

Illustrative analysis with GTAP-HS-TRQ modeling framework: USMCA expanded market access for U.S. dairy in Canada

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Objective

- Develop data base and CGE model to advance analysis of trade policies in dairy sectors
 - Construct GTAP-HS data: disaggregate output and trade in dairy products (mil) within the GTAP data base
 - Build GTAP-HS-TRQ model
 - Quantify impacts of trade policies at the detailed dairy commodity level, as well as other sectors and economy-wide impacts
 - Take into account tariff-rate quotas (TRQs)
 - Illustrate the value of this approach with analysis of expanded market access for US dairy commodities in Canada under USMCA

GTAP-HS database: key features

- GTAP 10p1 data base, reference year 2014
- Bilateral imports, protection rates, domestic production and demand for domestically produced commodities at the HS6 level within GTAP dairy products (mil) sector
 - FAOSTAT data on production, total country exports and imports (quantities, prices and values) of 23 dairy commodities at the country level
 - Other data sets to fill gaps in FAO data (Euromonitor International, OECD-FAO Agricultural Outlook)
 - *Gap filling techniques*
 - MACMAP data on HS6 bilateral trade values (CIF prices) and import tariff rates
 - MACMAP trade data and FAO production data use different classification systems (HS 2012 and CPC 2.1) => use intersection
 - MACMAP and FAO data are reconciled to match the GTAP data at the sectoral level
- In the final GTAP-HS data base
 - CGE level aggregation: 20 regions and 28 sectors, including mil
 - HS6 level: trade and domestic use of 9 commodities within GTAP sector “dairy products”

GTAP-HS model

- History of model development
 - Original concept was developed in Grant, Hertel, and Rutherford (2007)
 - Implemented in GTAP model (Narayanan et al. 2010)
 - Resynched with the latest code of the GTAP model (Aguiar et al. 2019)
- The general idea is that sectors of interest produce multiple commodities
 - Production sector definition follows the CGE model aggregation
 - Produced commodities and trade are defined at the HS6 level
 - In some cases, a more aggregate commodity categories (relative to the HS6 level) are used due to data limitations
- Implementation in CGE model
 - In production, an activity produces multiple commodities
 - In consumption, substitution among disaggregated commodities within aggregated commodity
 - Market clearing conditions
 - Price linkages

GTAP-HS-TRQ model

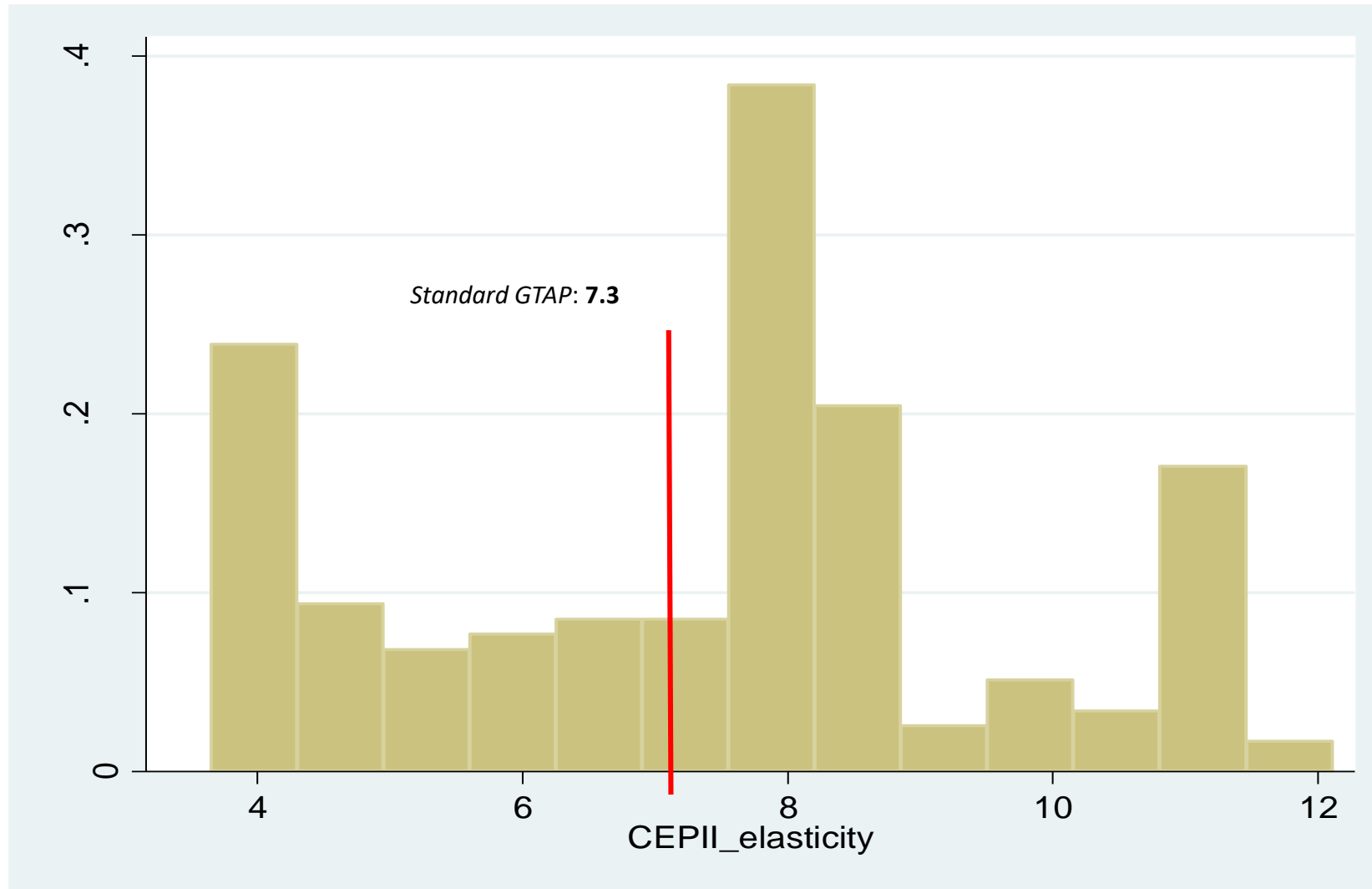
- Modify GTAP-HS model by incorporating structure that supports analysis of TRQ regimes
 - TRQ implementation builds on GTAP Technical paper 18 by Elbehri and Pearson (2005) and Beckman and Arita (2016)
- Collect additional data to support analysis of dairy trade at the detailed level
 - Tariff Analysis Online provided by WTO
 - Canada custom tariff schedule
 - Statistics Canada
 - Global Affairs Canada
 - USMCA Appendix 2: Tariff Schedule of Canada

Parameters at the HS6 level

- Specification of the GTAP-HS-TRQ model requires provision of selected supply and demand substitution elasticities at the detailed commodity level:
 - Elasticity of transformation between disaggregated commodities (milk, cheese, whey, etc.) supplied by an aggregate processed dairy sector (mil)
 - Currently using value of “-2”; in parallel working on refining the supply response
 - Substitution between different import suppliers at the disaggregate level (e.g. bananas imported to U.S. from Ecuador, Costa Rica, Colombia, etc.)
 - HS6 elasticity estimates provided by Fontagne et al. (2019) from CEPII. Trade weighted to match the dairy commodity classification of the GTAP-HS model
 - Substitution between domestic and imported commodities at the disaggregate level (e.g. domestic whey vs imported whey)
 - Currently using half of the value of elasticity of substitution between import suppliers

Frequency density of HS6 elasticities

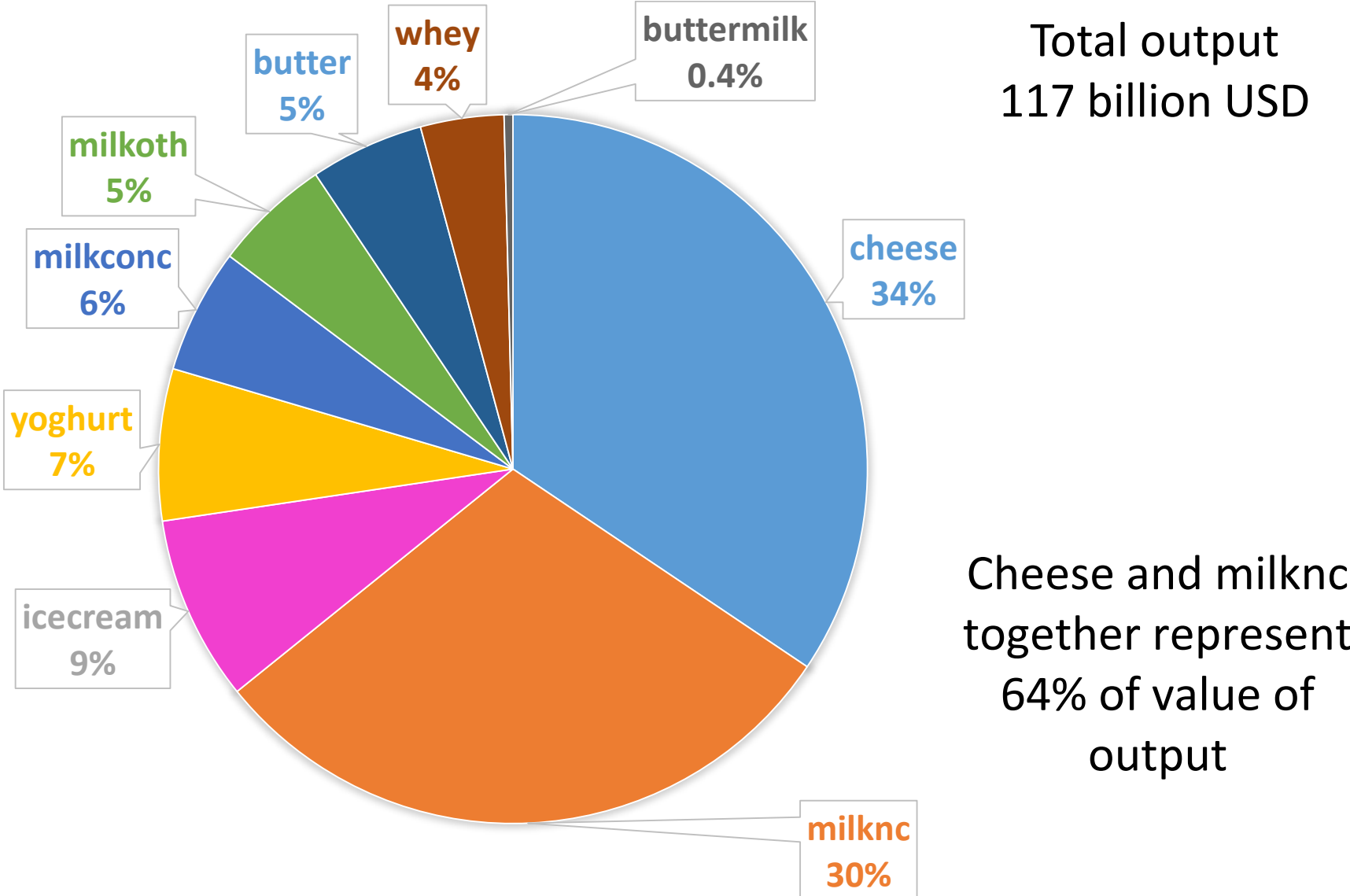
Note: Commodity and region-specific dairy trade elasticities are reported



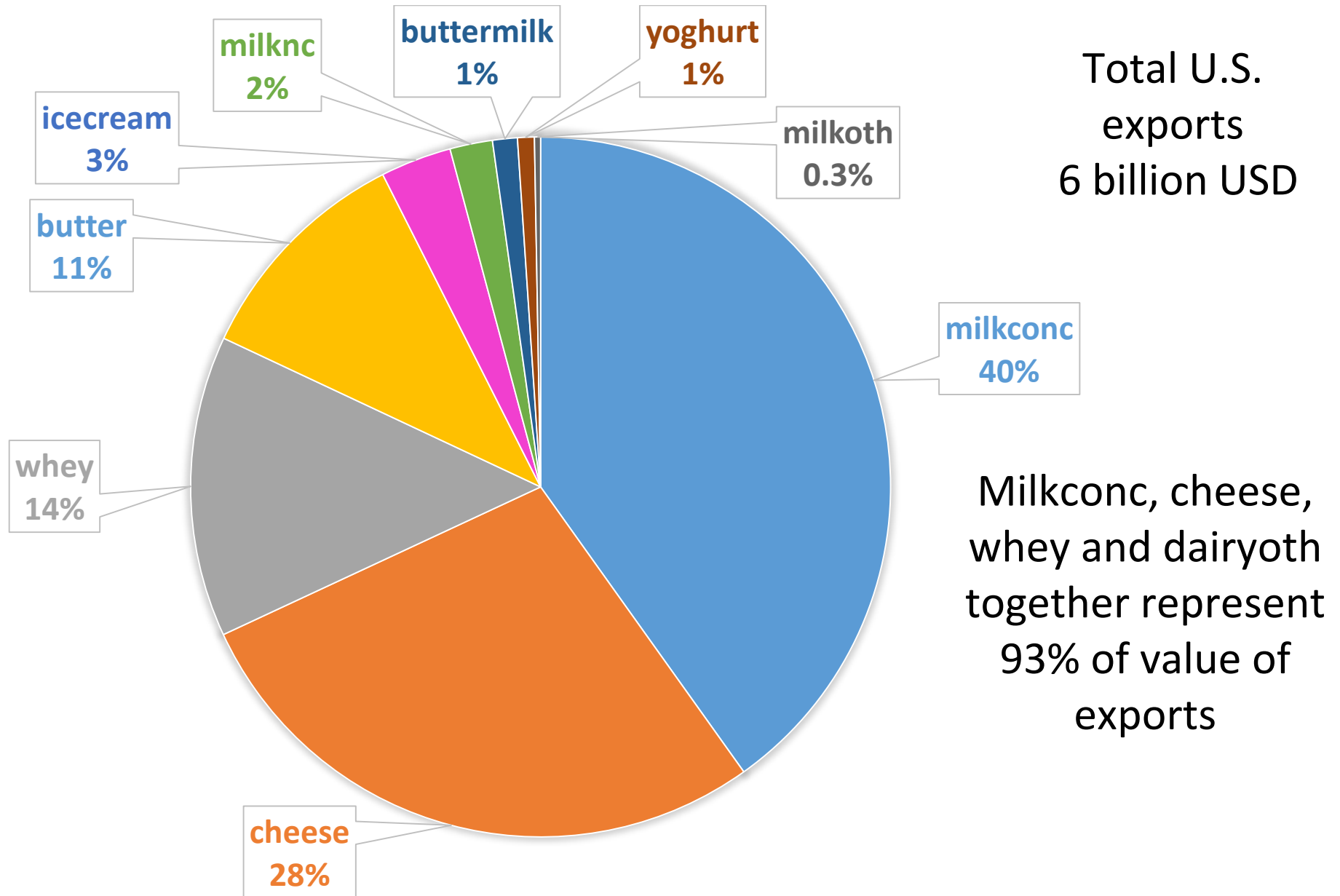
Disaggregated dairy in the GTAP-HS-TRQ

Commodity	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

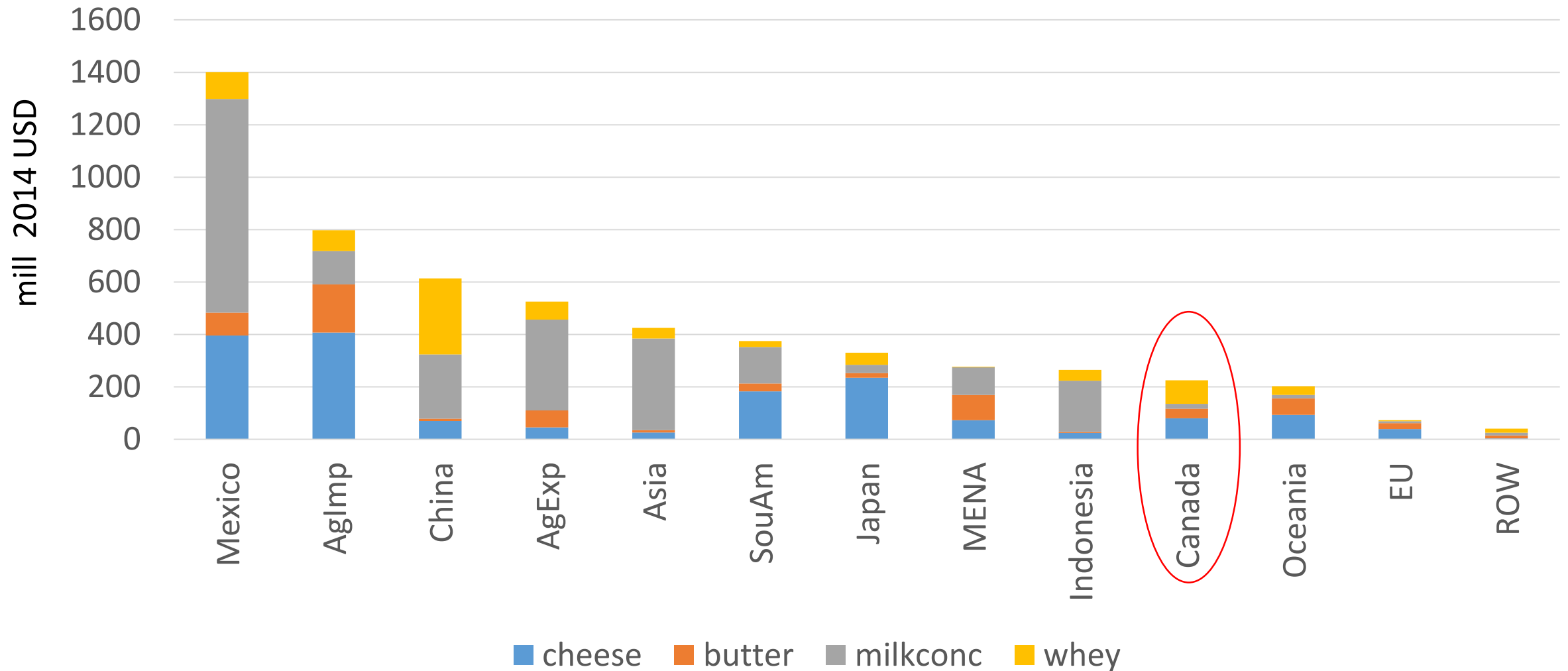
Structure of output of U.S. dairy sector



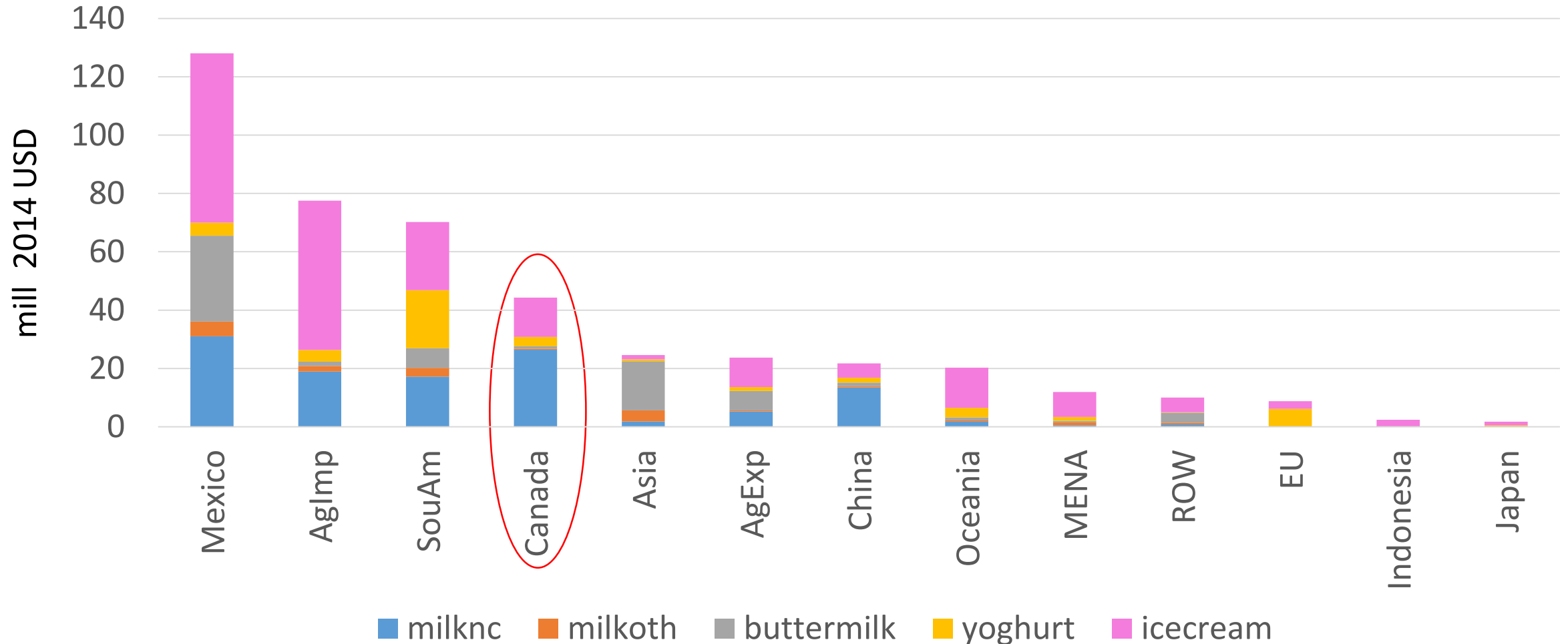
Structure of U.S. dairy exports



U.S. exports of cheese, dairyoth, milkconc and whey by destination (93% of total dairy exports)

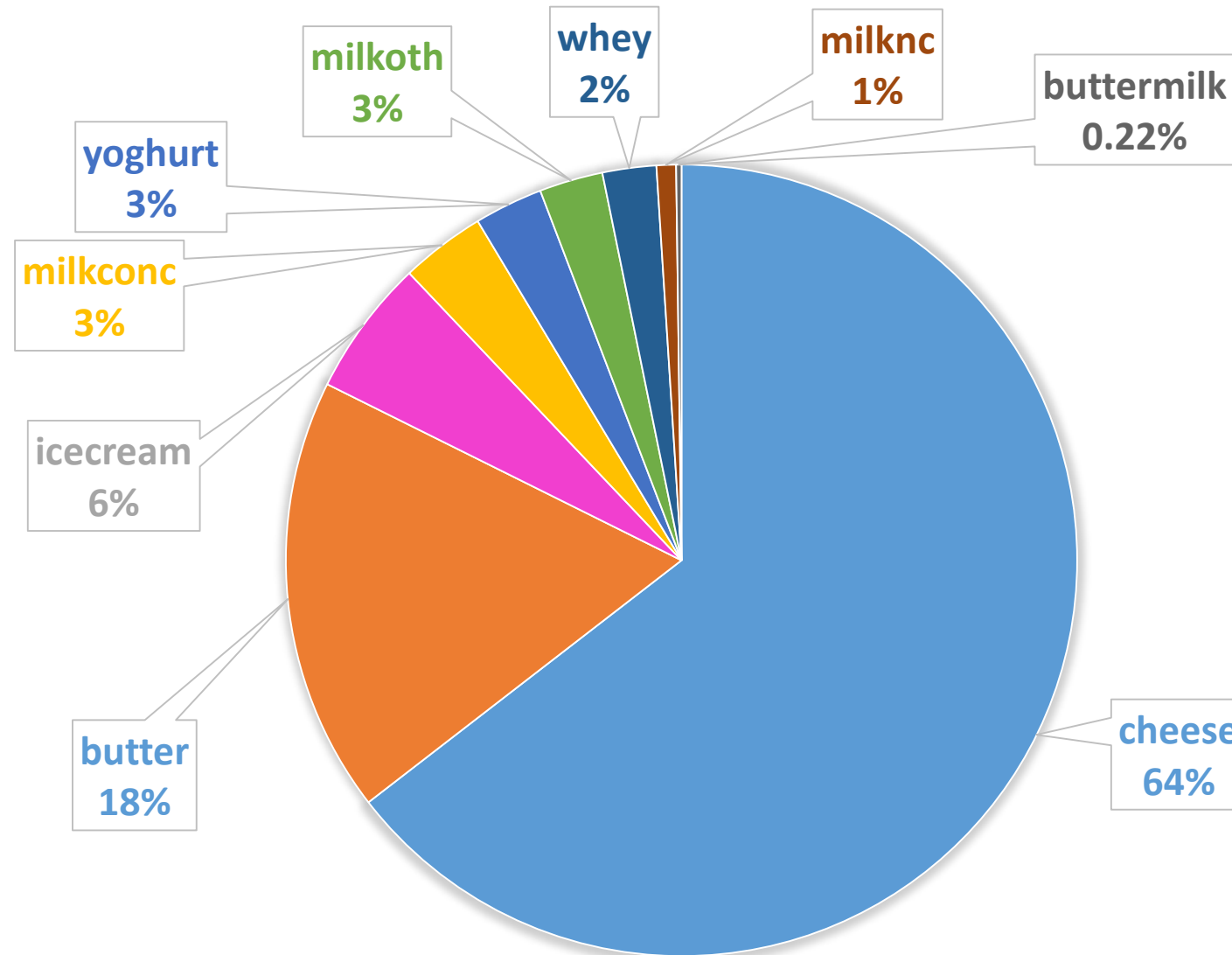


U.S. exports of milknc, milkoth, buttermilk, yoghurt and icecream by destination (7% of total dairy exports)

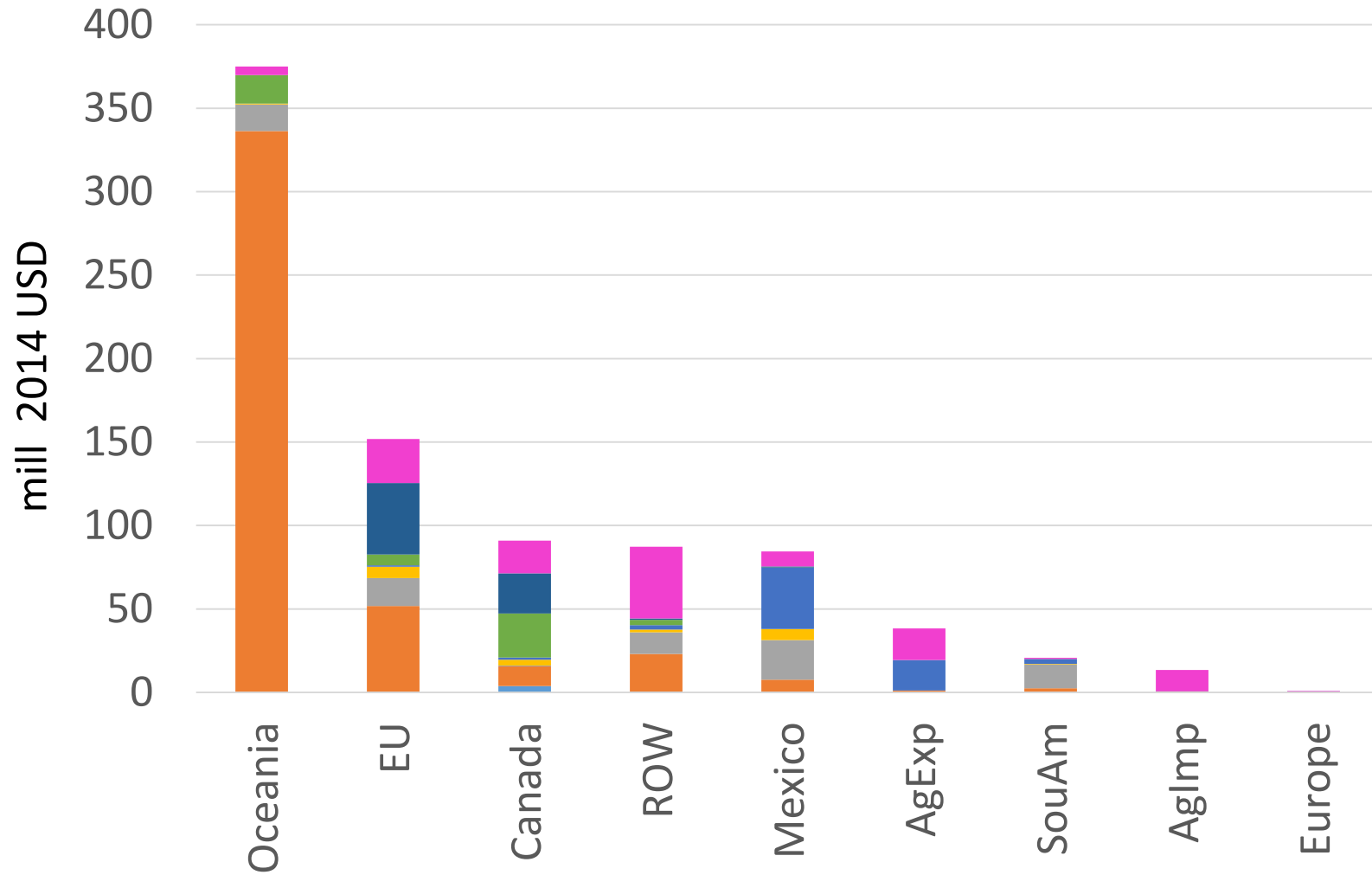


Structure of U.S. imports of dairy products

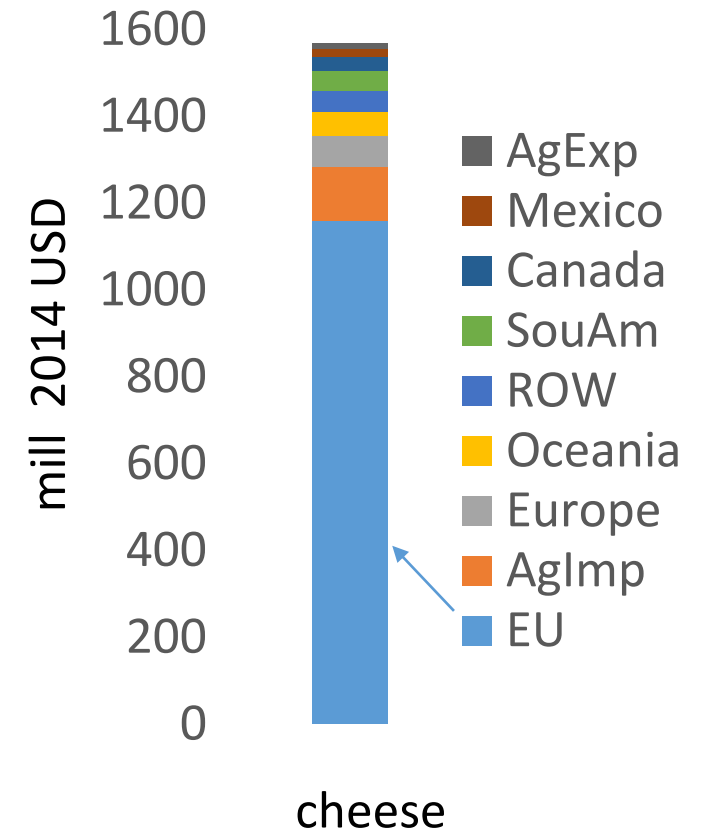
Total U.S. dairy imports
2.4 billion USD



U.S. imports of dairy by commodity and source



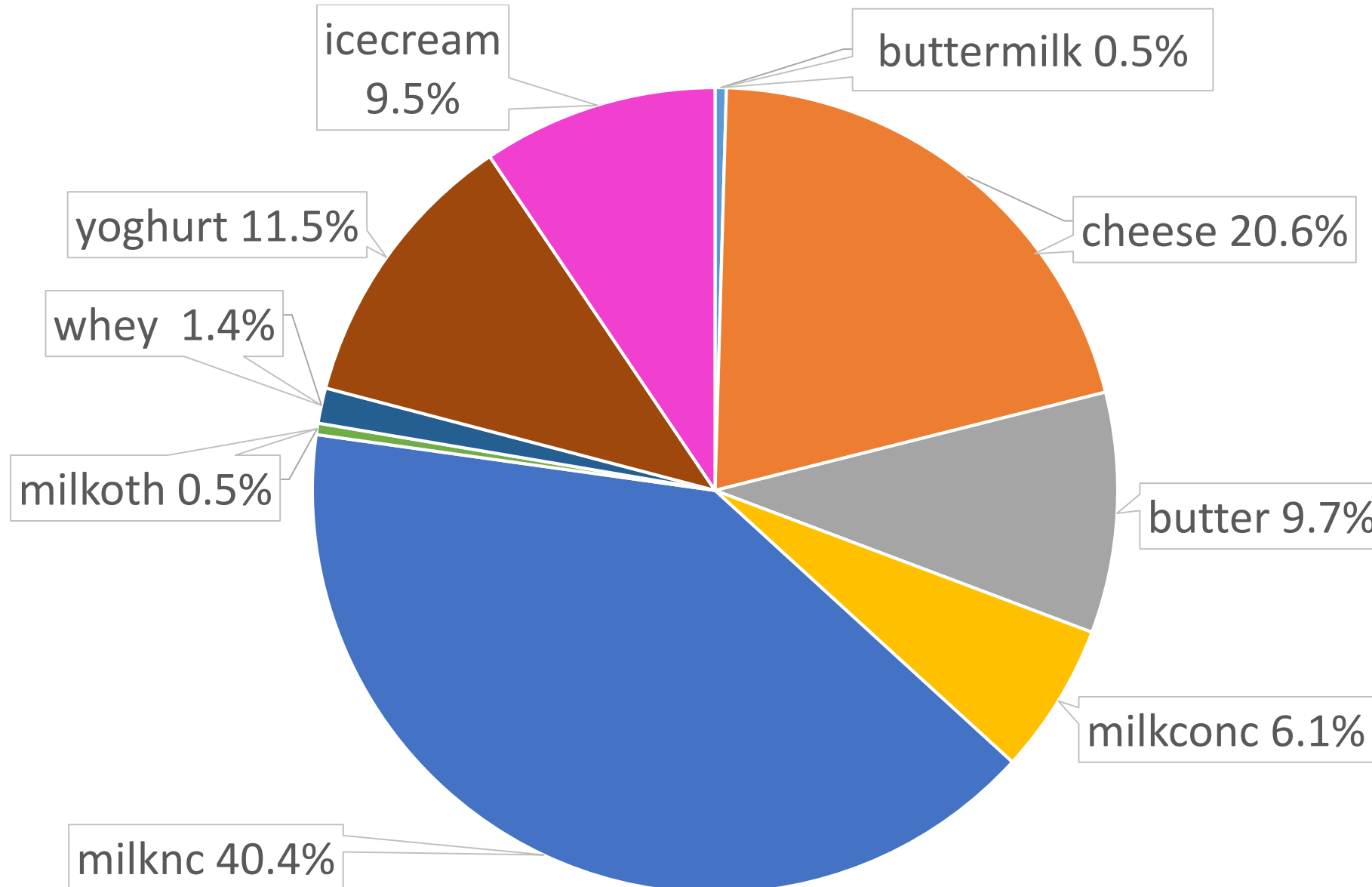
■ buttermilk ■ butter ■ milkconc ■ milknc
■ milkoth ■ whey ■ yoghurt ■ icecream



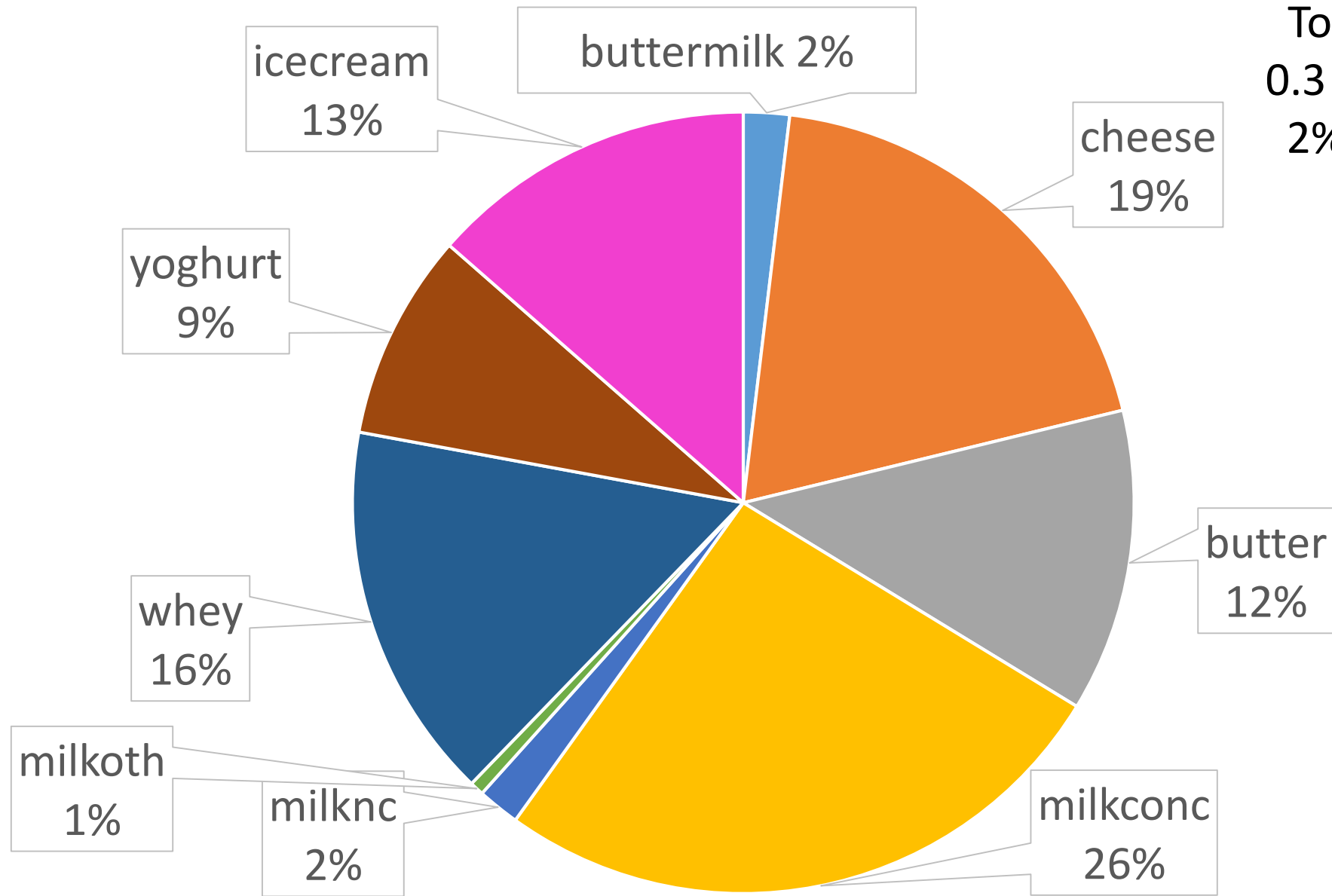
cheese

Structure of Canadian dairy sector output

Total output
15 billion USD

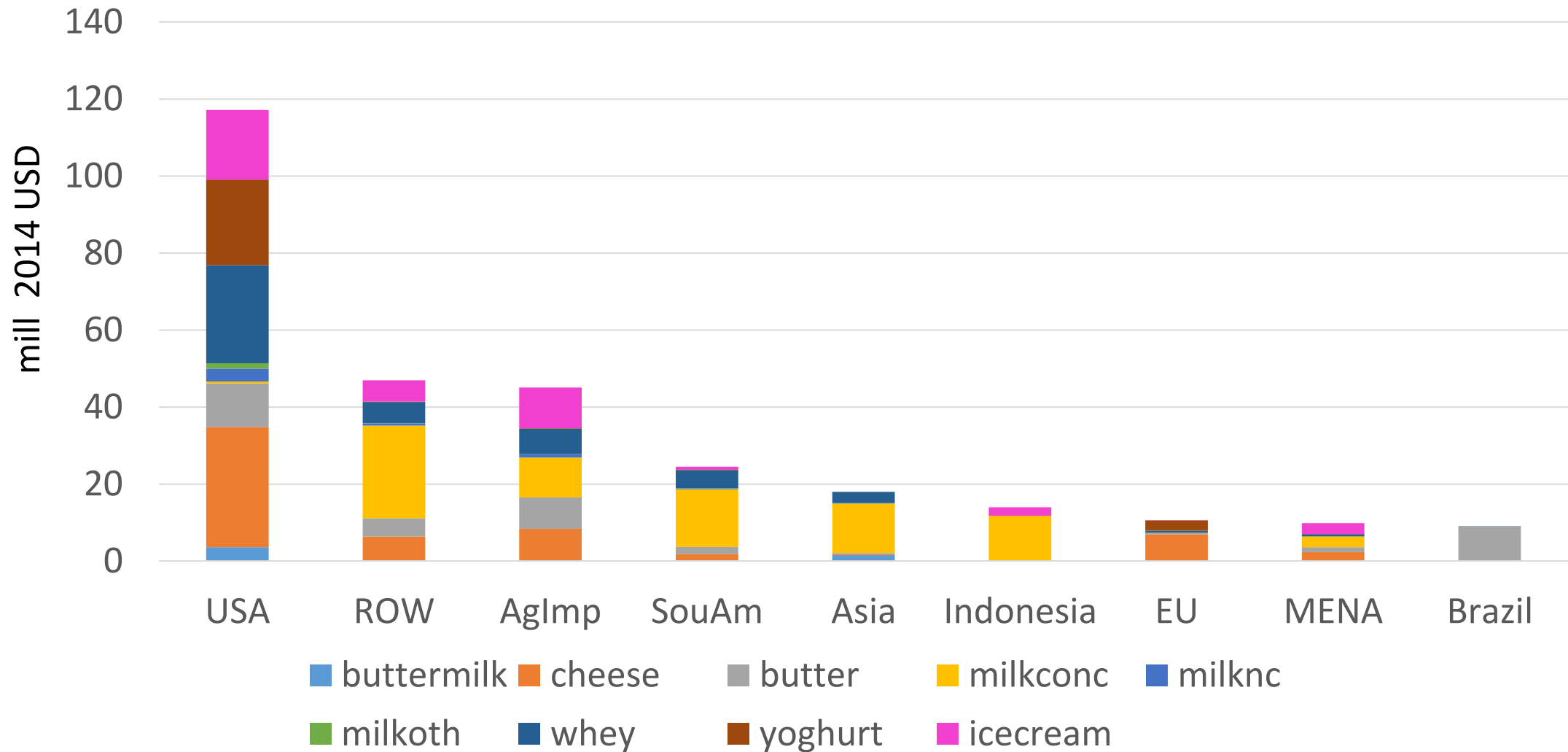


Structure of Canadian dairy exports

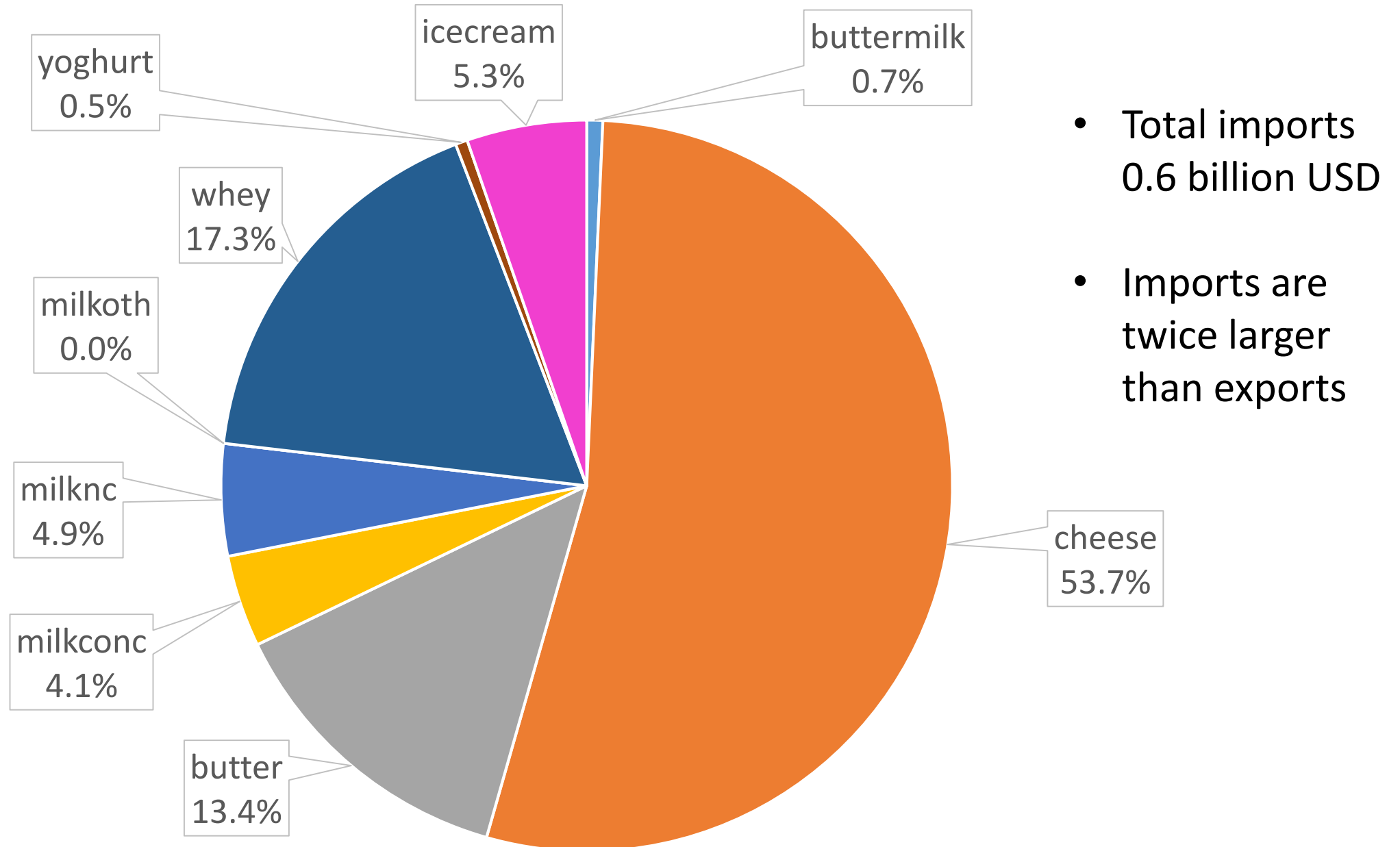


Total exports
0.3 billion USD,
2% of output

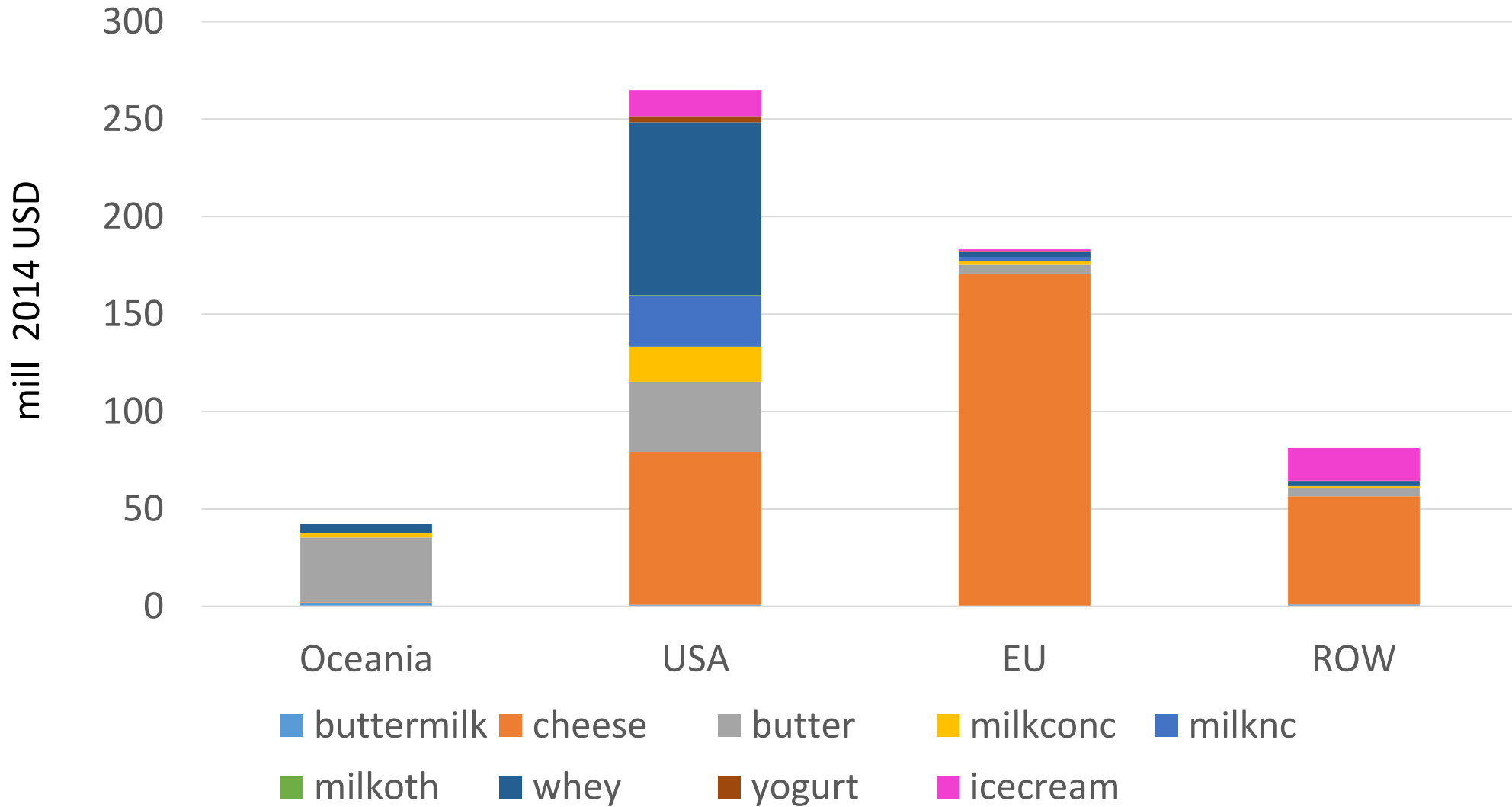
Canadian exports of dairy by commodity and source



Structure of dairy imports in Canada



Canadian imports of dairy by source and commodity



Tariff-rate quotas

- Tariff-rate quotas (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
- TRQs are pervasive in international dairy trade
- US dairy exports to Canada are subject to TRQs
- USMCA expands market access (quota) for US dairy commodities in Canada

Comm. in the model	HS-6 codes	Info	WTO within access commitment, MT	WTO in-quota tariff	WTO out-of-quota tariff	U.S. tariff-free access under NAFTA, MT
milknc	0401.10	fat<=1%	64,500	7.5%	241.3%	64,500
	0401.20	1%<fat<=6%				
	0401.40	fat 6-10%	394	7.5%	292.5%	394
	0401.50	fat =>10%				
milkconc	0402.10	fat<=1.5%	0	3.32c/kg	201.5%	0
	0402.21	fat>1.5%, n.s.	0	3.32c/kg	243%	0
	0402.29	fat>1.5%, other	0	3.32c/kg	243%	0
	0402.91	evaporated	11.7 for Australia	2.84c/kg	259%	0
milkoth	0402.99	condensed			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	blend. dairy powder	4,345	3%	270%	4,345

Comm. in the model	HS-6 codes	Info	WTO within access commitment, MT	WTO in-quota tariff	WTO out-of-quota tariff	U.S. tariff-free access under NAFTA, MT
cheese	0406.10	fresh	20412 with 66% is allocated to EU, leaving 6940 for other countries	3.32c/kg	245.6%	6940
	0406.20	grated and powd.		2.84c/kg	245.6%	
	0406.30	other processed		3.32c/kg	245.5%	
	0406.40	veined		3.32c/kg	245.5%	
	0406.90	other cheese		2.84-3.32¢/kg	245.5%	
yogurt	0402.10	yogurt	332	6.5%	237.5%	332
buttermilk	0403.90	buttermilk and powdered buttermilk	908 for New Zealand	3.32c/kg	208%	0
whey	0404.10	whey and modified whey	3198	3.32c/kg	208%	3198
icecream	2105.00	ice cream	484	6.7%	277%	484

U.S. dairy exports to Canada: commodities with zero applied import tariff

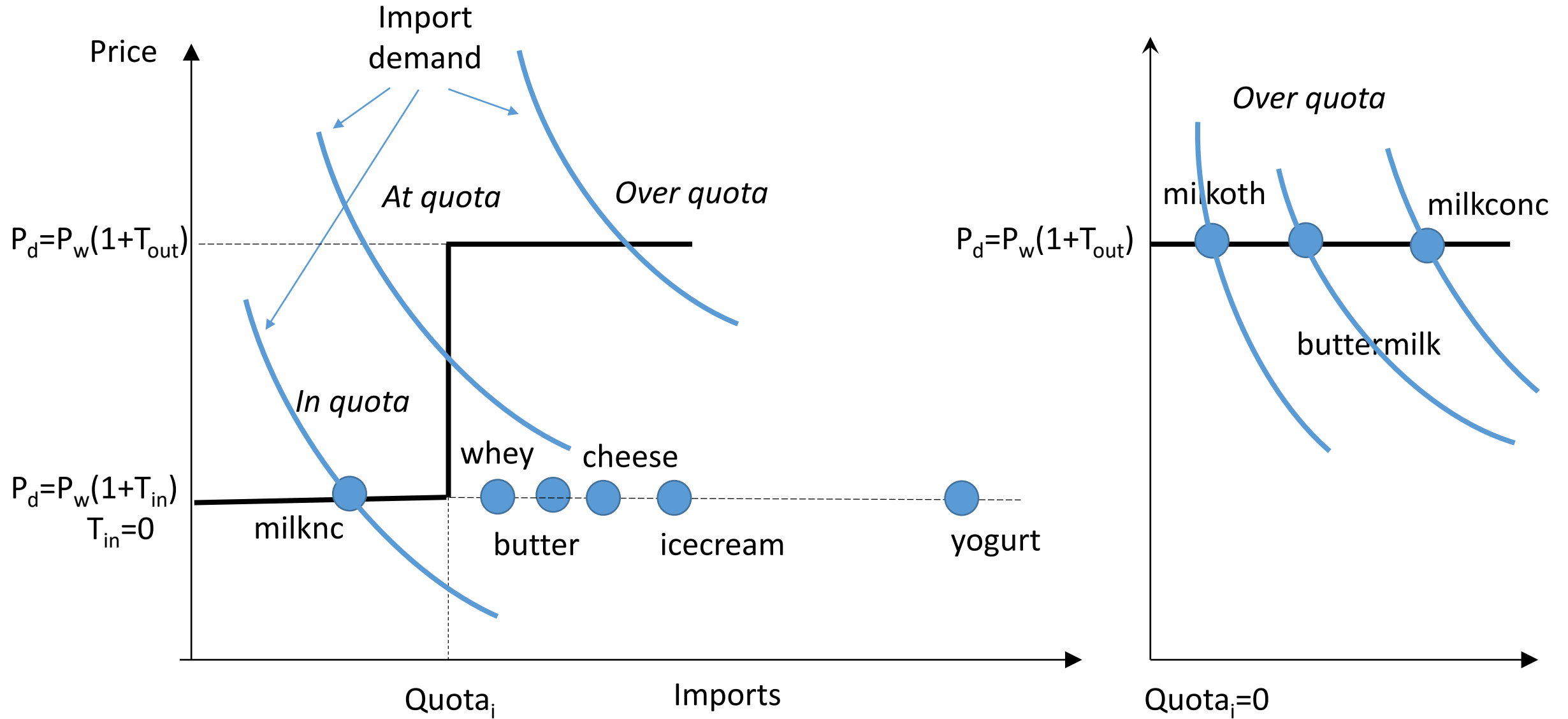
Commodity	Trade volume, MT	Current tariff-free access, MT	Import tariff, %	Canada suppl. imports (all partners)	Additional access under USMCA, MT
milknc	55,098	64,894	0	yes	68,855
butter	6,403	5,619	0	yes	7,119
cheese	8,398	6,940	0	yes	14,226
yogurt	794	332	0	yes	4,537
whey	52,823		0		
<i>whey powder</i>	3,577	3,198	0	yes	4,303*
icecream	4,629		0		
<i>Ice cream</i>	660	484	0	yes	785

*After year 10, this TRQ will be eliminated.

U.S. dairy exports to Canada: commodities with high applied tariff

Commodity	Volume, MT	Current tariff-free access, MT	Import tariff, %	Additional access under USMCA, MT
milkconc	8003	0	191	11,973
milkoth	47	0	242	61
buttermilk	133	0	201	761

U.S. dairy imports in Canada and TRQ regimes



How to implement these TRQs in the model?

- Only one of nine commodities falls into one of the three TRQ regimes
 - milknc is in quota
 - whey, butter, cheese, icecream and yogurt are above quota, but imported with zero tariff under supplementary imports authorized by Canada Minister
 - Quota is zero for milkoth, buttermilk and milkconc for U.S. exporters
 - Modeling complication: percent change applied to zero is zero
- Canadian Minister may, at his discretion, authorize imports of dairy products apart from the import access quantity, particularly if he/she judges that the importation of these products is required to meet Canadian market needs (Global Affairs Canada)
- Economic model equipped with TRQs may not be ideal/sufficient to model U.S.-Canada dairy trade
- Modelling effects of uncertainty in supply and demand on trade flows and production may be more appropriate

Illustration with GTAP-HS-TRQ model: expansion of market access for U.S. dairy in Canada

- Commodities with currently zero quota and high actual (observed) import tariff (milkoth, buttermilk, milkconc)
 - Assume “at quota” regime
 - Quota equals to observed trade volume
 - Actual tariff is less than “out-of-quota” tariff
 - No change to GTAP-HS database is required
- “In quota” milknc
 - Assume “at quota” regime
 - Justification: experts suggest that quota is filled for this commodity by Canadian households purchases of U.S. milk on U.S. territory and bringing them into Canada
 - Using Altax, modify initial GTAP-HS data base by incorporating half of out-of-quota tariff to create “at quota” case
- Over quota commodities with zero tariff due to supplemental imports (whey, butter, cheese, icecream, yogurt)
 - Assume they are in “over quota” regime
 - Justification: potential hidden rents
 - Using Altax, modify initial GTAP-HS data base by incorporating out-of-quota tariff to create “over quota” case

Results: TRQ regimes, import tariffs and quantities

Dairy product	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
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

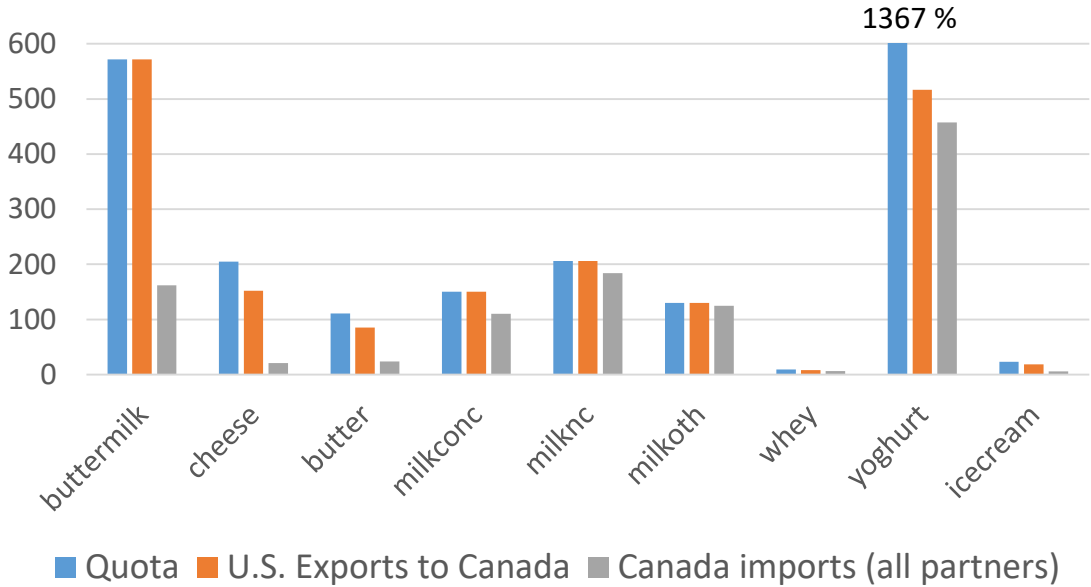
*Power of import tariff in the initial GTAP-HS data base

**Power of import tariff in the altered GTAP-HS data base

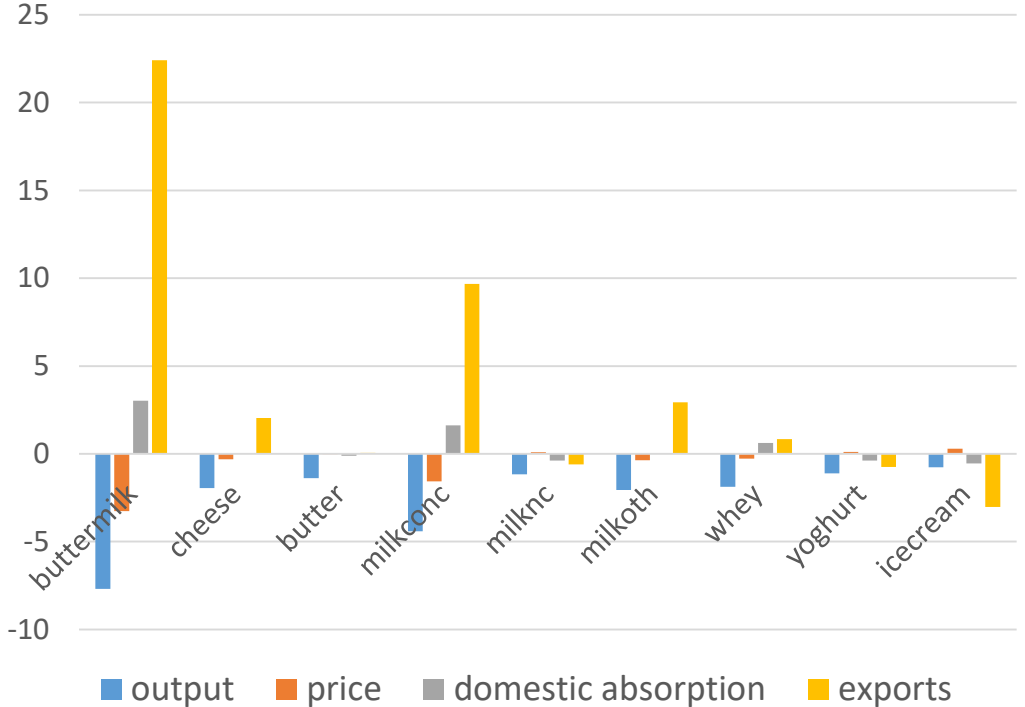
Note, increase in market access is modeled using altered GTAP-HS data base

Results: prices, output and trade in Canada

Change in quota and resulted changes in trade flows, % change

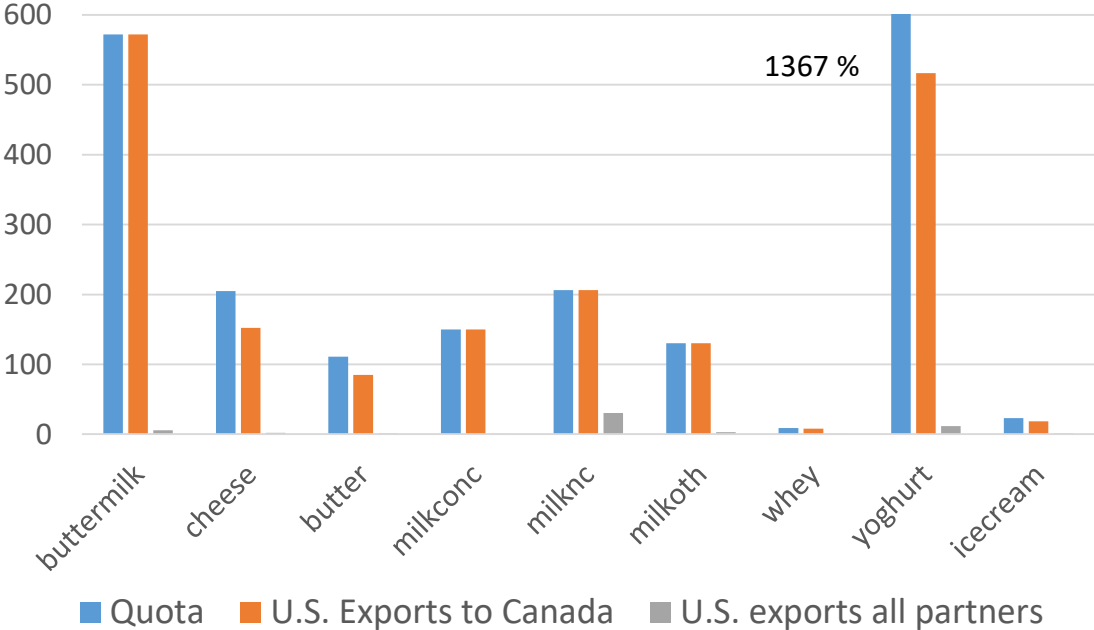


Impacts on Canadian dairy markets, % change

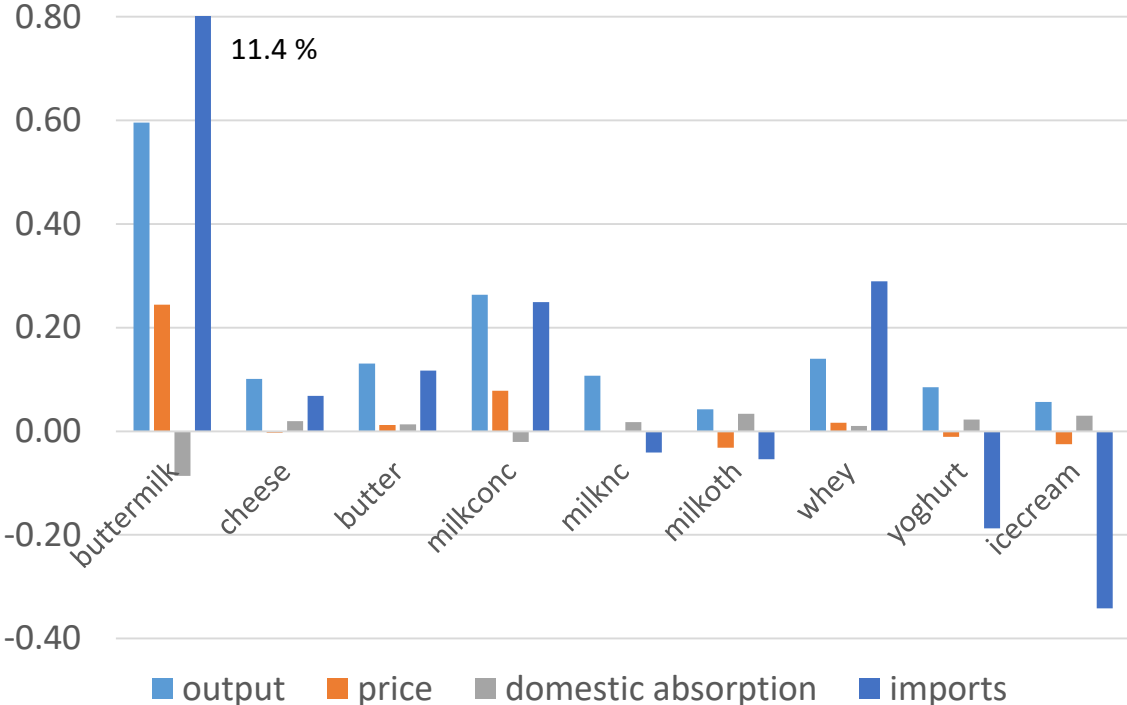


Results: prices, output and trade in United States

Change in quota and resulted changes in trade flows, % change



Impacts on U.S. dairy markets, % change



Aggr. dairy	U.S.	Canada
Output, %	0.1	-1.5
Price, %	0.0	-0.1

Impacts of the expanded market access for U.S. dairy in Canada

- Increase in traded quantity and reduction in actual import tariff for all U.S. dairy commodities imported by Canada
- Change from “above quota” to “at quota” regime for cheese, yogurt, whey, ice cream, and butter
- No change in “at quota” regime for all milk and cream (milknc, milkconc, milkoth) and buttermilk
- Small reduction (increase) in price and output of aggregated dairy in Canada (U.S.)
- Noticeable changes for some of the disaggregated commodities
 - 8% reduction in buttermilk output in Canada
 - Six-fold increase in exports of U.S. yogurt to Canada
- Increase in total quota rents for each dairy commodity, except whey

Summary

- Developed GTAP-HS-TRQ framework allows for analysis of tariff rate quotas at detailed commodity level
 - Exogenous changes in market access and in and over quota tariffs
 - Endogenous changes in trade flows, import tariffs and quota rents
- Analysis of expanded market access for U.S. dairy in Canada under USMCA is complicated
 - Supplementary imports by Canada that fluctuate from year to year; they result in above quota trade flows with zero tariff
- To demonstrate modeling with GTAP-HS-TRQ, we made assumptions
 - Initial quota
 - Modify GTAP-HS data base by introducing import tariff in cases with above quota trade flows but zero tariffs
- Under the assumptions, expanded market access results in increase in U.S. dairy exports to Canada, change in regime from “above quota” to “at quota” for five of nine dairy commodities, reduction in actual import tariffs on all U.S. dairy, but does not result in tariff free access for any of the U.S. dairy commodities

Selected references

- Aguiar, A., Corong, E., & van der Mensbrugghe, D. (2019). The GTAP-PE model. The Center for Global Trade Analysis, Purdue University. Mimeo.
- Beckman, J., & Arita, S. (2016). Modeling the Interplay between Sanitary and phytosanitary measures and tariff-rate quotas under partial trade liberalization. *American Journal of Agricultural Economics* 99 (4), 1078-1095.
- Elbehri, A., & Pearson, K. (2005). *Implementing Bilateral Tariff Rate Quotas in GTAP using GEMPACK* (GTAP Technical Paper No. 18). Purdue University, West Lafayette, IN: Global Trade Analysis Project (GTAP). Retrieved from https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=475
- Fontagné, L., Guimbard, H., & Orefice, G. (2019). *Product-Level Trade Elasticities* (Presented at the 22nd Annual Conference on Global Economic Analysis, Warsaw, Poland). Purdue University, West Lafayette, IN: Global Trade Analysis Project (GTAP). Retrieved from https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=5760
- Grant, J.H., Hertel, T.W., & Rutherford, T. (2007). Tariff line analysis of US and international dairy protection. *Agricultural Economics*, 37(s1), pages 271-280.
- Narayanan, B., Hertel, T., & Horridge, M. (2010). *Linking Partial and General Equilibrium Models: A GTAP Application Using TASTE* (GTAP Technical Paper No. 29). Purdue University, West Lafayette, IN: Global Trade Analysis Project (GTAP). Retrieved from https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=3192



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