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EXTENDING GENERAL EQUILIBRIUM TO THE TARIFF LINE:

U.S. DAIRY IN THE DOHA DEVELOPMENT AGENDA

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Abstract

Market access has been at the core of eight negotiating rounds of the General Agreement on Tariffs and Trade (GATT). Yet, agricultural trade remains a heavily protected sector, characterized by higher tariffs relative to industrial goods, large tariff dispersions, numerous specific tariffs and systems of tariff-rate-quotas. This has made the analysis of trade liberalization a formidable task among policy analysts. Previous studies of agricultural trade liberalization have used partial or general equilibrium models of trade. However, each of these modeling strategies has their drawbacks. General equilibrium (GE) models have been criticized because they face serious aggregation issues and miss much of the policy detail that occurs at the tariff line. Partial equilibrium (PE) models on the other hand are often more disaggregated but lack internal consistency and have nothing to say about the economy-wide effects from trade reform. The purpose of this paper is threefold. One, we develop a methodology that combines PE and GE modeling techniques permitting us to extend GE to the tariff line. Two, we introduce a fully disaggregated U.S. dairy sector and compare PE and GE liberalization results from global dairy reform, thereby offering some insight into the potential errors implicit in current GE studies. Finally, we illustrate how our methodology allows for an explicit treatment of tariff rate quotas in the U.S. dairy sector on a bilateral basis for narrowly defined product lines.

JEL Codes: F01, F17, Q17, Q18

Keywords: agricultural trade, mixed-complementarity problem, partial equilibrium, general equilibrium, Doha Development Agenda, WTO

Introduction

Market access has been at the core of eight trade liberalizing rounds of the General Agreement on Tariffs and Trade (GATT, 1994) and its successor, the World trade Organization (WTO). The Uruguay Round (UR) of multilateral trade negotiations brought agriculture under the disciplines of the GATT (1994) for the first time. Despite these efforts, agricultural trade remains highly protected and agricultural trade policies are notorious for their complexity and detail. On the one hand, the major achievement of the UR was in limiting the type and scope of border measures countries could use, rather than creating meaningful market access opportunities. On the other hand, the complexity and height of agricultural trade barriers has made the analysis of agricultural trade liberalization a formidable task and suggests that there may be substantial welfare gains by removing these barriers in the Doha Development Agenda.

One significant accomplishment of the UR was the requirement of WTO members to convert non-tariff barriers into more transparent tariff equivalents - a process known as tariffication. The resulting UR bound tariffs were reduced by an average of 36 percent over six years for developed countries and 24 percent over 10 years for developing countries.[1] Tariffs provide the immediate benefit of achieving transparency of import protection and are preferred by exporting nations because they are predictable, are generally non-discriminatory and are easier to negotiate from in future trade rounds. However, many WTO members including most OECD countries chose to convert their non-tariff barriers into specific tariffs or establish tariff-rate-quotas. While this has made visible the high levels of protection previously hidden by non-tariff barriers, it has also made it difficult to assess the implied protection rates.

[1] Least Developed Countries were exempt from tariff reductions but either had to go through the tariffication process or bind their tariffs creating a ceiling which could not be increased in the future.

The UR round allowed WTO Members to introduce tariff-rate-quotas (TRQs) on certain commodities designated in members' tariff schedules in instances where tariffs replaced non-tariff barriers. TRQs are two-tiered tariffs characterized by a low tariff applied to a fixed amount of imports (the tariff quota) and usually a much higher tariff applied to out-of-quota imports. Thirty-eight WTO Members have TRQs designated in their schedules for a total of 1,379 individual quotas in agricultural trade. Many developed countries opted to establish TRQs in international dairy markets and many over-quota tariff rates are complex, combining elements of specific and *ad valorem* duties (Meilke et al. 1999; Skully 1999).

While the UR put in place a set of rules to govern agricultural trade, countries continue to apply a complex array of border policies. Bureau and Salvatici (2003), note that it is precisely this reason that almost all modeling efforts of agricultural trade liberalization run into major difficulties that limit the scope and accuracy of their results. Computable general equilibrium models (CGE) provide important insights of the economy-wide effects from trade liberalization. However, most if not all, CGE models face serious aggregation issues (Bureau and Salvatici, 2003). Partial equilibrium (PE) models on the other hand, are often (although not always) more disaggregated but lack internal consistency and have nothing to say about the economy-wide effects of policies and how reform in other sectors might interact with those in the target sectors. Such inter-sectoral trade-offs are the hallmark of successful trade negotiations. Furthermore, to remain tractable, most GE and PE models require an aggregation of product lines into a manageable number of sectors. Aggregating sector detail in CGE models requires an aggregation of the implied protection rates using simple averages or perhaps some more sophisticated weighting mechanism. This problem is compounded when several tariff lines

contain both *ad valorem* and specific tariffs, as well as TRQs. This is the case for most developed countries in the international dairy complex which is the focus of this paper.

To illustrate our point regarding dairy trade, consider a few of the most widely used GE and PE policy simulation models including the Global Trade Analysis Project (GTAP) model, the ERS/Penn State Trade Simulation model (PEATSim), the USDA's SWOPSIM model, the OECD's Partial Evaluation Matrix (PEM) model, the UNCTAD's Agricultural Trade Policy Simulation Model (ATPSM) and the FAO's World Food Model (WFM). The PEATSim model treats dairy as six sectors including fluid milk, butter, cheese, non-fat dry milk (NFDM), whole milk and a composite called other dairy. In the SWOPSIM, ATPSM and PEM model, dairy is broken into three or four product lines including fluid milk, cheese, butter and powder. In the other two models (GTAP and FAO), dairy is treated as just one sector.

Meilke *et al*. (1999) documents the level of product aggregation for 16 simulation studies of world and/or regional dairy trade. For 12 out of 16 studies, dairy was treated as just a single commodity sector; for two studies, dairy was disaggregated into 5 commodities; and 2 studies disaggregated dairy into seven product lines. Thus, while a high degree of product aggregation has been required from a practical standpoint in GE and PE multi-region models, to date, these models have been limited in their ability to analyze complex policies among several product lines comprising the dairy sector. Product and tariff line aggregation are one of the biggest reasons why policy results are often fundamentally different when analyzing the same set of trade liberalization scenarios (Bureau and Salvatici 2003).

Purpose

Computable general equilibrium models have grown in importance, as a tool for both research and policy analysis. In general, CGE models are usually larger (i.e. more equations) than their partial equilibrium counterparts and encompass a wider spectrum of broad issues. However

because of aggregation issues, CGE models are often too highly aggregated with respect to product specificity, are overly simplistic about policy detail and are vulnerable to missing much of the policy detail that occurs at the tariff line. This study offers a quantitative approach aimed at redressing these limitations.

This study develops a methodology that allows us to incorporate a fully disaggregated (HS-6 tariff line) sub-sector trade model inside a CGE model. Specifically, we make three important contributions.

1. We introduce a methodology that combines partial and general equilibrium analysis which permits us to extend general equilibrium to the tariff line level in selected sectors.
2. We compare sub-sector (PE) and GE liberalization results where the latter does not include the full set of dairy policy detail under a global dairy liberalization, thereby offering some insight into the potential errors implicit in current GE studies.
3. We introduce a full set of U.S. dairy border policies including an explicit treatment of the TRQs for one product line in the U.S. (HS6 040690 – other cheese).

This paper is organized into 6 sections. Section two describes the current policy set in the U.S. dairy industry. Section three introduces our model and implementation. Section four discusses the data. In Section five we present some preliminary results from modeling global and U.S. dairy reform. In Section 6, present eh results from liberalizing TRQs in the US dairy market. Finally, in section six we conclude and highlight our future research directions.

Dairy Policy Set

To demonstrate our approach we start by focusing on the U.S. dairy sector. There is continued interest in understanding the U.S. dairy market as a result of the U.S. participation in NAFTA and many other regional trade agreements as well as playing an active role in the

Uruguay and Doha rounds of trade negotiations. The U.S. is a relatively small player in the world dairy export markets. In 2001, the share of U.S. dairy exports in the global total was about 5 percent. The European Union (EU), New Zealand and Australia are the world's largest dairy exporters. On the other hand, the U.S. is the world's largest dairy importer accounting for a total of $1.5 billion in dairy product imports in 2001 (Nicholson and Bishop 2004). New Zealand, the EU and Australia are the major export suppliers to the U.S market with the most important U.S. imports being specialty cheeses and casein products (Table 1).

However, like many other developed countries, dairy protection in the U.S. comes under a variety of different guises. Table 1 shows the 24 HS-6 dairy product lines that makeup the dairy sector. For 15 out of 24 dairy commodities the U.S. has an *ad valorem* tariff policy ranging from zero to 20 percent[2]. The U.S. also applies specific tariffs with an *ad valorem* equivalent impact ranging from 0 percent to 52 percent for all but one of the 24 tariff lines. For 20 out of 24 product lines the mean specific tariff on an *ad valorem* equivalent basis is larger than the applied *ad valorem* tariff. This highlights the importance of including specific tariffs in any analysis of trade liberalization, especially in international dairy markets. It is clear from table 1 that with bound rates around 60% for this sector, there is not a lot of "binding overhang" in U.S. dairy tariffs and even a modest tariff cutting scenario in the Doha Agenda will force a reduction in many bilateral applied rates.

The U.S. has also established a system of tariff-rate-quotas under the UR agreement for 19 out of 24 HS-6 product lines. This presents trade policy analysts with a complex situation. The basic economics of tariff-rate-quotas is presented in figure one using three cases. Case 1 is analogous to a pure tariff situation as imports enter at the lower in-quota tariff rate. Case 2 is

[2] Table 1 only shows the mean tariff over all partners for a particular HS-6 product line. Note that applied tariffs are not constant across export partners.

analogous to the pure quota situation as imports enter “at the tariff quota” and domestic prices are determined by the intersection of the excess demand (ED) and the vertical excess supply (ES) function. Note that for imports which are just at the quota level, there is a discontinuity in the ES function facing the importer between the over-quota rate and the in-quota rate. In this case, the difference between domestic prices and the tariff inclusive world price, times imports, represents quota rents. TRQ rents can accrue to the importer, the exporter, or both. Who gets the rents depends on the method of TRQ administration, and this can make a big difference in the welfare impacts of trade reform. In Case 3, import quantities are above the quota level established in the UR and a higher, often prohibitive tariff applies on all imports above the quota (over-quota). Quota rents are still realized on the in-quota portion of imports while tariff revenues are collected on the difference between the over-quota tariff inclusive domestic price and the world price (over-quota tariff revenues).

Figure 6 underscores the importance of understanding TRQs for modeling purposes and for successful trade negotiations in the DDA. If all imports are within the quota level then expanding the quota level or reducing the over-quota tariff is redundant and will not improve market access conditions. However, if imports are at-the-quota or over-quota, liberalizing TRQs in the DDA should focus on expanding the minimum access commitment (the quota), reducing the over-quota tariff or a combination of both. Reducing the in-quota tariff rate will not produce any substantial market access in cases two and three.

Thus, from a CGE modeling standpoint, illustrating the gains from trade liberalization when TRQs are involved is not a trivial task. Previously, CGE models have had to use the price-wedge method which relies on domestic to international price differentials or have had to rely on an aggregated measure of TRQ protection and assume it applies to the entire sector (e.g., Elbehri

et al. 2003). However, as seen from Table 1, policies differ across narrowly defined HS6 commodities, so a sub-sector approach is required. Moreover, as discusses shortly, preferential in-quota access and TRQ rents are allocated on a bilateral basis. Previous PE models using a net trade approach have not been able to capture quota allocations and quota rents bilaterally. Yet if those countries that gain the quota rent or have preferential access at the in-quota rate are also influential in setting the agenda for further TRQ liberalization then the enthusiasm for quota expansions that may erode these quota rents and preferential access will be moderated. By combining a fully disaggregated, source-differentiated sub-sector model inside a GE framework, we are able to explicitly model these tradeoffs at the tariff line. This represents an important advancement over previous studies using applied GE or PE methods.

Methods

Our method treats the GE model as a mixed complementarity problem (Rutherford 1995), which greatly facilitates modeling of TRQs in particular. The model follows earlier work of Böhringer and Rutherford (2005) in combining a “top-down” GE model with a “bottom-up” PE model. The basic idea is to incorporate simple iso-elastic demand and supply functions into the GE model, representing the industry’s aggregate response to aggregated prices coming from the PE model. After each PE solution, the GE model is recalibrated to reflect the new quantity level emerging from the PE model. Convergence is typically achieved after just a few iterations, once the quantity predictions by both PE and GE models are in agreement. This methodology permits us to integrate a fully disaggregated U.S. dairy sector consisting of 24 HS-6 product lines into a standard-sized GE model of global trade reform of 14 regions and 15 sectors, where the latter is implemented following the GTAP-in-GAMS model (Rutherford, 2005).

The partial equilibrium model is implemented in GAMS and mirrors the broad structure of the GTAP model, namely products are differentiated by origin in the manner of Armington (1969), and imports from different sources are aggregated into a composite good before substituting for domestically produced output. As with GTAP, we employ the "rule of two" by which the import-import substitution elasticity is twice as large as the import-domestic elasticity. In our base case, we adopt the values used in GTAP for these Armington elasticities (*etsubm*), 7.3 for import-import substitution and 3.65 for import-domestic substitution. These are clearly the most important parameters in this modeling exercise, as they determine the degree to which reductions in the tariffs reported in table 1 will affect trade flows within the industry. Fortunately, this parameter has been estimated with a fair degree of precision on disaggregated dairy import data for the US and several other importers (Hertel et al., 2004). In that study the Armington parameter was constrained to be equal for all product lines in the dairy sector. It is likely that its value varies considerably between relatively homogeneous products such as skim milk powder, and more differentiated products, such as cheese. As a sensitivity exercise, we vary these import elasticities by a factor of two in the PE model, in order to assess the impact of greater substitutability in demand.

In addition to the Armington parameters, there are two other key elasticities in our PE model. The first of these (ertnss) governs the ease with which the dairy sector can change its output mix. In the PE model, aggregate output (as determined by the GE model) can be transformed amongst 24 different sub-sector products, based on a constant elasticity of transformation. Because all of these products share the same basic input – fluid milk – we are inclined to believe that this transformation elasticity should be quite large, in absolute value. Of course, in the near term, for very large increases in a given dairy product, capacity may become a

constraint, and this can be evaluated *ex post* to see whether it is an issue. In our base case, we set the absolute value of this transformation elasticity (etrnss) equal to 4.0.

The other parameter required by our PE model is the elasticity of substitution in consumption (*esubc*) between the different dairy sub-sector products, once the latter have been aggregated across sources. In other words: how responsive are consumers to price when choosing among different types of cheeses, or between fresh milk and yogurt products? While this substitutability is surely larger than that between dairy products as a group and other food items, we are inclined to believe this is not nearly as large, in absolute value, as the transformation elasticity. So we set it equal to 1.0, and sub-sector supply is much more elastic than demand, at the product level.

Finally, our PE model does not require an elasticity of transformation between domestic sales and exports, as this is assumed to be infinite. This matches our assumption in the GE model, as well as that in the standard GTAP model.

Data

For the analysis we draw on the most detailed global dataset available at the HS6 tariff line: MAcMap (Bouët et al. 2004). This dataset has been developed jointly by the International Trade Center in Geneva (ITC) and Paris-based CEPII. MAcMap includes an exhaustive list of applied and bound *ad valorem* and specific tariffs, tariff-rate-quotas, as well as taking into account an extensive list of tariff preferences. Since this is done for all merchandise trade, the MAcMap dataset offers a unique snapshot of world protection and trade flows for 163 countries and 208 partners in 2001.

For our “top-down” aggregated GE model we rely on the widely used GTAP data set. Specifically, we draw on version 6 of the GTAP data base (Dimaranan, 2006). While the GTAP

data base uses MAcMap as an input to its protection module, and therefore the two are consistent here, the same is not true of the trade data. GTAP trade data are compiled by Mark Gehlhar (Gehlhar, 2006), whereas the MAcMap bilateral trade data come from the CEPII data base. For this reason, the two must first be reconciled. This is done in two steps. First, intra-EU trade is eliminated from the GTAP data base. These flows are not available at the sub-sector level, so we prefer to eliminate intra-EU trade at the GE level as well, rather than trying to create trade flows in some arbitrary manner. Secondly, we adjust the bilateral CEPII, sub-sector trade data to match the dairy product industry bilateral aggregate flows at the GE level. At this point both PE and GE models agree on the total amount of dairy industry trade between partner countries in the model.

To incorporate the TRQs into the sub-sector model, we draw on the HS-8 digit level Agricultural Market Access Database (AMAD)[3]. To illustrate our methodology, we start by modeling a particular US TRQ regime for HS-6 line 040690 which includes cheese except fresh, grated, processed or blue-veined (herein referred to as other cheese). Table 2 lists eight of our 14 model exporters which face a US TRQ policy along with the value and quantity traded, the quota level, the fill ratio and the in and over-quota tariff rates.

To aggregate the TRQ information from HS-8 to HS-6 digit level we performed a few calculations. First, the quota or minimum access level is defined as a quantity (kg) (AMAD, 2002). Thus, we need import quantities at the HS-8 digit level to determine which TRQ regime is binding. U.S. import quantities of other cheese at the HS-8 digit level were taken from the U.S. International Trade Center's (USITC) Interactive Trade Data Web (USITC, 2005) for the year 2001. Next we need to aggregate the HS-8 digit level TRQ information to the HS-6 digit level used in our model on a bilateral basis. To aggregate up to the HS-6 digit level, we used a value share weighted aggregation across model countries to aggregate imports, in-quota tariffs,

[3] AMAD is available at: www.amad.org.

over-quota tariffs and the quota level.[4] Once protection and quota rates were aggregated to the HS-6 digit level, all specific tariffs were converted to an *ad valorem* equivalent using a 2001 international reference price defined as the world import unit value price for a particular HS-6 product category.[5] Note these rates only vary by product line (HS6).

Table 2 illustrates the computed TRQ information at the HS-6 level. The first thing to note is that 8 out of our 14 model countries face a TRQ policy in the US. For 6 out of 8 of these countries the TRQ is binding depicted by a fill ratio greater than one. Thus, with the exception of Central America and Caribbean Countries (LAM) and Rest of Europe countries (ROE) who face an in-quota tariff of 11 and 8 percent respectively, the other six model countries face an over-quota tariff ranging from 43 to 67 percent.

Results

The results are organized in two scenarios. Scenario one discusses the results from a global dairy liberalization experiment in terms of the effects on welfare, trade and production. In each case the results of the "top-down" GE model and the "bottom-up" PE model are compared. Scenario two discusses the effects of TRQ liberalization in the U.S for other cheese (table 1). In this scenario, we progressively expand the tariff quota level to the point where it becomes non-binding for all countries. The discussion focuses on the trade, output, price and tariff quota rents associated with liberalization.

Scenario 1: Global Dairy Liberalization

Figure 2 depicts the welfare results defined in terms of equivalent variation as a percentage of total domestic demand, for eight representative countries and three combinations

[4] Note that the AMAD database also details a fairly exhaustive list of quota allocations by partner. AMAD quota allocations also include an "other" category such that any residual quota remaining is allocated equally across any remaining countries.

[5] For more information on the construction of the *ad valorem* equivalent of specific tariffs see Paul Gibson's WTO Tariff Level Dataset available at: http://www.ers.usda.gov/db/Wto/WtoTariff_database/

of parameters (etrnss = 4; esubc = 1; esubm = 1 or 2).[6] The first thing to note is how well the "top-down" GE model does in getting aggregate welfare right when the GE and PE parameters are equal (ertnss=4; esubc=1; esubm = 1). In New Zealand's (NZL) case, moving to a free trade situation in dairy results in a 5.4 percent increase in welfare predicted by the "top-down" (GE) model. Similarly, the sub-sector model predicts a 4.8 percent increase in welfare and a slightly larger 6.1 percent increase when we double the import-import substitution elasticity. This is no surprise since New Zealand is the world's top dairy exporter with very low rates of protection and subsidies granted to dairy producers, and stands to gain the most from global dairy reform. In terms of aggregate welfare for the other countries, both models agree on the welfare response to dairy trade liberalization with only small differences across all parameter choices.

Figure 3 shows the output predictions by both models for the same eight countries and parameter inputs. In this case, the GTAP (GE) model tends to under-predict the overall change in aggregate output and in some cases by an order of magnitude. The dairy sector output response in Australia (AUS), another large exporter, is 40 percent using the GE model and slightly larger (47%) in the sub-sector model when the Armington elasticities in the GE and sub-sector model agree. However, when the sub-sector Armington elasticity is doubled (esubm=2) the GE model seriously under predicts the output response. In the case of AUS, the sub-sector output response is a 104 percent increase. Similar differences in output responses occur in all other countries with the exception of NZL and the USA.

Finally, to get an idea of how well the GE and sub-sector models agree on the change in bilateral trade flows under global dairy reform, table 3 presents some simple regression results. In each regression, the simulated sub-sector (PE) bilateral trade flows are regressed on an

[6] Recall ertnss is the elasticity of transformation across sub-sector goods; esubc is the elasticity of substitution multiplier across sub-sector goods (equal to 1) and esubm is the sub-sector armington elasticity multiplier (equal to one or two).

intercept and the simulated GTAP (GE) trade flow response. In this way, we can judge how well the "top-down" (GE) model predicts sub-sector trade flows. Six regressions are reported in table 3, one for each set of sub-sector parameters.

The regression results indicate that when the Armington elasticity multiplier is one (columns 1 and 3), the GE model performs quite well as a predictor of the sub-sector bilateral trade flow response. In parameter setting (1), a significant slope coefficient of 0.90 suggests that GTAP trade flows would have to be scaled down by a factor of only 0.90 on average to match sub-sector trade flows. The GE and sub-sector models are even closer in parameter setting (3) with a slope coefficient of 1.04. However, when we double the Armington elasticity for sub-sector trade, the GE and sub-sector model predictions differ widely. For example, for sub-sector parameter setting (4), a statistically significant slope coefficient of 6.04 suggests that the GE simulated trade flows seriously under predict sub-sector trade flows and would have to be scaled up by a factor of six. Similar regression results are obtained for other parameter combinations in which the Armington elasticity multiplier is two (columns 2, 5 and 6).

To summarize, when we disaggregate to a much finer classification of goods, like we have done for the dairy sector, we expect to see a larger substitution among imports and between imports and domestic goods justifying the increase in the Armington elasticities. When we allow for greater substitution across sub-sector goods, the simulated GE response of output and trade flows from both scenarios tends to under predict the corresponding output and trade flow responses generated at the sub-sector level. However, in terms of aggregate welfare, the two models are remarkably consistent.

Scenario two: Liberalizing the U.S. tariff-quota on other cheese

In this scenario we liberalize the U.S. tariff-quota policy on other cheeses (040690, table 1) by expanding the quota level in ten percent increments until the quota is no longer binding for all countries[7].

Figure 4 illustrates the amount of over-quota imports after successive quota expansion. If the DDA were to negotiate a 20 percent quota expansion (1.2), Canada (CAN) would be the only country to move out of case 3. A 40 percent expansion in the minimum access quota level would move NZL out of case 3. However, whether the benefits of increased import opportunities for CAN and NZL are enough to offset the loss in quota rents is clearly an empirical question to be addressed shortly.

Figure 5 depicts the amount of in-quota imports using the same increments of quota expansion. To highlight the composition of US in-quota imports, we have included an additional exporter, the Rest of Europe (ROE) who is in-quota (case 1) in the baseline. As expected, in-quota imports increase (linearly) for all countries with each incremental quota expansion even when countries are in regime 2. However, as the US tariff-quota expands sufficiently, countries like CAN and NZL enter regime one and see their in-quota imports decline slightly before stabilizing. The small decrease in in-quota imports on the part of CAN and NZL is a result of the steady rise in EU15 in-quota imports. Interestingly, ROE in-quota imports are largely displaced as the U.S. expands its total imports from countries moving from over-quota (case 3) to the quota level (case 2) and then in-quota (case 1) (CAN, NZL and EU15).

Figure 6 displays the value of the tariff-quota rents on a bilateral basis. The first thing to note is the ability of our model to determine the value of these rents on a bilateral basis. Moreover, we are also able to show when quota rents disappear and the speed with which they

[7] For clarity, we present the results for the EU15 on the secondary vertical axis.

disappear. For example, tariff quota rents in NZL, an important source for US imports demand, increase at the same rate as the EU15 when both countries remain over-quota (case 3). However, with sufficient quota expansion (40 percent (1.4)), NZL enters case 2 (just at the quota level) and tariff quota rents dissipate quickly, reaching zero with a 90 percent quota expansion (1.9). From NZL's perspective in the trade negotiations and assuming that the quota rents accrue to the exporters, it can benefit from increased trade and quota rents as long as the U.S. quota expansion is less than 40 percent. Larger quota expansions such as 50 and 60 percent will result in NZL's quota rents falling substantially with the EU15 and South American (SAM) countries continuing to gain. Thus, increased TRQ liberalization in the DDA is likely to benefit some but at the expense of others whose quota rents are eroded.

Conclusion

Market access continues to be a contentious issue in the DDA. This is particularly true in agriculture, where many WTO members have made it clear that they are unwilling to negotiate on other topics until a suitable agreement on agriculture exists. Policy analysts interested in the effects of further trade liberalization often face a tradeoff: on the one hand, they can use a general equilibrium framework which typically requires a large degree of aggregation (the GTAP data base offers a maximum of 57 sectors); or constructing a partial equilibrium model that can be more disaggregated but has nothing to say about the general equilibrium effects and the overall impact of an agreement. We developed a methodology that bridges this gap by nesting a fully disaggregated PE model within a GE framework so that policy analysts can enjoy the best of both worlds.

We illustrated our approach by disaggregating global dairy trade into 24, HS-6 product lines, ranging from skim milk powder to yogurt, whey, blue cheese, etc. This is the level of detail

at which serious negotiations take place. We focused special attention on the United States, which is the world's most important dairy importer, and which restricts imports of many dairy products, using a mix of *ad valorem*, specific, and quota-driven tariffs (TRQs). One of our goals was to assess how well the aggregate GE model captures the impact of trade reforms

We find that the aggregate GTAP model does a remarkably good job of predicting the aggregate welfare impacts of global dairy trade reform. However, when it comes to predicting the global allocation of output in the dairy industry, the GE model performs more poorly. In general, it greatly understates the change in industry output that arises when the reform is analyzed at the sub-sector level and then aggregated up (PE/GE approach). The differences between the two models are even more striking when one focuses on bilateral trade flows. Here, the GE model does a good job of predicting sub-sector trade flows in our base case that includes identical Armington elasticities, and elastic supply relative to demand. However, when we double the disaggregated Armington elasticities, as might well be justified in a product-line model, the GE model under predicts the bilateral changes in some cases by a factor of six.

We also illustrated how partial reform of the U.S. TRQs on a bilateral basis has important impacts on trade, prices, the value of tariff quota rents and ultimately on economic welfare. The results indicate that partial reform of U.S. TRQs on the order of 20-40 percent expansion will benefit most countries through increased trade and quota rents. However, exporting countries that do not face a binding TRQ policy initially see their bilateral trade with the US being displaced as binding countries move out of quota. Furthermore, there are a few sensitive TRQ expansions where exporting countries see their quota rents evaporate (NZL and CAN) while other countries (EU15 and SAM) expand their trade and quota rents. Thus, those countries

whose rents are evaporated from partial TRQ reforms may not be enthusiastic supporters of large quota expansions in the DDA.

Future research will consider the differential impacts of liberalizing dairy imports by expanding the TRQ quota, versus cutting the out of quota tariff as well as simultaneous reforms. We expect this to have very different impacts on the welfare of exporters, who currently obtain the rents associated with in quota imports of products for which the marginal flow pays the out of quota tariff. Furthermore, while the US applies a mix of dairy border policies, its tariff rates and over-quota TRQ rates are some of the *lowest* in international dairy trade. For example, over-quota tariff rates on many dairy imports in Canada and Japan are in the neighborhood of 250 and 747 percent respectively (AMAD, 2001). However, whether the TRQ is binding and the method of TRQ administration are important considerations.

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Table 1. US Dairy Import Shares and Protection

Description	Import Value Share (%)	Mean Ad Valorem Tariff (%)	AVE of Specific Tariff (%)	TRQ
Milk not concentrated nor sweetened < 1% fat (040110)	0.048	0.00	0.5	No
Milk not concentrated nor sweetened 1-6% fat (040120)	0.275	0.00	2.2	No
Milk and cream not concentrated nor sweetened < 6% fat (040130)	0.729	0.00	33.7	Yes
Milk powder < 1.5% fat (040210)	1.124	0.00	2.0	Yes
Milk and cream powder unsweetened < 1.5% fat (040221)	0.979	0.00	19.5	Yes
Milk and cream powder sweetened < 1.5% fat (040229)	0.137	2.1	3.8	Yes
Milk and cream unsweetened, concentrated (040291)	0.237	0.00	11.74	Yes
Milk and cream nes sweetened or concentrated (040299)	1.066	3.7	17.8	Yes
Yogurt (040310)	0.520	3.5	7.8	Yes
Buttermilk, curdled milk, cream, kephir, etc. (040390)	0.363	2.1	26	Yes
Whey and modified whey(040410)	1.068	1.0	14.8	Yes
Natural milk products nes (040490)	3.429	2.0	4.6	Yes
Butter (040510)	1.977	0.00	26	Yes
Dairy spreads (040520)	1.708	3.0	23.9	Yes
Other milk fats and oils (040590)	2.423	0.9	5.0	Yes
Fresh cheese, unfermented whey cheese, curd (040610)	0.918	1.4	30.2	Yes
Cheese, grated or powdered, of all kinds (040620)	1.255	4.5	17.0	Yes
Cheese processed, not grated or powdered (040630)	2.228	4.0	21.5	Yes
Cheese, blue-veined (040640)	1.848	10.0	6.3	Yes
Cheese except fresh, grated, processed or blue-veined (040690)	52.301	4.6	20.1	Yes
Lactose & syrup containing weight 99 % or more lactose (170211)	0.213	4.7	0.00	No
Lactose and lactose syru (170219)	0.086	5.3	0.00	No
Ice cream and other edible ice (210500)	1.584	16.4	3.5	Yes
Casein (350110)	23.483	0.00	0.03	No

Note: AVE denotes *ad valorem* equivalent
HS-6 digit commodity concordances are given in parentheses

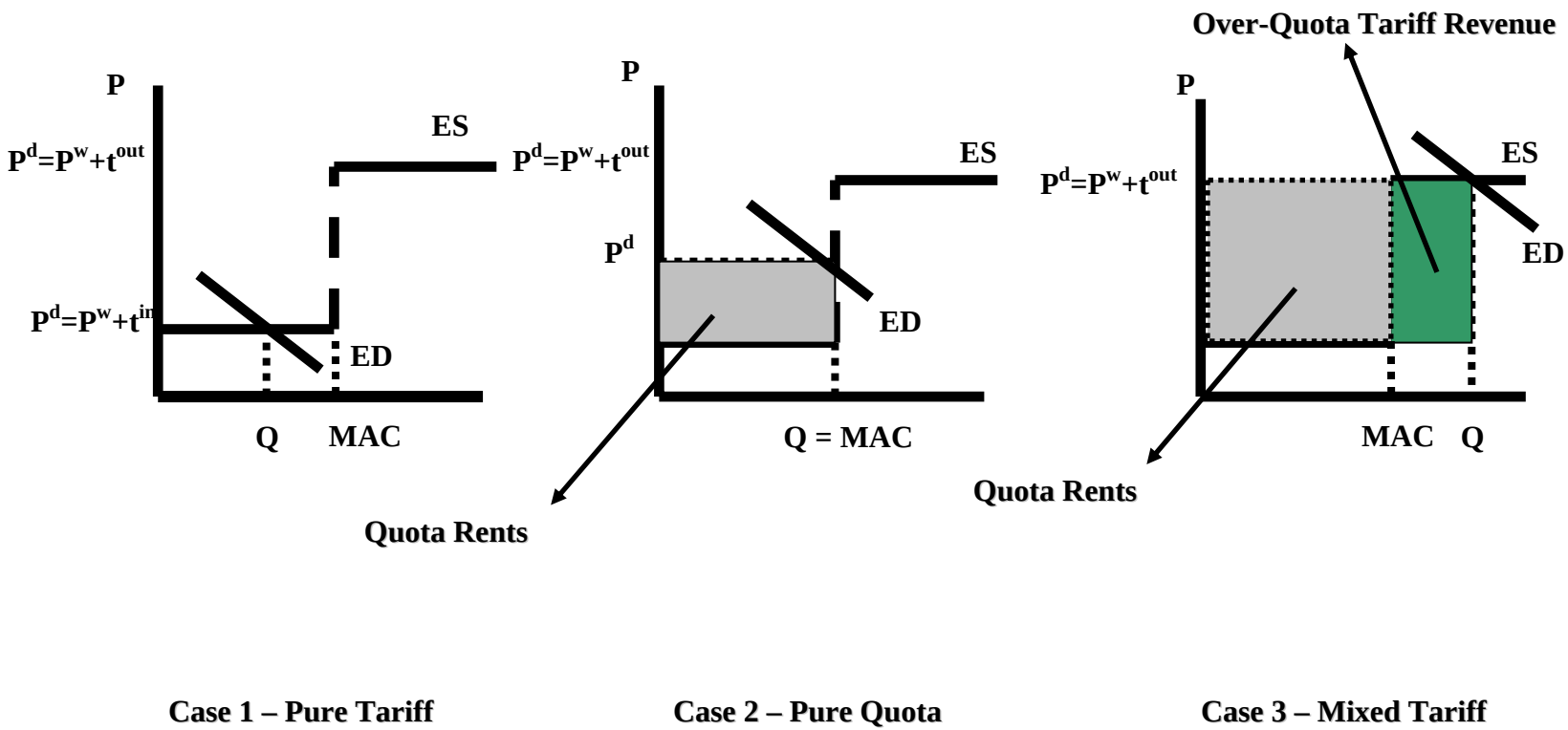

Figure 6. The economics of tariff-rate-quotas (TRQs)

Table 2. Illustration of TRQ detail for HS-6 line 040690 (Other Cheese)

Partner	Value ($)	Trade (kg)	Quota (kg)	Fill Ratio	Iqtariff (%)	Oqtariff (%)
Argentina	19,500,000	5,298,339	4,754,993	1.11	13.9	67.0
Australia	5,939,026	2,316,269	1,292,719	1.79	11.5	42.2
Canada	3,764,732	979,656	874,929	1.12	10.8	44.5
European Union (15)	17,500,000	4,067,250	2,445,409	1.66	9.7	54.9
Caribbean Communities	541,568	124,475	194,835	0.64	11.1	43.1
New Zealand	26,600,000	10,663,833	7,926,723	1.35	11.0	43.8
Rest of Europe	16,300,000	3,508,802	3,735,956	0.94	7.9	56.0
South America	3,747,041	1,029,156	464,549	2.22	13.2	64.9

Value = value of trade in $USD
Trade = quantity of trade in (kg)
Quota = the US Tariff Quota level in (kg)
Fill Ratio = the quota ratio of Trade (kg) divided by the Quota Level (kg) to determine if a partner is in/over quota
iqtariff = in-quota tariff
oqtariff = over-quota tariff
* Bold indicates the relevant tariff revenue values.

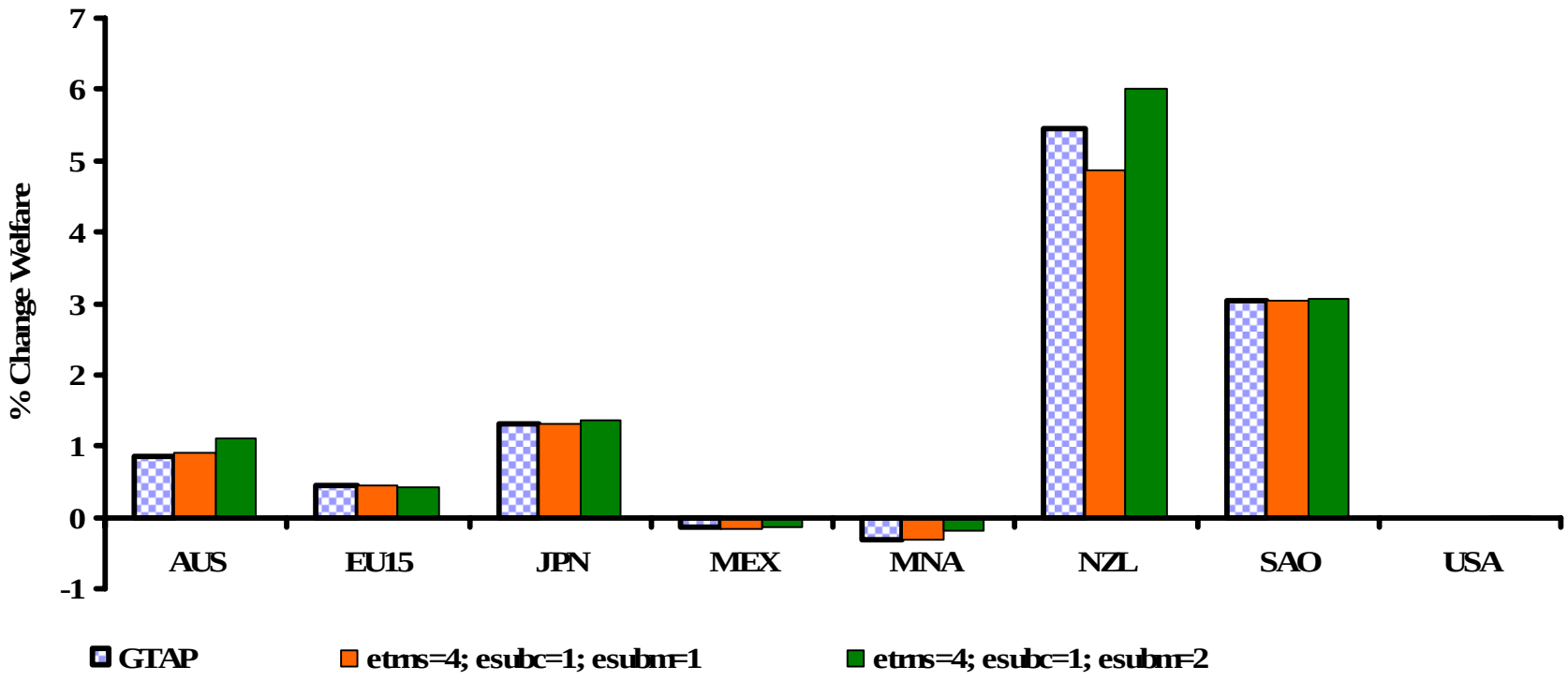

Figure 2. Welfare comparisons - global dairy liberalization.

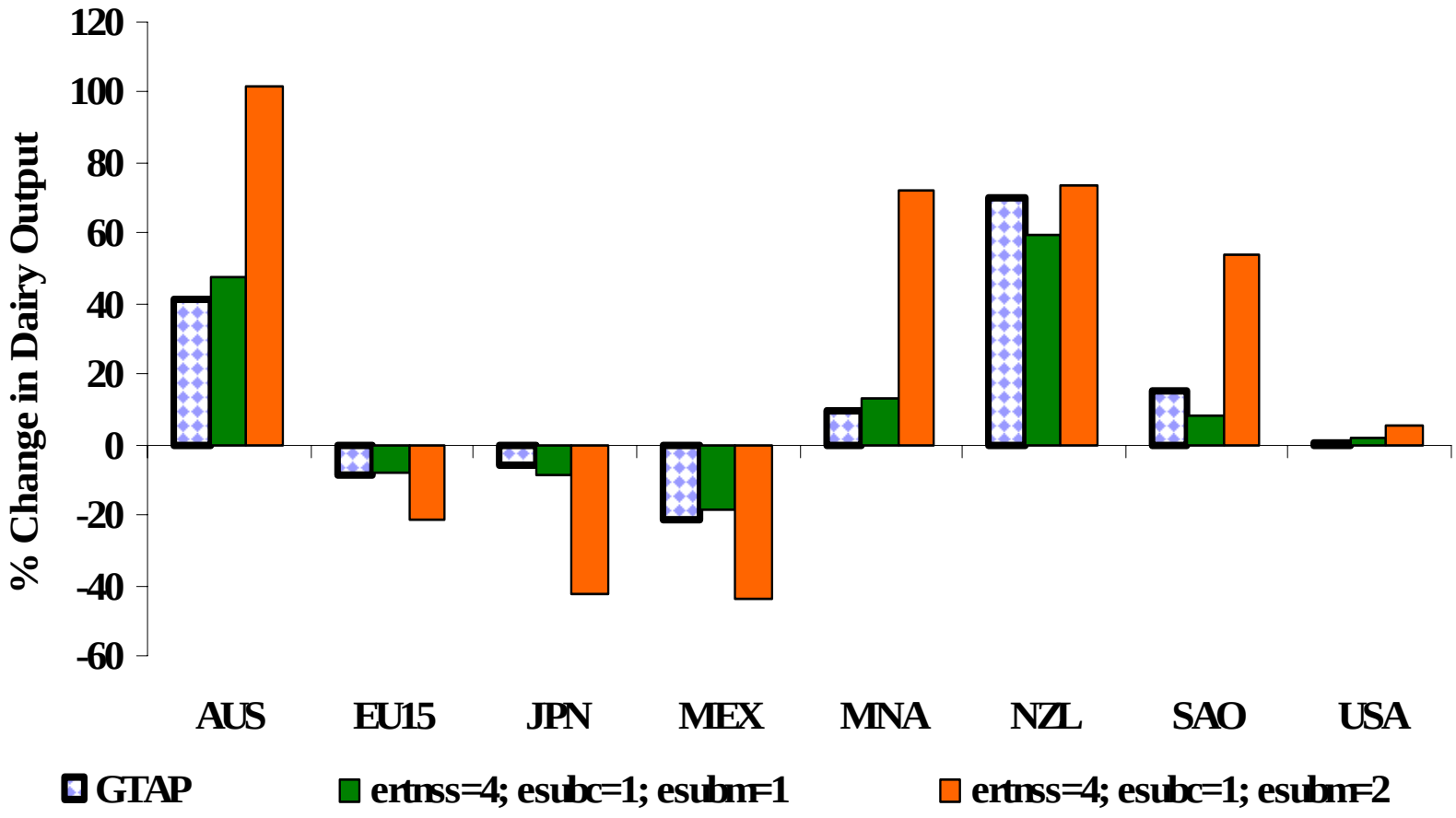

Figure 3. Output comparisons – global dairy liberalization

Table 3. Regression results for bilateral trade comparison – global dairy liberalization

	----------Parameter Settings----------					
	(1) ***[a]ertnss = 4*** ***esubc = 1*** ***esubm = 1***	***(2)*** ***[a]ertnss = 4*** ***esubc = 1*** ***esubm = 2***	***(3)*** ***[a]ertnss = 4*** ***esubc = 2*** ***esubm = 1***	***(4)*** ***[a]ertnss = 4*** ***esubc = 2*** ***esubm = 2***	***(5)*** ***[a]ertnss = 2*** ***esubc = 1*** ***esubm = 2***	***(6)*** ***[a]ertnss = 2*** ***esubc = 2*** ***esubm = 2***
Intercept	13.85	12.57	-3.22	-18.15	51.4	22.84
	(43.79)	(286.9)	(2.00)	(295.1)	(264.9)	(274.8)
Slope	0.90	5.68	1.04	6.04	5.12	5.44
	(0.07)	(0.46)	(0.003)	(0.49)	(0.44)	(0.46)
R-squared	0.50	0.48	0.99	0.50	0.47	0.48
No. Obs.	157	157	157	157	157	157

Note: each regression (1-6) is run separately. Standard errors are in parentheses.

[a/] etrnss denotes sub-sector transformation elasticity
esubc denotes the elasticity of substitution multiplier (multiplies GTAP value for sub-sector goods)
esubm denotes the sub-sector Armington elasticity multiplier (multiplies GTAP value for sub-sector goods)

[b/] In all regressions the slope variable is the GTAP (GE) simulated data as a predictor of the sub-sector trade (dependent variable) under alternative parameter settings depicted in the columns

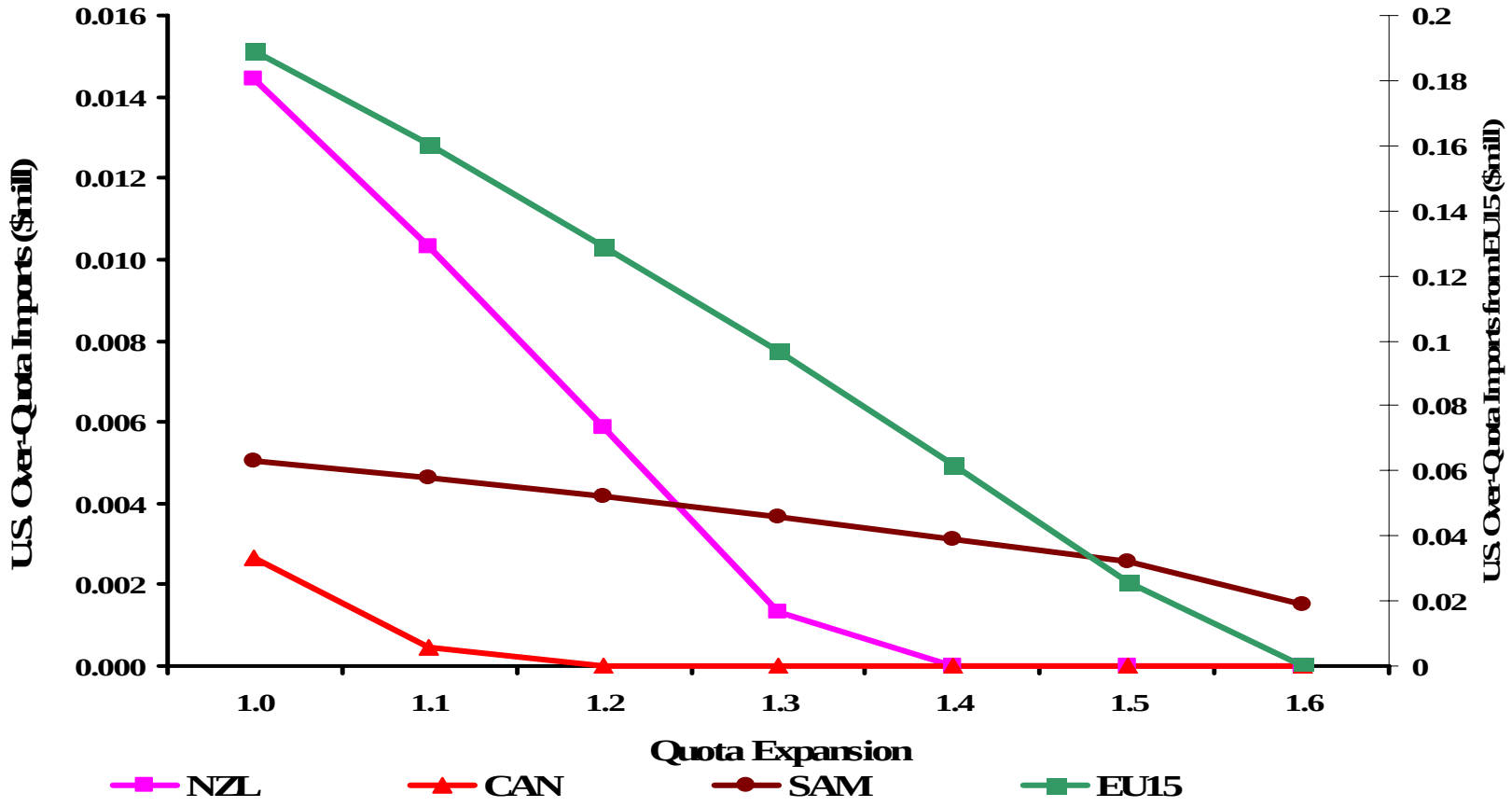

Figure 4. Over-quota imports with progressive quota liberalization

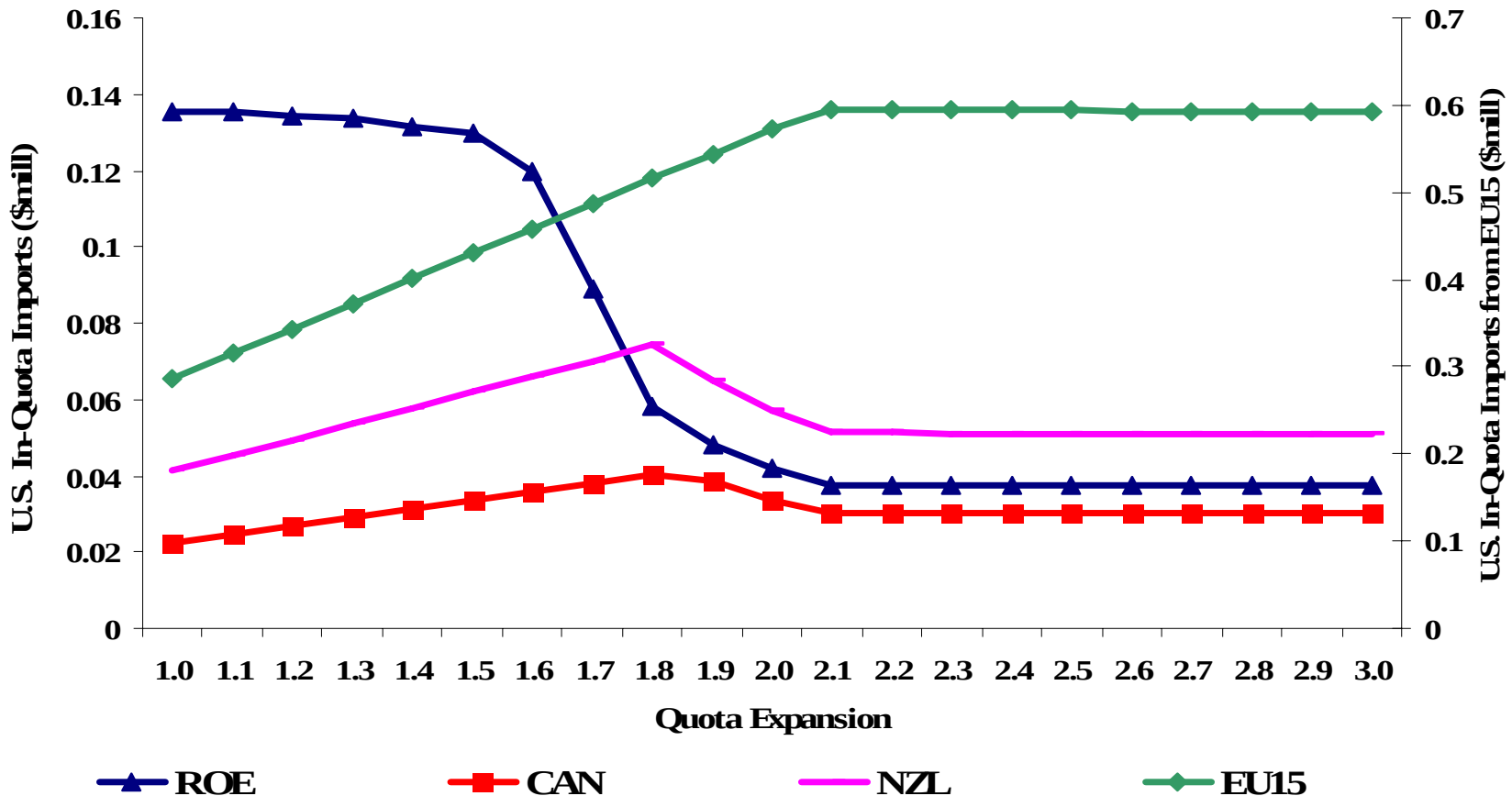

Figure 5. U.S. In-quota imports from selected exporters

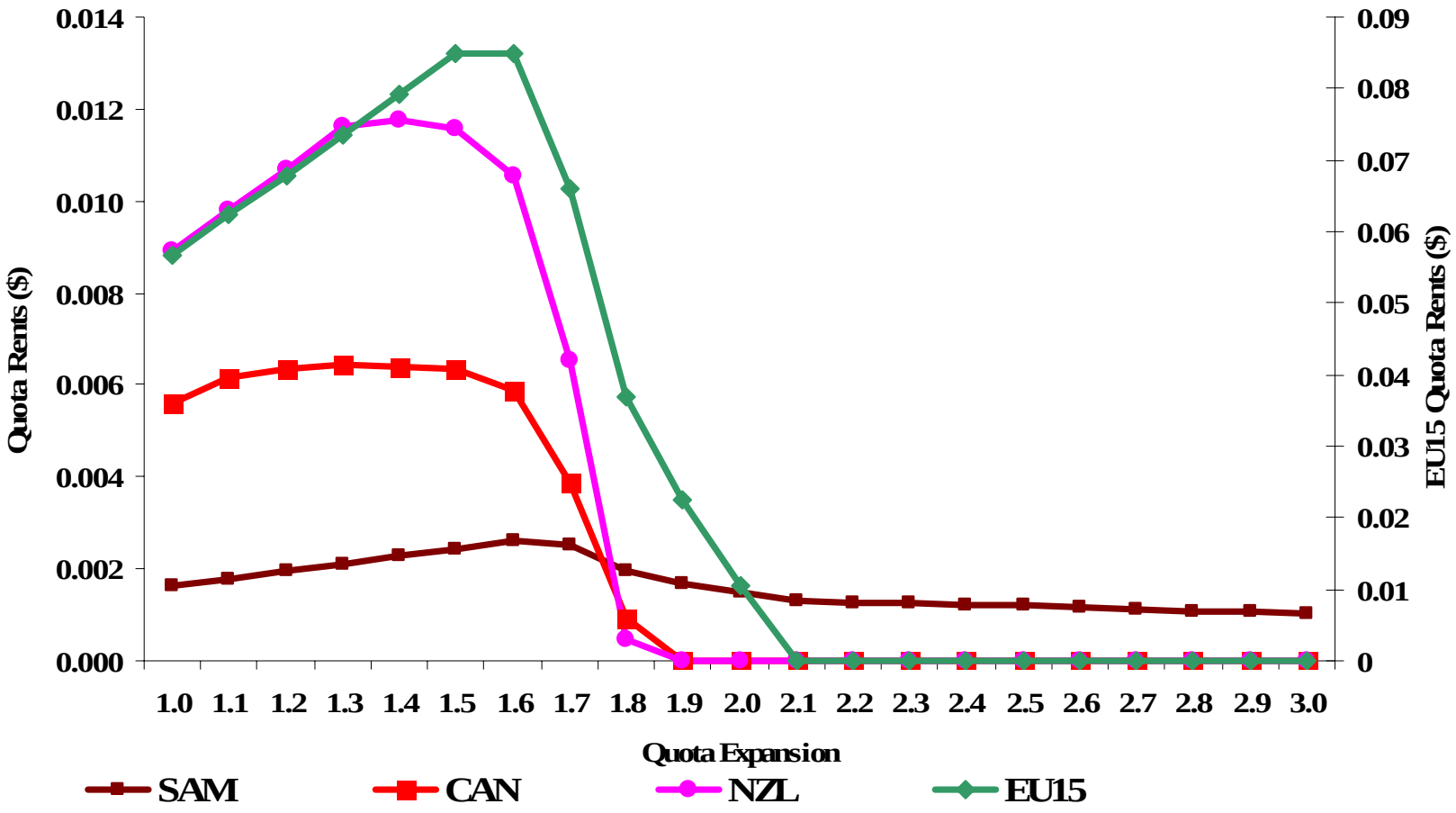

Figure 6. Value of tariff quota rents for selected countries