6 CONCLUDING REMARKS

The analysis proposed in this paper is based on a baseline referred to year 2013. We attempted to build a "realistic" setting, allowing insulation of the effects of trade liberalization from those of the other major policy changes which are affecting and will affect world markets within the time horizon of the supposed implementation of any agreement eventually reached in the Doha Round. Results are consistent with economists' expectations about the effects of a reduction in border protection, and for many countries confirm the notion that liberalization is positively related to the overall potential economic benefits that should arise from the increased role played by comparative advantages in shaping market prices and returns to primary factors.

The geography of the possible effects shows that most countries throughout Europe, the Americas and Asia may finally gain from improving their resource allocation after agricultural tariffs and export subsidies reductions by changing their agricultural production mix, or by moving labour and capital outside the primary sector. The same, however, does not apply to a number of African, Southern Asian, and (few) Latin American countries, whose possibilities to benefit from incentives toward relocating resources inside and outside agriculture are limited by the extent and the diversification of the economy; and whose terms of trade may deteriorate in a more liberalized environment.

The analysis of the interaction between the strategies of the two main country groups - developed and developing countries – definitely shows that there seems to be no reason, from an economic point of view, for confrontation within the multilateral negotiations of the Doha round: in terms of expected total economic benefits, free trade or "strong" trade liberalization would be the dominant strategy for both groups. At the same time, this result highlights the extent to which the analyses that assume a "neutral" government are ineffective for understanding countries' behaviour in the negotiations. Apparently, there are other variables that explain governments' behaviour, such as sensitivity to agricultural lobbies, and the attempts to maintain long standing protection.

The general equilibrium approach adopted here highlighted the difficulties for poorer and the less diversified economies to capture the opportunities arising from a more liberal trade environment. Potential losses arising from changes in the terms of trade for some of the more fragile economies considered here, imply the presence in these countries of far more limited possibilities to switch toward competitive activities. As mentioned, this calls for *ad hoc* measures to counteract negative effects for these countries, although such measures should be designed in such a way as to minimize interference with ongoing efforts toward increasing the ability of such economies to exploit the opportunities arising from the more liberalized world trade environment; therefore their design is not straightforward, and should most probably not be based on simple border protection.

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FIGURES

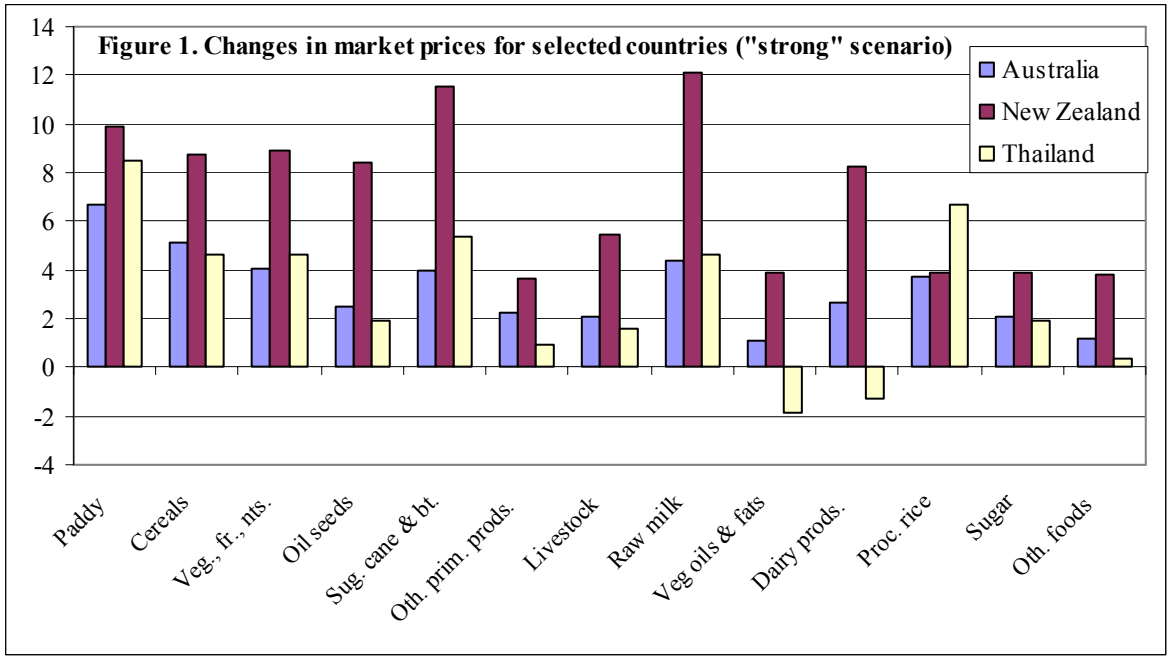
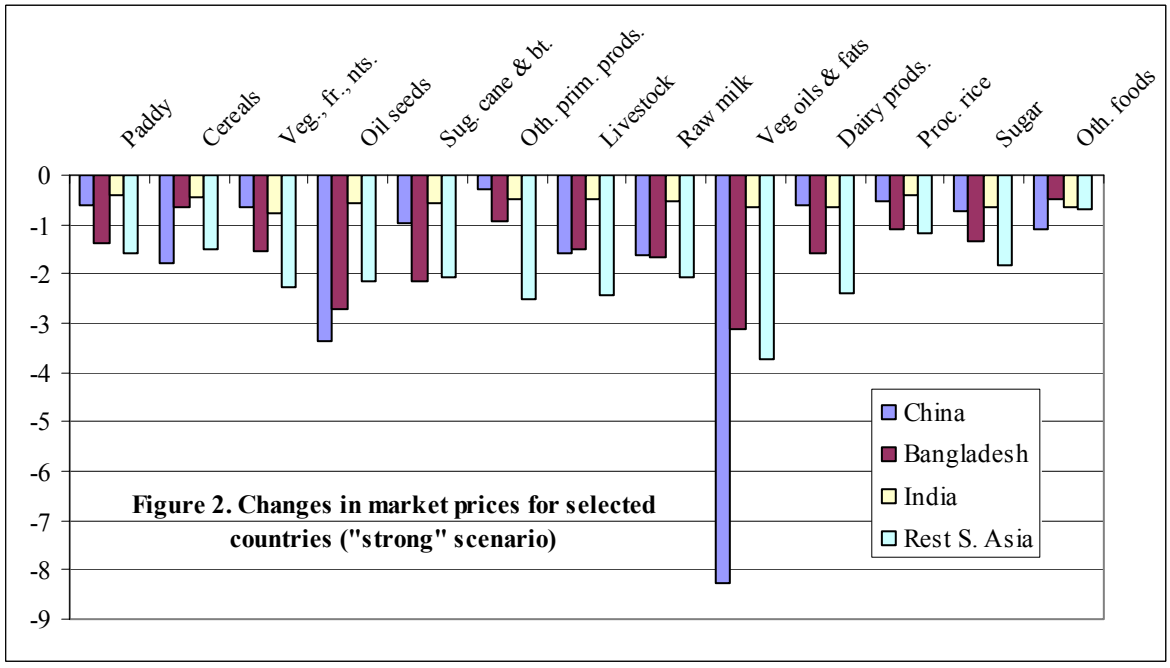


Figure 1. Changes in market prices for selected countries ("strong" scenario)
Australia
New Zealand
Thailand
14
12
10
8
6
4
2
0
-2
-4
Paddy
Cereals
Veg., fr., nts.
Oil seeds
Sug. cane & bt.
Oth. prim. prods.
Livestock
Raw milk
Veg oils & fats
Dairy prods.
Proc. rice
Sugar
Oth. foods


Paddy
Cereals
Veg., fr., nts.
Oil seeds
Sug. cane & bt.
Oth. prim. prods.
Livestock
Raw milk
Veg oils & fats
Dairy prods.
Proc. rice
Sugar
Oth. foods
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
China
Bangladesh
India
Rest S. Asia
Figure 2. Changes in market prices for selected countries ("strong" scenario)

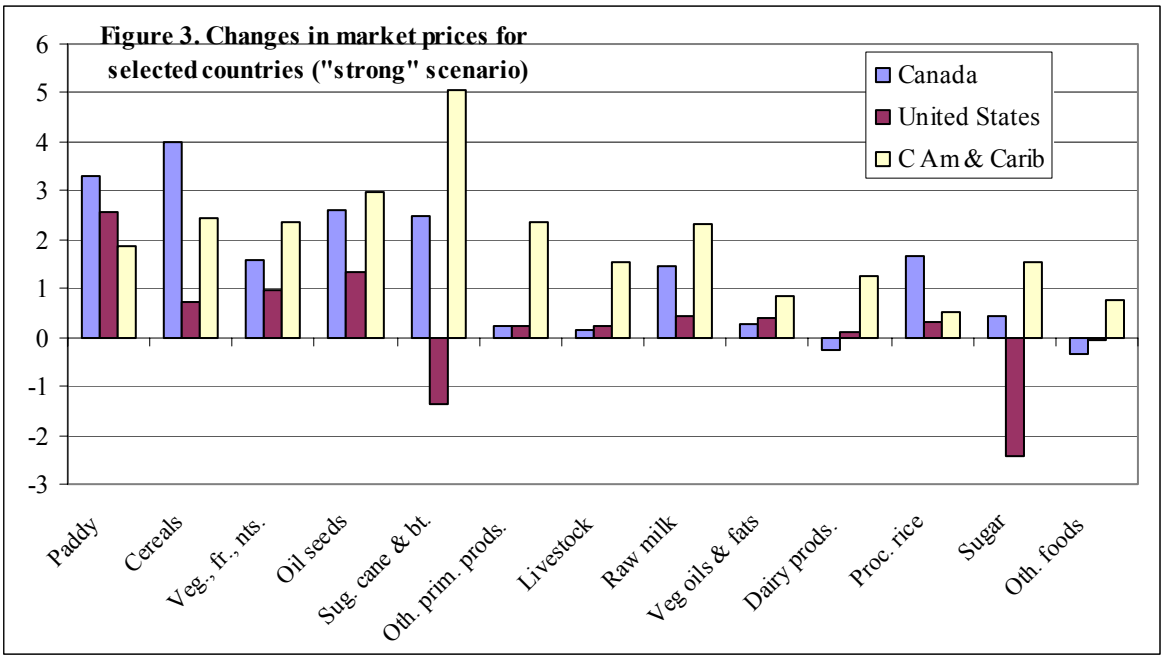


Figure 3. Changes in market prices for selected countries ("strong" scenario)
Canada
United States
C Am & Carib
6
5
4
3
2
1
0
-1
-2
-3
Paddy
Cereals
Veg., fr., nts.
Oil seeds
Sug. cane & bt.
Oth. prim. prods.
Livestock
Raw milk
Veg oils & fats
Dairy prods.
Proc. rice
Sugar
Oth. foods

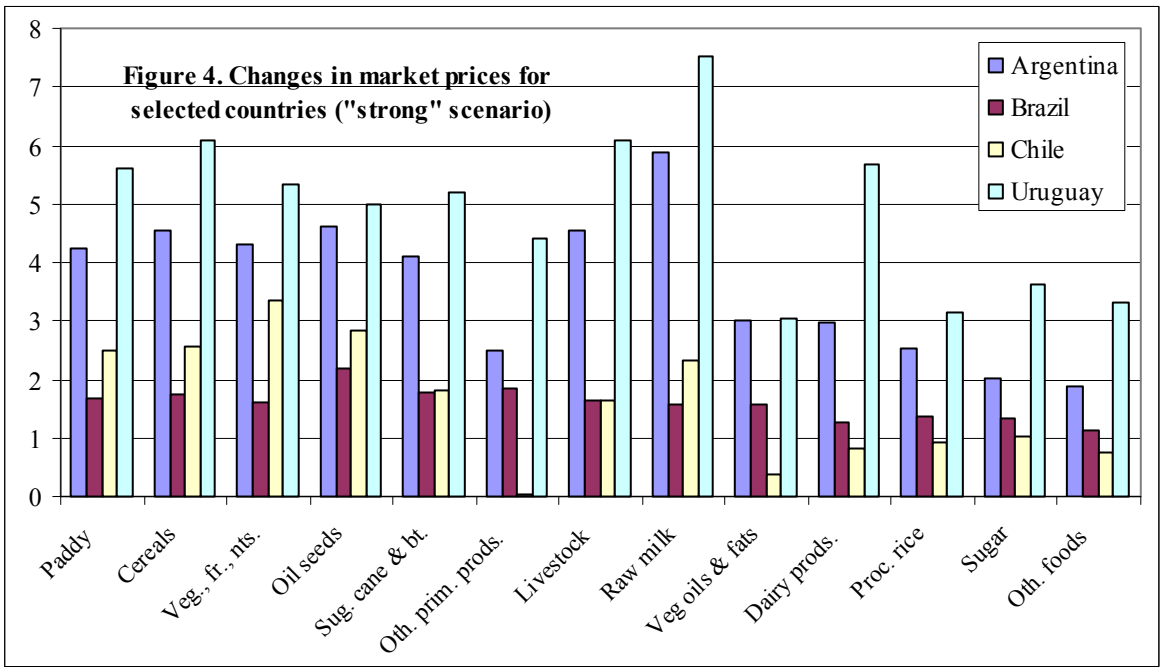


Figure 4. Changes in market prices for selected countries ("strong" scenario)
Argentina
Brazil
Chile
Uruguay
8
7
6
5
4
3
2
1
0
Paddy
Cereals
Veg., fr., nts.
Oil seeds
Sug. cane & bt.
Oth. prim. prods.
Livestock
Raw milk
Veg oils & fats
Dairy prods.
Proc. rice
Sugar
Oth. foods

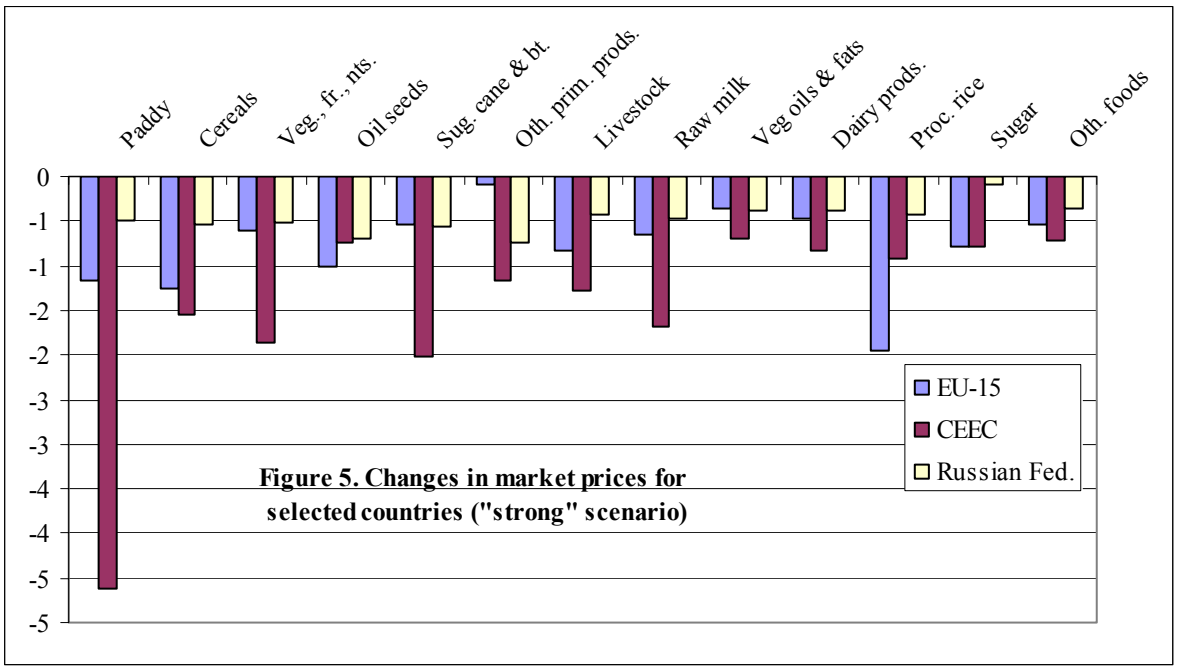


Figure 5. Changes in market prices for selected countries ("strong" scenario)

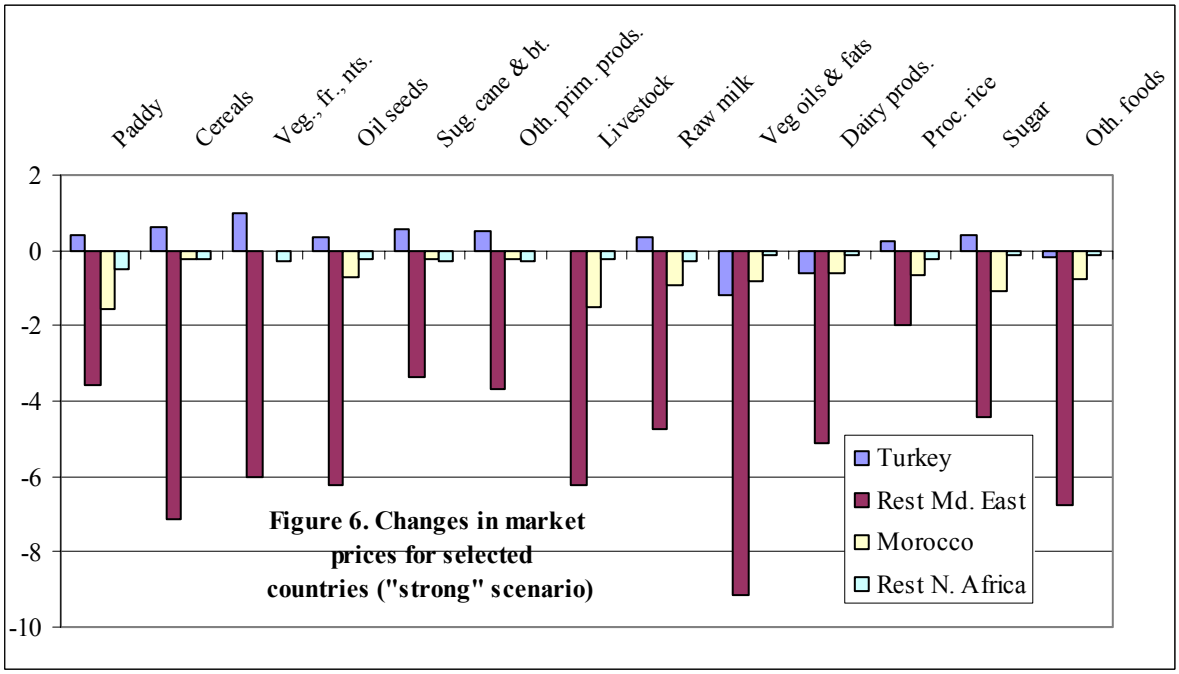


Figure 6. Changes in market prices for selected countries ("strong" scenario)

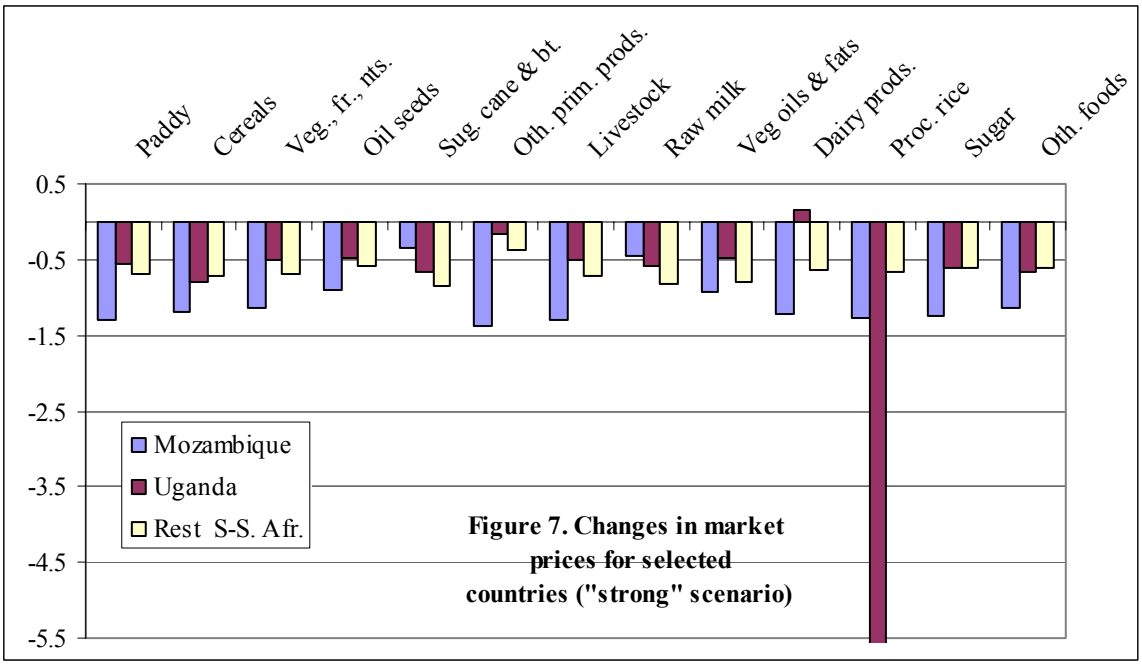


Figure 7. Changes in market prices for selected countries ("strong" scenario)

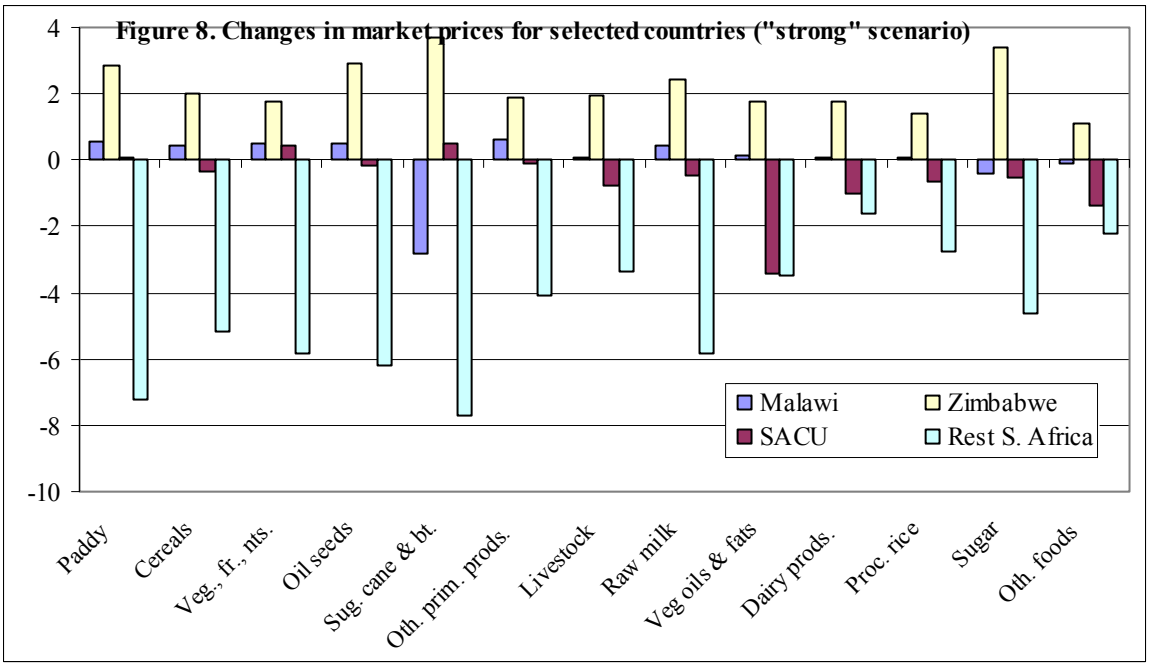


Figure 8. Changes in market prices for selected countries ("strong" scenario)

Figure 9. Percentage change in real return to land

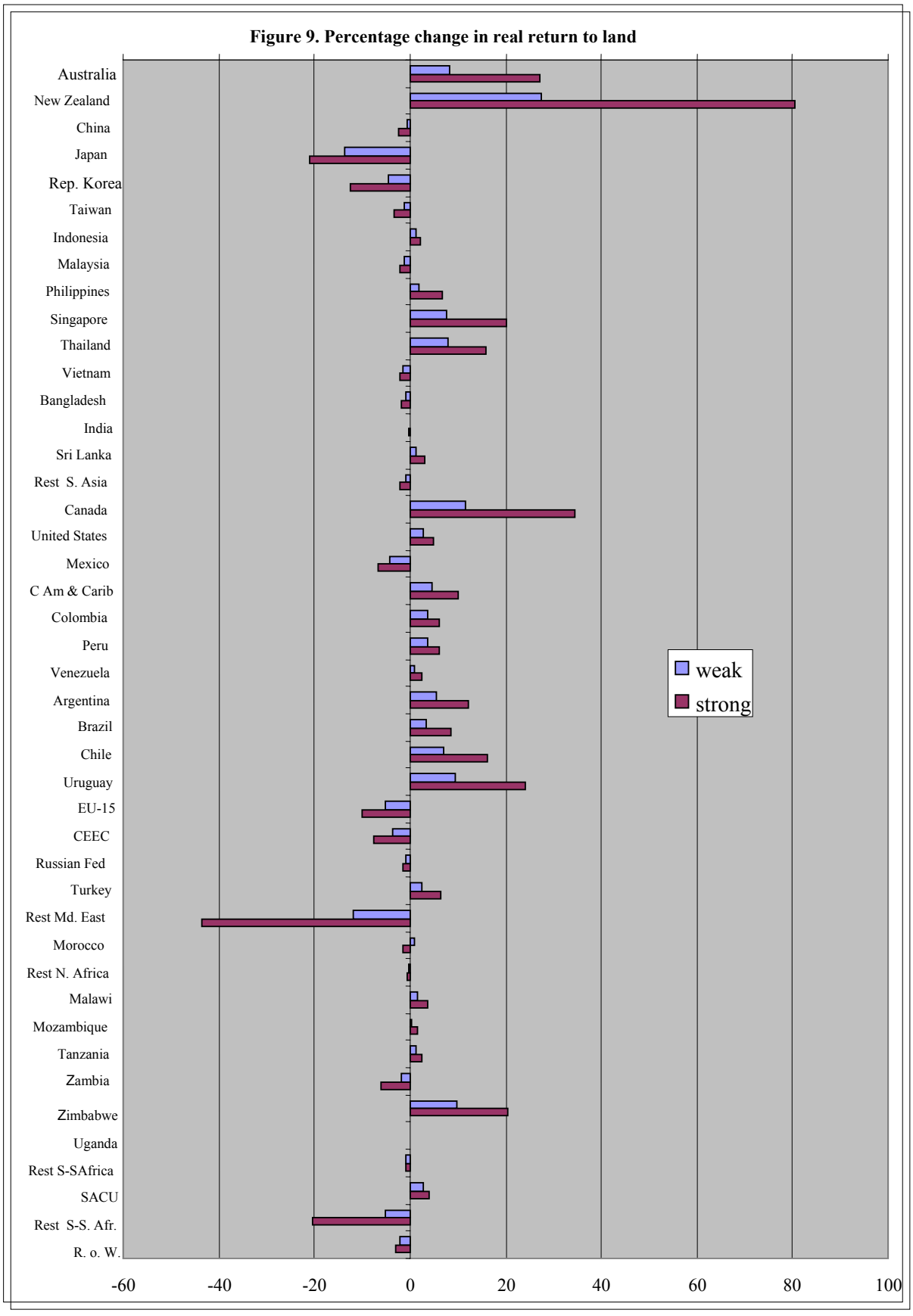


Figure 10. Percentage change in real return to labour

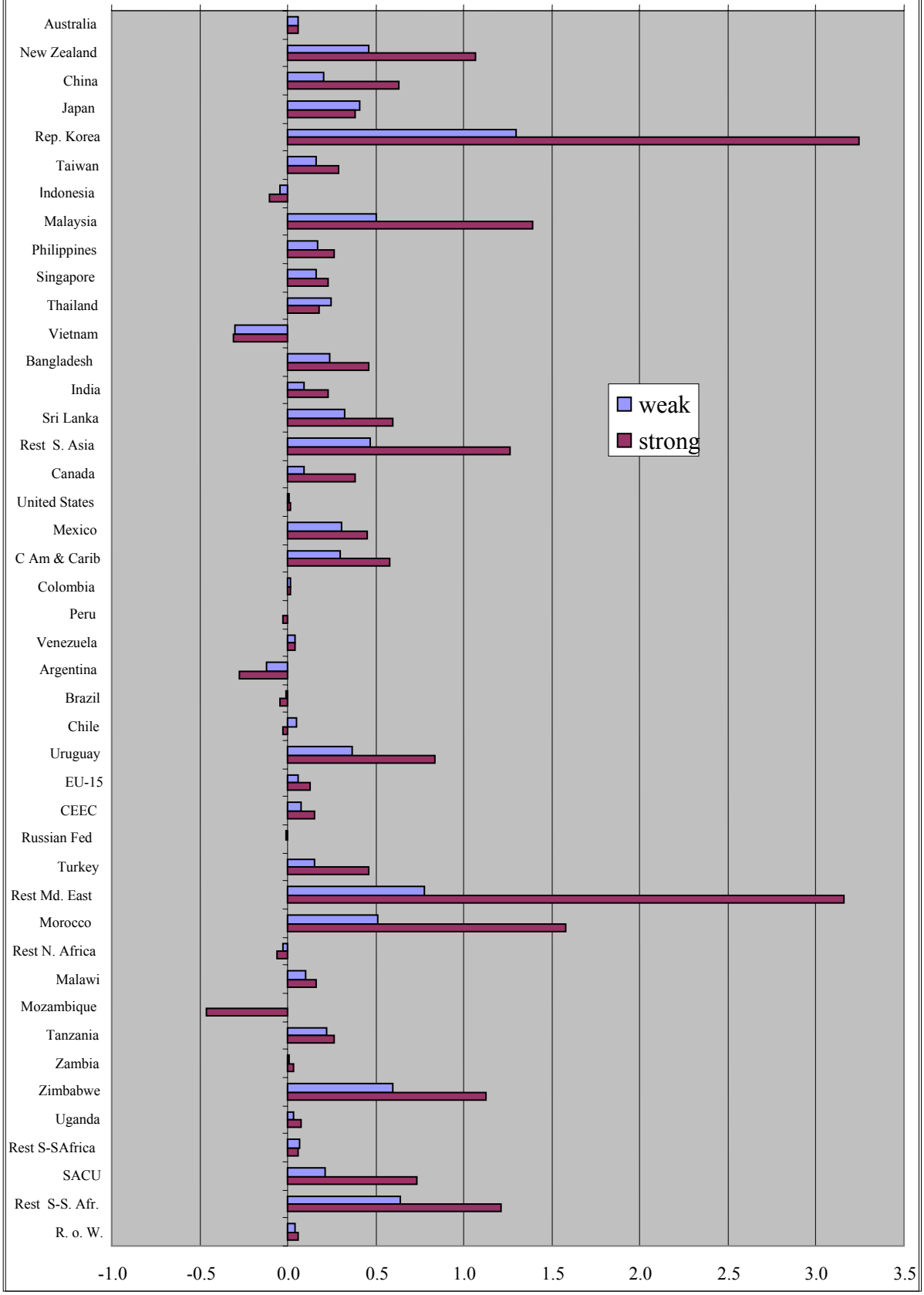


Figure 11. Percentage changes in the terms of trade

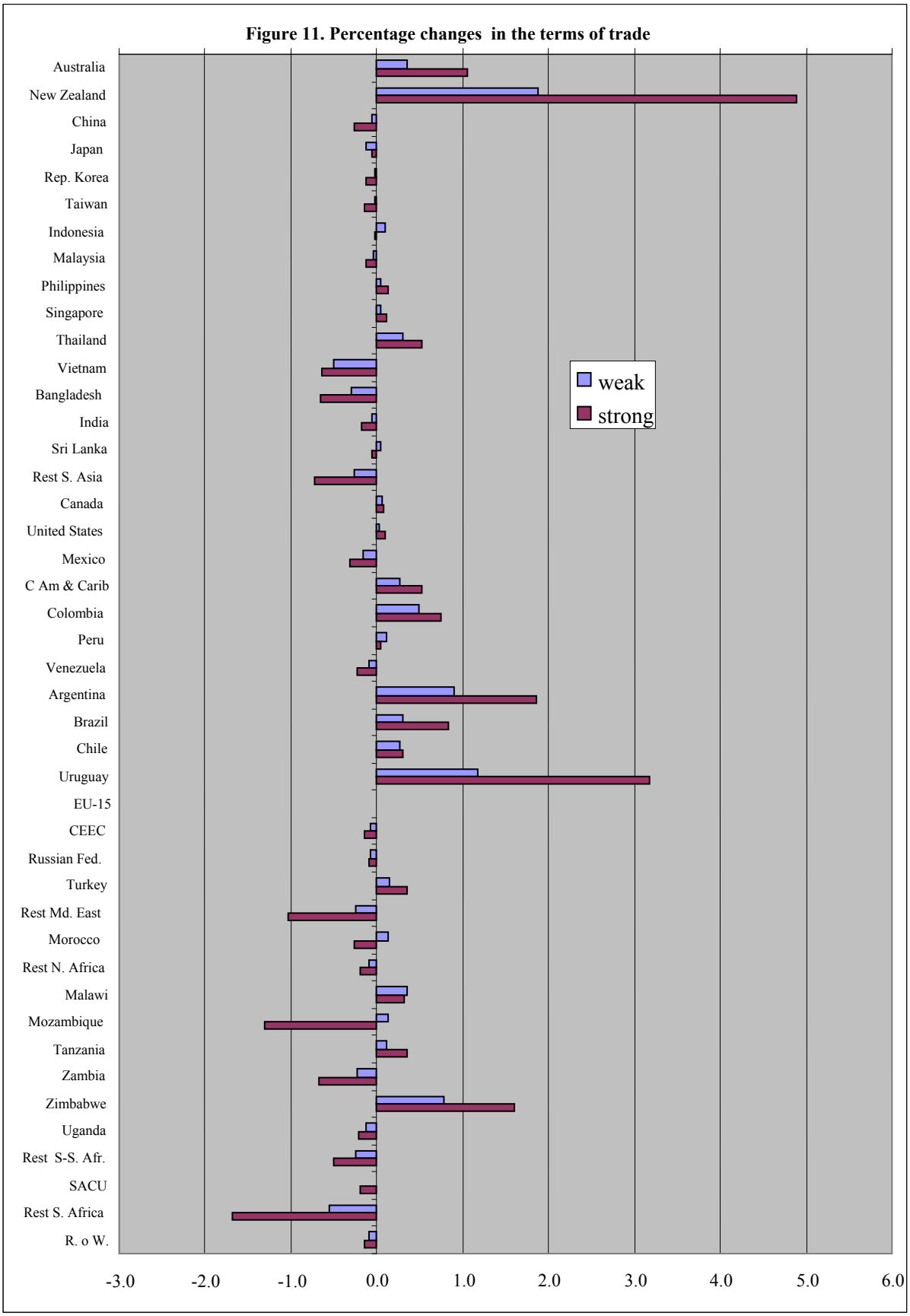


Figure 12. Trade balance (X-M) for total cereals (exc. rice).

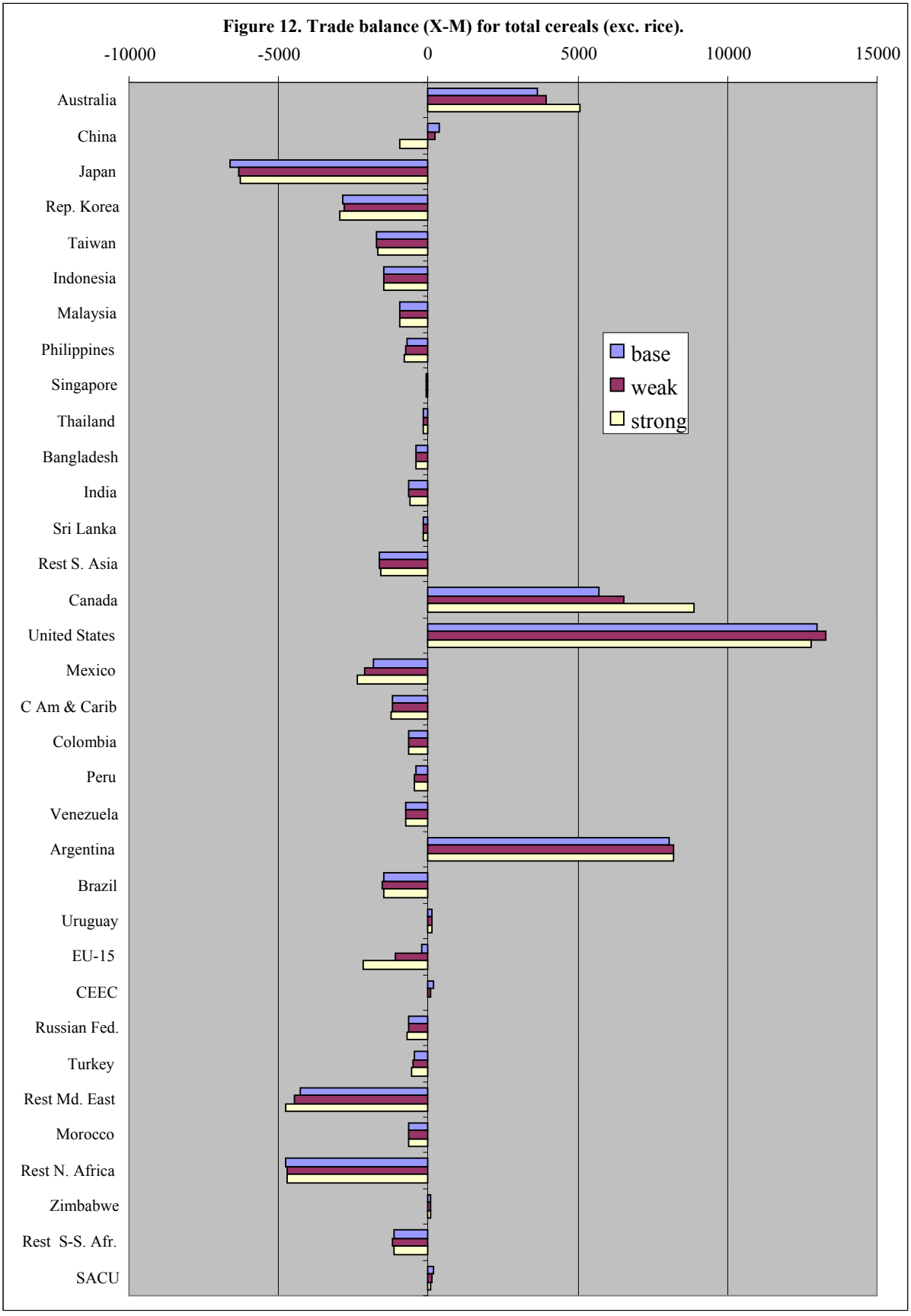
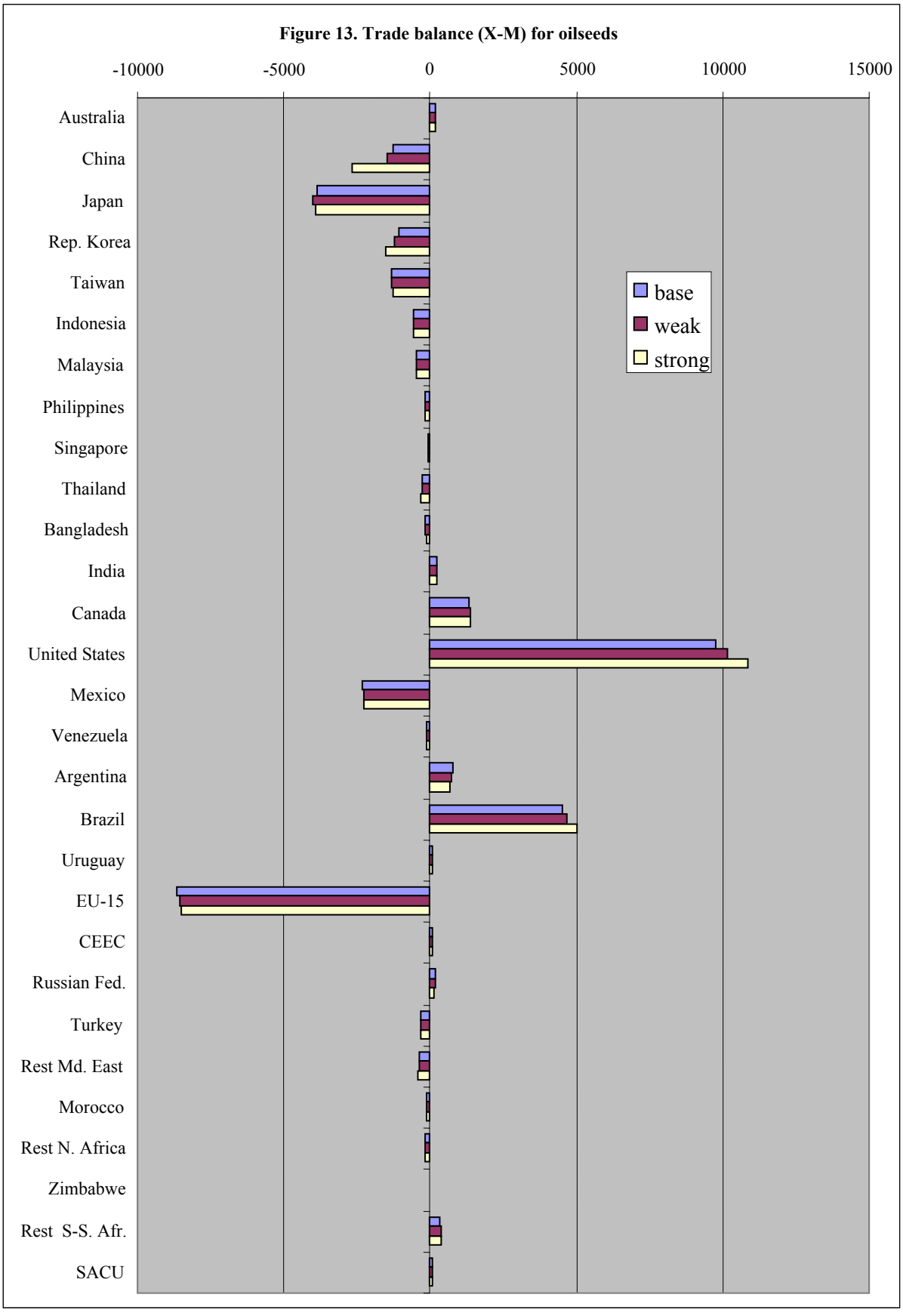


Figure 13. Trade balance (X-M) for oilseeds



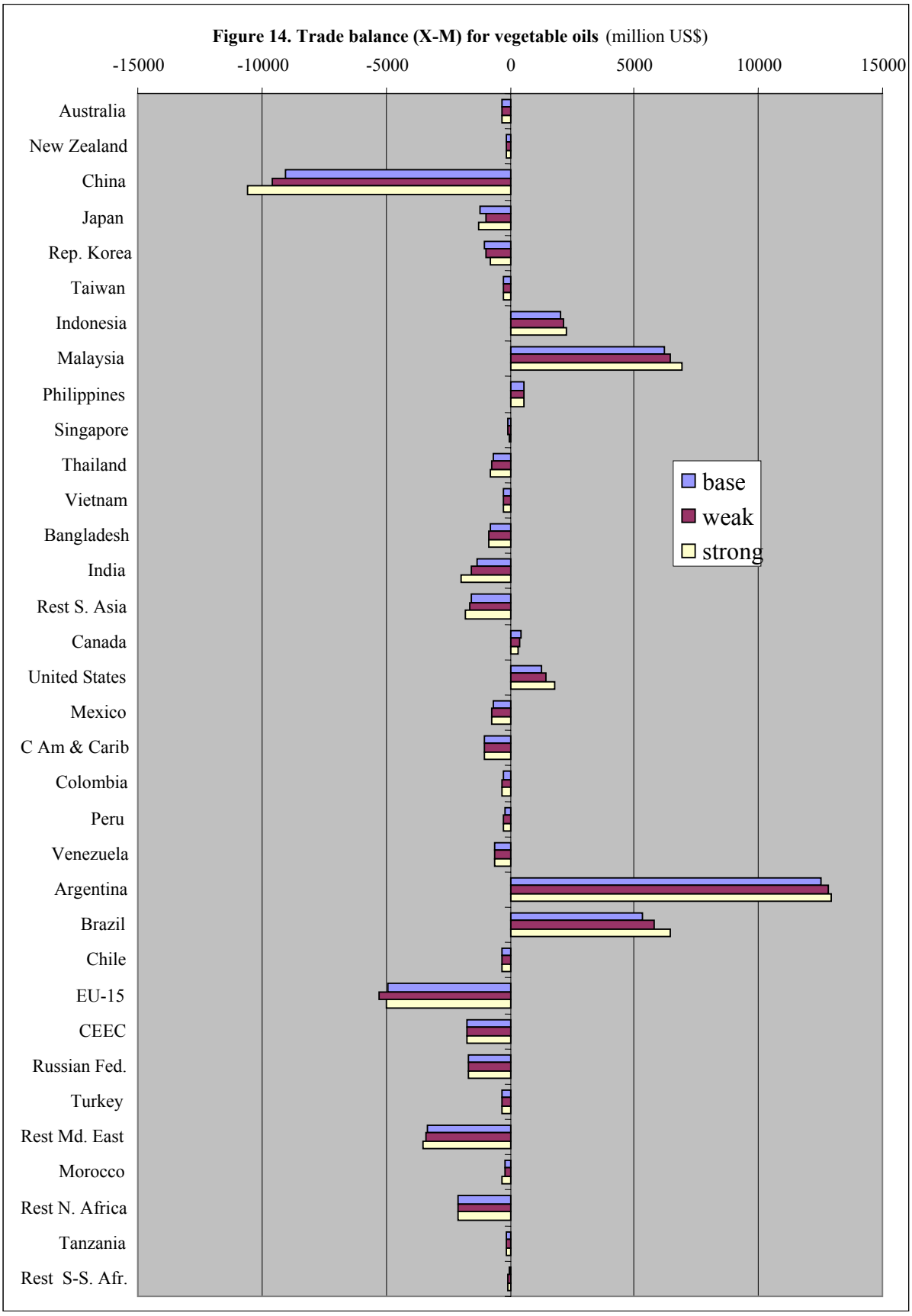


Figure 14. Trade balance (X-M) for vegetable oils (million US$)
-15000
-10000
-5000
0
5000
10000
15000
Australia
New Zealand
China
Japan
Rep. Korea
Taiwan
Indonesia
Malaysia
Philippines
Singapore
Thailand
Vietnam
Bangladesh
India
Rest S. Asia
Canada
United States
Mexico
C Am & Carib
Colombia
Peru
Venezuela
Argentina
Brazil
Chile
EU-15
CEEC
Russian Fed.
Turkey
Rest Md. East
Morocco
Rest N. Africa
Tanzania
Rest S-S. Afr.
base
weak
strong

Figure 15. Trade balance (X-M) for sugar (million US$)

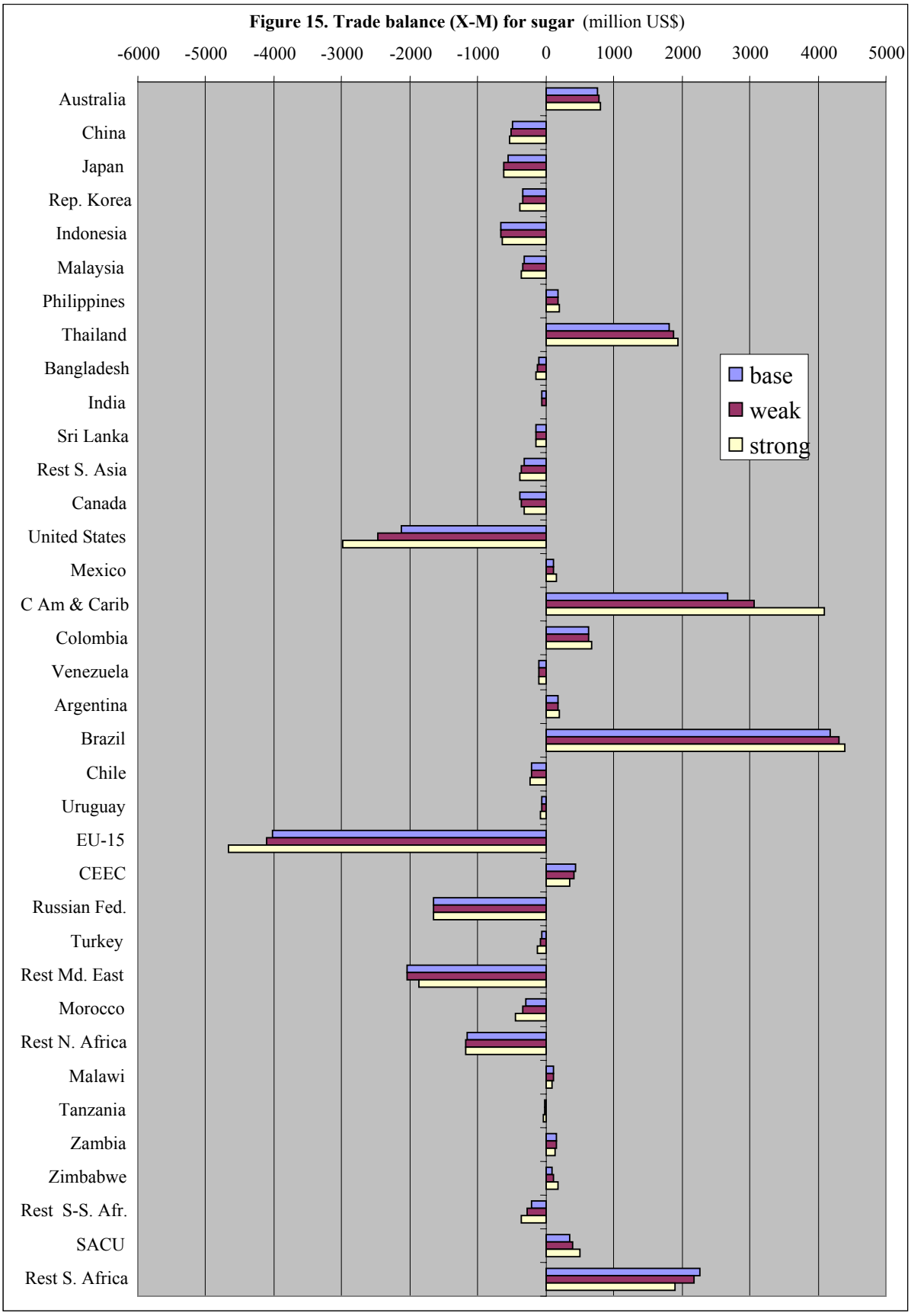


Figure 16. Trade balance (X-M) for paddy rice (million US$)

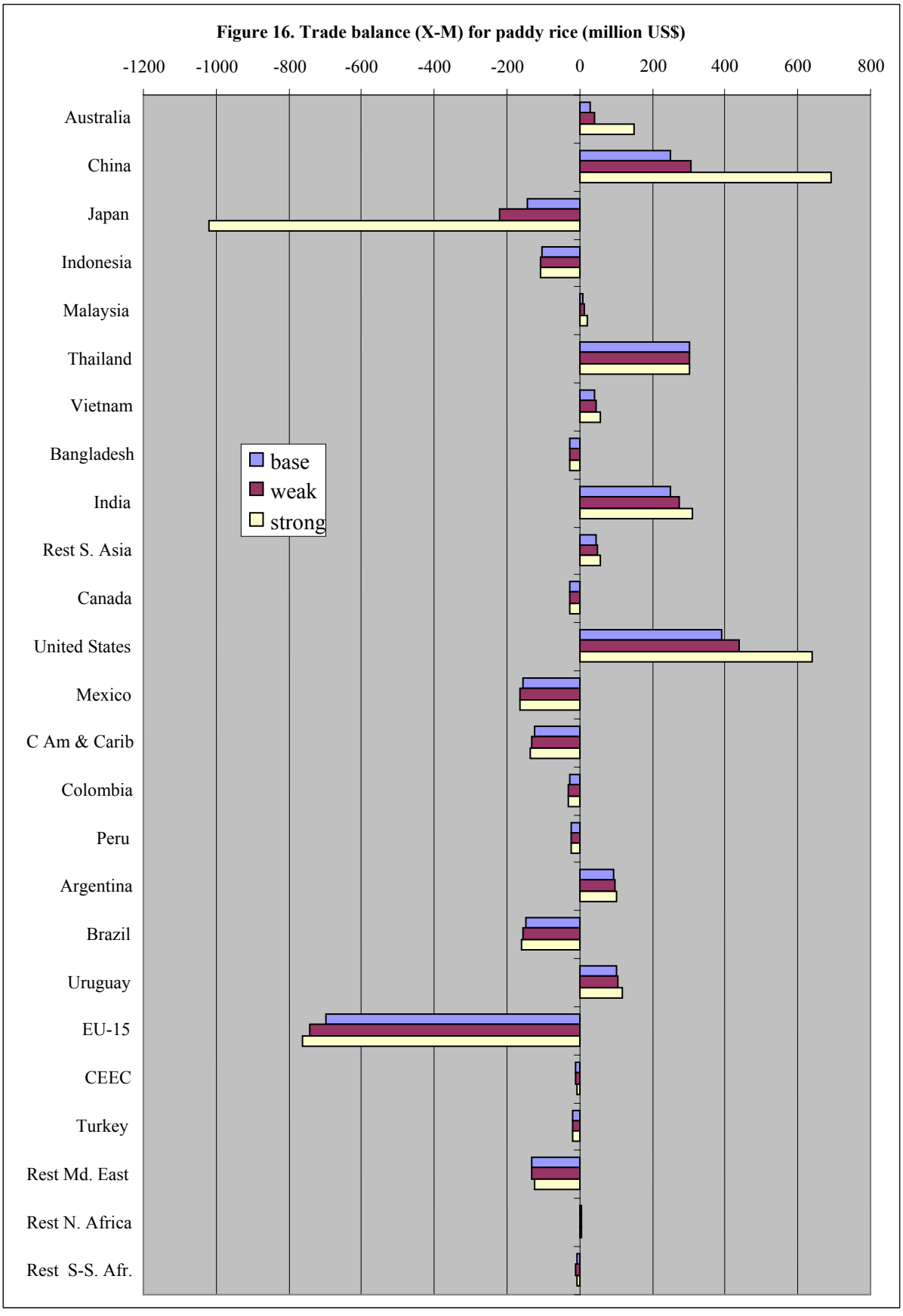
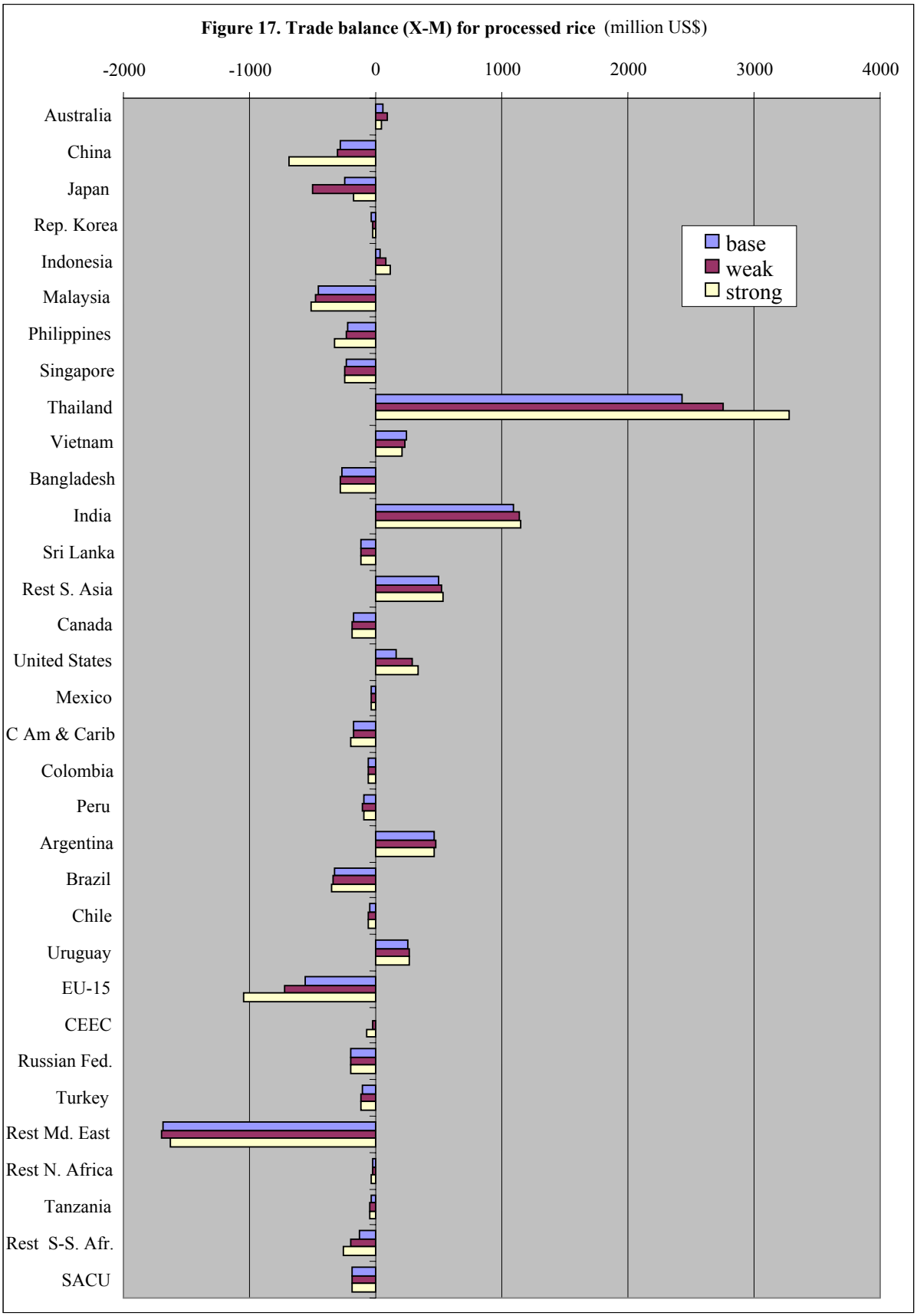


Figure 17. Trade balance (X-M) for processed rice (million US$)



TABLES

Table 1. Countries, regions, products and endowments

Countries/regions	Products	Endowments
Australia	Paddy rice	Land
New Zealand	Cereals	Labour
China	Vegetables, fruit, nuts	Capital
Japan	Oilseeds	Natural resources
Republic of Korea	Sugar cane, sugar beet	
Taiwan Province of China	Other primary products	
Indonesia	Livestock	
Malaysia	Raw milk	
Philippines	Vegetable oils and fats	
Singapore	Dairy products	
Thailand	Processed rice	
Vietnam	Sugar	
Bangladesh	Other food products	
India	Secondary sectors	
Sri Lanka	Services	
Rest of South Asia		
Canada		
United States		
Mexico		
Central America and the Caribbean		
Colombia		
Peru		
Venezuela		
Argentina		
Brazil		
Chile		
Uruguay		
EU-15		
CEEC		
Russian Federation		
Turkey		
Rest of Middle East		
Morocco		
Rest of North Africa		
Malawi		
Mozambique		
United Republic of Tanzania		
Zambia		
Zimbabwe		
Uganda		
Rest of Sub-Saharan Africa		
South Africa Custom Union		
Rest of Southern Africa		
Rest of World		

Table 2. Modelling the "Agenda 2000"reform of the CAP

Policy measure	Shock introduced	Sources of shock calculations
introduction of a beef slaughtering premium	increase in the output subsidy	subsidy expenditure / value of production in AGLINK; weight of beef in total livestock from Van Meijil and Van Tongeren (2002)
reduction in the premiums paid per head to beef producers	increase in the subsidy on capital use	44% reduction in the premium; weight of beef in total livestock from Van Meijil and Van Tongeren (2002)
increase in the (semi-decoupled) payment per hectare to cereals producers	increase in the subsidy on land use	+16%, from 54 to 63 Euro/ton
reduction in the cereals intervention price	import tariff reduction	corresponding to market price reduction as a % of intervention price reduction inVan Meijil and Van Tongeren (2002)
reduction in the (semi-decoupled) payment per hectare to oilseeds producers	reduction in the subsidy on land use	-33% from 94 to 63 Euro/ton
reduction in the intervention price of butter and smp	import tariff reduction	-22% as trade weighted average of butter and smp
increase in milk quotas	increase in (exogenous) output	6%
direct payments to milk producers	output subsidy	6%

Table 3. Total welfare effect for (proxies of) countries and regions groups

	Allocative efficiency			Terms of trade			Total		
	weak	**strong**	**free**	**weak**	**strong**	**free**	**weak**	**strong**	**free**
Proxy for the *G-20*									
China	1 490	3 769	4 467	-192	-1 092	-1 472	1 238	2 768	2 877
Indonesia	85	125	270	102	-11	271	171	97	471
Philippines	61	97	134	31	87	194	99	199	347
Thailand	328	259	1 020	427	727	2 255	741	966	3 204
India	191	419	576	-12	-17	-61	162	397	444
Rest of South Asia	139	334	479	-49	-124	-257	78	172	154
Mexico	511	742	1 075	-283	-538	-1 051	223	197	-16
Cent. Am. & Carib.	181	307	646	191	358	1 133	446	849	2 217
Colombia	27	39	86	225	352	915	264	412	1 051
Peru	16	20	67	38	37	161	66	76	288
Venezuela	19	28	97	-19	-49	-129	-1	-22	-39
Argentina	82	151	389	1 069	2 233	5 922	1 347	2 797	7 361
Brazil	103	221	392	455	1 214	2 392	977	2 463	5 029
Chile	14	12	37	141	174	616	163	197	683
United Rep. Tanzania	9	11	25	2	9	26	11	17	47
Zimbabwe	28	48	116	29	61	182	64	124	345
SACU	238	618	844	7	-134	-38	245	474	797
Total	3 522	7 200	10 717	2 160	3 287	11 059	6 292	12 180	25 257
Proxy for the *Least Developed Countries*									
Bangladesh	49	99	163	-30	-66	-158	10	10	-49
Mozambique	0	-4	-5	-1	-9	-50	2	-31	-152
United Rep Tanzania	9	11	25	2	9	26	11	17	47
Zambia	1	3	6	-4	-11	-25	-3	-8	-18
Malawi	2	3	6	4	3	12	6	6	18
Uganda	1	2	0	-2	-3	-5	-3	-4	-11
Rest of S-S.Africa	110	118	268	-204	-425	-929	-129	-385	-831
Rest of S. Africa	34	46	64	-70	-223	-434	-27	-144	-305
Total	206	277	528	-305	-726	-1 562	-132	-540	-1 302
Proxy for the *Net Food-Importing Developing Countries*									
Sri Lanka	25	49	74	3	-6	-20	29	43	57
Rest of South Asia	139	334	479	-49	-124	-257	78	172	154
Cent. Am. & Carib.	181	307	646	191	358	1 133	446	849	2 217
Peru	16	20	67	38	37	161	66	76	288
Venezuela	19	28	97	-19	-49	-129	-1	-22	-39
Morocco	147	387	535	21	-53	-16	175	330	562
Rest of North Africa	-32	-60	-122	-82	-163	-360	-137	-268	-580
Total	496	1 064	1 776	104	1	512	657	1 180	2 659
Proxy for *Developed Countries*									
Australia	-37	-114	-186	354	1 029	2 351	301	886	2 076
New Zealand	42	103	243	499	1 295	2 955	518	1 345	3 076
Japan	5 233	3 588	14 703	-1 378	-857	-7 588	3 887	2 606	7 325
Republic of Korea	1 920	3 772	5 185	-72	-254	-459	1 784	3 406	4 437
Canada	361	1 646	1 855	233	267	948	554	1 873	2 663
United States	305	691	464	427	1 149	2 522	633	1 716	2 396
EU-15	4 919	9 548	14 461	-530	-548	-2 756	4 357	9 014	11 437
CEEC	253	498	855	-88	-182	-395	105	187	199
Total	12 995	19 731	37 579	-555	1 899	-2 423	12 138	21 033	33 608
Proxy for the *Cairns Group*									
Argentina	82	151	389	1 069	2 233	5 922	1 347	2 797	7 361
Australia	-37	-114	-186	354	1 029	2 351	301	886	2 076
Brazil	103	221	392	455	1 214	2 392	977	2 463	5 029
Canada	361	1 646	1 855	233	267	948	554	1 873	2 663
Chile	14	12	37	141	174	616	163	197	683
Colombia	27	39	86	225	352	915	264	412	1 051
Indonesia	85	125	270	102	-11	271	171	97	471
Malaysia	251	705	934	-62	-221	-432	170	444	412
New Zealand	42	103	243	499	1 295	2 955	518	1 345	3 076
Philippines	61	97	134	31	87	194	99	199	347
SACU	238	618	844	7	-134	-38	245	474	797
Uruguay	54	124	309	98	263	722	173	439	1 166
Total	1 281	3 727	5 305	3 150	6 548	16 817	4 981	11 626	25 131
Other countries									
Russian Federation	33	58	75	-32	-13	-114	41	117	106
Rest of World	-106	-164	-407	-531	-855	-1 997	-710	-1 139	-2 720
Rest of Middle East	2 778	8 523	9 293	-862	-3 736	-5 998	1 721	3 834	1 778
Vietnam	-6	-3	-16	-48	-55	-124	-93	-104	-267
Taiwan P. of China	215	289	494	-65	-297	-486	142	23	40
Singapore	9	6	21	102	241	611	103	235	590
Uruguay	54	124	309	98	263	722	173	439	1 166
Turkey	168	515	676	143	341	650	326	888	1 369
Total	3 144	9 348	10 444	-1 194	-4 112	-6 737	1 704	4 292	2 062
Grand total	**20 250**	**37 625**	**60 665**	**-16**	**-103**	**-515**	**20 229**	**37 498**	**60 030**

Source: own calculations

Table 4. Welfare results from game simulations (million US$)

DGs\ DCs*	STATUS QUO (a_{DC}^{sq})	WEAK (a_{DC}^{w})	STRONG (a_{DC}^{s})	FREE TRADE (a_{DC}^{ft})
STATUS QUO (a_{DG}^{sq})	0; 0	3661; 9752 (13; 1)	3754; 15305 (19; 1)	26749; 24041 (9; 1)
WEAK (a_{DG}^{w})	5163; 1976 (8; 1)	8049; 12138 (8; 0)	8790; 17530 (10; 0)	23511; 18745 (11; 1)
STRONG (a_{DG}^{s})	12230; 4830 (10; 1)	15341; 15004 (8; 0)	16348; 21033 (9; 0)	29913; 21999 ** (11; 0)
FREE TRADE (a_{DG}^{ft})	26749; 24041 (9; 1)	29547; 32017 (9; 0)	31466; 38739** (8; 0)	26317; 33608 (11; 0)

In parenthesis the number of countries experiencing a loss in each group

* Developed countries (DCs) include: Australia, New Zealand, Japan, Rep. of Korea, US, Canada, and EU-25 (including EU-15 and CEEC). Other countries and regions listed in Table 1 are included in the Developing Countries (DGs) group.

** These are the game solutions. The most likely outcome occurs at a_{LDC}^{s} and a_{DC}^{ft}

Table 5. Ranking of dominant strategies for some of the most important countries

	1	2	3	4
EU-25	strong liberalization	weak liberalization		
US	status quo			free trade
Japan	free trade			status quo
Brazil	free trade	strong liberalization	weak liberalization	status quo
India	free trade	strong liberalization	weak liberalization	status quo
China	strong liberalization	free trade	weak liberalization	status quo

ANNEX

Table A1. Changes in market prices under the "weak" 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	Sugar	Oth. foods
Australia	1.9	1.4	1.3	1.0	1.4	0.8	0.8	1.5	0.4	0.9	1.1	0.7	0.4
New Zealand	3.8	3.3	3.4	3.2	4.3	1.3	2.2	4.4	1.5	3.1	1.6	1.5	1.5
China	-0.2	-0.4	-0.2	-0.9	-0.3	-0.1	-0.4	-0.4	-1.9	-0.2	-0.1	-0.2	-0.3
Japan	-1.7	-3.3	-1.5	-2.6	-1.5	-1.7	-2.7	-3.7	-12.0	-4.5	-1.5	-4.6	-1.9
Rep. of Korea	-2.3	-10.8	-2.8	-9.9	-0.5	-1.7	-3.6	-3.7	-13.1	-2.3	-2.1	-0.4	-6.6
Taiwan P. of C.	-0.3	-0.3	-0.5	-0.3	-0.5	-0.2	-0.4	-0.4	-0.2	-0.3	-0.3	-0.2	-0.6
Indonesia	0.8	0.9	0.8	0.5	0.7	0.7	0.2	0.5	0.1	0.1	0.7	0.3	0.2
Malaysia	-0.4	-0.4	-0.8	-0.3	-0.5	-1.8	-1.2	-2.7	-0.0	-1.4	-0.9	-1.0	-0.6
Philippines	0.6	0.1	1.3	0.5	0.7	0.1	0.1	-3.7	0.0	0.3	0.4	0.3	-0.2
Singapore	2.1	2.1	0.9	0.9	2.3	1.6	0.1	1.9	-0.2	-0.0	1.8	0.1	-0.2
Thailand	3.9	2.6	2.5	1.4	2.9	0.8	0.7	2.8	-0.6	-0.5	3.2	1.1	-0.2
Vietnam	-0.9	-1.0	-1.0	-1.6	-1.3	-0.9	-1.1	-0.9	-0.5	-0.3	-0.8	-1.0	-0.6
Bangladesh	-0.7	-0.4	-0.8	-1.1	-0.9	-0.4	-0.7	-0.8	-1.2	-0.6	-0.5	-0.5	-0.3
India	-0.1	-0.1	-0.3	-0.2	-0.2	-0.1	-0.2	-0.2	-0.2	-0.2	-0.1	-0.2	-0.2
Sri Lanka	0.5	-0.9	0.5	0.9	0.8	0.6	0.2	0.3	-0.4	0.1	-0.9	-2.5	-0.5
Rest S. Asia	-0.5	-0.5	-0.8	-0.8	-0.7	-1.0	-0.9	-0.7	-1.4	-0.9	-0.4	-0.7	-0.3
Canada	1.2	1.3	0.7	1.1	0.9	0.0	0.3	0.7	0.1	0.3	0.7	0.2	-0.1
United States	0.8	0.4	0.4	0.6	-0.4	-0.1	0.1	0.3	0.3	0.1	0.1	-0.9	-0.1
Mexico	-1.5	-1.9	-1.1	-1.2	-1.3	-0.0	-1.2	-1.4	-0.6	-1.4	-0.6	-0.8	-1.1
C Am & Carib	0.8	1.0	1.1	1.2	1.7	1.4	0.6	0.9	0.2	0.5	0.1	0.6	0.3
Colombia	0.9	0.6	0.9	0.8	0.9	1.8	0.6	0.8	0.2	0.4	0.3	0.3	0.3
Peru	0.8	0.7	0.8	0.8	0.8	1.3	0.6	0.8	0.4	0.2	-0.0	0.5	0.2
Venezuela	0.4	0.2	0.2	0.2	0.2	0.5	0.2	0.2	-0.1	0.1	-0.1	0.2	0.0
Argentina	2.1	2.2	2.0	2.2	1.9	1.4	2.0	2.6	1.4	1.4	1.2	1.0	0.9
Brazil	0.7	0.7	0.6	0.8	0.7	0.9	0.6	0.6	0.6	0.5	0.5	0.5	0.4
Chile	1.3	1.4	1.6	1.2	1.0	0.3	0.9	1.2	0.1	0.5	0.4	0.6	0.5
Uruguay	2.2	2.4	2.1	2.0	2.0	1.7	2.4	3.0	1.0	2.3	1.3	1.4	1.3
EU-15	-0.6	-0.6	-0.3	-0.6	-0.2	-0.1	-0.4	-0.3	-0.2	-0.2	-1.0	-0.2	-0.3
CEEC	-2.2	-0.8	-0.9	-0.4	-0.9	-0.6	-0.6	-0.9	-0.4	-0.4	-0.4	-0.4	-0.3
Russian Fed.	-0.3	-0.3	-0.3	-0.4	-0.3	-0.4	-0.2	-0.3	-0.2	-0.2	-0.2	-0.1	-0.2
Turkey	0.2	0.3	0.4	-0.0	0.3	0.3	0.1	0.2	-0.7	-0.1	0.1	0.2	-0.1
Rest Md. East	-0.9	-2.0	-1.4	-1.8	-0.8	-1.0	-1.4	-1.2	-2.8	-1.2	-0.5	-1.1	-1.8
Morocco	-0.0	0.3	0.4	0.1	0.4	0.1	0.0	0.2	0.0	0.0	0.1	-0.1	0.0
Rest N. Africa	-0.3	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
Malawi	0.5	0.5	0.5	0.5	-0.4	0.5	0.3	0.5	0.3	0.3	0.3	0.2	0.2
Mozambique	0.2	0.3	0.3	0.3	0.5	0.2	0.3	0.5	0.2	0.2	0.2	0.2	0.2
U. R.Tanzania	-0.2	-0.1	0.4	0.2	-0.1	0.3	-0.0	0.0	-0.0	-0.1	-0.2	-0.1	-0.1
Zambia	-0.5	-0.4	-0.5	-0.5	-1.0	-0.4	-0.3	-0.4	-0.4	-0.2	-0.3	-0.8	-0.3
Zimbabwe	1.4	1.1	0.9	1.4	1.3	1.0	0.9	0.9	0.8	0.8	0.7	1.3	0.4
Uganda	-0.3	-0.3	-0.3	-0.2	-0.3	-0.1	-0.3	-0.3	-0.2	-0.0	-2.0	-0.3	-0.3
Rest S-S. Afr.	-0.4	-0.5	-0.4	-0.3	-0.4	-0.2	-0.4	-0.4	-0.4	-0.4	-0.3	-0.3	-0.4
SACU	0.2	0.1	0.3	0.1	0.3	0.2	-0.1	0.0	-1.1	-0.2	-0.1	-0.1	-0.3
Rest S. Africa	-2.2	-1.5	-1.8	-1.8	-2.0	-1.2	-1.1	-1.6	-1.1	-0.5	-0.9	-1.3	-0.7
Rest of World	-0.8	-0.7	-0.8	-0.9	-0.8	-0.6	-0.4	-0.6	-0.2	-0.3	-0.4	-0.3	-0.2

Source: Own calculations

Table A2. Changes in market prices under the "strong" 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	Sugar	Oth. foods
Australia	6.7	5.1	4.1	2.5	4.0	2.2	2.1	4.4	1.1	2.6	3.7	2.1	1.2
New Zealand	9.9	8.7	8.9	8.4	11.5	3.7	5.5	12.1	3.9	8.3	3.9	3.9	3.8
China	-0.6	-1.8	-0.6	-3.4	-1.0	-0.3	-1.6	-1.6	-8.3	-0.6	-0.5	-0.7	-1.1
Japan	-2.5	-6.4	-2.5	-1.5	-1.9	-2.3	-4.0	-7.5	0.6	-1.5	-3.2	-4.0	-2.1
Rep. of Korea	-6.4	-28.7	-8.1	-25.6	-1.3	-2.7	-8.9	-9.4	-32.0	-5.4	-5.9	0.5	-16.4
Taiwan P. of C.	-1.0	-0.9	-1.3	-0.9	-1.2	-0.5	-0.8	-0.9	-0.3	-0.5	-0.8	-0.6	-1.2
Indonesia	1.1	1.4	1.0	0.8	0.9	0.9	0.0	0.7	0.1	0.0	0.9	0.4	0.2
Malaysia	-0.4	-1.0	-1.2	-0.1	-0.8	-5.9	-2.9	-3.7	0.1	-2.3	-2.3	-2.3	-1.4
Philippines	1.7	0.7	4.4	1.9	2.2	0.5	0.5	-6.3	0.1	2.0	1.1	0.7	-0.2
Singapore	4.5	4.7	2.5	2.5	5.8	4.1	0.5	5.0	0.0	0.0	4.0	0.1	-0.2
Thailand	8.5	4.6	4.7	1.9	5.4	1.0	1.6	4.6	-1.9	-1.3	6.7	2.0	0.3
Vietnam	-1.1	-1.4	-1.3	-2.1	-2.1	-1.2	-1.4	-0.9	-0.9	-0.3	-1.1	-1.4	-0.8
Bangladesh	-1.4	-0.6	-1.5	-2.7	-2.1	-0.9	-1.5	-1.7	-3.1	-1.6	-1.1	-1.3	-0.5
India	-0.4	-0.4	-0.8	-0.6	-0.6	-0.5	-0.5	-0.5	-0.7	-0.7	-0.4	-0.7	-0.6
Sri Lanka	1.1	-2.4	1.1	1.7	0.6	0.7	0.2	0.3	0.1	0.1	-1.6	-5.6	-0.7
Rest S. Asia	-1.6	-1.5	-2.3	-2.2	-2.1	-2.5	-2.4	-2.1	-3.7	-2.4	-1.2	-1.8	-0.7
Canada	3.3	4.0	1.6	2.6	2.5	0.3	0.1	1.4	0.3	-0.3	1.7	0.4	-0.4
United States	2.6	0.7	1.0	1.3	-1.4	0.2	0.2	0.4	0.4	0.1	0.3	-2.4	-0.1
Mexico	-1.7	-3.1	-1.7	-1.1	-1.8	0.0	-1.9	-2.2	0.3	-2.1	-0.8	-1.1	-1.7
C Am & Carib	1.9	2.5	2.4	3.0	5.1	2.3	1.5	2.3	0.8	1.2	0.5	1.6	0.8
Colombia	1.5	1.3	1.7	1.5	1.6	2.7	1.1	1.4	0.4	0.6	0.6	0.6	0.6
Peru	1.1	1.2	1.3	1.3	1.3	1.9	1.0	1.2	0.6	0.9	-0.1	0.7	0.3
Venezuela	0.8	0.4	0.5	0.7	0.4	0.8	0.3	0.5	-0.1	0.3	-0.1	0.4	0.1
Argentina	4.2	4.6	4.3	4.6	4.1	2.5	4.5	5.9	3.0	3.0	2.5	2.0	1.9
Brazil	1.7	1.7	1.6	2.2	1.8	1.9	1.6	1.6	1.6	1.3	1.4	1.3	1.1
Chile	2.5	2.6	3.4	2.8	1.8	0.0	1.6	2.3	0.4	0.8	0.9	1.0	0.7
Uruguay	5.6	6.1	5.3	5.0	5.2	4.4	6.1	7.5	3.1	5.7	3.2	3.6	3.3
EU-15	-1.2	-1.3	-0.6	-1.0	-0.5	-0.1	-0.8	-0.7	-0.4	-0.5	-2.0	-0.8	-0.5
CEEC	-4.6	-1.5	-1.9	-0.7	-2.0	-1.2	-1.3	-1.7	-0.7	-0.8	-0.9	-0.8	-0.7
Russian Fed.	-0.5	-0.5	-0.5	-0.7	-0.6	-0.7	-0.4	-0.5	-0.4	-0.4	-0.4	-0.1	-0.4
Turkey	0.4	0.6	1.0	0.4	0.6	0.5	0.0	0.3	-1.2	-0.6	0.2	0.4	-0.2
Rest Md. East	-3.6	-7.1	-6.0	-6.2	-3.4	-3.7	-6.2	-4.8	-9.1	-5.1	-2.0	-4.4	-6.8
Morocco	-1.6	-0.2	0.0	-0.7	-0.2	-0.2	-1.5	-0.9	-0.8	-0.6	-0.6	-1.1	-0.8
Rest N. Africa	-0.5	-0.2	-0.3	-0.2	-0.3	-0.3	-0.3	-0.3	-0.1	-0.1	-0.2	-0.1	-0.2
Malawi	0.6	0.4	0.5	0.5	-2.8	0.6	0.1	0.4	0.2	0.1	0.1	-0.4	-0.1
Mozambique	-1.3	-1.2	-1.1	-0.9	-0.3	-1.4	-1.3	-0.4	-0.9	-1.2	-1.3	-1.3	-1.2
U.R. Tanzania	0.0	0.1	1.1	0.4	-0.2	0.6	0.0	0.2	0.0	-0.1	0.0	-0.2	0.0
Zambia	-1.6	-1.3	-1.6	-1.6	-4.0	-1.1	-1.0	-1.3	-1.2	-0.8	-0.9	-3.0	-0.8
Zimbabwe	2.8	2.0	1.8	2.9	3.7	1.9	1.9	2.5	1.8	1.8	1.4	3.4	1.1
Uganda	-0.6	-0.8	-0.5	-0.5	-0.7	-0.2	-0.5	-0.6	-0.5	0.2	-5.7	-0.6	-0.7
Rest S-S. Afr.	-0.7	-0.7	-0.7	-0.6	-0.9	-0.4	-0.7	-0.8	-0.8	-0.6	-0.7	-0.6	-0.6
SACU	0.1	-0.4	0.4	-0.2	0.5	-0.1	-0.8	-0.5	-3.4	-1.0	-0.6	-0.5	-1.4
Rest S. Africa	-7.2	-5.2	-5.8	-6.2	-7.7	-4.1	-3.4	-5.8	-3.5	-1.6	-2.7	-4.6	-2.2
Rest of World	-1.3	-1.0	-1.2	-0.8	-1.3	-0.9	-0.6	-0.9	-0.3	-0.5	-0.7	-0.5	-0.4

Source: Own calculations

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