Detailed representation and analysis of trade policies in dairy sectors

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Selected paper prepared for presentation at the 2020 Agricultural & Applied Economics Association

Virtual Meeting, August 10-11, 2020

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Introduction

Changes in demand and trade policies have been key drivers of the expansion of the world dairy trade in recent decades. In particular, dietary changes, together with sizable population and income growth, have led to large increases in the total demand for dairy in developing countries. On the other hand, projections of domestic demand for dairy in the United States and other developed countries indicate limited opportunities for growth (OECD-FAO, 2015). Vitaliano (2016) notes that the share of these countries in the global consumption will fall below their respective shares in global milk production. Taken together, these trends have significant implications for major dairy exporters such as the EU, New Zealand, United States and Australia (OECD-FAO, 2015).

Trade policy changes over the last three decades have facilitated growth in world dairy trade. The Uruguay Round of trade negotiations under the General Agreement on Tariffs and Trade (GATT) came into effect in 1995. It established binding limits on agricultural export subsidies and domestic support, imposed disciplines on sanitary and phytosanitary (SPS) measures, and achieved transparency of import protection by converting non-tariff import restrictions to tariffs. It also ensured that the quantities imported before the agreement took effect continued to be imported, and it guaranteed that some new quantities were charged duty rates that were not prohibitive (World Trade Organization, 2020). As a result, the tariff rate-quota (TRQ) system emerged from the Uruguay Round Agreement on Agriculture (URAA). 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. However, the amount of market access created under the URAA has been limited (Grant et al., 2007; Vanzetti and Peters, 2003), as such, one goal of the Doha Development Agenda (DDA) was to expand minimum access and reduce the levels of out-of-quota tariffs. One sector targeted for improved market access was dairy, but the DDA effort has stalled in recent years. As a result, countries interested in further trade liberalization turned to bilateral and multilateral agreements (Vitaliano, 2016).

One such multilateral agreement that affects dairy trade is the North American Free Trade Agreement (NAFTA) signed by Canada, Mexico, and the United States in 1994. The agreement eliminated tariffs on all dairy products between the United States and Mexico but left significant restrictions on dairy trade between Canada and the United States. Another important multilateral agreement that could have affected U.S. (and global) dairy trade was the Trans-Pacific Partnership (TPP) agreement (Peterson et al., 2016). Under the TPP, U.S. dairy producers would have likely benefited from larger exports, including some increases in exports to Canada, and reduced import tariffs imposed by trading partners. However, the United States withdrew from the TPP in 2017.

In 2018, the United States, Mexico, and Canada, signed a new trade deal to replace NAFTA, known as the United States-Mexico-Canada Agreement, or USMCA. The USMCA was ratified by all three countries in March 2020 and will come into effect on July 1, 2020. Under the USMCA, Canada provides the United States with tariff-free access to 3.59% (Zhou et al. 2018) of the Canadian dairy market, achieved with additional tariff-rate quotas (TRQs) exclusively for U.S. dairy products above existing levels. In addition, Canada agreed to eliminate class 6 and 7 pricing provisions that set unusually low domestic prices of skim milk components for domestic producers of dairy products (Greene, 2019), and to raise the duty-free limit on purchases from the United states to $150 from the previous $20 level, allowing Canadian consumers to have greater duty-free access to the U.S market. However, there still exist barriers to trade as Canada's domestic supply management system remains intact (Schmitz and Seale, 2019).

Computable general equilibrium (CGE) models have been used widely to analyze trade policies because they can capture inter-sectoral and economy-wide impacts. However, to remain tractable and to avoid data limitations, very often these models require aggregation across product lines and different policy instruments. This makes these models too coarse to inform policy negotiations. This is particularly true in the case of dairy products characterized by heterogeneity in protection instruments, the frequent use of specific tariffs, and the multitude of tariff rate quotas (Grant et al., 2007), the marginal impact of which can vary dramatically depending on which TRQ regime is active. Partial equilibrium (PE) models, on the other hand, are often more disaggregated but lack internal consistency and provide limited information about the economy-wide effects of trade reform or how reform in other sectors might interact with those in the target sectors (Grant et al., 2007).

In this paper, we develop a global CGE modeling framework to analyze the impacts of changes in TRQs and other trade policies in dairy sectors at the detailed commodity level, and apply it to the analysis of the expanded market access for U.S. dairy in Canada under the USMCA.

Modeling framework

GTAP-HS-TRQ model

For this work, we build on a multi-sector, multi-region, comparative static CGE model called GTAP-HS (Chepeliev et al., 2019; Aguiar et al., 2019a; Narayanan et al., 2010), which allows for the incorporation of detailed trade data and analysis of trade policies at the detailed commodity level. The GTAP-HS model is a special version of the GTAP CGE model (Corong et al., 2017; Hertel, 1997). In GTAP-HS, sectors of interest produce multiple commodities, typically defined at the 6-digit level of the Harmonized System (HS6). These commodities are consumed domestically and traded internationally. Demands for these goods by domestic firms, government, and private consumption are modeled in a two-stage process, with individual commodities first substituting for one another at the HS6 level; they then enter the aggregate CGE model consumption category. The Armington assumption is employed to model international trade in HS6 commodities: the disaggregated commodity that enters the aggregate GTAP consumption category is a composite of a domestic HS6 commodity and an imported composite, where the imported composite consists of HS6 commodities from various trading partners.

Similar to the standard GTAP framework, the GTAP-HS framework described so far provides an ad-valorem equivalent (AVE) estimates for tariffs, specific tariffs, compound tariffs, and tariff-rate-quotas (TRQs). This allows analysis of changes in tariff rates but is not suitable for analysis of changes in TRQ regimes which are at the heart of the changes in dairy trade policies proposed under the USMCA. To explicitly implement bilateral TRQs in our model, we follow the approach documented in Elbehri and Pearson (2005) and Beckman and Arita (2016). The new model, nicknamed GTAP-HS-TRQ, can handle quantity constraints, changes in TRQ regimes and quota rent reallocation.

GTAP-HS data base

The key component of the modeling framework presented in this paper is the data base with detailed representation of dairy sectors developed in Chepeliev (2019). The starting point in the construction of this data base is the Global Trade Analysis Project (GTAP) data base version 10 with reference year 2014 (Aguiar et al., 2019b). In the GTAP data, however, all dairy products are represented by just one aggregated sector, “processed dairy”. Chepeliev (2019) disaggregated output, domestic absorption and trade flows of the aggregate dairy sector within the standard GTAP data base. This task required information on bilateral trade, protection rates, domestic production and demand at the detailed commodity level. Domestic consumption of each commodity was estimated using the Food and Agricultural Organization (FAO) statistical data on production, total country exports and imports (quantities, prices, and values) of 23 dairy commodities at the country level (155 countries) for the year 2014, as well as data from the Euromonitor International. Processed FAO data was used to estimate domestic consumption and export values, while the MACMAP dataset provided information on the bilateral trade flows and tariff rates at the HS6 level. Both datasets were reconciled to match the GTAP data at the aggregate sectoral level. MACMAP and FAO data use different classification systems. The intersection of dairy products reported in both datasets resulted in 9 (mutual) commodity categories. Five of these categories represent individual HS6 commodities, the other four are aggregations over several HS6 codes (Table A1).

The constructed data base is consistent with version 10 of the GTAP data base with the reference year 2014, and is constructed at the GTAP disaggregated level. In this analysis, we aggregate this data base into 20 regions and 28 GTAP sectors, including "processed dairy" disaggregated into 9 commodities (see Appendix Tables A2 and A3 for regional and sectoral aggregations). Additional information on dairy product-specific TRQ regimes and traded volumes is obtained from WTO, Statistics Canada, Global Affairs Canada, and Global Trade Atlas. Appendix Table A4 provides information on Canada within access commitment (quota), in-quota and out-of-quota tariffs in dairy sectors under WTO, and U.S. preferential duty-free access within the established quotas.

Substitution parameters

Supply of dairy commodities at the HS6 level is governed by a constant elasticity of transformation (CET) functional form -- output of aggregated dairy sector in each region is transformed into 9 commodities: cheese and curd, butter, yogurt, buttermilk, etc. (see Table A1)[1]. We assume a value of -2 for the elasticity of transformation among the disaggregated commodities.

Part of the total quantity of HS6 commodity produced in a region is supplied to the domestic market, while the rest is supplied to the export markets and shipped to various destinations. Specification of international trade at the HS6 level is similar to the one in the standard GTAP model (Corong et al. 2017, Hertel 1997) and employs a two-level CES structure. First, for a given HS6 commodity, bilateral trade flows from different sources are aggregated into imported bundle. Then, imported bundle and domestically produced HS6 commodity are aggregated into domestically absorbed bundle at the HS6 level. Fontagné et al. (2019) estimate trade elasticities at the HS6 level by exploiting the variation in bilateral applied tariffs for each product category for the universe of available country pairs. We use estimates reported in Fontagné et al. (2019) to parametrize substitution between imports sourced from different destinations. We then set the elasticity of substitution between imported bundle and domestically produced HS6 commodity within domestic absorption of the HS6 commodity to one half of the elasticity among imports from different destinations.

Using region-specific trade weights, we aggregate the HS6 level elasticity estimates for dairy reported in Fontagné et al. (2019) to match the level of commodity detail for dairy commodities (Table A1) and regional aggregation (Table A2) in the GTAP-HS-TRQ model.

[1] The model structure is depicted in Figure 1 in Chepeliev et al. (2019). That work uses the GTAP-HS modeling framework to analyze impacts of retaliatory tariffs on vegetables, fruit and nuts at the HS6 commodity level.

Most of the substitution elasticities at the disaggregate commodity level are higher than substitution elasticity at the aggregate level in the GTAP data base (see Figure 1). This is plausible as we expect that importers substitute more easily across import sources at a more disaggregated level.

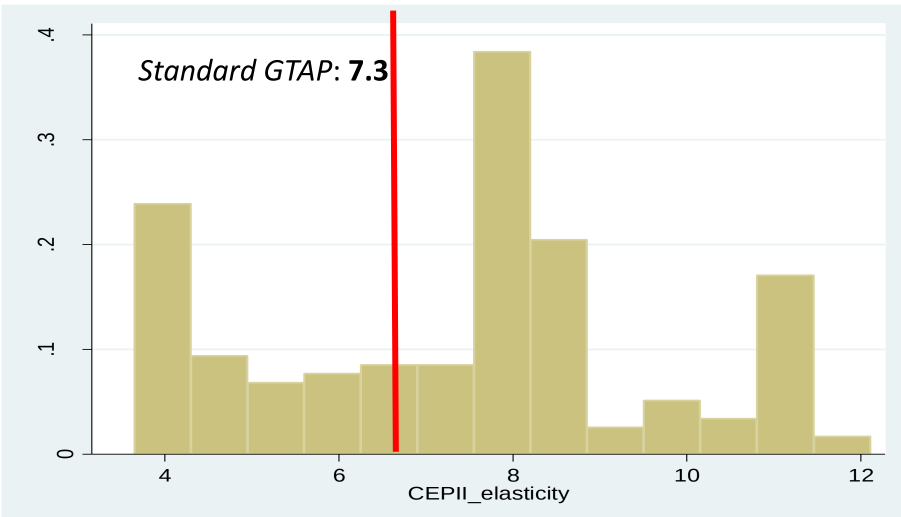

Figure 1. Frequency density of disaggregated import elasticities for dairy at the GTAP-HS sector level
Source: Based on Fontagné et al. (2019) and Aguiar et al. (2019b).
Note: Commodity and region-specific elasticities are reported. Red line corresponds to the elasticity among import sources for "mil" sector currently used in GTAP.

Domestic absorptions of the disaggregated dairy commodities are aggregated into the GTAP dairy consumption category using a CES function. Aggregated dairy is then used as intermediate input in domestic production sectors and consumed by the regional household and government sector. The elasticity of substitution among disaggregated dairy commodities within the aggregate consumption of dairy is set to 0.5.

U.S. and Canada dairy trade and USMCA

Total value of U.S. dairy output in the reference year of the analysis is 117 bill USD (Aguiar et al., 2019), with cheese and milk/cream (not concentrated and not sweetened) representing 30% and 34% of the value of output, followed by ice cream (9%) and yogurt (7%). 95% of output is consumed domestically, and 5%, 6 bill USD, is exported. Concentrated and/or sweetened milk and cream (milkconc), cheese, whey and butter are largest exported categories and represent 93% of value of U.S. dairy exports (Figure 2). The largest shares of these exports are shipped to Mexico and the Agricultural Importers region in our aggregation, while 4.6%, mostly cheese and whey, are shipped to Canada (Figures 3a and 3b).[2] The United States imports 2.4 bill USD of dairy in the reference year, mostly cheese (64%) and butter (18%) from EU and Oceania.

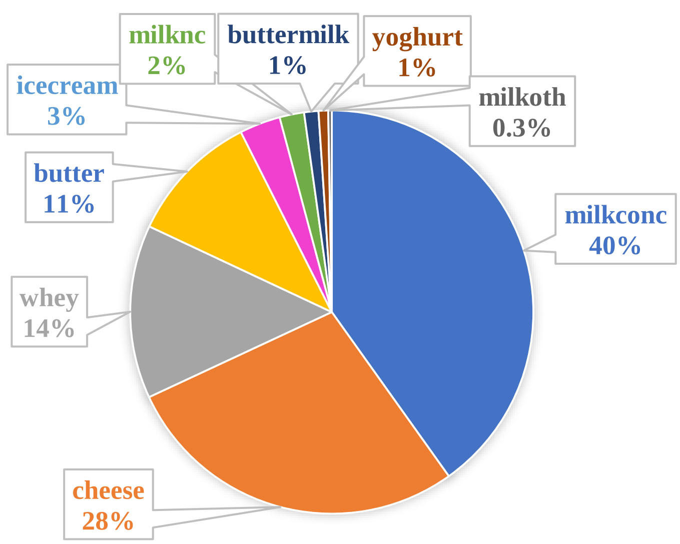

Figure 2 Structure of U.S. dairy exports

[2] In the GTAP version 10 data base (Aguiar et al. 2019) with reference year 2014 and in the GTAP-HS data base (Chepeliev, 2019) that matches GTAP aggregate sector trade flows, Canada is the sixth largest destination for U.S. dairy exports. In contrast, Greene (2019) lists Canada as second, after Mexico, largest market for U.S. dairy. We think that the difference in ranking is due to commodities included in total dairy category.

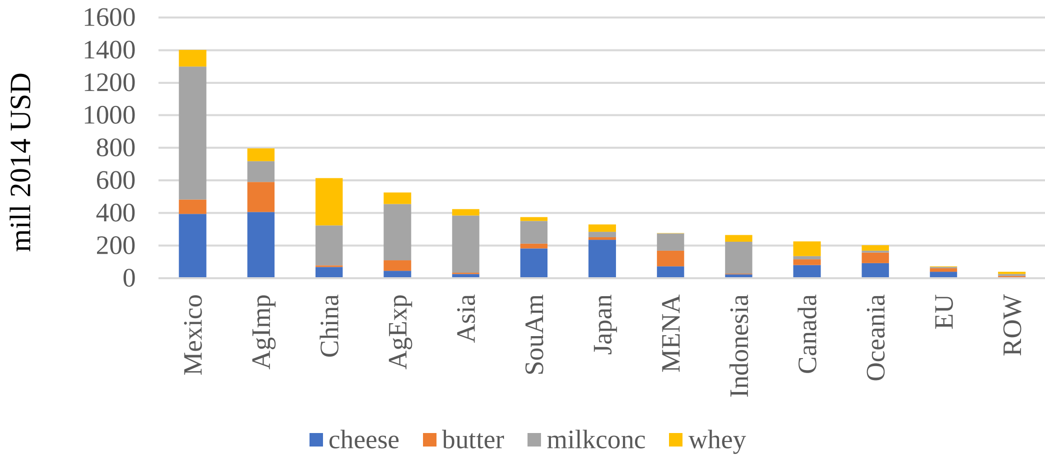

Figure 3a U.S. exports of concentrated or sweetened milk and cream, cheese, whey and butter by destination (93% of total dairy exports)

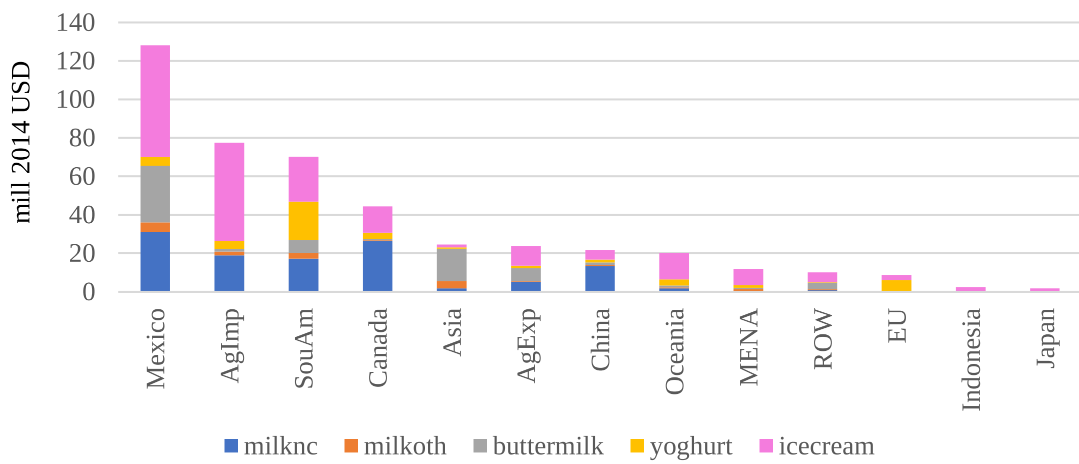

Figure 3b U.S. exports of not sweetened and not concentrated milk and cream, other milk and cream, buttermilk, and yogurt (7% of total dairy exports).

Output of the Canadian dairy sector is about 15 bill USD (Aguiar et al. 2019), also with cheese and milk/cream (not sweetened and not concentrated) representing the largest shares (21% and 40%, respectively). 2% of output, 0.3 bill USD, is exported, mostly concentrated or sweetened milk and cream, cheese, whey and ice cream. Of these exports, 40% are shipped to the United States. Imports of dairy commodities in Canada are twice as large as exports, 0.6 bill USD. More than half of these imports are cheese, followed by whey and butter (Figure 4).

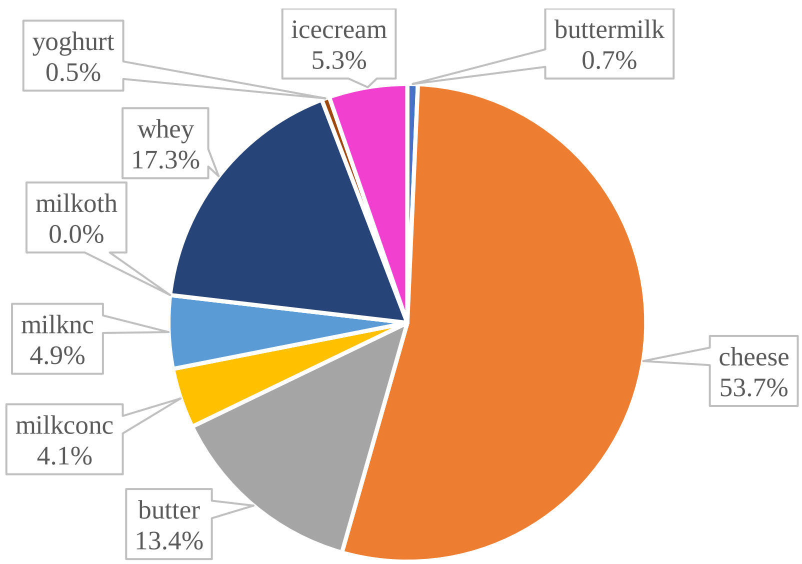

Figure 4 Structure of dairy imports in Canada

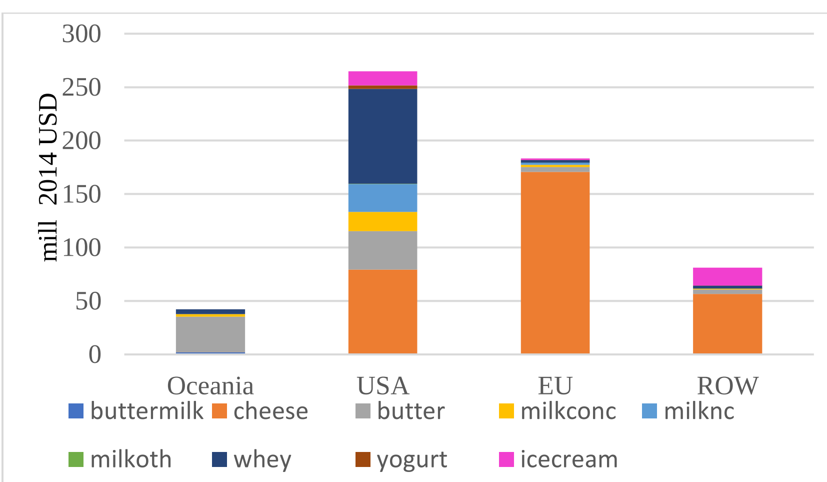

Figure 5 Canada dairy imports by source and commodity

43% of all Canadian dairy imports are from the United States, with cheese, whey and butter representing the largest categories (Figure 5). As such, the United States is an important trading partner for Canada in dairy markets, though ultimately, the share of U.S. dairy commodities in the total Canadian dairy market is 2% (Aguiar et al., 2019b).

All dairy commodities imported by Canada are subject to either very high simple tariffs or TRQs with very high out-of-quota tariffs, 200-300% (Table A4). In terms of our model commodity groupings, six out of the nine dairy categories are subject to TRQs with non-zero initial quota. Imports of the remaining three categories (shaded rows in Table A4), concentrated or sweetened milk and cream and buttermilk, have zero quotas (with exception for milk and cream from Australia and buttermilk from New Zealand) and are subject to very high tariffs.

In addition to market access commitments and MFN in-quota and out-of-quota tariffs negotiated with WTO, Canada also has preferential trade agreements with several trading partners. According to the agreement with the United States, U.S. dairy commodities in Canada are tariff free if imported within the access commitment. This is the case for six out of the nine dairy commodities in the model. For example, the quota on imported yogurt in Canada is set at 332 MT. However, quantities above 332 MT should be subject to 237.5% import tariff. Another example is cheese with global quota set at 20,412 MT. Canada allocates 66% of this quota to EU, leaving 34% (6940 MT) for all other trading partners. Under the preferential trade agreement, United States can export to Canada up to 6940 MT of cheese tariff free. U.S. exports of cheese to Canada above 6940 MT are subject to 245.5% import tariff (Table A4).

Finally, the Canadian Minister may, at her/his discretion, authorize imports of dairy products apart from the import quota, particularly if she/he judges that the importation of these products is required to meet Canadian market needs. Supplemental import permits may be issued to address domestic market shortages, to assist Canadian manufacturers to compete in foreign markets under the Import for Re-Export Program, and for other reasons (Global Affairs Canada, 2014, 2019). While fluctuating from one year to another, size of these Supplementary Imports can be significant relative to the Canada import quotas established under the WTO.[3]

Table 1 reports duty-free access in Canada dairy markets negotiated under the WTO, actual trade volumes of U.S. dairy exports to Canada, and the actual import tariff paid on U.S. dairy shipped to Canada.[4] Actual duty-free volumes of butter, cheese, yogurt and ice cream imported by Canada from the United States are higher than the duty-free access commitments negotiated with WTO (Table 1). For example, Canada imported 794 MT of U.S. yogurt with zero tariff, more than twice the quota quantity. It is likely the tariff free volumes above quota are due to the supplementary imports permits issued for these commodities. In the case of not concentrated and not sweetened milk and cream (commodity “milknc” in the model), supplemental imports, while available (Global Affairs Canada, 2014), did not play a role as we find that the volume of U.S. exports to Canada were less than quota. Recall that there are three dairy commodities that were traded with high import tariffs: milk and cream concentrated or containing added sweeteners (milkconc and milkoth) and buttermilk (Table 1). With the exception of New Zealand and Australia, Canada does not allow any duty free access for these goods. While Global Affairs Canada (2014) indicates that supplemental import permits were available for these commodities, it seems that either none or only very few were issued for these three dairy commodities imported from the United States. In summary, of the nine dairy commodities, only three commodities representing 7% of U.S. dairy exports to Canada

[3] For example, quota on butter, dairy spreads, and oils and fats derived from milk is 3,274 MT, while supplementary import permits under IREP reached 7,025 MT in 2014 and 17,804 MT in 2019 (Global Affairs Canada, 2014, 2019).
[4] In Chepeliev (2019) import tariff information is sourced from MACMAP. MACMAP reports 3-year average data. 2014 reference year represents weighted average data for 2013, 2014 and 2015.

Table 1 U.S. dairy exports to Canada: trade volumes and import tariffs in the reference year of the analysis, and additional access under USMCA

Dairy commodity	Description	Trade volume, MT	Current tariff-free access, MT	Actual import tariff, %	Additional access under USMCA, MT
1	2	3	4	5	6
milknc	milk and cream, not concentrated nor containing added sugar or other sweetening matter	55,098	64,894	0	68,855
butter	butter and other fats and oils derived from milk; dairy spreads	6,403*	5,619	0	7,119
cheese	cheese and curd	8,398*	6,940	0	14,226
yogurt	yogurt	794*	332	0	4,537
whey	whey and modified whey	52,823		0	
whey powder		3,577*	3,198	0	4,303**
icecream	ice cream	4,629		0	
icecream		660*	484	0	785
milkconc	milk and cream, concentrated or containing added sugar or other sweetening matter	8003	0	191	11,973
milkoth	other milk and cream, concentrated or containing added sugar	47	0	242	61
buttermilk	buttermilk and powdered buttermilk	133	0	201	761

*Commodities for which (1) Canadian Ministry authorized supplementairy imports and (2) it is assumed in the analysis that part of the U.S. exports to Canada was shipped under the supplementary import permits.
**After yeat 10 since ratification of USMCA, these TRQ will be eliminated.
Source: Constructed by authors using WTO Tariff Analysis Online, Global Trade Atlas, Global Affairs Canada, and USMCA Appendix 2: Tariff Schedule of Canada - (Tariff Rate Quotas).

are subject to import tariffs. These tariffs are MFN out-of-quota, in the range from 191 to 242% (Table 1).

Having discussed policy environment for U.S. – Canada dairy trade, we now turn to the USMCA provisions. The USMCA creates additional TRQs exclusively for U.S. dairy products above existing levels. For most of the dairy commodities discussed in the agreement, these additional quotas will increase from year 1 to year 19 after the agreement comes into force, and then stay fixed at that level.[5] We map this information to our 9 dairy commodities and present these additional quotas in the last column of Table 1. For milk and cream (not concentrated and not sweetened, milknc), butter and whey powder the additional quotas are comparable to the current tariff-free access and actual tariff-free exports. For cheese, the agreement triples tariff-free access (additional 14,226 vs. current 6,940 MT). The USMCA brings large changes to U.S. exporters of yogurt by increasing quota from 332 to 4,537 MT. Perhaps, most significant impact should be felt by U.S. exports of condensed and/or sweetened milk and cream and buttermilk, as these products originated from the United States currently have zero tariff-free access and are subject to very high tariffs in Canada market.

USMCA expanded market access for U.S. dairy in Canada

The first step in analyzing the impacts of expanded market access for U.S. dairy in Canada is to identify for each commodity which TRQ regime is active in the reference year of the analysis. Figure 6 shows three possible regimes under the TRQs. $Quota_i$ on the horizontal axis denotes the minimum access commitment. The supply of imports is represented with a step function (in

[5] Greene (2019): "The TRQ amounts would be established for year 1 and doubled in year 2 and would then increase by 50%, 33%, 25%, and 20% in years 3-6. After year 6, the quantities of each category would increase at a compound growth rate of 1% for the subsequent 13 years. After year 19, the quotas would be fixed at the year-19 level."

bold). The lower horizontal portion from 0 to $Quota_i$ represents in-quota imports, and the upper horizontal portion from $Quota_i$ to infinity represents over-quota imports. The vertical portion at the imported quantity $Quota_i$ that connects lower and upper segments represent at-quota regime. P_w and P_d denote the world price and the domestic price in Canada, T_{in} and T_{out} represent the in-quota and over-quota tariffs. Because of the preferential agreement between Canada and the United States, T_{in} is zero for dairy commodities imported by Canada from the United States. The preferential agreement, however, covers only imported quantities within minimum access amount, and over-quota tariffs are in the 200-300% range (Table A4).

We now attempt to place each of the nine dairy commodities in one of the three TRQ regimes in Figure 6. Because of the Supplementary Imports, actual duty-free import volumes for five of the nine U.S. dairy commodities imported by Canada are higher than the WTO quota (butter, cheese, yogurt, whey powder, and ice cream). Three of the other commodities (buttermilk, and concentrated and/or sweetened milk and cream) are traded with a very high import tariff, with currently zero quota for U.S. in Canada market. The three commodities with zero quota (essentially, simple high tariff case) and five commodities traded under supplementary import permits do not fall into one of the three TRQ regimes.[6] The only commodity that we can assign one of the TRQ regimes is not concentrated and not sweetened milk and cream (milknc). Because traded quantity of this commodity is less than the quota amount, the commodity falls into "in-quota" regime. Consequently, simulating an increase in quota for this commodity in the model will result in no change in traded quantities and prices. In summary, given the current state of trade between U.S. and Canada, an economic model

[6] Furthermore, an increase in the quota from zero to a level proposed under the USMCA creates a modeling complication as the percent change in quota applied to zero quota is zero.

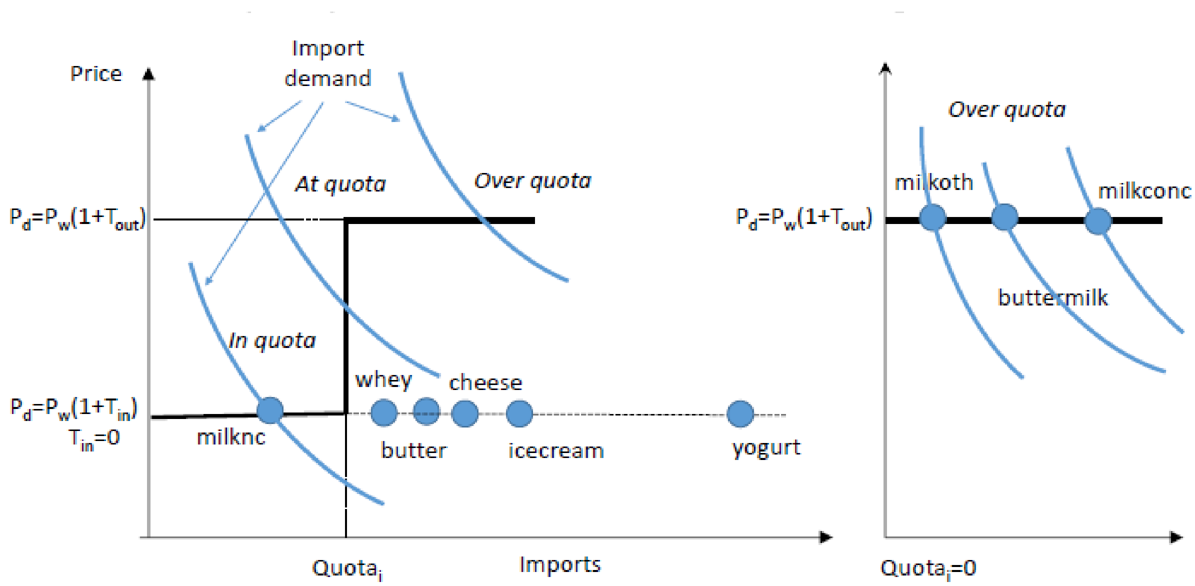

Figure 6 U.S. dairy imports in Canada and TRQ regimes

Table 2 Results of the illustrative analysis of the USMCA

Dairy commodity	Actual import tariff, power*	Base import tariff, power**	Base TRQ regime	Increase in quota, %	Policy TRQ regime	Policy import tariff, % change in power	Policy import quantity, % change
1	2	3	4	5	6	7	8
buttermilk	3.014	3.014	at quota	572	at quota	-34	572
milkoth	3.420	3.420	at quota	130	at quota	-18	130
milkconc	2.912	2.912	at quota	150	at quota	-27	150
milknc	1.000	1.708	at quota	206	at quota	-19	206
butter	1.000	3.700	above quota	111	at quota	-18	85
cheese	1.000	3.455	above quota	205	at quota	-15	152
yogurt	1.000	3.375	above quota	1367	at quota	-37	516
whey	1.000	1.120	above quota	9	at quota	-5	8
icecream	1.000	1.404	above quota	23	at quota	-2	18

*Power of import tariff in the initial GTAP-HS data base
**Power of import tariff in the altered GTAP-HS data base
Note, increase in market access is modeled using altered GTAP-HS data base.

equipped with TRQ structure is not ideal or sufficient to model expanded market access for U.S. dairy in Canada.

While TRQs are common in dairy trade globally, not all of these trade flows are affected by supplementary imports and zero initial quotas that complicate the analysis of U.S.-Canada dairy trade under USCMA. Moreover, the modeling approach proposed in this paper can be applied to analyze changes in policies regulating trade in other commodities subject to TRQs. To illustrate the usefulness of the approach, we make assumptions and proceed with an analysis of expanded market access for U.S. dairy in Canada.

Several assumptions are required to model expanded market access for these goods. We assume that commodities with zero quota and high tariff (buttermilk, milkconc and milkoth) are in the at-quota regime (vertical part of the import supply in Figure 6) with initial quota equal to the observed trade volume. At-quota commodities are subject to an import tariff higher than the in-quota tariff T_{in}, but lower than the out-of-quota tariff T_{out} (Figure 6). Comparison of the MFN out-of-quota tariffs listed in Table A4 and actual tariffs shown in Table 2 shows this is the case for these three commodities. For example, the power of the actual tariff on buttermilk is 3.014 (Table 2), while the power of the MFN out-of-quota tariff is 3.08 (Table A4).

Further, we assume that commodities traded above the quota, but with zero tariff due to the Supplementary Imports program, are in the above-quota regime. These are butter, cheese, yogurt, whey powder, and ice cream. Commodities in the above-quota TRQ regime should be traded under the high import tariff (upper horizonal part of import supply in Figure 6). To create proper above-quota regime for these five commodities, we incorporate the MFN above-quota tariff (Table A4) into the GTAP-HS data base using AlterTax simulation (Malcolm, 1998). This simulation allows to change tax rates in the data while maintaining the internal consistency of the data base and minimizing the impacts of the tax change on the value flows in the data base.

For not concentrated and not sweetened milk and cream (milknc) traded in quantities below the quota we assume the at-quota regime. Justification for this assumption is that trade crossing the U.S.-Canada border may be higher than recorded in the statistical data, as the quota is filled by Canadian households who purchase U.S. milk and cream in the U.S. and bring them back to Canada. The initial quota is assumed to be equal to the observed trade volume, and the at-quota tariff is set at half of the above-quota tariff (Table 2). The later is accomplished using AlterTax simulation.

We then simulate expanded market access for U.S. dairy in Canada by increasing quotas for dairy commodities. These increases are shown relative to the initial quotas, negotiated with WTO or assumed for this illustrative analysis, in column 5 of Table 2. The results indicate an increase in traded quantity and a reduction in the actual import tariffs for all U.S. dairy commodities imported by Canada (Table 2). TRQ regimes changed from “above quota” to “at quota” for butter, cheese, yogurt, whey, and ice cream. Figures A1 and A3 demonstrate that for the “at-quota” commodities that do not change their TRQ regime (buttermilk, milkoth, milknc and milkconc), the increase in quota directly translates into an increase in traded quantity, while for the “above-quota” commodities, the increase in traded quantity is smaller than the increase in quota. Aggregate U.S. dairy exports to Canada increases by 76%, while overall U.S. dairy exports to all destinations increase by 2%. Overall, the expanded market access for U.S. dairy in Canada results in small reductions in total dairy output (1.5%) and domestic prices (0.1%) in Canada, and negligible increase in aggregate dairy output and prices in the US. However, changes in some of the dairy commodity markets in Canada are very large: output of buttermilk falls by 8% (Figure A2), while imports of yogurt from U.S. experiences six times increase (Figures A1).

Conclusions

In this paper, we develop a global modeling framework, called GTAP-HS-TRQ, to analyze dairy trade patterns and continuously evolving dairy trade policies at the detailed commodity level. To our knowledge, this is the first CGE modeling framework that represents trade, output and domestic absorption, and allows analysis of tariff rate quotas in dairy at a very detailed, close to 6-digit of the Harmonized System, level. Specifically, the model allows analysis of endogenous changes in trade flows, actual import tariffs and quota rents due to exogenous changes in market access and in- and over-quota tariffs. We apply this methodology to the analysis of one of the many contemporary policy issues in dairy trade -- the expanded market access for U.S. dairy in Canada under USMCA.

One of the instruments Canada uses to protect its dairy industry are TRQs with very high out-of-quota tariffs, between 200% and 300%, reaching 313.5% for some commodities. Under USMCA, Canada provides the United States with tariff-free access to 3.59% of the Canadian dairy market. Currently, only about 5% of U.S. dairy output is exported, and only 0.2% of the output is exported to Canada, representing 2% of total Canadian dairy market before the agreement.

We find that while there are non-zero in-quota tariffs on dairy imports in Canada, the actual tariffs on most of U.S. dairy imported by Canada are zero due to the U.S. preferential duty-free access in Canada within the established quota. This is the case for six of the nine disaggregated commodities in our analysis. Furthermore, Canadian Minister may authorize imports of dairy products apart from the import quota. Because of these Supplementary Imports, actual tariff-free import volumes for five of these six dairy commodities are higher than their respective quotas. The remaining three out of the nine commodities have zero quota for U.S. in Canada market and are traded with very high out-of-quota tariff. It should be noted these commodities represent only 7% of total U.S. dairy exports to Canada.

Presence of the Supplementary Imports that fluctuate from year to year, as well as zero current quota for some of the U.S. dairy commodities complicate our analysis of changes in TRQ regimes. To proceed with the illustrative analysis, we make assumptions regarding initial quotas and modify the data by incorporating high import tariff for commodities actually sold over quota duty-free. Overall, the expanded market access for U.S. dairy in Canada results in small reductions in total dairy output and domestic prices in Canada, and negligible increase in total dairy output and prices in the United States. While changes for some of the dairy markets in Canada may be large, overall impact of the proposed expanded market access in each of the two countries is small.

Finally, potential new applications and extensions of the methodology presented in this paper include analysis of new preferential tariff treatment for U.S. dairy exports to Japan under U.S.-Japan Preferential Trade Agreement, as well as sensitivity analysis of the results with respect to substitution and transformation parameters.

Acknowledgements

This research was supported by Economic Research Service, United States Department of Agriculture, cooperative agreement 58-3000-8-0054.

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Appendix

Table A1 Disaggregated dairy in the GTAP-HS-TRQ

Dairy commodity code in the model	Description	HS6 codes
milknc	milk and cream, not concentrated nor containing added sugar or other sweetening matter	0401.10, 0401.20, 0401.40, 0401.50
milkconc	milk and cream, concentrated or containing added sugar or other sweetening matter	0402.10, 0402.21, 0402.29, 0402.91
milkoth	other milk and cream, concentrated or containing added sugar	0402.99
butter	butter and other fats and oils derived from milk; dairy spreads	0405.10, 0405.90, 0405.20, 0404.90
cheese	cheese and curd	0406.10, 0406.20, 0406.30, 0406.40, 0406.90
yogurt	yogurt	0403.10
buttermilk	buttermilk and powdered buttermilk	0403.90
whey	whey and modified whey	0404.10
icecream	ice cream	2105.00

Source: Chepeliev (2019)

Table A2 Mapping from disaggregated to aggregated GTAP regions

No.	Aggregate region	Description	GTAP region
1	Oceania	Oceania	aus nzl xoc
2	China	China	chn hkg
3	Japan	Japan	jpn
4	AgImp	Agricultural importers	kor twn sgp che irn sau are egy
5	Asia	Asia	mng xea brn khm lao phl xse bgd npl pak lka xsa
6	Indonesia	Indonesia	idn
7	AgExp	Agricultural exporters	mys tha vnm chl ukr tur zaf
8	India	India	ind
9	Canada	Canada	can
10	USA	USA	usa
11	Mexico	Mexico	mex
12	SouAm	South America	xna bol col ecu pry per ury ven xsm cri gtm hnd nic pan slv xca dom jam pri tto xcb
13	Argentina	Argentina	arg
14	Brazil	Brazil	bra
15	EU	European Union	aut bel cyp cze dnk est fin fra deu grc hun irl ita lva ltu lux mlt nld pol prt svk svn esp swe gbr bgr hrv rou
16	Europe	Europe	nor xef alb blr xee xer kaz kgz tjk xsu arm aze geo
17	Russia	Russia	rus
18	MENA	Middle East and North Africa	bhr isr jor kwt omn qat xws mar tun xnf
19	ECOWAS	Economic Community of West African States	ben bfa civ gha gin nga sen tgo xwf
20	Africa	Africa	cmr xcf xac eth ken mdg mwi mus moz rwa tza uga zmb zwe xec bwa nam xsc xtw

Source: Developed by authors.

Table A3 Mapping from disaggregated to aggregated GTAP sectors

No.	Disaggregated sectors		Aggregated sectors	
	Code	Description	Code	Description
1	pdr	Paddy rice	Rice	Paddy rice
2	wht	Wheat	Wheat	Wheat
3	Corn	Corn	Corn	Corn
4	Othgro	Other coarse grains	Othcoarse	Other coars grains
5	v_f	Vegetables, fruit, nuts	V_F	Vegetables, fruit, nuts
6	Soy	Soy	Soy	Soy
7	Rape	Rape seed	Rapeseed	Rape seed
8	Othosd	Other oil seeds	Othosd	Other oil seeds
9	c_b	Sugar cane, sugar beet	Sugar	Sugar cane, sugar beet
10	pfb	Plant-based fibers	Plantfibers	Plant-based fibers
11	ocr	Crops nec	Othercrops	Crops nec
12	ctl	Bovine cattle, sheep and goats, horses	Animals	Livestock and Meat Products
13	oap	Animal products nec	Animals	Livestock and Meat Products
14	rmk	Raw milk	Animals	Livestock and Meat Products
15	wol	Wool, silk-worm cocoons	Animals	Livestock and Meat Products
16	frs	Forestry	NatResources	Natural resources
17	fsh	Fishing	NatResources	Natural resources
18	coa	Coal	Coal	Coal
19	oil	Oil	Oil	Oil
20	gas	Gas	Gas	Gas
21	omn	Minerals nec	NatResources	Natural resources
22	cmt	Bovine meat products	Beef	Bovine meat products
23	Pork	Pork	Pork	Pork
24	OthMeat	Other meat	Othermeat	Other meat
25	vol	Vegetable oils and fats	VegOil	Vegetable oils and fats
26	mil	Dairy products	Milk	Dairy products
27	pcr	Processed rice	Rice	Processed rice
28	sgr	Sugar	Sugar	Sugar
29	ofd	Food products nec	Ofd	Food products nec
30	b_t	Beverages and tobacco products	B_t	Beverages and tobacco products
31	tex	Textiles	L_Mfg	Light Manufacturing
32	wap	Wearing apparel	L_Mfg	Light Manufacturing
33	lea	Leather products	L_Mfg	Light Manufacturing
34	lum	Wood products	L_Mfg	Light Manufacturing

No.	Disaggregated sectors		Aggregated sectors	
	Code	Description	Code	Description
35	ppp	Paper products, publishing	L_Mfg	Light Manufacturing
36	p_c	Petroleum, coal products	P_c	Petroleum, coal products
37	crp	Chemical, rubber, plastic products	H_Mfg	Heavy Manufacturing
38	nmm	Mineral products nec	H_Mfg	Heavy Manufacturing
39	i_s	Ferrous metals	H_Mfg	Heavy Manufacturing
40	nfm	Metals nec	H_Mfg	Heavy Manufacturing
41	fmp	Metal products	L_Mfg	Light Manufacturing
42	mvh	Motor vehicles and parts	L_Mfg	Light Manufacturing
43	otn	Transport equipment nec	L_Mfg	Light Manufacturing
44	ele	Electronic equipment	H_Mfg	Heavy Manufacturing
45	ome	Machinery and equipment nec	H_Mfg	Heavy Manufacturing
46	omf	Manufactures nec	L_Mfg	Light Manufacturing
47	ely	Electricity	Ely	Electricity
48	gdt	Gas manufacture, distribution	Gas	Gas manufacture, distribution
49	wtr	Water	OthServices	Other services
50	cns	Construction	OthServices	Other services
51	trd	Trade	OthServices	Other services
52	otp	Transport nec	OthServices	Other services
53	wtp	Water transport	OthServices	Other services
54	atp	Air transport	OthServices	Other services
55	cmn	Communication	OthServices	Other services
56	ofi	Financial services nec	OthServices	Other services
57	isr	Insurance	OthServices	Other services
58	obs	Business services nec	OthServices	Other services
59	ros	Recreational and other services	OthServices	Other services
60	osg	Public Administration, Defense, Education, Health	OthServices	Other services
61	dwe	Dwellings	OthServices	Other services

Source: Developed by authors.

Note: Standard GTAP 10p2 Data Base (Aguiar et al., 2019b) distinguishes 57 sectors. In this paper, we use a disaggregated version of the GTAP Data Base with 61 sectors. In particular, "Cereal grains nec" is disaggregated into "Corn" and "Other coarse grains"; "Oil seeds" is split into "Soy", "Rape seed" and "Other oil seeds"; and "Other animal products" is disaggregated into "Pork" and "Other meat".

Table A4 Canada within access commitment (quota), in-quota and out-of-quota tariffs in dairy sectors under the WTO, and U.S. preferential duty-free access within the established quotas.

Comm. in the model	HS-6 codes	Product details	WTO within access commitment, MT[7]	WTO in-quota tariff	WTO out-of-quota tariff*	U.S. pref. access, MT
milknc	0401.10	milk and cream, fat<=1%	64,500	7.5%	241.3%	64,500
	0401.20	milk and cream, 1%<fat<=6%				
	0401.40	milk and cream, 6%<fat<=10%	394	7.5%	292.5%	394
	0401.50	milk and cream, fat>10%				
milkconc	0402.10	milk powder, fat<=1.5%	0	3.32c/kg	201.5%	0
	0402.21	milk and cream powder, fat>1.5%, unsweetened	0	3.32c/kg	243%	0
	0402.29	milk and cream powder, fat>1.5%, sweetened	0	3.32c/kg	243%	0
	0402.91	milk and cream other, unsweetened	11.7 for Australia	2.84c/kg	259%	0
milkoth	0402.99	milk and cream other, sweetened			255%	0
butter	0405.10	butter	3274, of which 2000 reserved for New Zealand	11.38c/kg	298.5%	1,274
	0405.90	other		7.5%	313.5%	
	0405.20	dairy spreads		7%	274.5%	
	0404.90	blended dairy powder	4,345	3%	270%	4,345
cheese	0406.10	fresh	20,412 with 66% allocated to EU, leaving 6940 for other countries	3.32c/kg	245.5%	6940
	0406.20	grated or powdered		2.84c/kg		
	0406.30	processed cheese, not grated or powdered		3.32c/kg		
	0406.40	veined		3.32c/kg		
	0406.90	other cheese		2.84-3.32c/kg		
yogurt	0402.10	yogurt	332	6.5%	237.5%	332
buttermilk	0403.90	Buttermilk and other fermented and acidified milk and cream	908 allocated for New Zealand	3.32c/kg	208%	0
whey	0404.10	whey and modified whey	3198	3.32c/kg	208%	3,198
icecream	2105.00	ice cream	484	6.7%	277%	484

Source: Constructed by authors using Canada Customs Tariffs Schedule and WTO Tariff Analysis Online.
*Out-of-quota MFN tariff presented in the table is a lower bound, as the tariff depends on volume of trade. For example, out-of-quota tariff on powdered whey is 208%, but not less than $2.07/kg.

[7] MT denotes metric tonnes.

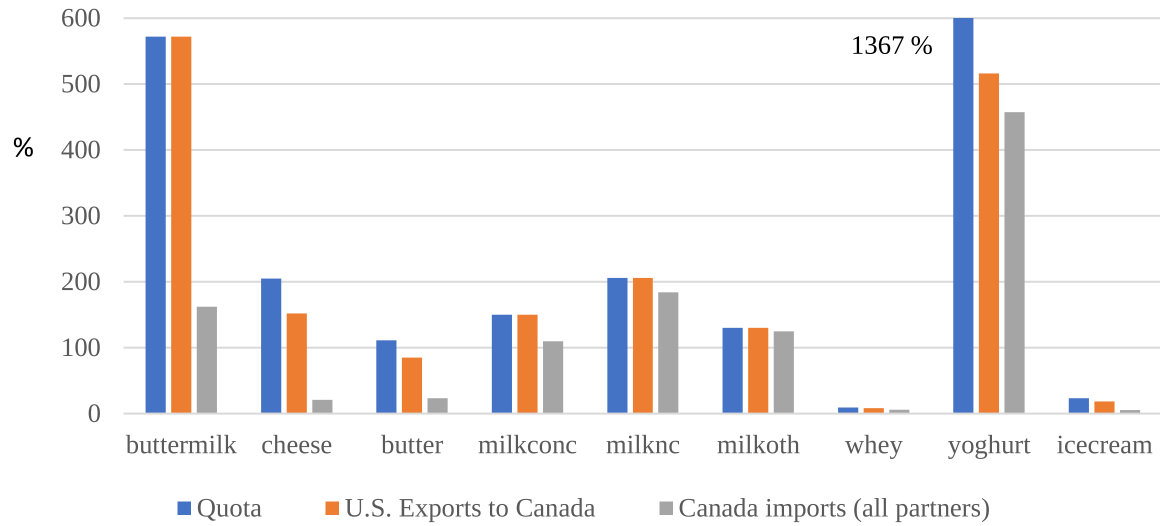

Figure A1 Change in quota and resulted changes in Canada trade flows

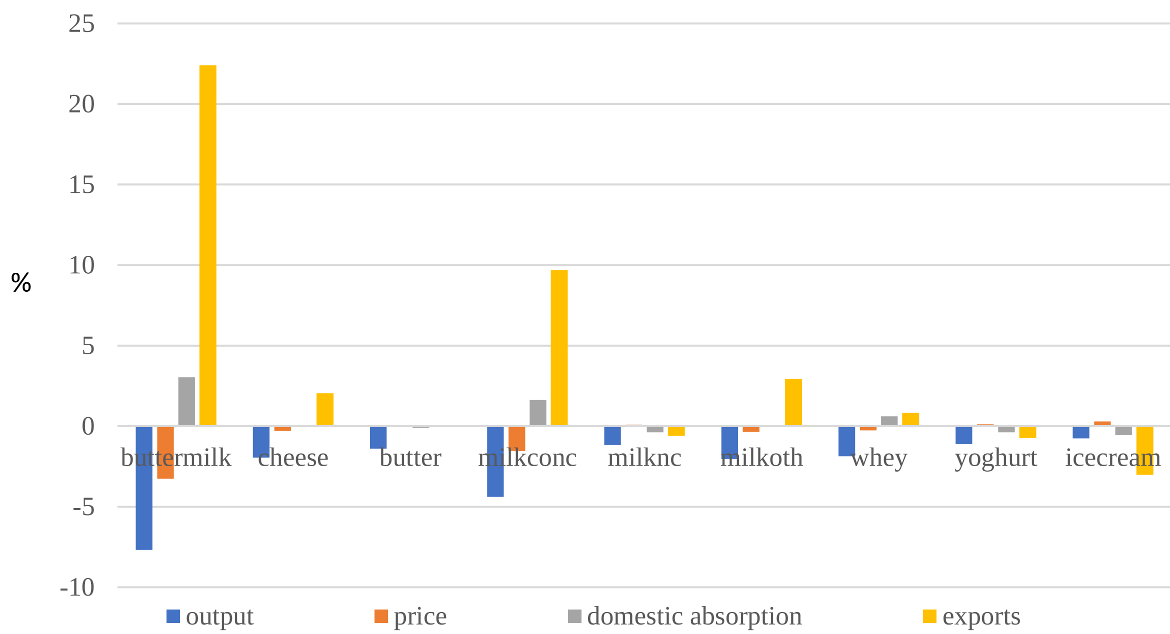

Figure A2 Impacts on dairy markets in Canada

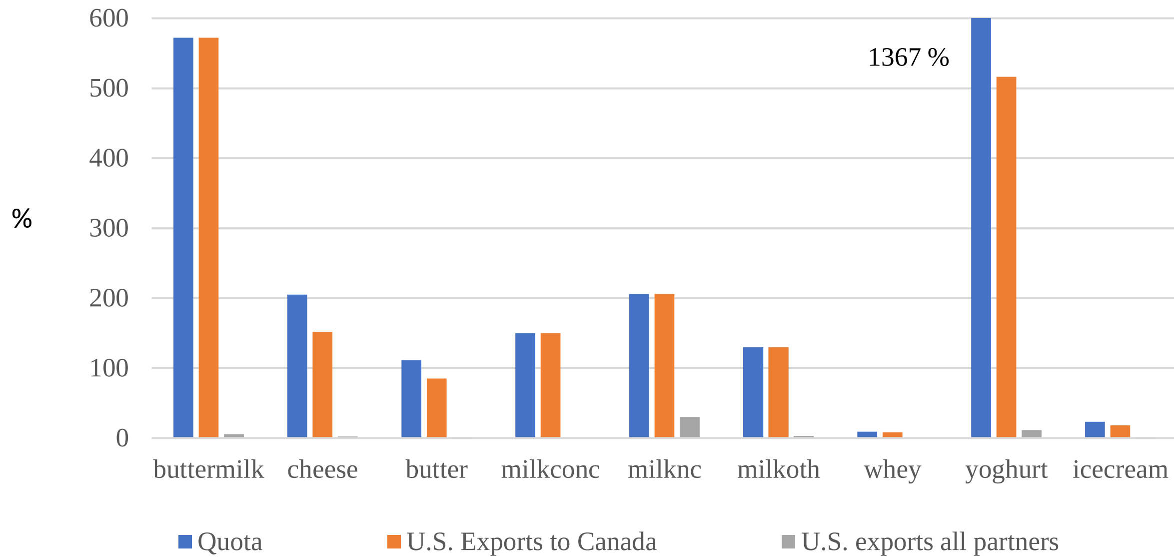

Figure A3 Change in quota and resulted changes in U.S. trade flows

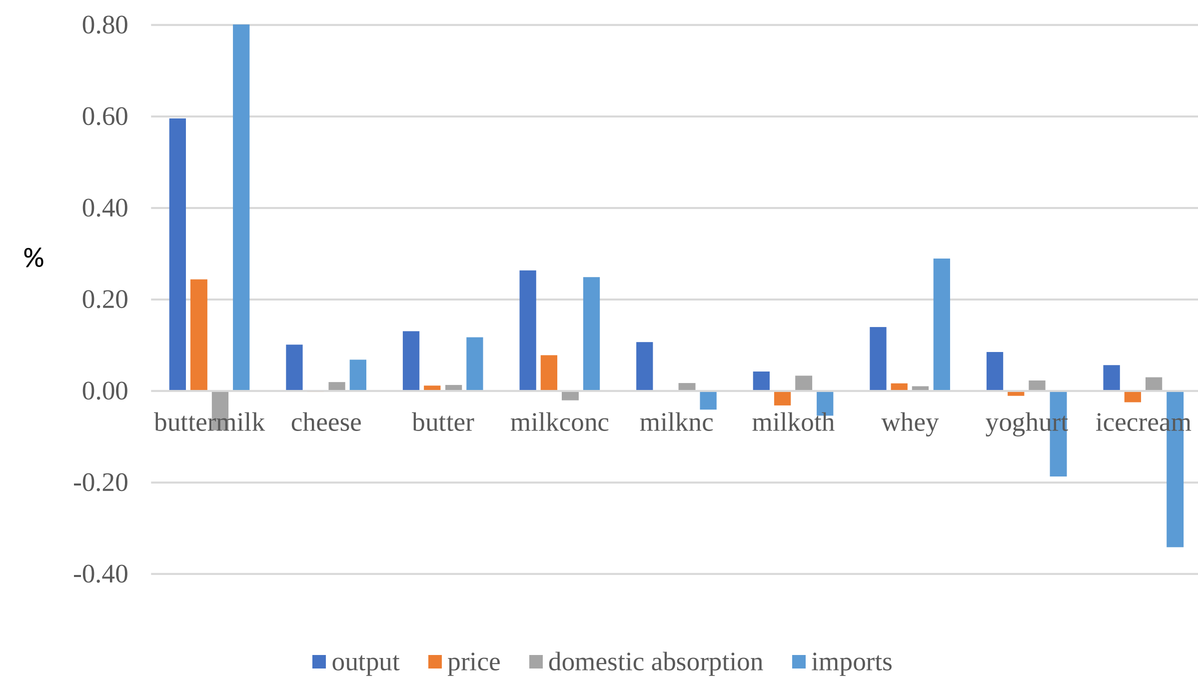

Figure A4 Impacts on U.S. dairy markets