EXTENDING GENERAL EQUILIBRIUM TO THE TARIFF LINE:

U.S. DAIRY IN THE DOHA DEVELOPMENT AGENDA

Jason H. Grant

Thomas W. Hertel

Thomas F. Rutherford

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Department of Agricultural Economics, Purdue University, 403 W State Street, West Lafayette, IN 47907-2056, jhgrant@purdue.edu, hertel@purdue.edu
Ann Arbor Michigan, tom@mpsge.org

Introduction

Agricultural trade policies are notorious for their complexity and detail. This has always made the analysis of agricultural trade liberalization a formidable task. The Uruguay Round (UR) of multilateral trade negotiations brought agriculture under the disciplines of the General Agreement on Tariffs and Trade (GATT), 1994 for the first time. One of the cornerstones of the UR was the requirement of WTO members to convert non-tariff barriers into more transparent tariff equivalents through a process known as tariffication. The resulting 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] The UR round also allowed members to introduce systems of tariff-rate-quotas (TRQs) on certain commodities designated in members' tariff schedules. These TRQs are typically characterized by a low tariff applied to a fixed amount of imports (the tariff quota) and a much higher tariff applied to out of quota imports. Many developed countries opted for this alternative, especially in international dairy markets (Meilke et al. 1999).

Despite these efforts to bring agriculture under the disciplines of the GATT, 1994, countries still maintain 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 and market access run into major difficulties that limit the scope and accuracy of their results. Typically, the limitations and criticisms of modeling trade liberalization arise for two reasons, one related to aggregation issues, and the second, due to the lack of a reliable and consistent protection dataset.

[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.

Several partial and general equilibrium (PE and GE) trade models have been used to assess the impacts of agricultural reform and increased market access on the welfare of economic agents.[2] 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.

The lack of a reliable and consistent protection dataset also limits the scope of both GE and PE analyses. For tractability, 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, USDA's SWOPSIM model, OECD's Partial Evaluation Matrix (PEM)

[2] The Global Trade Analysis Project (GTAP, Hertel 1997); the Static World Policy Simulation Model (SWOPSIM, Roningen et al. 1991); The World Food Model (FAO 1995); the Agricultural Trade Policy Simulation Model (ATPSM, UNCTAD, 1995); The World Trade Organization Model (WTOM, Francois, 1995); the FAPRI Model (Devadoss, et al. 1989) and the FAPRI-UMC World Dairy Model (Cox and Zhu, 1997) are important contributions.

model, UNCTAD's Agricultural Trade Policy Simulation Model (ATPSM) and the FAO's World Food Model (WFM). In 3 out of 5 of these models (SWOPSIM, ATPSM and the 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 document in detail 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. Bureau and Salvatici (2003) claim that 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.

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, CGE models of trade liberalization are often too highly aggregated with respect to product specificity and are overly simplistic about policy detail. Because of aggregation issues, CGE models 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.

The purpose of this study is to develop a methodology that allows us to incorporate a fully disaggregated (HS-6 tariff line) sub-sector trade model inside a CGE model. More specifically we make three important contributions in this study.

1. We introduce a methodology that blends partial and general equilibrium analysis which permits us to extend general equilibrium to the tariff line level in selected sectors.
2. We compare and contrast sub-sector (PE) results with GE liberalization results that does not include full policy detail focusing on the US and global dairy liberalization, thereby offering some insight into the potential errors implicit in current GE studies.
3. We illustrate how our methodology can incorporate a full set of dairy policy detail including explicit treatment of TRQs.

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. 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[3]. 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. First of all, if import quantities are above the quota level established in the UR then a higher, often prohibitive tariff applies on all imports above the quota

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[3] 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.

(over-quota). For imports which are just at the quota level, there is a discontinuity in the excess-supply function facing the importer between the over-quota rate and the in-quota rate. Furthermore, if the quota is filled, TRQs generate rents that 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.

Thus from a CGE modeling standpoint, illustrating the gains from trade liberalization when TRQs are involved is not a trivial task. By nesting a fully disaggregated partial equilibrium model inside a GE framework, we are able to explicitly model all of these policies at the tariff line level. This represents an important advancement over previous studies using applied GE methods. Previously, these models 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 HS-lines, so a sub-sector approach is required.

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 import good before substituting for domestically produced output. As with GTAP, we employ the so-called "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 the sub-sector Armington elasticities (*etsubass*), 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 particular 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 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 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. In our sensitivity analysis, we reduce this to 2.0.

The other parameter required by our PE model is the elasticity of substitution in consumption (*esubss*) 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. However, in our sensitivity analysis, we consider the possibility that this value might be as high as 2.0. 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 level: 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 (TRQs) and TRQ rents, as well as taking into account an extensive list of tariff preferences (for more details see Bouët et al. 2004). 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 Global Trade Analysis Project 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 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 the partner countries in the model.

To incorporate TRQs into the sub-sector model, we draw on one of the most detailed sources of TRQ information at the HS-8 digit level available from the Agricultural Market Access Database (AMAD)[4]. To illustrate the usefulness of 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

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

as other cheeses). 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, the in and over-quota tariff rates and tariff revenues. 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, over-quota tariffs and the quota level.[5] 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.[6] 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

[5] 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.

[6] 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/

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 into two sections. Section A and B present two simulation scenarios of dairy trade liberalization. Scenario A liberalizes dairy policies globally. That is, this scenario presents the results when all countries move to a free trade regime in dairy. All other policies are left in tact. Scenario B involves a unilateral liberalization of the U.S. dairy sector including the elimination of over-quota tariff rates in U.S cheese HS-6 category 040690. In each case the results of the "top-down" GE model and the "bottom-up" PE model for both dairy simulation scenarios (A and B) are compared under alternative parameter settings.

Section A: Global Dairy Liberalization

Figure 1 shows the welfare results defined in terms of equivalent variation as a percentage of consumption, for eight key countries and six combinations of parameter settings (etrnss = 4 or 2; esubss = 1 or 2; multiplier for esubass = x 1 or x 2).[7] The first thing to note is the fairly large welfare changes as a percentage of national consumption in some countries. In New Zealand's 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 changes in welfare ranging from 4.8 to 6.1 percent depending on the elasticities of substitution. This is no surprise since New Zealand is the world's top dairy exporter with very low rates of protection and subsidies

[7] Recall ertnss is the elasticity of transformation across sub-sector goods; esubss is the elasticity of substitution across sub-sector goods and esubass is the sub-sector armington elasticity multiplier. In the figures presented, we frequently refer to sub-sector welfare or output as SS-4,1,1 meaning sub-sector with corresponding elasticities/multipliers of 4, 1 and 1.

granted to dairy producers, and stands to gain the most from global dairy reform. In terms of aggregate welfare for other countries, both models agree on the welfare response to dairy trade liberalization with only small differences across all parameter specifications in the PE model.

Figure 2 shows output predictions by both models for the same eight countries and six parameter combinations. In this case, the GTAP (GE) model tends to under-predict the overall change in aggregate output -- in some cases by an order of magnitude. The dairy sector response to trade reform in Australia (AUS), another large exporter, is 40 percent using the GE model and slightly larger (47%) in the sub-sector model when we allow for the same Armington elasticities in the GE and sub-sector model. However, when the sub-sector Armington elasticity is doubled (mult-esubass = x 2) the GE model seriously under predicts the output response. In the case of Australia, the sub-sector output response ranges from 98 to a 104 percent increase. Similar differences in output responses occur in all other countries with the exception of New Zealand and the US. In these two cases, the GE and sub-sector models agree on the dairy sector output response. [Jason, it would be nice to get a feel for what is driving these differences. I assume that Australia specializes in some particular sub-sector products, whereas NZ does not.]

Finally, to get an idea of how well the GE and sub-sector models agree on the change in bilateral trade flows when dairy is liberalized, table 3 presents some simple regression results. In each regression, the simulated sub-sector bilateral trade flows from dairy liberalization are regressed on an intercept and the simulated GTAP (GE) trade flow response. In this way, we can judge how well the “top-down” (GE) model predicts the simulated sub-sector trade flows. Six regressions are reported, one for each sub-sector parameter setting.

The regression results indicate that when the Armington elasticity multiplier is one (SS-4,1,1 and SS-4,2,1) in columns (1) and (3), the GE model performs quite well as a predictor of the sub-sector bilateral trade flow response. For the case of SS-4,1,1, a significant slope coefficient of 0.90 suggests that GTAP trade flows would have to be scaled down by a factor of 0.90 on average to match sub-sector trade flows. The GE and sub-sector models are even closer for the case of SS-4,2,1 with a slope coefficient of 1.04. This is the case where there is greater substitution in consumption between the sub-sector products, and here the GTAP flows must be scaled up, but only by about 4 percent, on average. 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 parameters of SS-4,2,2, a 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 6 to match. Similar regression results are obtained for other parameter combinations in which the Armington elasticity multiplier is 2 (i.e. SS-4,1,2; SS-2,1,2; and SS-2,2,2).

Scenario 2 – Unilateral US Dairy Liberalization

In this scenario, we simulate a unilateral liberalization of the US dairy sector, including the elimination of over-quota tariff rates where these are applicable in the US market (Table 2). In the current version of this paper, we do not provide a formal treatment of the effects of TRQ expansions or quota rent allocations. This is a topic that will be addressed in a subsequent version of the paper.

Figure 4 illustrates the welfare impacts of the GE and sub-sector models for selected countries. Again, the GE model does a good job of matching sub-sector welfare changes resulting from US dairy liberalization for all parameter cases and all countries.

Figure 5 depicts the output responses to US liberalization for these same countries. Similar to the output responses in scenario A, the output responses of the GE and sub-sector models disagree when the Armington elasticity is doubled (SS-4,1,2; SS_4,2,2; SS-2,1,2; SS-2,2,2). The largest discrepancies between the GE and sub-sector model occurs in Canada and the US responses. In these two cases the GTAP model predicts about a 1 (-1.6) percent increase (decrease) in Canadian (US) output, whereas the sub-sector models with larger Armington parameters predicts a 4 (-4.8) percent increase (decrease) respectively. A similar pattern is evident in other countries.

Finally, table 4 presents another set of regression results regarding the trade flow responses to US dairy liberalization. This time, all 8 parameter settings are illustrated. When the Armington elasticity multiplier is one and therefore corresponds to the GE elasticity, the simulated GE and sub-sector trade flow responses are very close with slope coefficients close to one. In fact, a test that the slope coefficients equal one for SS-4,2,1; SS-4,1,1, SS-2,2,1 and SS-2,1,1 is only marginally rejected in each case at the 5 percent significance level. Similar to the global reform scenario, when we double the Armington elasticities to reflect the increased substitution possibilities at the sub-sector level, the GE and sub-sector models do not agree on the trade flow response with the former under predicting the latter by a factor of 2.4 to 2.7 (table 4) .

To summarize, when we disaggregate to a much finer classification of goods, like we have done for dairy, we expect to see a larger substitution among imports and between imports and domestic goods justifying the increase in the Armington elasticities. Thus, aggregated GE models may under predict the response of sub-sector production, demand and trade flows. The results for output and trade support this claim. The simulated GE response of output and trade flows from both scenarios falls short of 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.

Conclusion

Market access continues to be a contentious issue in the trade negotiations of the WTO. 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 for agriculture exists. Policy analysts focusing on market access issues 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 is more disaggregated but has nothing to say about general equilibrium effects and the overall impact of an agreement. Our methodology 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 illustrate 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 focus special attention on the United States, which is the world's most important dairy importer, and which significantly 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, and a future goal of this study is to illustrate how the PE-GE model can be used to look at complex partial reforms, such as selectively expanding TRQs for a particular product/market combination.

We find that the aggregate GTAP model does a remarkably good job of predicting the aggregate welfare impacts of dairy trade reforms – at both the US and global levels. However, when it comes to predicting the global allocation of output in the dairy industry, the GE model evidences larger errors. In general, it 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 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 by a factor of six.

In the experiments discussed thus far, TRQs have not played an important role. However, in subsequent versions of this paper we will examine the impact of partial reforms of the US dairy sector. In particular, we will consider the differential impacts of liberalizing dairy imports by expanding the TRQ quota, versus cutting the out of quota tariff. 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.

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Table 1. US Dairy Imports 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

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

Partner	Value ($)	Trade (kg)	Quota (kg)	Fill Ratio	iqtariff (%)	oqtariff (%)	In-Quota Tariff Revenue*	Over-Quota Tariff Revenue*
Argentina	19,500,000	5,298,339	4,754,993	1.11	13.9	67.0	$2,712,200	**$13,100,000**
Australia	5,939,026	2,316,269	1,292,719	1.79	11.5	42.2	$656,321	**$2,594,333**
Canada	3,764,732	979,656	874,929	1.12	10.8	44.5	$420,014	**$1,605,615**
European Union (15)	17,500,000	4,067,250	2,445,409	1.66	9.7	54.9	$1,792,799	**$10,100,000**
Caribbean Communities	541,568	124,475	194,835	0.64	11.1	43.1	**$59,874**	$234,284
New Zealand	26,600,000	10,663,833	7,926,723	1.35	11.0	43.8	$2,818,617	**$12,100,000**
Rest of Europe	16,300,000	3,508,802	3,735,956	0.94	7.9	56.0	**$1,152,047**	$9,316,798
South America	3,747,041	1,029,156	464,549	2.22	13.2	64.9	$518,142	**$2,504,043**

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 1. Welfare comparisons from global dairy reform.

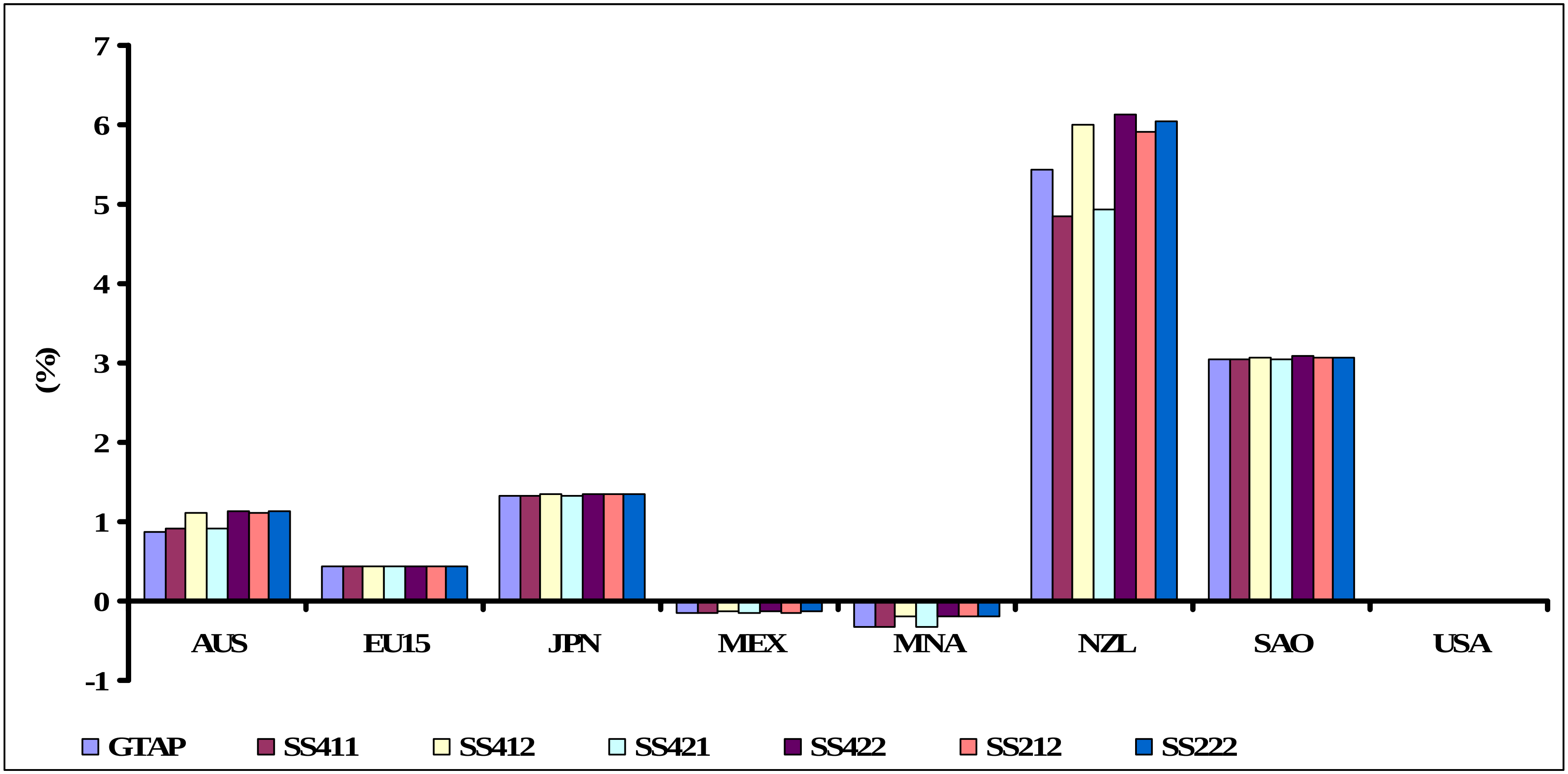

Figure 2. Global dairy reform output comparisons

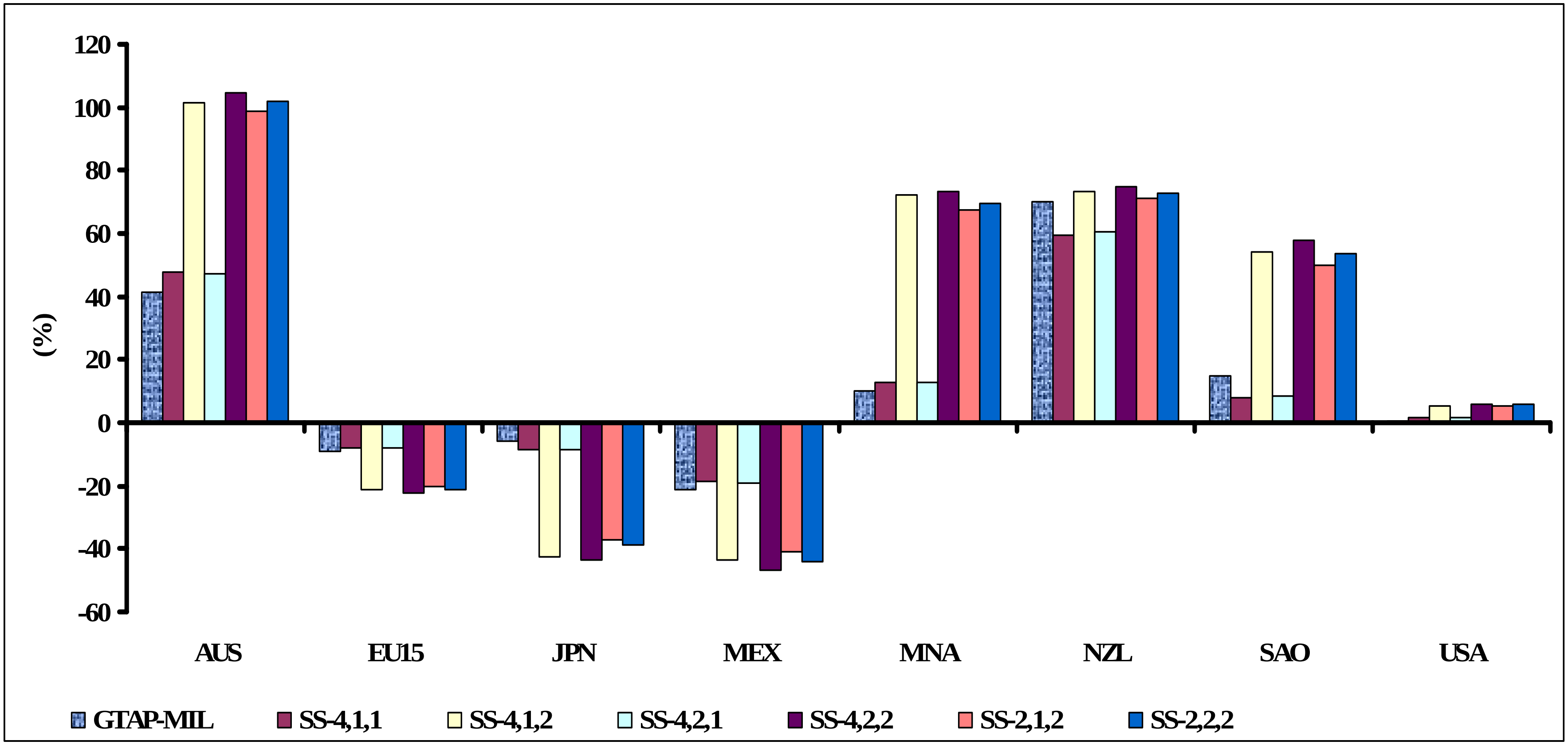

Table 3. Global dairy reform bilateral trade comparison regression results

	(1) [a]*SS-4,1,1*	*(2)* [a]*SS–4,1,2*	*(3)* [a]*SS–4,2,1*	*(4)* [a]*SS–4,2,2*	*(5)* [a]*SS–2,1,2*	*(6)* [a]*SS-2,2,2*
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 (1-8) is run separately

[a/] SS denotes Sub-sector. SS-4,1,1 denotes Sub-sector trade with transformation elasticity of 4; elasticity of substitution across sub-sector goods of 1; and a sub-sector Armington elasticity multiplier of 1. The Armington elasticity multiplier is used to inflate the GTAP dairy sector Armington elasticity for sub-sector goods

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

Figure 4. US dairy reform welfare comparisons

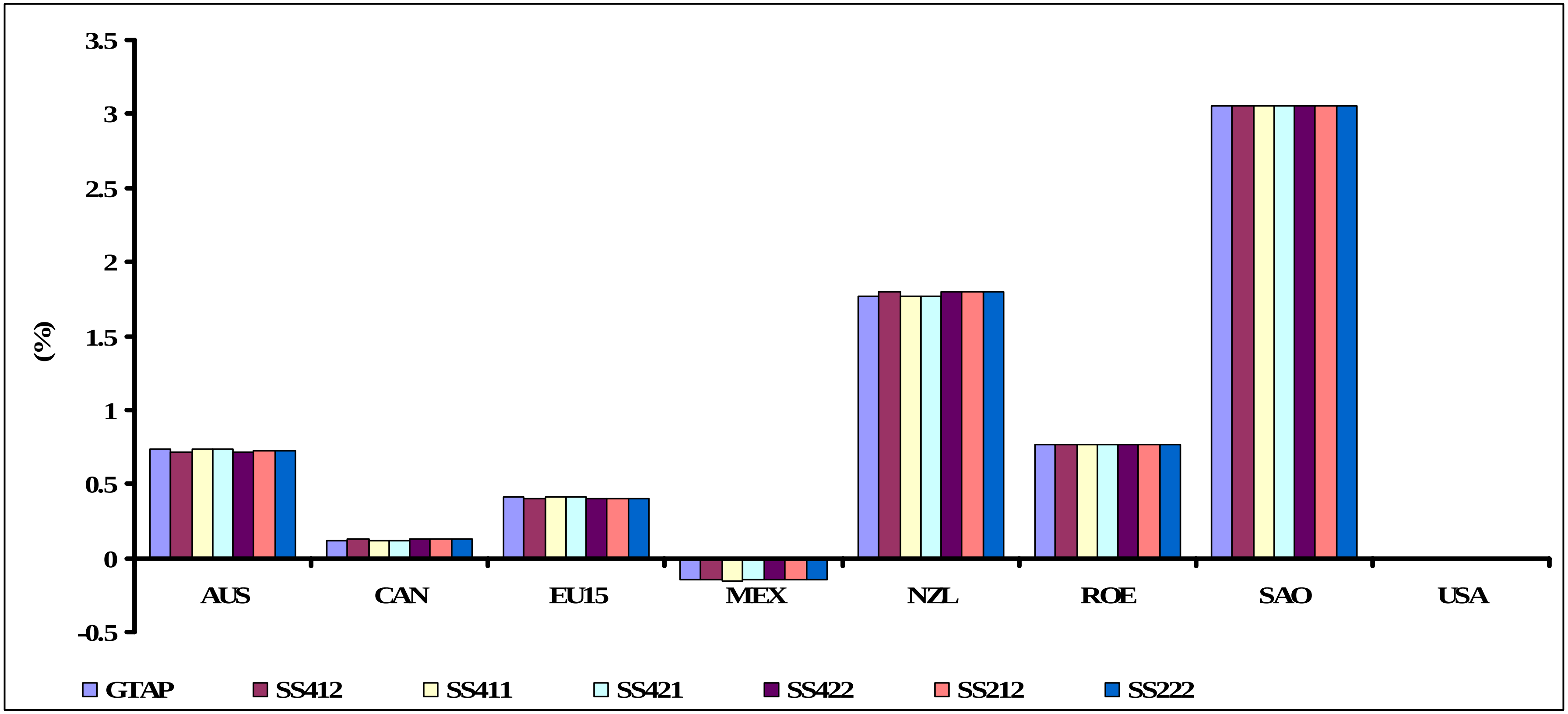

Figure 5. US dairy reform aggregate dairy output comparisons

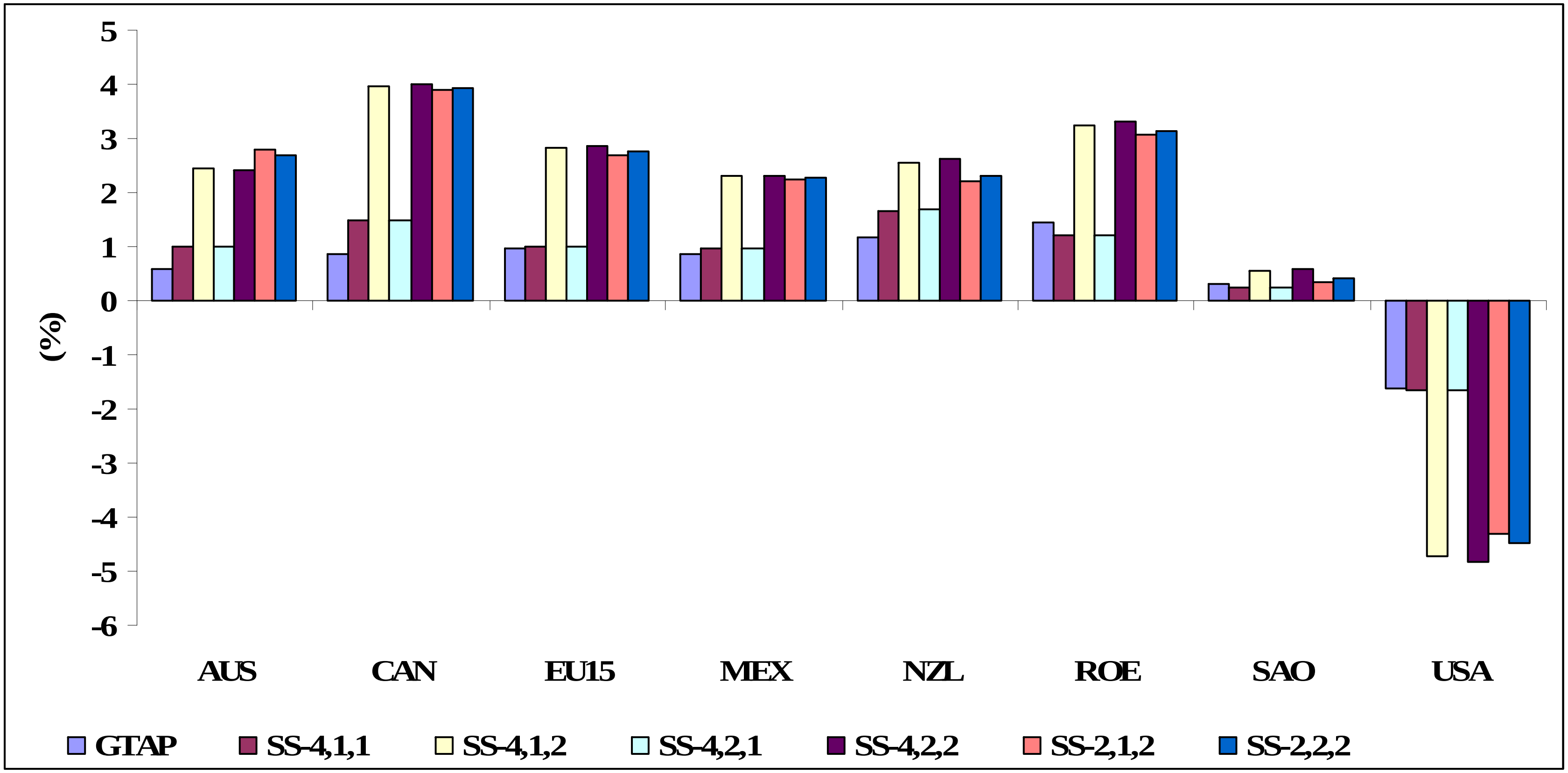

Table 4. U.S. unilateral dairy reform bilateral trade comparison regression results

	(1) [a]*SS-4,1,1*	*(2)* [a]*SS–4,1,2*	*(3)* [a]*SS–4,2,1*	*(4)* [a]*SS–4,2,2*	*(5)* [a]*SS–2,2,1*	*(6)* [a]*SS-2,1,2*	*(7)* [a]*SS-2,2,2*	*(8)* [a]*SS-2,1,1*
Intercept	1.68	8.73	1.70	8.92	1.58	7.99	8.35	1.53
	(1.02)	(4.75)	(1.01)	(4.81)	(1.00)	(4.49)	(4.56)	(1.00)
Slope[b]	0.91	2.66	0.92	2.73	0.90	2.41	2.51	0.88
	(0.03)	(0.16)	(0.03)	(0.16)	(0.03)	(0.15)	(0.15)	(0.03)
R-squared	0.83	0.65	0.83	0.66	0.82	0.63	0.65	0.82
No. Obs.	157	157	157	157	157	157	157	157

Note: each regression (1-8) is run separately

[a/] SS denotes Sub-sector. SS-4,1,1 denotes Sub-sector trade with transformation elasticity of 4; elasticity of substitution across sub-sector goods of 1; and a sub-sector Armington elasticity multiplier of 1. The Armington elasticity multiplier is used to inflate the GTAP dairy sector Armington elasticity for sub-sector goods

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