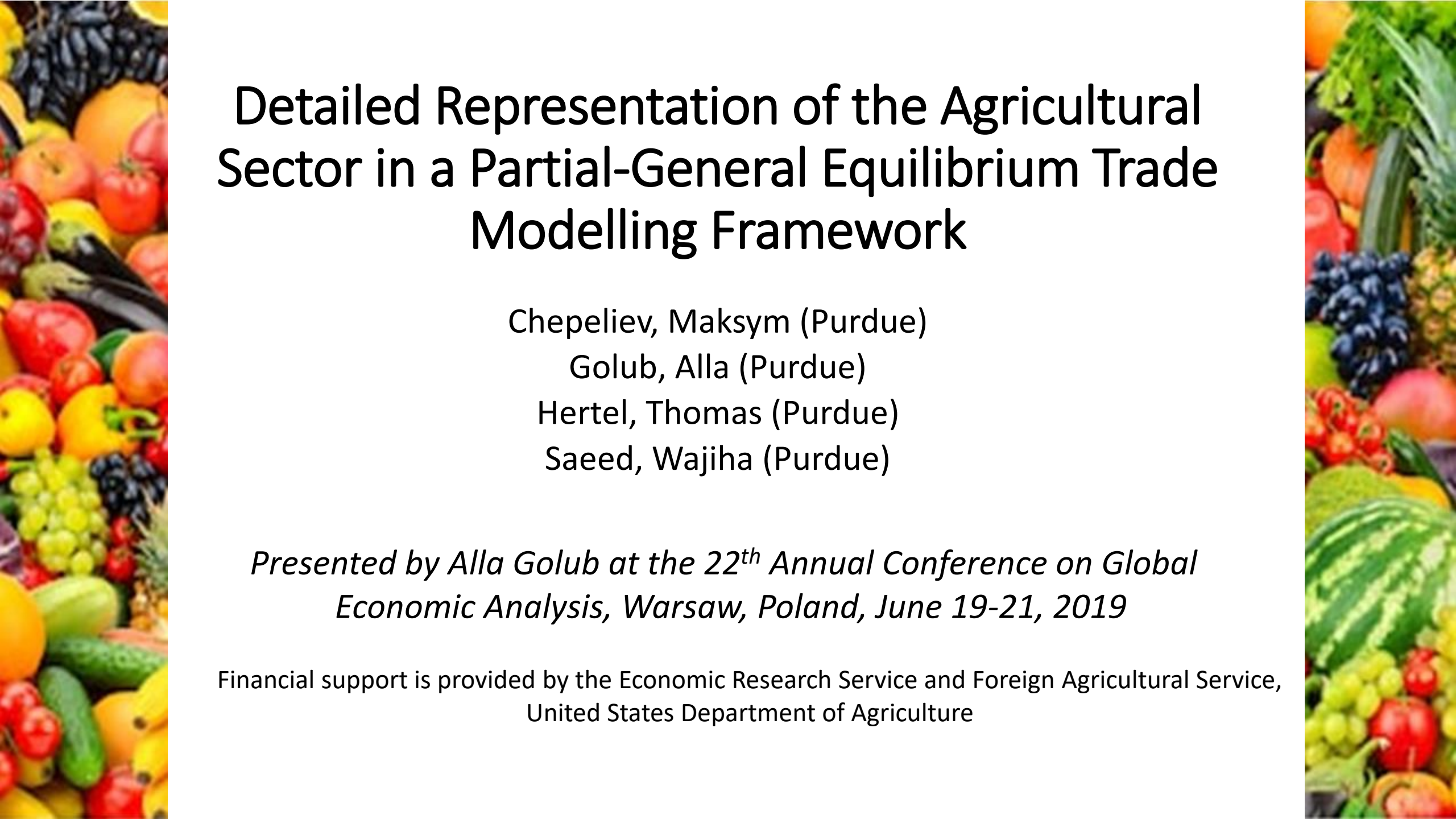




Detailed Representation of the Agricultural Sector in a Partial-General Equilibrium Trade Modelling Framework

Chepeliev, Maksym (Purdue)

Golub, Alla (Purdue)

Hertel, Thomas (Purdue)

Saeed, Wajiha (Purdue)

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Introduction

- When evaluating trade policies, policy makers want to know impact on GDP, trade balance, employment and output by sector, for which **general equilibrium model** is needed
 - CGE model factors in all sectors in the economy, for which aggregation of sectors and commodities is required
 - In CGE analysis based on the GTAP data base, maximum 65 sectors (v.10) and no more than 20 for agricultural and food products
- As negotiations over specific trade policy proceed, policy makers want to know impact on a few sensitive commodities, for which **partial equilibrium model** is needed
 - PE model allows to represent policies and trade relationships at the detailed commodity level
 - However, PE may not incorporate all the relevant linkages and policy detail across key sectors and regions of the world, and cannot capture economy-wide changes in welfare

Introduction

- Level of aggregation in CGE models leads to a variety of problems for evaluation of the economic impacts of trade policy changes (Narayanan et al., 2010)
 - Some sectors aggregate large number of commodities, while there exist huge variations in protection levels and characteristics across “tariff lines” for many commodities
 - Aggregation of sectors may result in ‘false competition’
 - Trade negotiations are conducted at highly disaggregated tariff lines
- This suggests the need for a PE-GE, nested modeling framework to support trade policy analysis

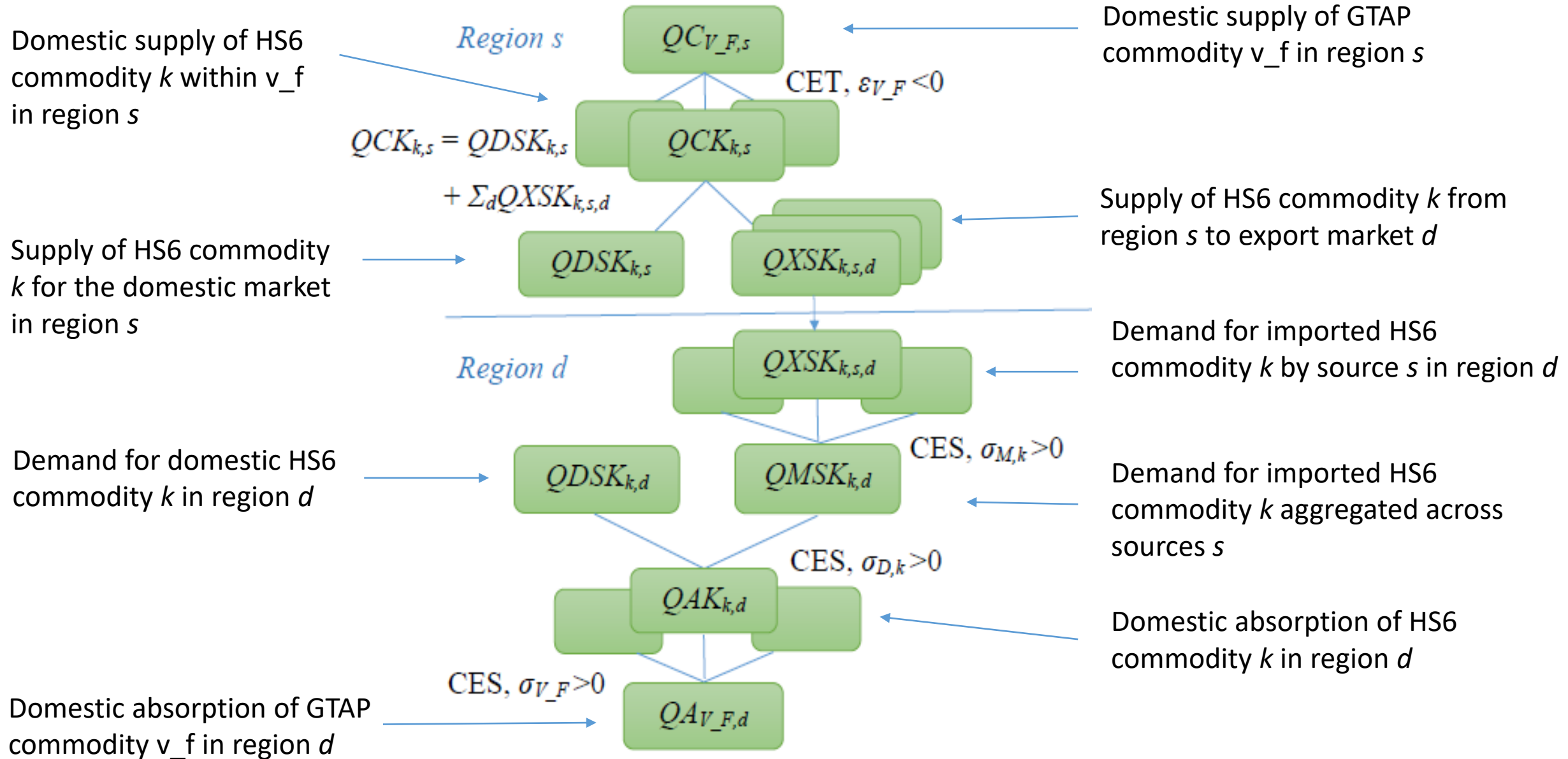
Objective

- Develop PE-GE data base and model to advance trade policy analysis with focus on agriculture
 - Disaggregate two sectors in the GTAP data base
 - vegetables, fruit and nuts (v_f)
 - dairy products (mil)
 - Develop **integrated** PE-GE data base to remove inconsistencies in bilateral trade, trade policies and production which inevitably arise when conducting independent GE and PE analyses
 - Build PE-GE modeling framework that allows to quantify impacts of trade policies at the detailed commodity level, as well as other sectors and economy-wide impacts
 - Illustrate the value of this approach

PE-GE model

- GTAP-PE model (Aguiar et al. 2019)
 - Original concept developed in Narayanan et al. (2010)
 - Uses GTAP model version 7 (Corong et al. 2017)
- The general idea is that sectors of interest produce multiple products
 - 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
- PE model is nested within the GTAP GE model and captures output, domestic consumption and trade at the HS6 level by using
 - CET and CES structures
 - Market clearing conditions
 - Price linkages

Quantity linkages in the PE-GE model



Price linkages in the PE-GE model

Basic price of domestically supplied HS6 commodity k within v_f in region s

FOB price of HS6 commodity k exported from region s to region d

Price including cost of insurance and freight of HS6 commodity k imported from s to d

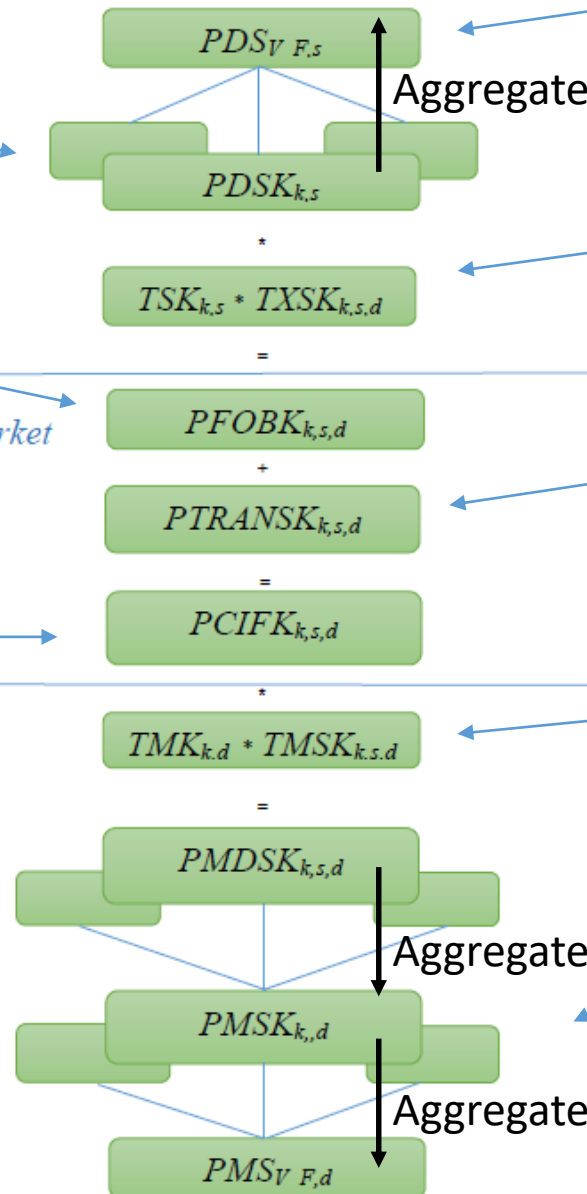
Basic price of HS6 commodity k imported from region s in domestic market in region d

Basic price of the imported GTAP commodity v_f in region d

Region s

World market

Region d



Basic price of domestically supplied GTAP commodity v_f in region s

Destination-generic and destination specific export taxes in region s

Cost of international transport of the HS6 commodity k imported from s to d

Source-generic and **source-specific import taxes in region d**

Basic price of the imported HS6 commodity k in domestic market in region d , aggregated across all sources s

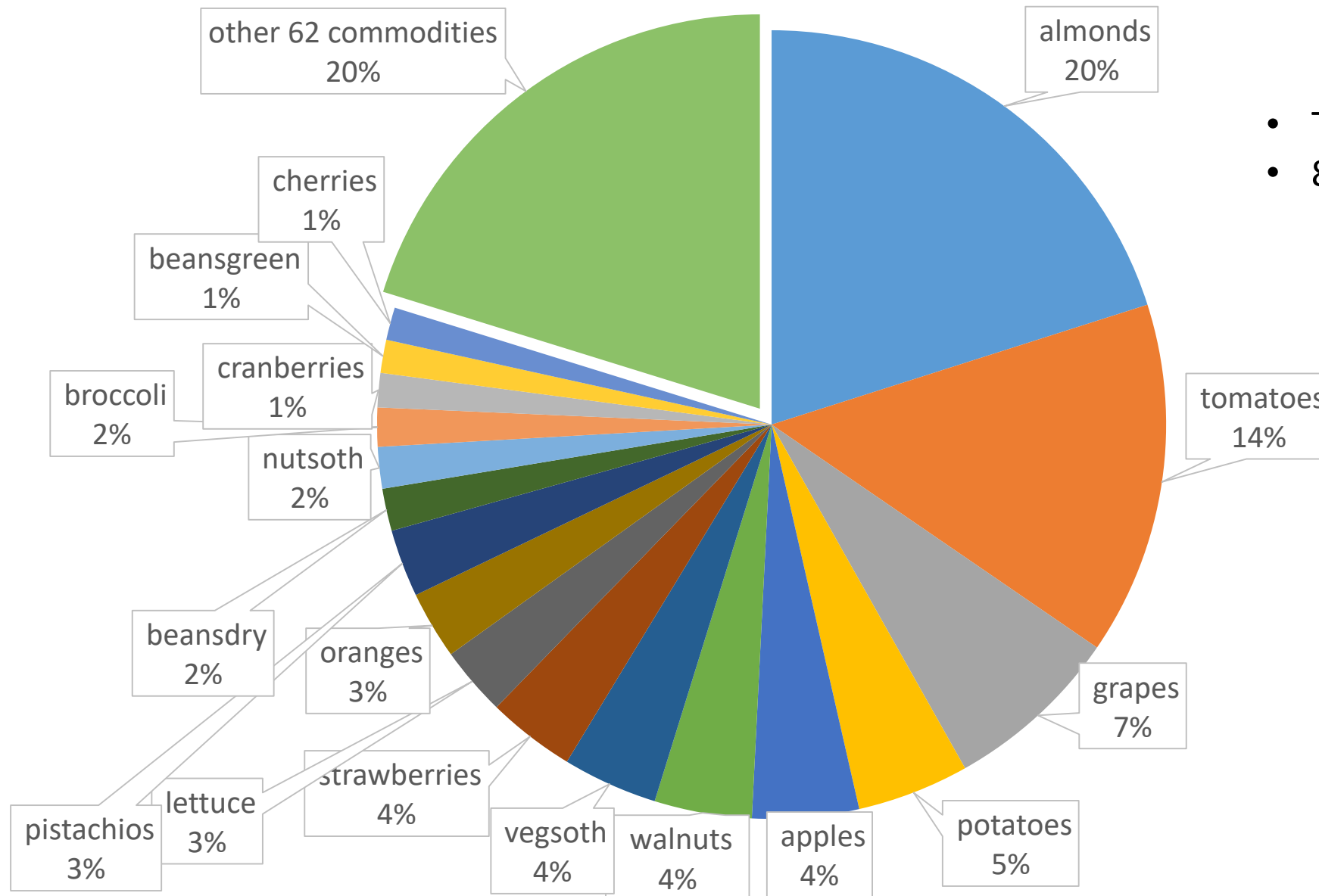
PE-GE data base

- GTAP 10p2 data base, reference year 2014
- Bilateral imports, protection rates, domestic production and demand for domestically produced commodities at the HS6 level within GTAP vegetables, fruit and nuts (v_f) and dairy products (mil) sectors
 - FAOSTAT data on production, total country exports and imports (quantities, prices and values) of 93 vegetables, fruits, nuts and 23 dairy commodities at the country level
 - Other data sets to fill gaps in FAO data (Euromonitor , 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 PE-GE data base
 - GE part: 20 regions and 28 sectors, including v_f and mil
 - PE part: trade and domestic use of 79 commodities within GTAP sector “vegetables, fruit and nuts” and 9 commodities within GTAP sector “dairy products”

Policy scenarios

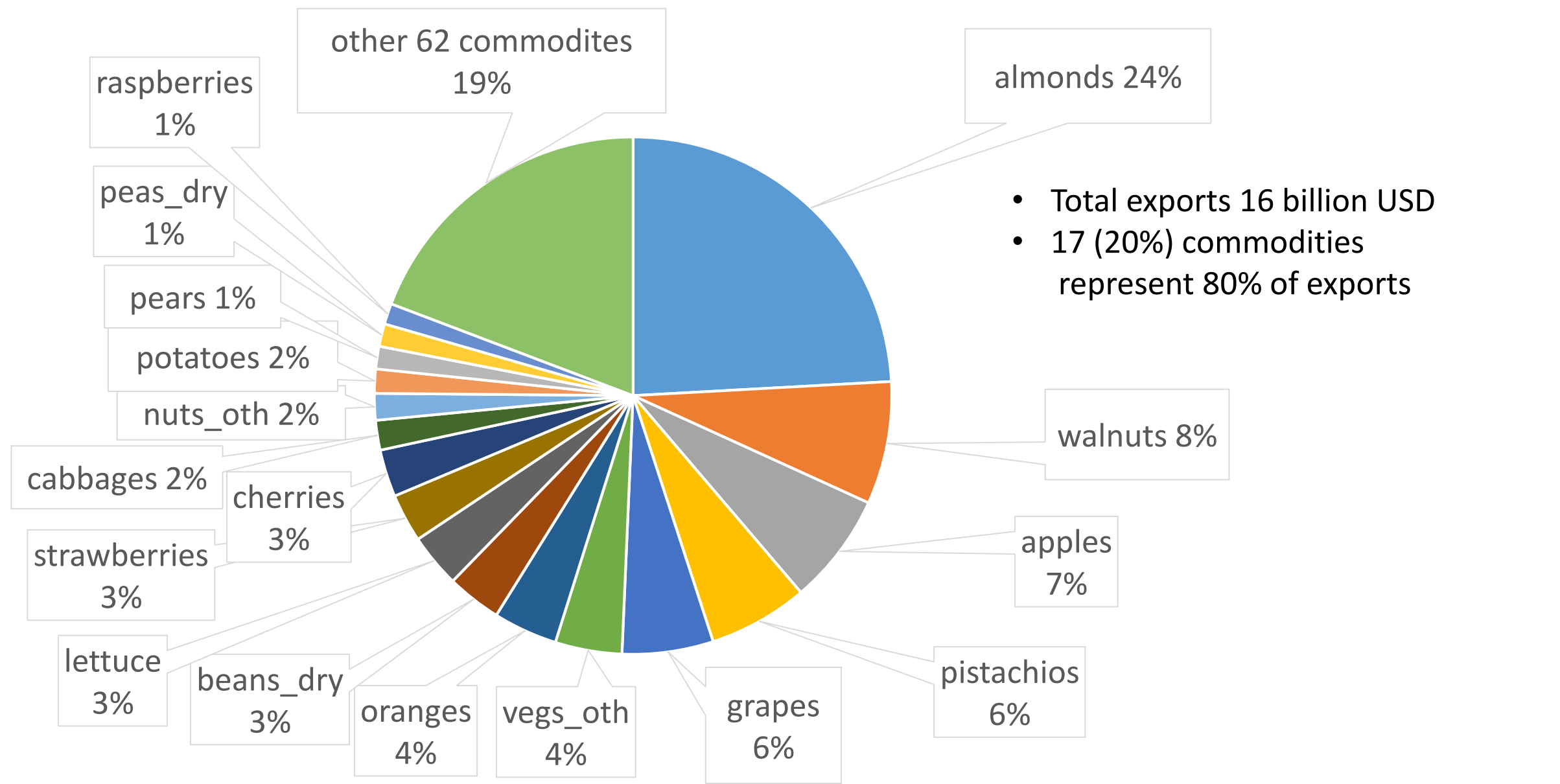
- In March 2018, U.S. has implemented tariffs of 25% on steel and 10% on aluminum imports from most countries
- Affected trade partners initiated retaliatory tariffs, extended well beyond these two commodities, including many agricultural imports from U.S.
- U.S.-China trade war
- One of the targeted U.S. agricultural sectors is vegetables, fruit and nuts
 - Over hundred individual commodities
 - 21% of the U.S. agricultural exports
- Scenarios
 1. Increase in tariffs on U.S. vegetables, fruit and nuts only
 2. All tariffs

Structure of U.S. output of vegetables, fruit and nuts sector

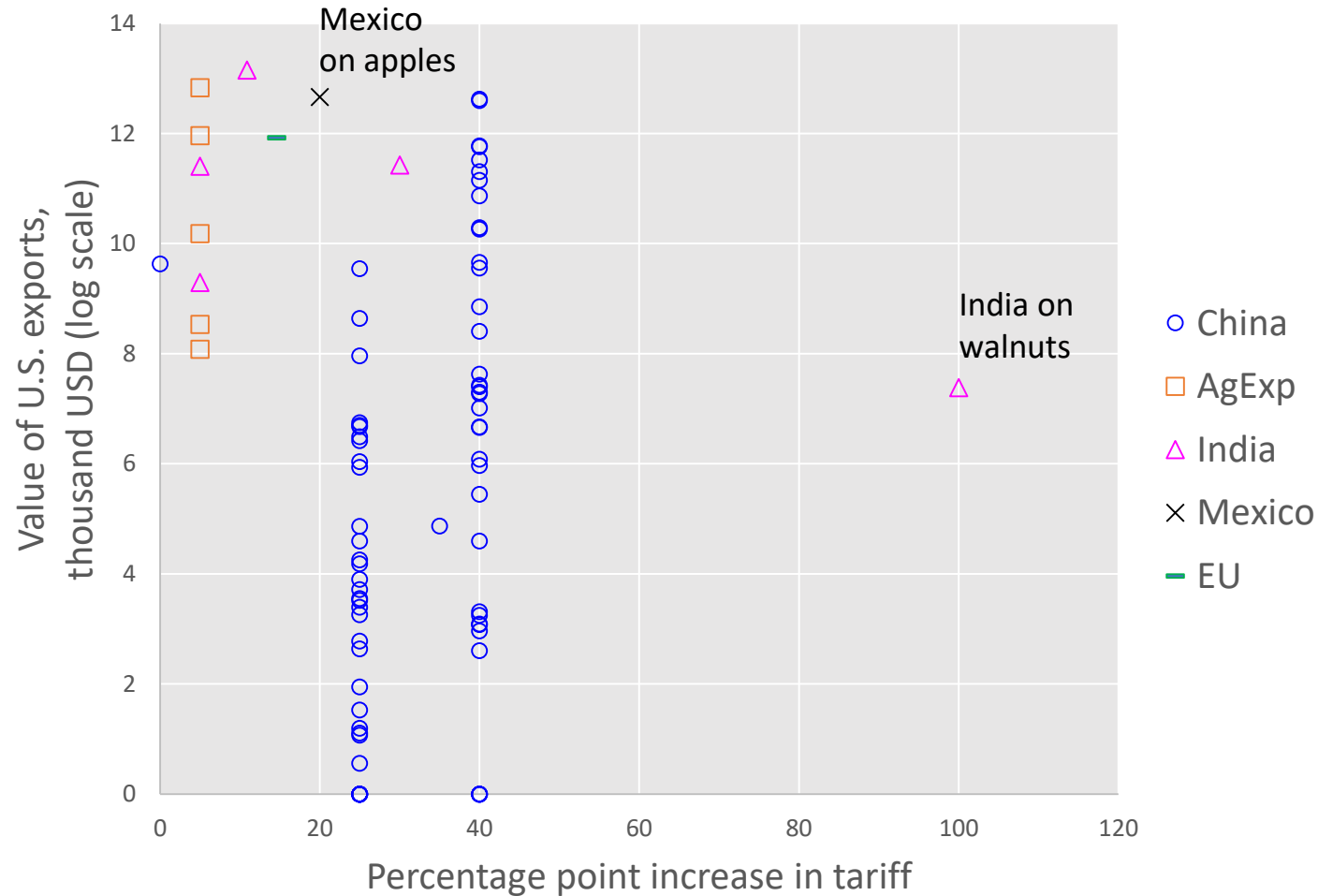


- Total output 46 billion USD
- 80/20 rule: of 79, 17 (20%) commodities represent 80% of output by value

Structure of U.S. exports of vegetables, fruit and nuts before tariffs



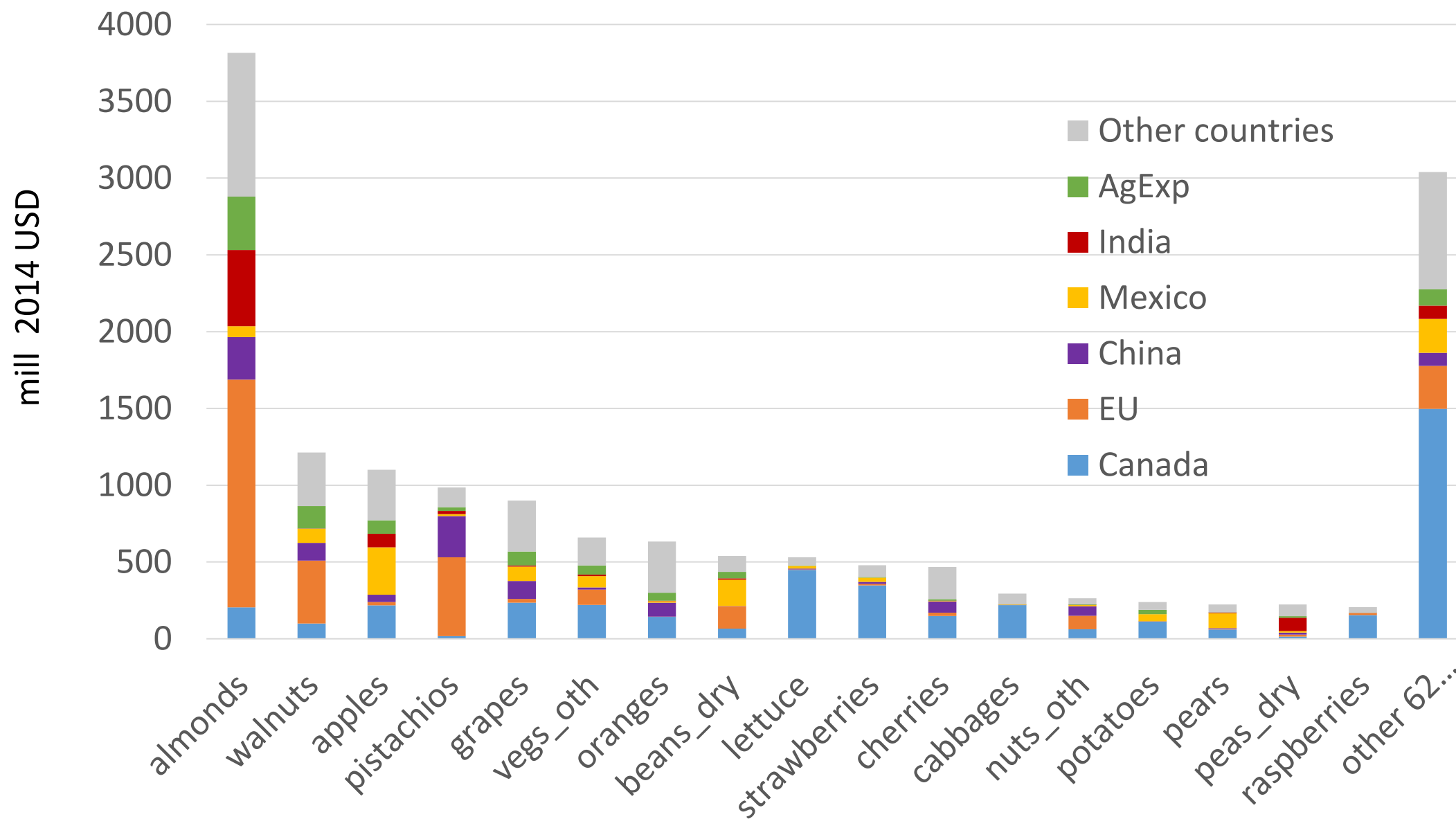
Export values vs. retaliatory tariffs imposed on U.S. vegetables, fruit and nuts



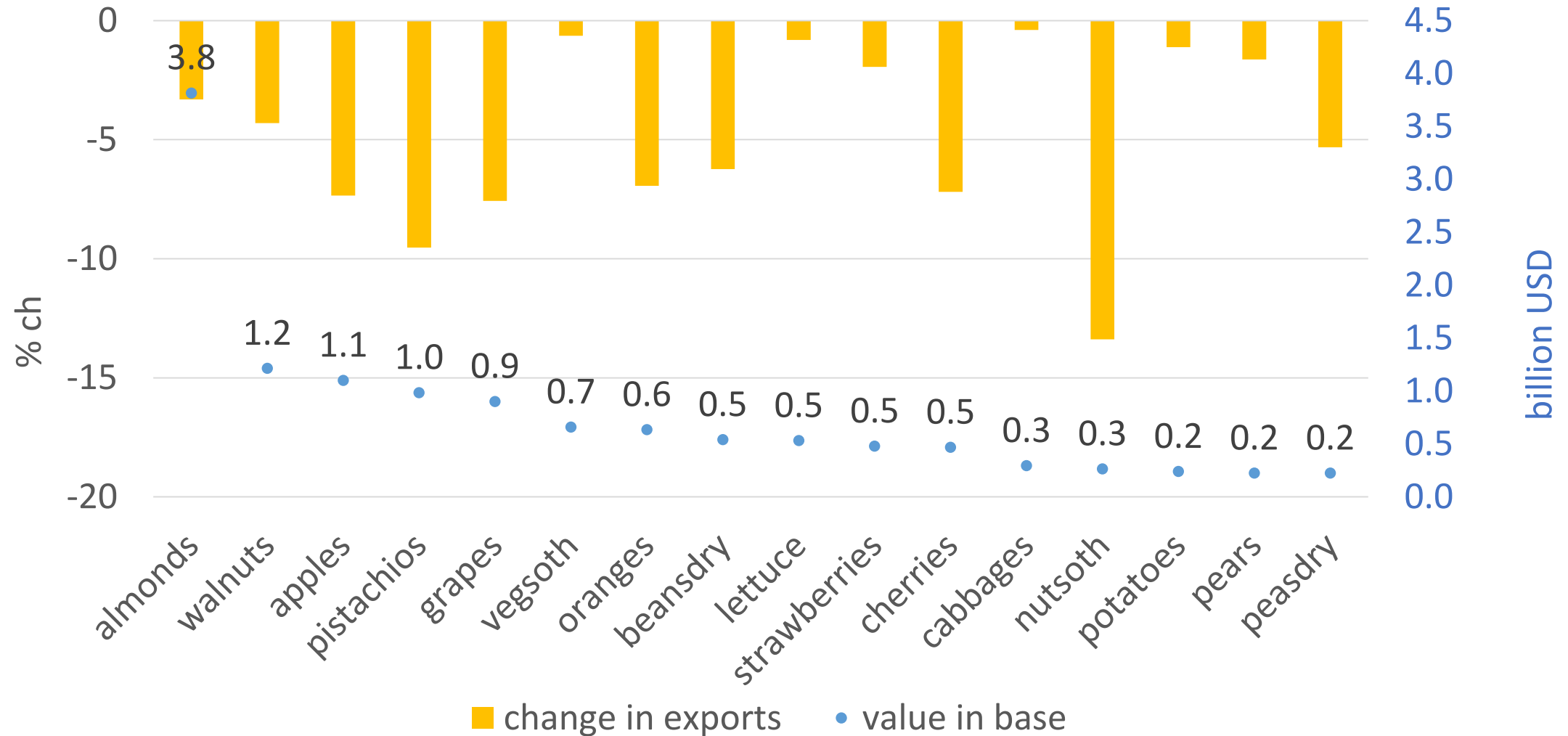
Note: Each point corresponds to the commodity at the HS6 level.

Source: Developed using Li (2018), UN (2018).

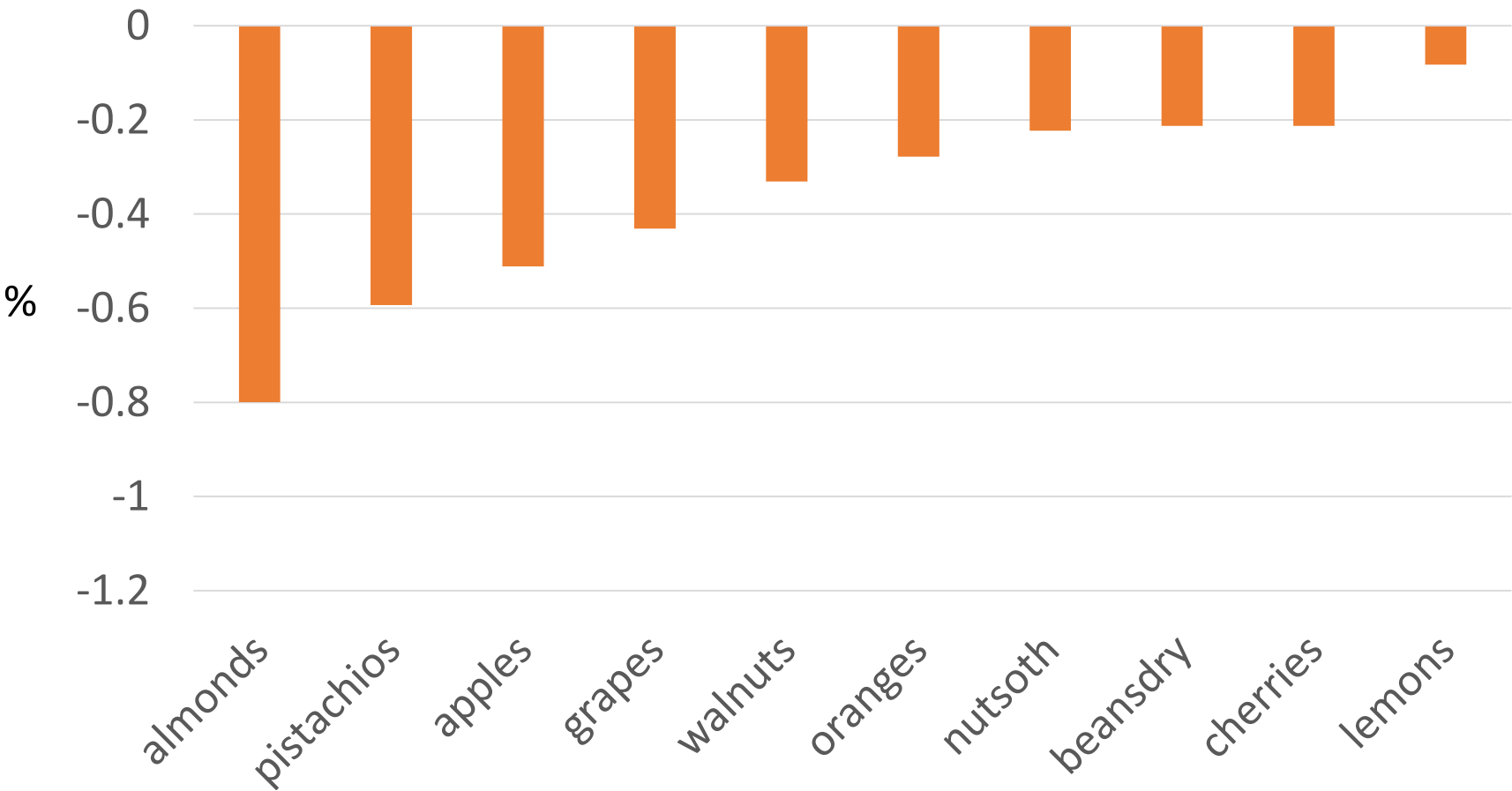
U.S. exports of vegetables, fruit and nuts by commodity and destination



Scenario 1: Change in U.S. exports of vegetables, fruit and nuts due to retaliatory tariffs (top 17 commodities by value)

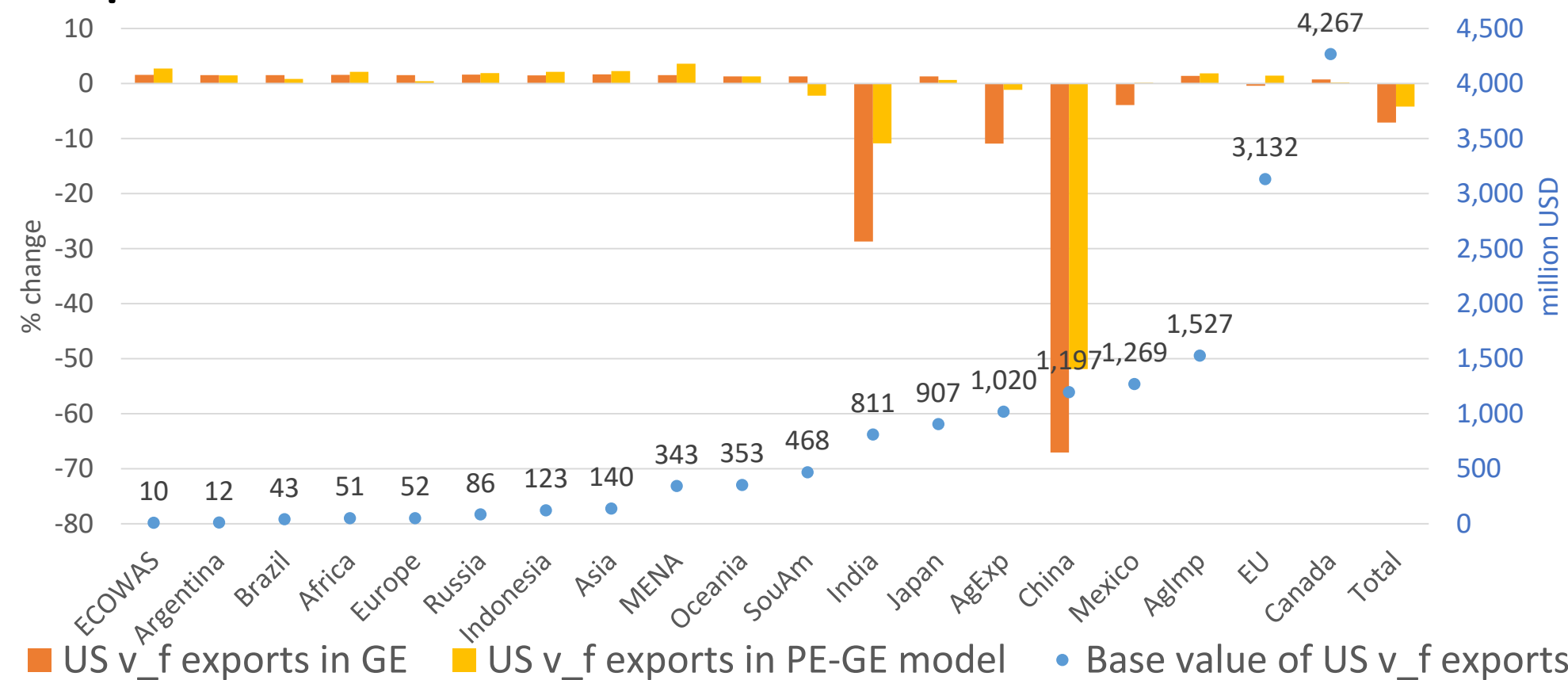


Scenario 1: Contribution to change in U.S. total exports of vegetables, fruit and nuts due to retaliatory tariffs (top 10 largest contributors)



U.S. total exports of vegetables, fruit and nuts are reduced by 4.2%

Scenario 1: Change in U.S. aggregate v_f exports and output: PE-GE vs GE



Model	v_f output, %	v_f exports, %
PE-GE	-1.3	-4.2
GE	-2.2	-7.1

Scenario 2

No	Component	U.S. trade partners	U.S. tariffs on foreign goods	Foreign tariffs on U.S. goods
1	North American trade frictions	Canada, Mexico	steel and aluminum	- Reciprocal tariffs on steel and aluminum - Mexica's tariffs on apples, meat and other food - Canada's tariffs on yoghurt, meat and other food
2	U.S.-China trade frictions	China	- Steel and aluminum - All tariffs in \$200 bn <i>Round 1: Tariff increases on 71 HS6 within v_f (uniform 10% increase)</i> <i>Round 2 is not included</i>	- Tariffs in \$3 bn round: No v_f targeted in this round - First wave of \$50 bn round: tariff increases on 49 HS6 v_f (uniform 15% increase) - Second wave of \$50 billion round: tariff increases on 100 HS6 v_f (uniform 25% increase) <u>Not included:</u> Tariffs in \$60 billion round
3	U.S. and the ROW	Other countries	steel and aluminum	Retaliatory tariffs by EU, India and Turkey

Scenario 2: Change in the U.S. exports of vegetables, fruit and nuts

Region	Reference value, mill USD	Change, %		
		North American trade frictions	U.S.-China trade frictions	ALL
Oceania	353.0	0.2	3.2	3.6
China	1196.9	0.3	-53.9	-53.7
Japan	906.6	0.2	2.4	2.7
AgImp	1527.5	0.3	3.9	4.2
Asia	139.5	0.2	4.9	5.4
Indonesia	122.8	0.2	2.8	3.1
AgExp	1020.0	0.2	3.4	0.7
India	811.5	0.1	3.2	-9.1
Canada	4267.2	0.6	1.7	1.7
Mexico	1269.4	-3.2	-0.9	-0.8
SouAm	468.4	0.2	4.9	5.1
Argentina	11.7	0.4	6.0	6.4
Brazil	42.7	0.4	6.0	6.4
EU	3132.4	0.3	3.7	2.3
Europe	51.6	0.4	4.9	5.3
Russia	86.0	0.2	3.1	3.4
MENA	343.4	0.3	4.8	5.1
ECOWAS	10.4	0.3	5.8	6.0
Africa	50.8	0.3	5.7	6.0
Total U.S. exports	15811.8	0.1	-1.6	-2.6

Scenario 2: Change in regional welfare, mill 2014 USD

Regions\Scenarios	North American trade frictions	U.S.-China trade frictions	ALL
Oceania	72.2	951.3	1068.6
China	1423.6	-47166.3	-45602.3
Japan	408.8	4348.0	4412.6
AgImp	344.2	3862.6	3691.7
Asia	16.9	1240.6	1220.0
Indonesia	33.6	446.3	462.8
AgExp	185.0	3217.7	2645.2
India	164.8	1381.9	1534.2
Canada	-2676.8	2656.5	3352.3
USA	-1494.0	-24340.8	-26976.1
Mexico	-131.8	4274.2	4778.2
SouAm	129.6	1620.2	1465.4
Argentina	28.1	588.5	610.4
Brazil	114.8	3073.9	3234.7
EU	1411.9	12057.3	12177.4
Europe	11.4	278.6	245.4
Russia	-75.8	172.6	205.9
MENA	-4.5	523.6	360.8
ECOWAS	-6.5	394.6	364.8
Africa	-9.0	397.1	367.4
World	-53.7	-30021.4	-30380.4

Conclusions

- Developed PE-GE data base and model to advance trade policy analysis with focus on agriculture
- Quantified impacts of the recently introduced trade frictions between U.S. and trading partners
 - Vegetables, fruit and nuts exports by commodity and total, and by trading partner
 - Welfare impacts
- When comparing PE-GE with GE results, we find that GE overstates impacts on aggregate sector output and trade
- On aggregate level, U.S. and China suffer the most, while other regions gain
 - Canada and Mexico are losing due to trade frictions within NAFTA, but gain due to U.S.-China trade war
- While aggregate U.S. exports of v_f decrease by 2.6% (scenario 2), impacts are highly heterogeneous across individual commodities
 - U.S. exports of some of the v_f commodities are reduced by more than 15%
 - For many of the v_f commodities, U.S. exports to China are reduced by more than 50%

Next steps

- Incorporate tariff-rate quotas (dairy products)
- Sensitivity analysis
 - Substitution elasticities
- Expand PE-GE data base to cover more agricultural and food sectors
- Include use by agent at the HS6 level (household, intermediate use by production activities, government, investment) in the PE-GE framework
 - Data (completed)
 - Food Balance Sheets (FAO)
 - Assumptions
 - Model
- Associate production of commodities with the specific U.S. states and explore regional impacts

Thank you!

