Partial Liberalization of the World Sugar Market:
A General Equilibrium Analysis of Tariff-Rate Quota Regimes

Aziz Elbehri*
USDA/ERS, Washington DC, USA

Thomas Hertel
Purdue University, W. Lafayette, Indiana, USA

Merlinda Ingco
The World Bank, Washington DC, USA

and

K. R. Pearson
Monash University, Melbourne, Australia

Abstract

In this paper we develop a TRQ model within GTAP that explicitly handles the tariff rate quota regimes and we apply it to an analysis of partial multilateral sugar liberalization. Results show that a combination of tariff reduction and quota expansion by the U.S. and the E.U. is welfare improving for both importers and exporters. However, either instrument alone results in losses for one or the other group.

Keywords: Tariff rate quota; Trade policy; General equilibrium; Sugar

---

Paper presented as a Selected Paper at the AnnualConference on Global Economic Analysis, June 28-30, 2000
Melbourne, Australia

* Corresponding author, Tel.: 202-694-5291; e-mail: aelbehri@ers.usda.gov

1. Introduction

The tariff-rate quota (TRQ) system emerged from the Uruguay Round Agreement on Agriculture (URAA) as a new policy mechanism to ensure both tariffication and market access. Tariffication required conversion of non-tariff barriers into tariff-equivalents to be lowered over a period of time, while market access ensured that quantities imported before the agreement could continue to be imported[1]. There are nearly 1400 tariff lines notified under TRQs, about 200 are country specific rather than global (OECD, 1998). Moreover, most of the domestically sensitive agricultural products in OECD countries are covered by TRQ regimes.

There are basically two problems with the TRQ regime to be addressed in the upcoming WTO negotiations: the overall level of access, and the administration of TRQs (Skully, 1999). Expanded market access will depend on increasing the volume of imports allowed under the current regime of TRQs, either via expanded minimum access commitments or via reductions in over-quota tariffs. The other important area of reform is a need for more transparent administration mechanisms and a need to address the significant concerns that have arisen regarding implementation. For example the "first-come first-served" principle favored by WTO Secretariat has come under criticism due to unintended detrimental effects on trade resulting from uncertainty about firm's access to quotas (Abbott and Morse, 1999). In some agricultural commodities (i.e., sugar), quota allocation is often based on diplomatic considerations and historical ties rather than least cost production criteria (Skully, 1999).

Given the importance of market access issues in the upcoming WTO round on agriculture, economists have recently begun focusing attention on the TRQ import regimes (Abbott and Paarlberg, 1998) and the implementation mechanisms (Skully, 1999; Tsigas and Ingco, 1998). What is needed however, are quantitative models of import regimes that take into account the TRQ mechanism. During the Uruguay Round most quantitative trade policy analyses viewed "policy" in agriculture in terms of tax or subsidy equivalents. In other words, observed price differences are taken as a good approximation of the incidence of price or quantity barriers. Hence the modeling of the Uruguay Round was usually based on tariff equivalents of various policy measures (Martin and Winters, 1995). However, given the prominence of quotas in the current agricultural policy regime (sanctioned via the TRQ mechanism), the modeling of border measures must explicitly come to grips with this unique blend of price and quantity constraints.

This paper examines the consequences of liberalizing the sugar TRQ import regime using an applied general equilibrium model that explicitly accounts for TRQ mechanisms. The model has several features that are suitable for examining the sugar TRQ regime. First is the ability to examine liberalization scenarios on a bilateral basis (e.g., sugar imported by the United States from the Philippines) as well as multi-lateral basis (e.g., sugar imported from the U.S. and the E.U. from all exporting regions). Another valuable feature of the model is the explicit calculation of quota rents and their distribution between importers and exporters. This feature is particularly useful for assessing the welfare effects on small developing countries that currently depend on rents generated from quota-based preferential access. A third advantage of this approach is that it provides a more comprehensive vehicle for analyzing interactions with other

[1] Developing countries were given the option of "ceiling bindings" with full discretion on the level of the tariff bindings. Many developing countries established "ceiling bindings" at levels significantly higher than applied tariffs (Ingco, 1996).

aspects of a multilateral trade agreement. While we don't take full advantage of this aspect in the present study, which focuses only on sugar liberalization, future analyses could examine interactions between liberalization in other sectors and the TRQ regime for sugar.

The objectives of this analysis are as follow. First, we examine the possible trade-off effects between tariff cuts and quota expansion within the TRQ regime in the case of sugar, and the welfare implications for sugar exporters and importers. We explore the linkages between quota rent changes, tariff revenue losses and trade expansion under a liberalized TRQ. We also seek to assess which of the TRQ instruments, over-quota tariffs or quota volume, is the most effective means of expanding sugar market access. A second objective is to provide a quantitative assessment of global market access liberalization in the sugar case, emphasizing the implications for partial sugar liberalization by the EU, the US and Japan on global sugar trade.

The remainder of the paper is organized as follows. Section 2 provides a graphical description of the economics of trade liberalization under the TRQ regime and lays down the conceptual underpinning for the empirical analysis. Section 3 provides an overview of the existing sugar TRQ and non-TRQ import regimes in OECD countries, with particular emphasis on the EU, the US and Japan. Section 4 describes the model, the TRQ implementation and the benchmark database. Section 5 discusses the simulation results and section 6 concludes.

2. Economics of trade liberalization under the TRQ regime

A tariff rate quota is a trade policy regime that combines elements of tariffs and quotas. Under the TRQ, imports up to some fixed quantity are subject to a low tariff (in-quota tariff) while imports above that quantity are charged a higher tariff (over-quota tariff). Figure 1 illustrates three possible regimes under the TRQ[2]. The quota is represented by the quantity Q. Given a small country assumption, import supplies under the TRQ regime are represented by a step function with two horizontal lines. The lower line represents the in-quota imports and extends from the origin to Q. The other horizontal line represents the effective import supply of over-quota imports and extends from Q to infinity. At the import volume Q there is a discontinuity: a vertical line joins the in-quota and over-quota segments. M represents actual imports that are determined by the import demand function that depends on to the domestic price of imports, P_m , in the importing country. In Figure 1, T_{in} represents the power of the in-quota tariff and T_{out} the power of the over-quota tariff[3]. The ratio of T_{out} and T_{in} is T_r^{max} . P_w is the world price. The world price multiplied by the power of the *ad valorem* in-quota tariff $T_{in} = (1+ t_{in})$, dictates the price of imports in the domestic market: P_m. Under the TRQ regime, imports can be above the quota Q when T_{out} is effective (case 1), or imports can equal Q when the quota is effective (case 2). When imports are below Q, T_{in} is the effective instrument (case 3).

In case 1, import demand M exceeds the quota, Q, and the domestic price of imports is determined by $P_m = P_w * T_{out}$ so that positive quota rents arise (shaded area in Figure 1, Case 1).

[2] We abstract from special cases such as endogenous quotas (Boughner and De Gorter, 1999) and cases when countries may apply in-quota tariff for over-quota imports.

[3] The power of the tariff is equal to one plus the ad valorem rate divided by 100. For example, if the over-quota tariff rate is 60%, the power of the over-quota tariff is 1.6.

The total value of the rent is the per unit rent, P_w*(T_{out} - T_{in}), multiplied by the quota volume, Q. In case 3, imports M are below the quota Q and the domestic price of imports equals the world price multiplied by the power of the in-quota tariff ($P_m = P_w * T_{in}$). The TRQ behaves just like a tariff and no quota rents arise ($T_r = 1$). In case 2, import demand intersects the import supply step function on its vertical portion at a quantityQ. In this case, the domestic import price, P_m, equals $P_w * T_{in} * T_r$, where $1 < Tr < T_r^{max}$.

Figure 2 illustrates the trade and revenue implications of liberalizing the TRQ regime in the case when the over-quota tariff is binding (M > Q). To simplify the discussion, we assume that all quota rents accrue to the exporting region. In Case 1 of Figure 2, the over-quota tariff is reduced but remains above the in-quota tariff, T_{in}. Since the demand curve is downward sloping, imports increase while quota rents are reduced. The determinants of the welfare implications for importers and exporters are quite different. For the importer, welfare will be affected by the net tariff revenue changes (difference of loss of area C and the gain of area D). For the exporting region, the net revenue effect will depend on the difference between the quota rent loss (equal to area A) and the extra revenue from added exports.

In Case 2 of Figure 2, liberalization scenario 2, the quota level is expanded from Q to Q'. In this case quota rents may increase or decrease depending on whether the quota rent loss represented by area A is compensated by the gain of areas B + D. If the quota expansion results in a net increase in quota rents, the exporter will definitely increase welfare since exports also expand. For the importer the net welfare effect is ambiguous and depends on the net tariff revenue change corresponding to the difference between the in-quota tariff revenue loss (areas C+B) and the tariff revenue gain (area F).

In Case 3 of Figure 2, the tariff cut and quota expansion are combined with the quota expanding from Q to Q' and imports from M to M' (>Q'). If we assume the same level of tariff cut and quota expansion as in cases 1 and 2, we would expect the new total quota rents to be in between case 1 (tariff quota only) and case 2 (quota increase only). Again the change in quota rents is equal to the difference between area A (loss) and B + D (gain). The tariff revenue changes to the importer are equal to the difference between C+B (loss) and F+G (gain).

3. Overview of sugar import regimes

Sugar is one of the most highly regulated agricultural commodities, particularly within the largest developed economies: the EU, the US, and Japan. The EU sugar program operates under an intervention price above the world price, maintained primarily through import restrictions implemented with a TRQ regime and the subsidization of exports to prevent excessive stock increases. High tariffs on over-quota imports prevent the intervention price from being undermined by import competition. Moreover, the 'special safeguard' provision imposed by the EU via an additional duty effectively prevents any sugar imports above the TRQ. The EU sugar import quota allocation is targeted mostly to the ACP countries as well as India. ACP sugar receives the same support price as internally-produced EU sugar and enters the EU duty free. As a result, economic rents accrue to the ACP exporters under this preferential regime.

For the US, the sugar TRQs are administered to ensure that the domestic price stays at or above the loan rate (Haley, 1999). The U.S. sugar TRQs are allocated as bilateral quotas to exporting countries on the basis of their average market shares of U.S. sugar imports in the period 1975-1981, exclusive of the highest and lowest years (Swarez, 1997). While these quotas have not changed, the exporters' relative ability to supply sugar have evolved over the years. Consequently, it is argued that the current US sugar quota allocation mechanism induces economic inefficiencies (Skully, 1999b).

Japan is another major sugar importer that intervenes heavily in the sugar market through a mix of producer price supports, levies and tariffs on imports. Japan's sugar production is only one third of consumption, and much of the intervention takes place in the form of high import tariffs (Sheales et al., 2000).

Several developments are likely to nudge OECD governments towards greater market access. These include: EU enlargement, implementation of NAFTA, the expiry of the current EU sugar regime in 2001, and the APEC negotiations aiming for a free trade area by 2010. In the US case, an agreement for moderate market access expansion for sugar could still leave the domestic program unaffected, but significant new market access commitments might require downward adjustments to the loan rate provided to sugar processors, which serves as a minimum domestic price. On the other hand, the absence of a market access agreement will likely expose the price support program to outside pressure after 2003/4 when the "Peace Clause" expires. Aziz: please explain this final statement

The same conflicts in policy goals between market access and domestic support can also be expected for the EU. As the EU is set to review its sugar program beginning in 2001, several factors are likely to push in the direction of reductions in production quotas with possible additional price support cuts. This includes binding UR commitments and the prospects of WTO challenges to export subsidies after the expiry of the "Peace Clause" in 2003/4.

Given all these considerations, any new WTO agreement on sugar market access would likely consist of a partial sugar trade liberalization affecting over-quota or MFN tariffs. Depending on the extent of sugar liberalization, such an agreement could have significant consequences for consumers, producers and processors in the importing countries. For exporters, particularly developing countries, the revenue effects from a market access agreement would be determined by the offsetting effects of quota rent revenues and trade volume changes changes. These effects are examined in the present analysis.

4. Empirical analysis

4.1. Simulation model

In this analysis we employ a TRQ model (Elbehri and Pearson, 2000) implemented within an applied general equilibrium model, GTAP (Hertel, 1997) using the GEMPACK software (Harrison and Pearson, 1996). The GTAP model is a multi-region multi-sector applied general equilibrium model currently in use by scores of researchers in more than 40 countries on five

continents. Since the GTAP model production and demand structures are fully described elsewhere (Hertel, 1997) they will not be repeated here. In this section we briefly describe the TRQ features of the model. (For a detailed description of how to implement the TRQ regime in GTAP, see Elbehri and Pearson, 2000.)

The discontinuities inherent in the two-tier tariff system, as described in section 2, was modeled as a mixed complementarity problem. The TRQ mechanism is implemented at the bilateral level - that is at the level of each trade flow represented by a triple of indices (*i,r,s*) where *i* is the commodity, *r* is the source region and *s* is the destination region. The TRQ behavior was handled in the model via non-differentiable equation (1), which abstracts from the triple dimension (*i,r,s*) for ease of exposition.

$$\begin{aligned} &IF\ (T_r + M/Q <= 2,\ THEN\ T_r = 1), \\ &ELSE\ IF\ (T_r + M/Q >= 1 + T_r^{max}\ ,\ THEN\ T_r = T_r^{max}, \\ &ELSE\ IF\ (T_r + M/Q > 2\ and\ T_r + M/Q < 1 + T_r^{max}\ ,\ M = Q\ and\ 1 < T_r < T_r^{max}) \end{aligned} \qquad (1)$$

As before, M and Q are imports and the quota, respectively; T_{out}, T_{in} and T_r are the power of the tariff for the over-quota, in-quota, and the unit per quota rent, respectively. T_r^{max} is the maximum level of the power of the ad valorem quota rent and is equal to the ratio of T_{out} over T_{in}.

Each of the three lines of equation 1 corresponds to one of three cases of the TRQ regime represented in figure 1. The first line corresponds to case 3 of figure 1 whereby imports are within the quota level. The second line corresponds to case 1 with over-quota imports, and the third line describes case 2 where imports are equal to the quota. Starting from the initial benchmark database where the TRQ status of each triple (*i,r,s*) is known in terms of in-quota, at-quota or above quota position, equation (1) is used to solve for the effective TRQ instrument. In each of the three cases, the linkage between domestic and world prices is as follows[4]:

$P_m = P_w * T_{in}$	in-quota (case 3, figure 1), where Tr = 1	(2.1)
$P_m = P_w * T_{in} * T_r$	at-quota (case 2, figure 1), where $1 < Tr < T_r^{max}$	(2.2)
$P_m = P_w * T_{out}$	over-quota (case 1, figure 1), where $Tr = T_r^{max} = T_{out}/T_{in}$	(2.3)

The model also solves for the equilibrium total quota rents (Q_r) associated with each triple *(i,r,s)* via the following equation:

$$Q_r = Pw * T_{in} * (T_r - 1) * Q \qquad (3)$$

In addition, the model solves for the portions of the total quota rents that accrue to the source (*r*) and destination region (*s*) for each commodity *i*. The distribution of quota rents between exporters and importers is performed as part of the model solution based on exogenously specified quota rent shares provided on a bilateral basis. In the case where imports are within quota ($M < Q$), T_r is equal to 1 and quota rents reduce to zero.

[4] As in all GE models, prices in the GTAP model are relative to a numeraire. In our implementation, this is taken to be a global primary factor price index as suggested by de Melo and Robinson (1989) and de Melo and Tarr (1992).

4.2 TRQ data set and model calibration

The underlying data structure for the model is the GTAP database version 4 benchmarked for 1995 and covering 50 treadable sectors and a world economy divided into 45 countries/regions. There are five primary factors in the model: agricultural land, physical capital, skilled labor, unskilled labor, and natural resources. Land and natural resources are fixed factors used by a subset of tradeable sectors, while labor and physical capital and labor are used by all sectors. We have chosen to make labor perfectly mobile across sectors, while capital, land and natural resources are sector-specific in the spirit of the Ricardo-Viner trade model.

The present analysis uses an aggregation of 20 regions and 13 tradable sectors. The regional aggregation covers the major importing and exporting sugar markets in the world including the OECD and those developing countries with significant shares of world sugar trade. Eight out of 13 sectors in the model are agricultural sectors. Table 1 shows the sugar import shares for the three key markets in the model from the benchmark database. For example, we find that Japan sourced 35 percent of sugar imports from Australia, 25.6 percent from Thailand, and 9 percent from the Caribbean region.

Supplemental data (beyond the GTAP data base) are required to implement the TRQ regime. These include: the sugar quota volume, total imports, in-quota tariffs and over-quota tariffs. These data are shown in table 2. Quota volume data were obtained from country submissions on market access to the WTO. These data must first be aggregated, prior to use in the model. For this purpose, quantity-to-value conversion was carried out using unit values derived from the FAO Agrostat database. From the first three columns of table 2 we see that imports exceeded the quota in 1995 for both the US and the EU markets. In this analysis, the initial quota-to-import ratio in the benchmark data (shown in column 3 table 2) is assumed to hold uniformly across all bilateral import flows into the US and the EU markets. These ratios will be free to vary independently in subsequent model simulations.

In addition to trade data, we also collected supplementary tariff data for TRQ commodities. For in-quota tariffs, we used country tariff schedules for the US and the EU. For Canada and Japan we used Uruguay Round tariff schedules. For developing countries we used the UNCTAD TRAINS database. These tariffs are on an *ad valorem* equivalent basis and are aggregated to the GTAP commodity level using trade values as weights. For over-quota tariffs, we applied the OECD Secretariat estimates of the *ad valorem* equivalents of over-quota tariffs based on specific rates derived from import volumes and values per tariff line (OECD, 1998). These specific tariff rates were compared with world market prices to obtain over-quota *ad valorem* tariffs. For sugar, the over-quota *ad valorem* tariffs for the US and the EU used in the benchmark database were 129 percent and 147 percent, respectively (table 2). For Japan, the benchmark MFN *ad valorem* tariff for sugar was 143 percent.

The model solution also includes the post-equilibrium quota rents distributed between exporting and importing regions based on specified quota shares incorporated into the

benchmark data[5]. Quota rent allocation between importers and exporters was relatively straightforward in the case of sugar. For TRQ sugar imports into the EU, quota rents are allocated to the ACP exporters and India consistent with the preferential access agreement with the EU. For sugar imports from third countries, the EU is assumed to capture quota rents. In the case of the US, sugar exporters with bilateral quotas are assumed to capture all quota rents associated with their exports[6]. However, for imports from other countries without specific quota allocations, the associated quota rents are assumed to be captured by the importer (i.e., the U.S.).

5. Simulation results

To examine the economic effects of partial liberalization of the world sugar market, we consider three sets of policy experiments: i) EU partial sugar liberalization only; ii) US partial TRQ liberalization only; and iii) multilateral, partial sugar trade liberalization. These policy experiments are listed in table 3. EU liberalization is analyzed under three cases: over-quota tariff reduction by 1/3 (EU_T), TRQ quota expansion by 1/3 (EU_Q), and a combination of both tariff and quota shocks (EU_TQ). The same three cases are used to analyze the US sugar TRQ liberalization (US_T, US_Q, and US_TQ). These experiments are designed to help isolate the effects on welfare from changing in quota rents and trade volumes. In the multilateral sugar policy liberalization experiments with tariff cut only (MULTI_T) and a combination of tariff cuts and quota expansion (MULTI_TQ), the goal is to quantify the welfare and trade effects from a partial multilateral sugar liberalization. These multilateral experiments are also designed to differentiate the net welfare effects on importers between unilateral vs multilateral liberalization options.

5.1 Partial sugar TRQ liberalization by the EU

Under the scenario EU_T where the EU cuts the over-quota tariff by one third, the global sugar trade volume increases by $US 234 M or 1.3 percent (table 4 column 1). The EU expands sugar imports by 5.1 percent or $US 198.5 M (table 4), reduces its sugar exports by 12.1 percent and reduces domestic sugar output by 4.1 percent (Appendix 1). This increased trade is captured largely by the rest of Africa region which experiences a $US 272.4 M increase (46.7%), South Africa with $US 65.0 M (24.9%), Caribbean countries with $US 138.4 M (10.9%), and rest of Latin America $US 94.9 M (15.5%) (table 5). Be sure to correct export volume numbers in table 5 and in the text.

The aggregate welfare effects of each liberalization experiment are reported in table 6. The top panel reports changes in the US and the EU tariff revenues. This is followed by quota rents with the final panel reporting aggregate welfare changes. When the EU cuts its over-quota tariff,

[5] Since the standard GTAP model implicitly assumes that all quota rents accrue to the importing region, the initial income data in the benchmark data set were adjusted based on the quota rent sharing assumptions. To this end a simulation was performed for income adjustment to preserve the underlying income and expenditure balance in the model.

[6] For TRQ commodities other than sugar, quota rent shares between importers and exporters may be hard to gather. In this case, information on the mechanism of TRQ implementation may serve as a guide to derive reasonable assumptions. For example in the case where the TRQ is applied globally, i.e. on the basis of first-come first-served, one might expect the quota rents to be shared between importers and exporters. Likewise, information on who holds the right to import and import/export licenses may also provide some basis for quota rent sharing assumptions.

recall from figure 2 that, while it loses tariff revenue on current over-quota imports, the expansion in import volume creates the possibility of an increase in total tariff revenue. This is indeed the case, as can be seen from the top panel in table 6 where the EU tariff revenue rises by $491.3 millions under EU_T. In contrast to the tariff revenue effects, exporters lose quota rents on existing in-quota imports (a much larger amount), and this is not offset by the increase export volume. Therefore, quota rents fall (second panel in table 6). This decline is largest for the major preferential exporters, with rents to rest of Africa falling by $138.5 M and Caribbean export quota rents falling by $77.7 M.

The decline in quota rents closely mirrors the decline in aggregate welfare for the major sugar exporters to the EU (Rest of Africa, Caribbean, Rest of Latin America and South Africa). Non-quota holding partners, such as Australia and Thailand, show minimal welfare changes. The EU, on the other hand, benefits significantly from the cut in over-quota tariffs, as the increase in tariff revenues dominates the loss in EU quota rents. Also, the increased imports improve economic efficiency in the EU, thereby contributing significantly to the overall welfare gain of $822.5 M (Table 6, bottom panel, first column).

When the EU expands the sugar quota by one-third, imports increase only marginally ($33.8 M), since the quota is well below current imports in the benchmark equilibrium (table 2). Furthermore, as imports from the preferred source rise, so too does their price, thereby limiting the growth in demand. Thus the main consequence of expanding the EU's sugar quota is to transfer EU tariff revenue to exporters in the form of higher quota rents (recall figure 2, case2). This may be seen from the second column in table 6, labeled EU_Q. Here, exporters gain, while the EU loses. The largest welfare gains accrue in the rest of Africa region ($US 133.7 M), Caribbean region ($US 81.8 M), rest of Latin America ($US 45.9 M), and South Africa ($US 35.2 M). India, another quota-holding exporter to the EU also shows a small but positive welfare. The quota-rent shifting effect can be easily seen by comparing the magnitude of the positive sugar trade balance for the major exporting regions under the two scenarios (Appendix 2). Despite the much larger positive sugar trade balance under EU_T compared to EU_Q, welfare gains for exporters under EU_Q are positive while the same show a welfare loss under EU_T.

The combination of over-quota tariff reduction and quota expansion by the EU (scenario EU_TQ) results in welfare gains for both the EU and the net exporting countries (table 6). For the EU, the welfare gain of $US 474.7 M results from both a tariff revenue increase ($US 93 M) (which dominates the small loss in quota rents) and the efficiency gains from expanded imports. For the exporting countries the per unit quota rent losses from lower over-quota tariffs are more than offset by the expanded quota volume, resulting in generally positive changes in quota rents, and therefore a net welfare gain (though this is smaller than in the EU_Q case). Note that the production and trade effects under the EU_TQ scenario are very similar to the EU_T scenario. This is because in the post-simulation equilibrium, the binding instrument under both scenarios is the over-quota tariff. In this case, the quota expansion basically affects the division of quota rents and tariff revenues, and hence the welfare results. A graphical illustration of this equilibrium is shown in Section 2, figure 2 case 3. In that case, the quota is expanded from Q to Q' while the new equilibrium level of imports M' is larger than Q'. Hence the (lowered) over-quota tariff is still the effective policy instrument that determines the equilibrium domestic price.

Overall, a comparison of these three EU sugar liberalization cases suggests that reductions in over-quota tariffs or quota expansion alone may not be beneficial to both exporting and importing countries. However, a combination of both tariff cut and quota expansion can be welfare improving for both exporting and importing countries. As we will see in the case of the US, this important result can be generalized to other bilateral TRQ cases when quota-holding exporters extract either part or the whole of the economic rents that result from a binding TRQ regime.

5.2 Partial sugar TRQ liberalization by the US

In considering the US partial liberalization of sugar, we must bear in mind that the volume of over-quota imports is very small (table 2). In effect we are at the border between regimes. This means that there is less scope for transferring over-quota tariff revenues to exporters in the form of quota rents. Furthermore, any expansion in the quota results in a decline in per unit quota rents. As a consequence, the US_Q scenario generates small losses for most sugar exporters, although these losses are far less than under the US_T scenario whereby exporter quota rents are reduced with the cut in out-of-quota tariff.

In the case of combined tariff and quota US sugar liberalization (US_TQ) the quota is the binding instrument in the post-liberalization equilibrium. Therefore, the results under US_Q and US_TQ are identical. The out-of-quota tariff cut becomes irrelevant in the presence of an expanded quota. A graphical illustration of this equilibrium is shown in figure 1 case 2. In that case, the quota expansion results in a new equilibrium level of import $M = Q$. This outcome underscores the complexity of the TRQ regime and the importance of determining which regime within the TRQ mechanism is the relevant instrument that determines equilibrium trade and hence welfare.

5.3 Multilateral sugar import liberalization

The multilateral, partial sugar import liberalization tariff scenario (MULTI_T) consists of the US and EU cutting over-quota tariffs and other regions cutting their tariffs by one third. Under this scenario, sugar output in the major OECD markets declines by 9.8 percent for Japan, 4.3 percent for the US and 2.2 percent for the EU (Appendix 1). The sugar exporting countries expand output with the highest increases shown by the Caribbean countries (12.5%), Australia (7.0%), Thailand (6.5%), and the African region (5.9%). Smaller output increases are shown for rest of Latin America and South Africa. Under the MULTI_T scenario, the volume of world sugar trade expands by over $US 1.7 billion, with Africa (including South Africa) capturing $US 391.3 M (including South Africa) of that expansion (table 5). The Caribbean region, rest of Latin America, and Brazil increase exports by $US 274.5 M, $US 155.6 M, and $US 42.3 M, respectively. In addition, sugar exporters like Australia and Thailand, which benefit relatively little from the US and the EU partial tariff liberalization, show a bigger gain under the multilateral liberalization scenario (MULTI_T) with the amount of $US 168.7 for Australia and $US 141.9 for Thailand. This is because Australia and Thailand supply most of Japan's sugar imports (table 1), and hence benefit from Japan's MFN sugar tariff reduction in this scenario. Under the MULTI_T scenario, sugar imports by Japan expand by $US 262 M followed by the EU with $US 223 M and the US with $US 215 M. The MENA (Middle East and North Africa)

region - a net sugar importer, also shows a substantial expansion of imports ($US 241.7 M) under this scenario resulting largely from cutting its own sugar import tariffs.

The comparison between the multilateral liberalization scenario and unilateral liberalization by the US and the EU reveals several valuable insights. The implications for the US and the EU are quite different between the two alternatives. While the EU sugar imports are larger under a multilateral liberalization scenario (MULTI_T) compared to unilateral scenario (EU_T), the US sugar imports are somewhat smaller under MULTI_T vs. US_T. In the US, which is primarily a sugar importer, welfare and trade effects are mostly affected by US sugar policy. Whereas, for the EU, which is both a sugar importer and exporter, both domestic and multilateral sugar reforms affect how the EU domestic sugar industries and overall welfare respond to those reforms. We see from table 5 that EU sugar exports fall much less under MULTI_T. This in turn generates smaller efficiency gains and smaller overall welfare gains.

The net global welfare gains under scenario MULTI_T was $US 1,181 M. The largest welfare gain is captured by the EU ($US 614.1 M) followed by the US ($US 292.2 M) and Japan ($US 264.7 M). For exporting countries the welfare effects were largely negative for countries that rely on preferential access to the US and the EU markets. For these exporters, the welfare loss is dominated by the quota rent erosion and is highest for rest of Africa ($US – 144.7 M), followed by the Caribbean region ($US –115.2 M), Rest of Latin America ($US –94.7), South Africa ($US –35.1 M) and Brazil ($US –17.6). On the other hand, sugar exporters like Thailand, that export predominantly to non-TRQ Japan shows a positive welfare under a more liberalized trade regime. For Australia, which exports significantly to both Japan (with non-TRQ market) and to the US and the EU, the net welfare effects are mixed and net impact is marginally negative.

In the case when the US and the EU also expand their quota volume by 1/3 in addition to a multi-lateral tariff cut by one third (scenario MULTI_TQ), welfare results are different both in magnitude for importers and in direction for some exporters. The EU and the US welfare gains in table 8 are much smaller compared to the MULTI_T case ($US 263.7 M for the EU and $US 119.8 M for the US), while Japan's welfare gains remain largely unchanged, since it doesn't have a TRQ regime. Under MULTI_TQ, the rest of Africa region recaptures much of the welfare loss realized under MULTI_Q compared to MULTI_T (Table 6). Other exporting regions also reverse the welfare loss under MULTI_T into a net gain under the MULTI_Q scenario. These include the Caribbean region ($US 32.3 M), Australia ($US 15.8 M), South Africa ($US 7.0 M), and Brazil ($US 5.4 M). On other hand, exporters like Thailand which serves mostly the Japanese market, shows no change in welfare when the US and the EU expand their quotas in addition to a multi-lateral tariff cuts.

6. Conclusions

This paper develops a modeling framework for analyzing bilateral tariff-rate quotas within the widely used GTAP multi-sector, multi-regional general equilibrium model. We apply the model to an analysis of the global sugar market, emphasizing sugar TRQs in the US and the EU. Among the features of the TRQ model are the bilateral treatment of the TRQs and the explicit allocation of quota rents between importers and exporters. This latter feature is critical in the

sugar case, given that many quota-holding exporters also benefit from preferential access and capture the economic rents associated with sales in the high-price protected markets. To explore the implications of sugar TRQ reform, we examine separately the reduction of over-quota tariffs and quota expansion by the US and the EU. We also examine the consequences of a global liberalization of sugar trade including both the TRQ import and MFN tariff regimes.

Results show that reducing EU over-quota tariffs by one-third results in a net welfare gain for the EU but a net welfare loss for exporting countries, as quota rents are shifted to the importing region. On the other hand, expanding quotas by one-third leads to net welfare gains by the quota-holding exporters while the liberalizing country (EU) shows a net welfare loss from reduced tariff revenues. However, the combination of tariff reductions and quota expansion results in welfare improvement for both the importing and the exporting countries. This suggests that any sugar liberalization scheme will have to include both elements in order to make it politically feasible.

In the case of US sugar liberalization, we find that welfare results are also driven by the interactions between shifting quota rents and the effects of trade expansion. In the US case there are very few over-quota imports. Therefore, liberalization via quota expansion leads to a regime switch whereby all sugar import expansion in the US occurs within the quotas. This leads to a decline in quota rents for exporters, and hence welfare losses—although these are small in magnitude.

These results highlight the complexity of the TRQ mechanism and suggest that the modalities of reforming the TRQs can be critical in determining the distribution of gains from trade liberalization between importers and exporters. They also cast doubt on the assertion that any liberalization of the world sugar market could lead many exporting developing countries suffering severe difficulties. Our analysis shows that a combination of over-quota tariff reductions and quota expansion could minimize the negative impacts on those exporters whose domestic industries critically depend on the existing preferential access.

References

Abbott, P. and B.A. Morse (1999), TRQ Implementation in Developing Countries, paper presented at the conference on Agriculture and the New WTO Trade Agenda in the WTO 2000 Negotiations, World Bank/WTO, October 1-2, 1999, Geneva, Switzerland.

Abbott, P. and P. Paarlberg (1998), Tariff Rate Quotas: Structural and Stability Impacts in Growing Markets, Agricultural Economics 19, 1998, pp. 257-67.

Boughner, D.S. and H. de Gorter (1999), The Economics of 2-tier Tariff Rate Import Quotas and the Agreement on Agriculture in the WTO. Department of Agricultural, Resource and managerial Economics, Cornell University.

Elbehri, A. and K. R. Pearson (2000), Implementing Bilateral Tariff Rate Quotas in GTAP using GEMPACK, GTAP Technical Paper (forthcoming).

Harrison, W.J. and K.R. Pearson (1996), Computing Solutions for Large General Equilibrium Models Using GEMPACK, Computational Economics vol. 9, pp. 83-127.

Hertel, T.W. (ed.) (1997) Global Trade Analysis: Modeling and Applications, Cambridge University Press.

Ingco, M.D. (1996), "The Uruguay Round and the Least-Developed Low-Income Food Deficit Countries", Paper presented to the Inter-Agency Meeting of the World Food Situation and Net Food Importing Countries, the World Bank, Washington, D.C., 18-19 December.

Ingco, M.D. and M. Tsigas, (1998). "Implementing Market Access Commitments in Agriculture: Welfare Evaluation of Issues for the Next Round of WTO Negotiations." Paper presented at the First Annual Global Analyses, June 8-10, Purdue University.

OECD (1998). Review of tariffs and non-tariff barriers: tariff regimes of the QUAD countries. OECD: Paris.

OECD (1999), Sugar Policy Reform: Price Regulation Options. OECD: Paris.

Sheales, T., S. Gordon, A. Hafi, and C. Toyne (2000), "Sugar: International policies affecting market expansion", ABARE Research Report 99.14.

Skully, D.W. (1999a), The Economics of TRQ Administration. Working Paper #99-6, International Agricultural Trade Research Consortium.

Skully, D.W. (1999b), "The Sugar TRQ System in the US", In: Sugar and Sweetener; USDA/ERS, September 1999.

Martin, W. and A. Winters (1995) (eds.), The Uruguay Round and the developing economies. World Bank Discussion paper 307.

Haley, S. (1999), "Stocks-to-use ratios and sugar pricing relationship: Implications for U.S. sugar policy", In: Sugar and Sweetener; USDA/ERS, September 1999.

Swinbank, A. (1999), "EU agriculture, Agenda 2000 and the WTO commitments", World Economy Vol. X: 41-54.

Figure 1. The Three Tariff Rate Quota Regimes

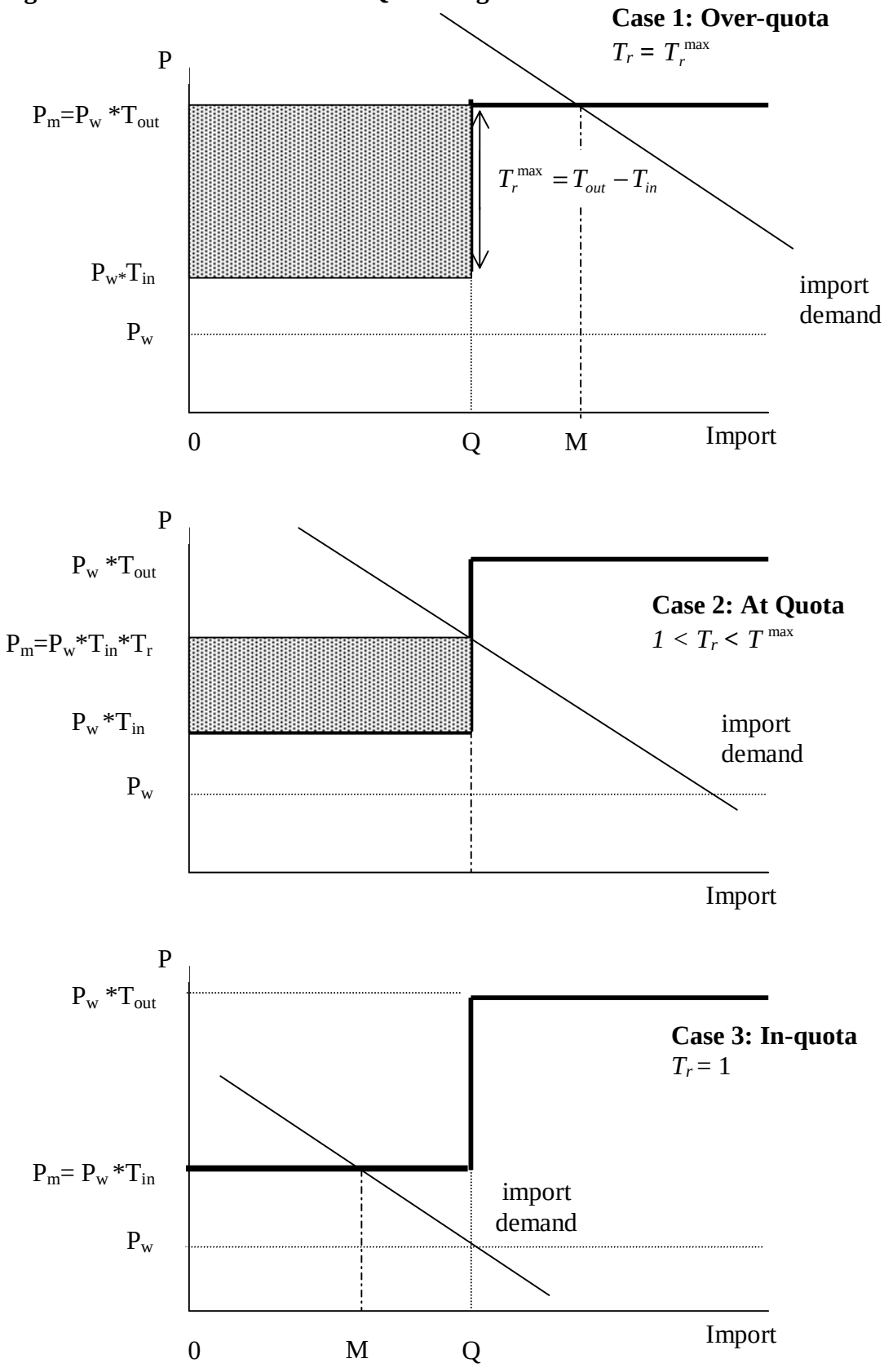

Figure 2. Three TRQ liberalization scenarios

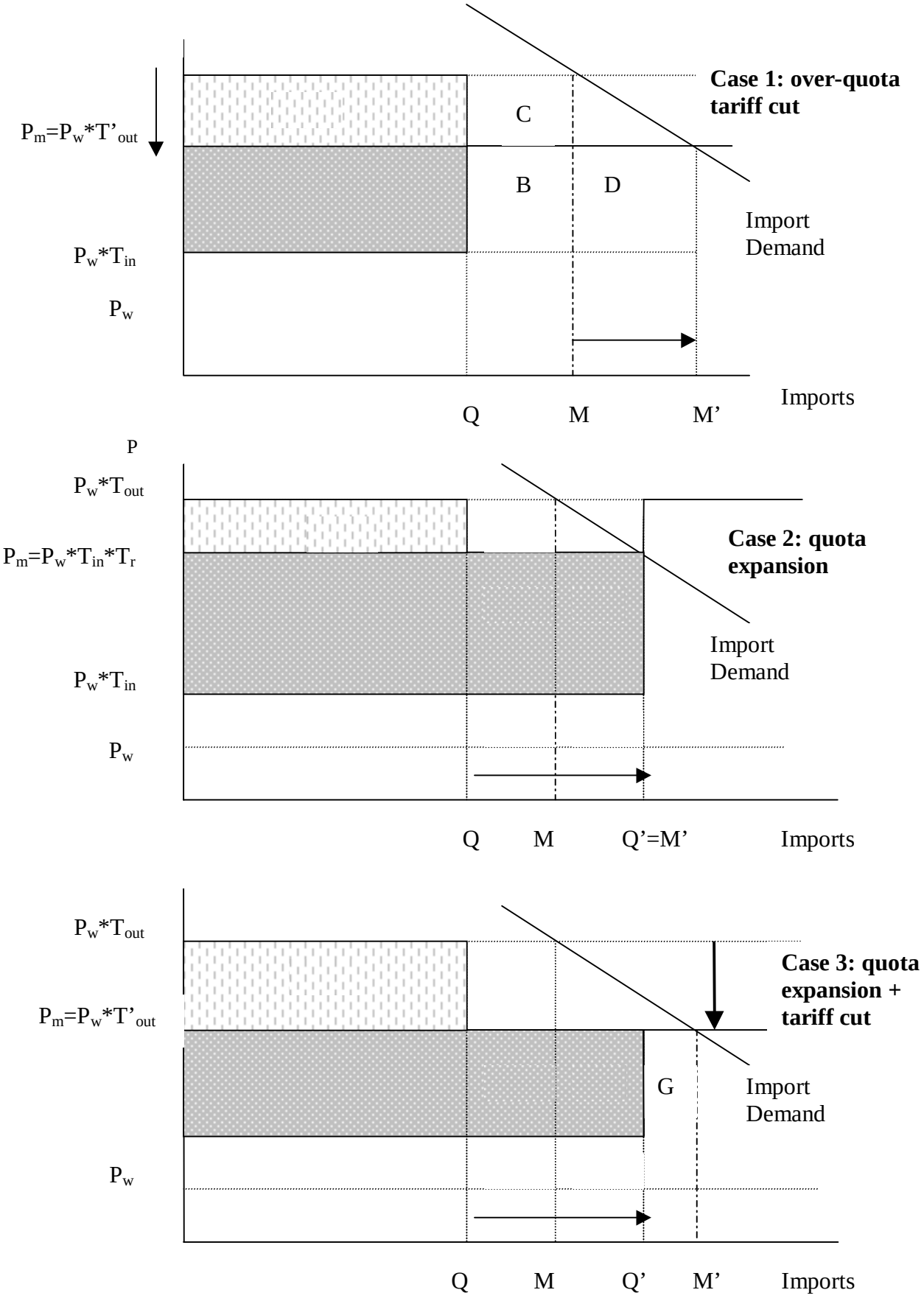

Table 1 Percantage shares of sugar imports for EU, US, and Japan by source (Benchmark database, 1995)

Importers:	EU	USA	JPN
Exporters:			
Australia (AUS)	0.3	7.6	35.0
Philippines (PHL)	0.0	7.2	0.9
Thailand (THL)	0.3	1.2	25.6
United States (USA)	0.5	0.0	5.0
Brazil (BRA)	0.6	10.2	0.0
Caribbean Americas (CAC)	5.6	28.1	9.0
Rest of Latin America (RLA)	3.5	17.7	0.3
European Union (EU)*	66.6	0.8	2.4
South Africa (SAF)	2.5	2.2	8.7
Rest of Africa (RAF)	10.2	3.7	0.0
Others	9.8	21.3	13.0
TOTAL	100.0	100.0	100.0

Source: GTAP, version 4.
*: Intra-EU trade is treated as international trade

Table 2 Sugar tariff rate quota data for the US and the EU (1996).

	Total imports ($US M)[1]	*Tariff quota ($US M)*[1]	*Quota/ total imports*	*In-quota Ad valorem tariff*	*Out-of quota Ad valorem tariff*[2]
European Union	1,351.44	1,169.81	0.87	0.00	147.00
United States	891.90	865.15	0.97	2.44	129.00

1: Values represent trade weighted average using WTO country submissions for tariff quota commodities and using average 1995-97 world import unit values from UNCTAD TRAINS. Value for the US is derived from USDA, DARTS database; 2: Source: OECD (1998)

Table 3 Model scenarios for sugar import regime liberalization

Simulation	*Description*
EU_T	Reduction of over-quota tariff rate for EU sugar TRQ by 33%
EU_Q	Expansion of sugar quota volume for EU by 33%
EU_TQ	Reduction of over-quota tariff rate and expansion of quota volume for EU sugar TRQ by 33%
US_T	Reduction of over-quota tariff rate for US sugar TRQ by 33%
US_Q	Expansion of sugar quota volume for US by 33%
US_TQ	Reduction of over-quota tariff rate and expansion of quota volume for US sugar TRQ by 33%
MULTI_T	Multilateral sugar import regime liberalization: global cut in import tariffs or over-quota tariffs by 33%
MULTI_TQ	Multilateral sugar import regime liberalization: global cut in import tariffs or over-quota tariffs and quota volume expansion by 33%

Table 4 Sugar market access liberalization: import changes in $US 1995 millions (percent changes in parentheses)

Scenarios	EU sugar TRQ Liberalization			US sugar TRQ Liberalization			Multilateral sugar impoty liberalization	
	EU_T	*EU_Q*	*EU_TQ*	*US_T*	*US_Q*	*US_TQ*	*MULTI_T*	*MULTI_TQ*
Japan	0.2	0.0	0.1	1.1	1.2	1.2	262.6	262.7
	(0)	(0)	(0)	(0)	(0.1)	(0.1)	(36.1)	(36.1)
Korea	0.0	0.0	0.0	0.1	0.1	0.1	15.7	15.7
	(0)	(0)	(0)	(0)	(0)	(0)	(3.2)	(3.2)
China	-0.2	-0.3	-0.4	-0.1	-0.3	-0.3	74.3	74.0
	(0)	(0)	(0)	(0)	(0)	(0)	(8.1)	(8.1)
Taiwan	0.0	0.0	-0.1	0.1	0.1	0.1	8.3	8.3
	(-0.1)	(0)	(-0.1)	(0)	(-0.1)	(-0.1)	(7.6)	(7.6)
India	0.1	0.0	0.1	0.0	0.0	0.0	55.6	55.6
	(0)	(0)	(0)	(0)	(0)	(0)	(32)	(32)
Rest of Asia	1.3	0.4	1.3	0.5	0.5	0.5	84.9	84.9
	(0.1)	(0)	(0.1)	(0)	(0)	(0)	(8)	(8)
Canada	-0.1	0.0	-0.1	4.4	4.9	4.9	11.7	12.1
	(0)	(0)	(-0.1)	(0.7)	(0.7)	(0.7)	(2.3)	(2.4)
United States	0.7	0.1	0.6	212.5	243.8	243.8	215.1	244.5
	(0.1)	(0)	(0.1)	(23.7)	(27.2)	(27.2)	(23.9)	(27.2)
Rest of Latin America	0.3	0.0	0.2	0.7	0.7	0.7	30.6	30.6
	(0)	(0)	(0)	(0.1)	(0.1)	(0.1)	(7.6)	(7.6)
European Union	198.5	33.7	198.1	0.2	0.2	0.2	223.0	222.6
	(5.1)	(1)	(5.1)	(0)	(0)	(0)	(5.6)	(5.6)
MENA	17.0	4.8	17.0	1.1	1.2	1.2	241.7	241.9
	(0.3)	(0.1)	(0.3)	(0)	(0)	(0)	(7.4)	(7.4)
Rest of Africa	6.2	2.6	7.1	0.0	0.1	0.1	58.3	59.3
	(0.6)	(0.3)	(0.7)	(0)	(0)	(0)	(6.9)	(7)
Rest of World	9.4	2.7	9.4	0.1	0.1	0.1	402.6	402.7
	(0.3)	(0.1)	(0.3)	(0)	(0)	(0)	(13.5)	(13.5)
Total	234.0	44.5	234.3	224.1	256.8	256.8	1701.6	1732.8
	(1.3)	(0.2)	(1.3)	(1.6)	(1.8)	(1.8)	(9.4)	(9.6)

Source: Authors' simulations

Table 5 Sugar market access liberalization: export changes in $US 1995 millions (percent changes in parentheses)

	EU sugar TRQ Liberalization			US sugar TRQ Liberalization			Multilateral sugar impoty liberalization	
Scenarios	*EU_T*	*EU_Q*	*EU_TQ*	*US_T*	*US_Q*	*US_TQ*	*MULTI_T*	*MULTI_TQ*
Australia	-3.2	-0.8	-3.0	18.7	20.1	20.1	168.8	170.2
	(-0.3)	(-0.1)	(-0.2)	(1.5)	(1.6)	(1.6)	(13.3)	(13.4)
Philippines	0.0	0.0	0.0	18.5	20.5	20.5	21.6	23.4
	(0)	(0)	(0.1)	(24.5)	(27.2)	(27.2)	(28.7)	(31.1)
Thailand	-3.1	-0.7	-2.8	-3.4	-3.5	-3.5	142.0	142.1
	(-0.2)	(-0.1)	(-0.2)	(-0.3)	(-0.3)	(-0.3)	(11.6)	(11.6)
China	23.5	7.7	23.5	-4.9	-5.5	-5.5	32.9	32.4
	(10.2)	(3.4)	(10.3)	(-2.2)	(-2.4)	(-2.4)	(14.3)	(14.1)
Taiwan	0.0	0.0	0.0	-2.1	-2.3	-2.3	-1.5	-1.8
	(0.1)	(0)	(0.1)	(-20.4)	(-22.6)	(-22.6)	(-14.8)	(-17)
India	9.9	3.1	9.9	-4.1	-4.6	-4.6	4.6	4.2
	(10.7)	(3.4)	(10.7)	(-4.5)	(-4.9)	(-4.9)	(5)	(4.5)
Rest of Asia	52.3	17.1	52.4	-0.4	-0.4	-0.4	70.8	70.9
	(20)	(6.5)	(20)	(-0.1)	(-0.1)	(-0.1)	(27.2)	(27.2)
United States	19.9	5.7	20.1	17.5	20.2	20.2	79.6	82.6
	(3.4)	(1)	(3.4)	(3)	(3.5)	(3.5)	(13.7)	(14.2)
Mexico	20.1	5.4	20.1	5.8	6.3	6.3	31.0	31.5
	(21.7)	(5.8)	(21.7)	(6.3)	(6.8)	(6.8)	(33.5)	(34)
Brazil	8.1	2.9	8.4	22.0	25.7	25.7	42.4	46.2
	(0.5)	(0.2)	(0.5)	(1.3)	(1.5)	(1.5)	(2.5)	(2.8)
Caribbean Americas	138.4	41.9	136.8	69.4	81.3	81.3	257.4	268.1
	(10.9)	(3.3)	(10.7)	(5.4)	(6.4)	(6.4)	(20.2)	(21)
Rest of Latin America	94.9	28.5	94.9	45.3	52.8	52.8	155.6	162.6
	(15.5)	(4.7)	(15.5)	(7.7)	(9)	(9)	(25.8)	(27)
European Union	-825.2	-252.3	-825.2	-6.8	-6.8	-6.8	-317.1	-314.7
	(-12.1)	(-3.7)	(-12.1)	(-0.1)	(-0.1)	(-0.1)	(-4.6)	(-4.6)
South Africa	65.0	19.1	64.9	5.4	6.3	6.3	96.5	97.2
	(24.9)	(7.3)	(24.8)	(2.1)	(2.4)	(2.4)	(36.9)	(37.2)
Rest of Africa	272.5	56.6	271.3	10.0	9.6	9.6	294.8	293.2
	(46.7)	(9.7)	(46.5)	(1.7)	(1.6)	(1.6)	(50.6)	(50.3)
Rest of World	132.2	39.7	132.4	-3.9	-4.3	-4.3	146.8	146.6
	(26.1)	(7.8)	(26.1)	(-0.8)	(-0.8)	(-0.8)	(28.9)	(28.9)
Total	234.0	44.5	234.3	224.1	256.8	256.8	1701.6	1732.8
	(1.3)	(0.2)	(1.3)	(1.6)	(1.8)	(1.8)	(9.4)	(9.6)

Source: Authors' simulations

Table 6 Welfare effects of sugar import liberalization

Scenarios	EU sugar TRQ Liberalization			US sugar TRQ Liberalization			Multilateral sugar impoty liberalization	
	EU_T	*EU_Q*	*EU_TQ*	*US_T*	*US_Q*	*US_TQ*	*MULTI_T*	*MULTI_TQ*
	Changes in sugar tariff revenues ($US million)							
United States	0.3	0.0	0.3	125.3	-52.7	-52.7	126.9	-52.7
European Union	491.3	-319.3	93.0	0.2	-0.1	-0.1	500.4	102.1
	Changes in quota rents ($US million)							
Australia	0.0	0.0	0.0	-19.0	-5.1	-5.1	-18.9	-4.9
Japan	-0.1	0.1	0.0	-0.2	-0.4	-0.4	-0.6	-0.6
Korea	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.2
Philippines	0.0	0.0	0.0	-17.6	-5.0	-5.0	-17.6	-4.8
Thailand	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
China	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Taiwan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
India	-6.5	4.7	-0.9	0.0	0.0	0.0	-6.5	-0.9
Rest of Asia	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
Canada	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
United States	-0.1	0.0	-0.1	-30.3	-8.7	-8.7	-30.5	-8.3
Mexico	0.0	0.0	0.0	-7.1	-1.9	-1.9	-7.1	-1.9
Brazil	0.0	0.0	0.0	-25.1	-7.8	-7.8	-25.1	-7.5
Carrabean Americas	-77.7	56.3	-10.8	-71.4	-23.0	-23.0	-149.2	-33.3
Rest of Latin America	-48.1	35.5	-6.6	-44.1	-13.5	-13.5	-92.3	-19.8
European Union	-124.3	90.6	-17.4	-0.2	-0.2	-0.2	-125.3	-18.6
MENA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
South Africa	-34.6	25.6	-4.8	-5.2	-1.6	-1.6	-39.8	-6.3
Rest of Africa	-138.5	114.3	-18.9	-9.2	-2.0	-2.0	-147.9	-21.0
Rest of World	-32.2	23.6	-4.5	0.0	0.0	0.0	-32.9	-5.4
	Welfare ($US million)							
Australia	0.2	0.6	0.6	-20.2	-3.2	-3.2	-1.9	15.8
Japan	3.4	-4.2	-0.8	3.6	2.3	2.3	264.7	259.1
Korea	0.7	-0.1	0.5	0.3	0.6	0.6	4.2	4.2
Philippines	0.3	0.2	0.4	-15.9	-0.2	-0.2	-15.2	0.8
Thailand	-1.1	0.0	-0.9	-1.8	-1.8	-1.8	35.5	35.7
China	1.8	0.5	1.8	0.1	0.0	0.0	11.4	11.2
Taiwan	0.6	-0.1	0.4	-0.4	-0.5	-0.5	-0.8	-1.0
India	-5.7	5.8	0.6	-0.6	-0.7	-0.7	16.4	22.5
Rest of Asia	10.8	3.5	10.8	0.0	-0.3	-0.3	17.9	17.6
Canada	1.0	0.5	1.2	1.4	3.1	3.1	1.5	3.4
United States	-5.3	-7.8	-10.3	312.5	147.6	147.6	292.3	119.8
Mexico	5.1	1.8	5.4	-6.2	0.5	0.5	0.1	7.2
Brazil	1.2	-0.2	0.7	-22.7	0.6	0.6	-17.6	5.4
Carrabean Americas	-57.7	81.8	25.2	-68.9	-5.1	-5.1	-115.2	32.3
Rest of Latin America	-46.3	45.9	3.4	-44.8	-7.2	-7.2	-94.7	-7.0
European Union	822.5	-168.3	474.7	3.7	1.0	1.0	614.1	263.7
MENA	13.7	6.7	15.9	1.1	1.5	1.5	7.9	10.7
South Africa	-33.1	35.2	4.2	-5.7	-1.0	-1.0	-35.1	7.0
Rest of Africa	-135.0	133.7	0.3	-9.7	-1.5	-1.5	-144.7	-1.2
Rest of World	-9.0	38.1	25.2	1.4	1.6	1.6	340.5	374.8
Global	568.1	173.6	559.3	127.2	137.3	137.3	1181.3	1182.0

Appendix 1 Sugar market access expansion and sugar output effects (percentage change)

(percent)

Scenarios	EU sugar TRQ Liberalization			US sugar TRQ Liberalization			Multilateral sugar import Liberalization	
	EU_T	*EU_Q*	*EU_TQ*	*US_T*	*US_Q*	*US_TQ*	*MULTI_T*	*MULTI_TQ*
Australia	-0.1	0.0	-0.1	0.8	0.8	0.8	7.0	7.1
Japan	0.0	0.0	0.0	0.0	0.0	0.0	-9.8	-9.8
Korea	-0.1	0.0	-0.1	0.0	0.0	0.0	6.7	6.7
Philippines	0.0	0.0	0.0	2.8	3.1	3.1	3.3	3.5
Thailand	-0.1	0.0	-0.1	-0.2	-0.2	-0.2	6.5	6.5
China	0.6	0.2	0.6	-0.1	-0.1	-0.1	-1.7	-1.7
Taiwan	0.0	0.0	0.0	-0.4	-0.4	-0.4	-2.3	-2.3
India	0.1	0.0	0.1	0.0	0.0	0.0	-0.9	-0.9
Rest of Asia	0.8	0.3	0.8	0.0	0.0	0.0	-0.5	-0.5
Canada	-0.9	-0.3	-0.9	12.1	13.5	13.5	12.2	13.1
United States	0.3	0.1	0.3	-5.2	-5.9	-5.9	-4.3	-5.0
Mexico	1.7	0.5	1.7	0.4	0.5	0.5	2.5	2.6
Brazil	0.1	0.0	0.1	0.2	0.2	0.2	0.3	0.4
Carrabean Americas	7.0	2.1	6.9	3.5	4.1	4.1	12.5	13.1
Rest of Latin America	1.7	0.5	1.7	0.8	1.0	1.0	2.2	2.3
European Union	-4.1	-1.2	-4.1	0.0	0.0	0.0	-2.2	-2.2
North Africa & Middle East	0.1	0.0	0.1	0.0	0.0	0.0	-1.9	-1.9
South Africa	1.1	0.3	1.1	0.1	0.1	0.1	1.6	1.7
Rest of Africa	6.3	1.3	6.3	0.2	0.2	0.2	5.9	5.9
Rest of World	1.6	0.5	1.6	-0.1	-0.1	-0.1	-5.4	-5.4

Source: Authors' simulations

Appendix 2 Sugar market access expansion: Change in sugar trade balance by region ($US 1995 millions)

Scenarios	EU sugar TRQ Liberalization			US sugar TRQ Liberalization			Multilateral sugar import Liberalization	
	EU_T	*EU_Q*	*EU_TQ*	*US_T*	*US_Q*	*US_TQ*	*MULTI_T*	*MULTI_TQ*
Australia	-3.1	-0.7	-2.9	17.9	19.3	19.3	162.6	164.0
Japan	-0.1	0.0	-0.1	-0.3	-0.4	-0.4	-271.5	-271.5
Korea	-0.1	0.0	-0.1	0.0	0.0	0.0	5.3	5.3
Philippines	0.0	0.0	0.0	18.2	20.2	20.2	21.2	23.0
Thailand	-3.1	-0.6	-2.8	-3.4	-3.5	-3.5	140.9	141.0
China	22.2	7.3	22.2	-4.6	-5.0	-5.0	-49.0	-49.3
Taiwan	0.0	0.0	0.0	-2.0	-2.3	-2.3	-10.4	-10.6
India	10.0	3.1	10.0	-4.1	-4.6	-4.6	-61.8	-62.2
Rest of Asia	52.1	17.0	52.2	-0.4	-0.5	-0.5	-11.4	-11.4
Canada	-2.4	-0.8	-2.4	32.3	36.0	36.0	29.1	31.6
United States	11.3	3.1	11.3	-234.4	-269.3	-269.3	-199.4	-232.6
Mexico	23.7	6.3	23.7	6.4	6.9	6.9	36.1	36.6
Brazil	9.4	3.4	9.8	25.3	29.7	29.7	48.6	53.1
Carrabean Americas	139.7	42.9	138.7	69.7	82.1	82.1	251.6	263.6
Rest of Latin America	90.4	27.2	90.4	44.8	52.4	52.4	118.3	125.3
European Union	-899.7	-246.3	-898.2	-3.1	-3.0	-3.0	-536.1	-534.5
North Africa & Middle East	14.8	5.0	14.8	-0.2	-0.2	-0.2	-154.5	-154.4
South Africa	64.3	19.0	64.3	5.3	6.2	6.2	93.9	94.6
Rest of Africa	264.5	54.3	263.0	9.7	9.3	9.3	247.8	245.8
Rest of World	114.2	34.3	114.4	-3.3	-3.6	-3.6	-59.0	-59.2

Note: Change in trade balance doesn't sum to zero due to fob - cif differences.