

Quantifying Disruptive Trade Policies

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Commerce Department Short Course
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- Motivation
- Applied Trade Policy Analysis
- Armington, Krugman and BRF
- Some Calculations
- Under the Hood



- Academic arguments in favor of cooperative free trade are pervasive,
- but the conventional wisdom is challenged by a wave of nationalist political movements.
- Theoretical arguments require reality check to contribute to the policy debate.

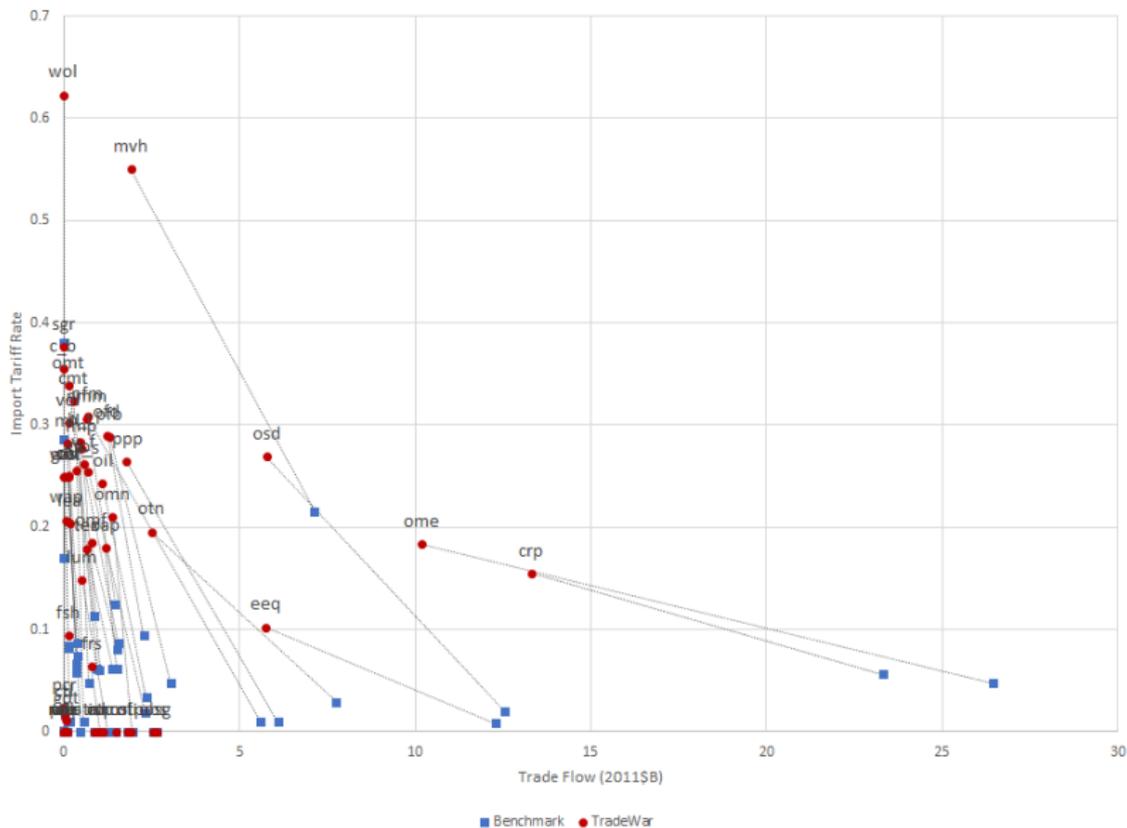


- *Bilateral disputes* with escalating tariffs, e.g. US – China in 2018 or Smoot-Haley in 1930. Underlying logic – one or the other trading partner sees the current division of gains from trade as unfair.
- *Protective policies* with a more narrow strategic rationale – e.g., China's concern for food security. Like energy security, food security has a long history. The key policy question: Is the cost of food self-sufficiency worth the benefits?
- Concern over *bilateral trade deficits*, interpreted by naive politicians as “unfair”. In these cases, how costly are policies which establish balanced bilateral trade?

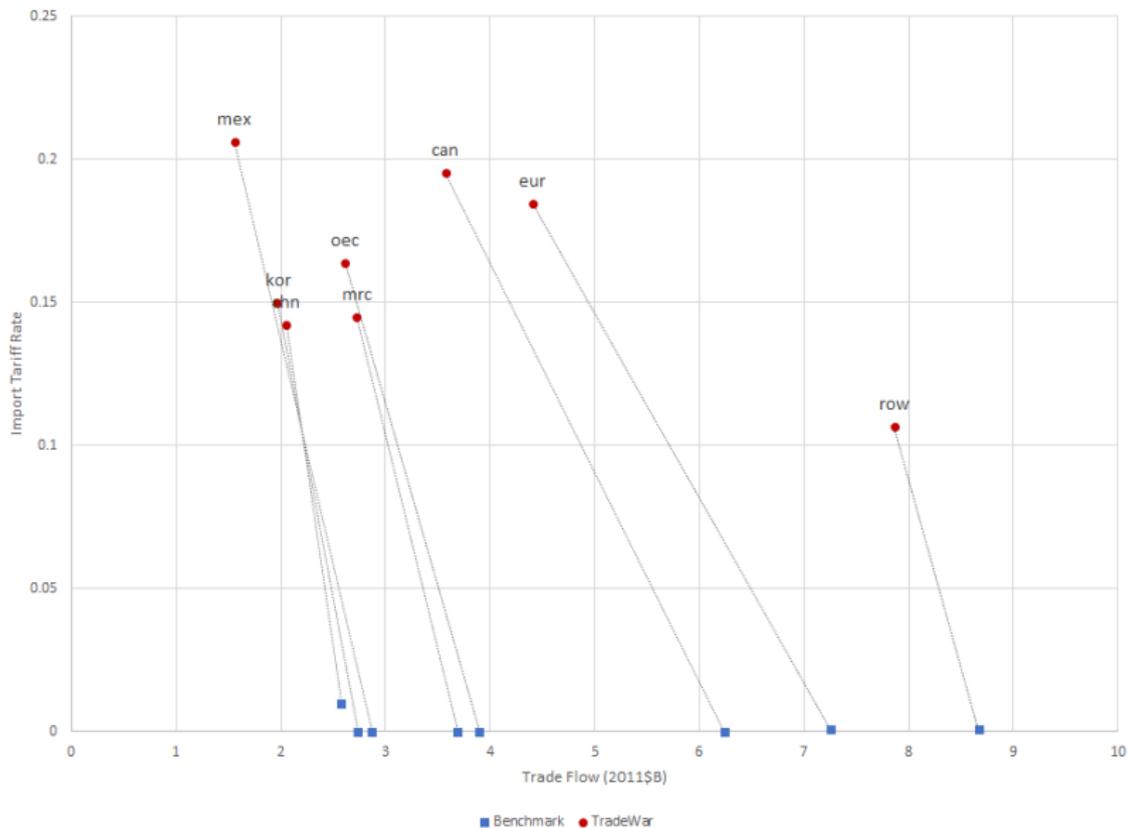


- Minghao Li, a colleague at Iowa State University's Center for Agriculture and Rural Development, has compiled and generously shared data consistent with the GTAP conventions on tariffs and other distortions related to the 2018 trade war (updated to August 2018). (See <https://www.card.iastate.edu/china/trade-war-data/>.)
- We aggregate these data to our scope of study. For those countries that negotiated an exemption from the steel tariffs (Brazil and Argentina, and South Korea) we simply applied a Voluntary Export Restraint (VER) equal to 15% ad valorem.

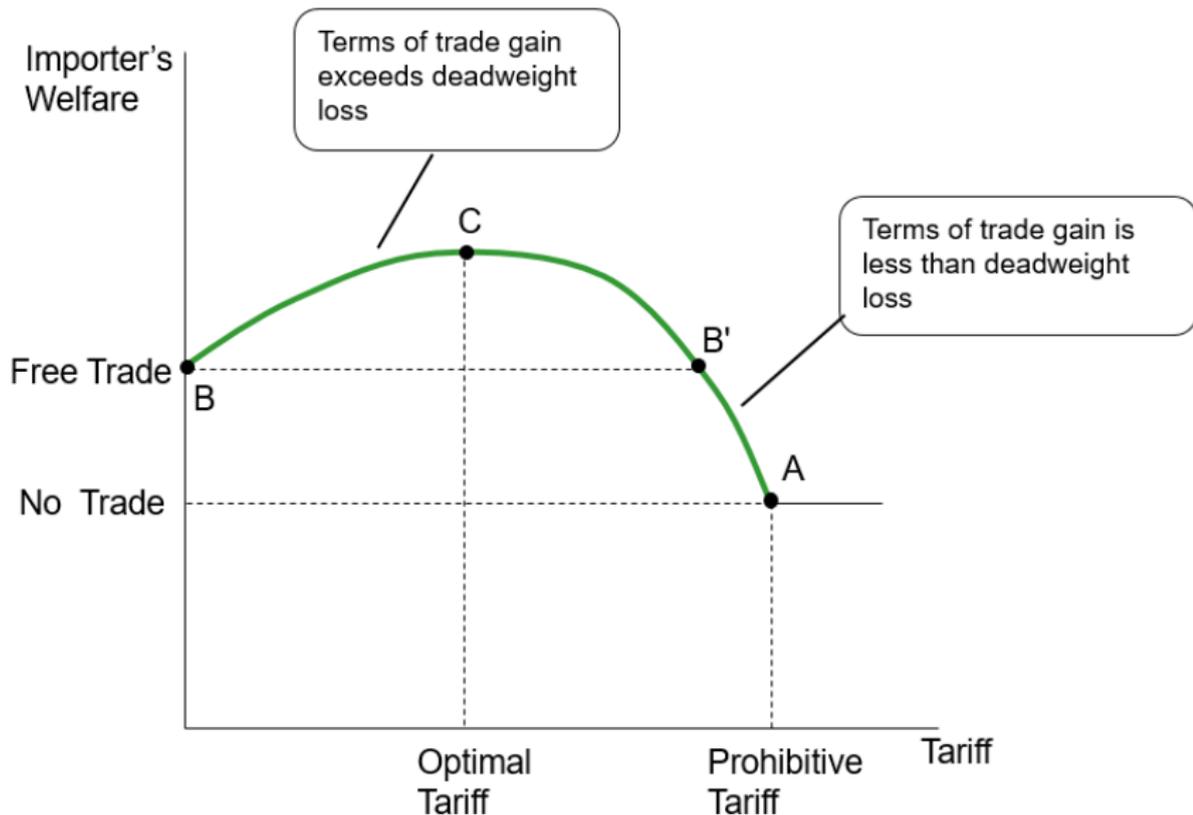
USA Exports to the CHN



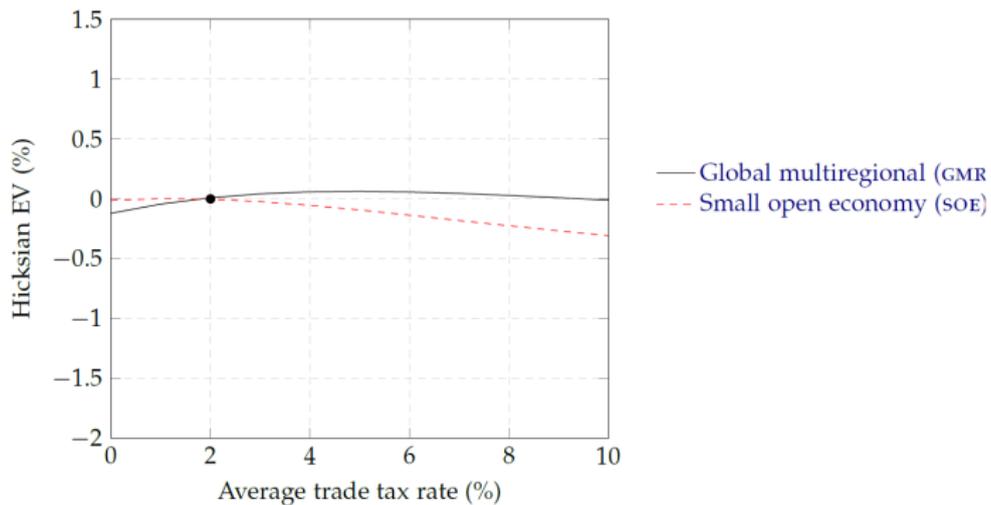
USA Tariffs on Steel (model dataset)



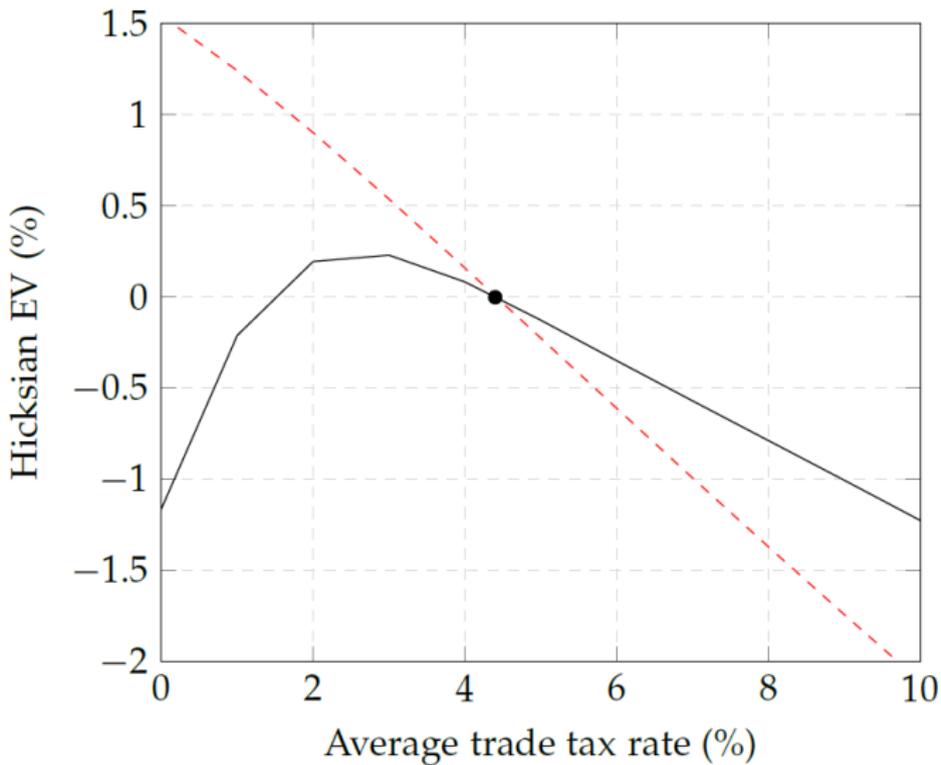
Optimal Tariffs: the Scope for Trade Wars



Welfare Effects of Tariffs: USA



Welfare Effects of Tariffs: CHN

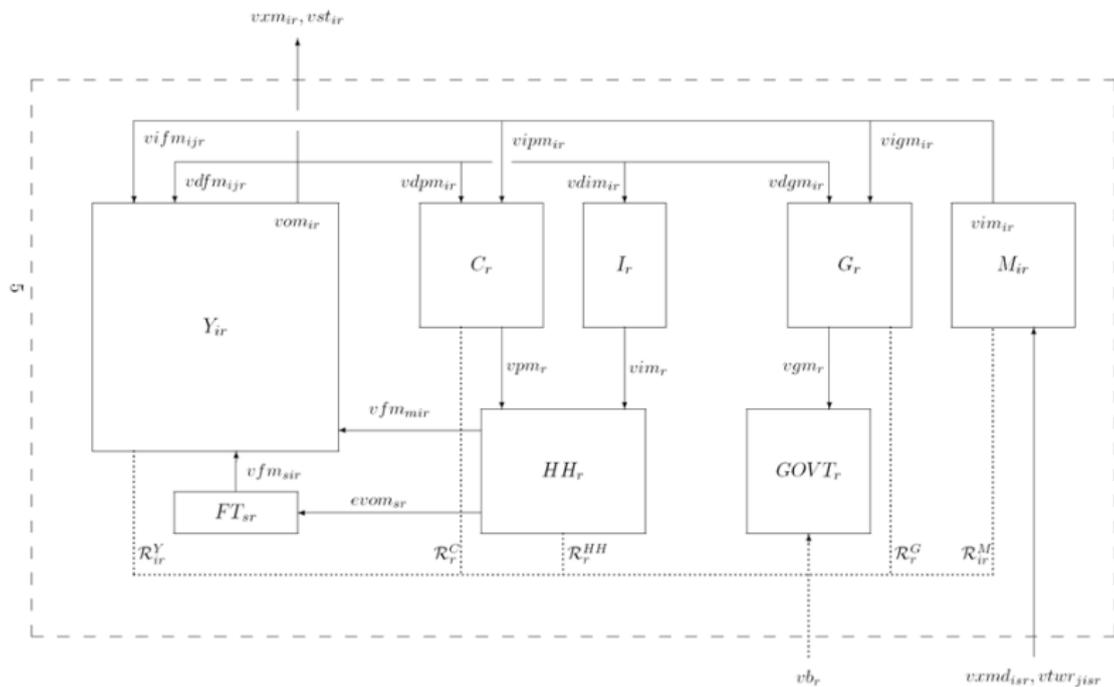


Journal of Global Economic Analysis, Volume 1 (2016), No. 2, pp. 1-77.

GTAPINGAMS: Multiregional and Small Open Economy Models

BY BRUNO LANZ^a AND THOMAS F. RUTHERFORD^b

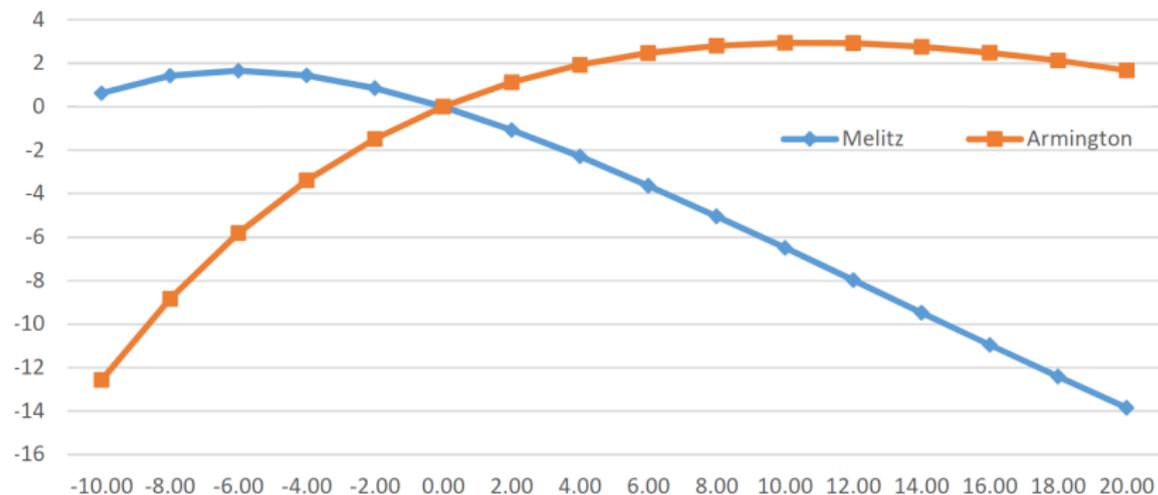
GTAP Transactions



GTAP Commodities (57)

PDR	Paddy rice	LUM	Wood products
WHT	Wheat	PPP	Paper products, publishing
GRO	Cereal grains nec	P_C	Petroleum, coal products
V_F	Vegetables, fruit, nuts	CRP	Chemical,rubber,plastic prods
OSD	Oil seeds	NMM	Mineral products nec
C_B	Sugar cane, sugar beet	LS	Ferrous metals
PFB	Plant-based fibers	NFM	Metals nec
OCR	Crops nec	FMP	Metal products
CTL	Cattle,sheep,goats,horses	MVH	Motor vehicles and parts
OAP	Animal products nec	OTN	Transport equipment nec
RMK	Raw milk	ELE	Electronic equipment
WOL	Wool, silk-worm cocoons	OME	Machinery and equipment nec
FRS	Forestry	OMF	Manufactures nec
FSH	Fishing	ELY	Electricity
COA	Coal	GDT	Gas manufacture, distribution
OIL	Oil	WTR	Water
GAS	Gas	CNS	Construction
OMN	Minerals nec	TRD	Trade
CMT	Meat: cattle,sheep,goats,horse	OTP	Transport nec
OMT	Meat products nec	WTP	Sea transport
VOL	Vegetable oils and fats	ATP	Air transport
MIL	Dairy products	CMN	Communication
PCR	Processed rice	OFI	Financial services nec
SGR	Sugar	ISR	Insurance
OFD	Food products nec	OBS	Business services nec
B_T	Beverages and tobacco products	ROS	Recreation and other services
TEX	Textiles	OSG	PubAdmin/Defence/Health/Educat
WAP	Wearing apparel	DWE	Dwellings
LEA	Leather products	CGD	Aggregate investment

Structural Sensitivity of China's Optimal Tariff





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The Static Economic Effects of the UK joining the EEC: A General Equilibrium Approach

MARCUS H. MILLER
London School of Economics

and

JOHN E. SPENCER
The New University of Ulster

The Review of Economic Studies 44(1) **1977**

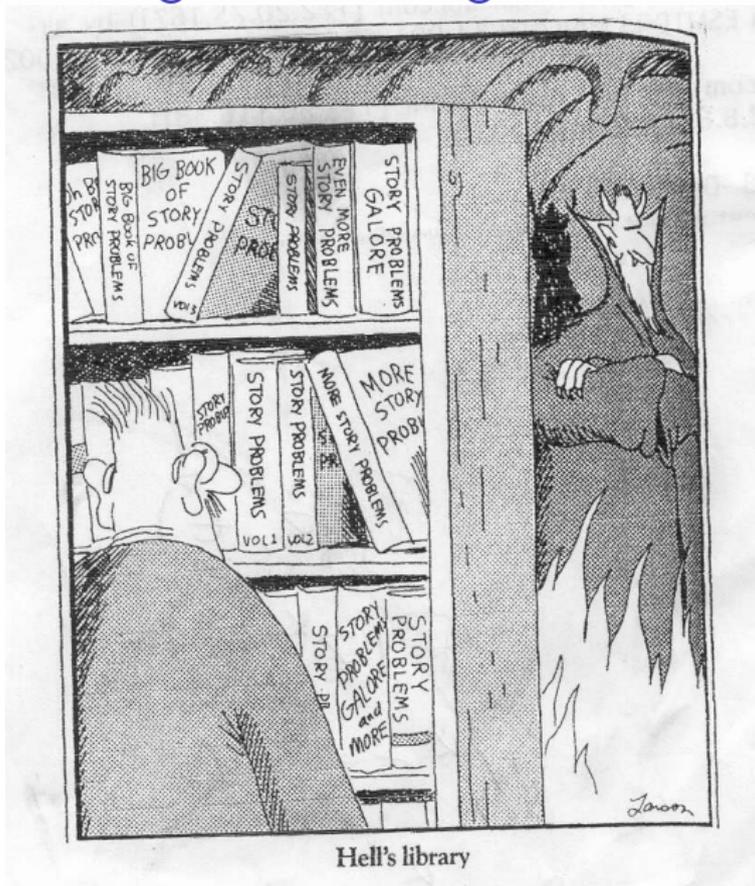


- Standard neoclassical multi-sector multi-region Armington trade model
- Constant-returns-to-scale (CRTS) perfect competition setting
- Gains from specialisation and inter-industry trade due to differences in comparative advantage
- Endogenous terms-of-trade \Rightarrow scope to extract rents from strategic trade policies (tariffs, quotas or NTBs)

In Defence of a Neoclassical Approach

1. Versatile: can be extended to take into account many aspects which are often assumed to be ignored: risk and uncertainty, technological details, expectations.
2. Can be both calibrated and estimated. Hence, it is possible to formulate a model which matches both with the current economic statistics (supply and demand) and which matches historical evidence about the responsiveness of quantity to price.
3. Approach can be consistent with the principle of Occam's Razor: "A scientific theory should be as simple as possible, but no simpler."
4. Modesty is warranted: existence of model results should be a *necessary but not a sufficient* condition as justification for a particular policy proposal.

The CGE Challenge: Translating Stories into Equations



Hell's library



- i. Incorporate new trade theory à la Krugman:
 - Trade increases varieties as intermediate input to industries (leading to productivity gains) and input to consumption (directly increasing welfare due to the increased availability of foreign varieties).
 - Increasing-returns-to-scale (IRTS) with imperfect competition.
- ii. Add an extension with a reduced form version of Melitz (the bilateral representative firms model - **BRF**).
- iii. Representation of FDI (data adjustments, nesting, ...).



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- **Armington** (1969) as subsequently applied by Shoven and Whalley is based on perfect competitive markets and constant returns to scale.
- **Krugman** (1979, 1980) is based on imperfect competition in which changes in the number of firms (varieties) influences aggregate productivity. Key simplifying assumption: all varieties are sold in all regions.
- **Bilateral Representative Firms** (BRF) is a model which emphasizes the extensive margin of trade. Like the Krugman, BRF incorporates a Dixit-Stiglitz variety effect, but unlike Krugman, not all varieties from region r are sold in every region s .



The CRTS trade model incorporates regionally differentiated goods and is immediately appealing from an empirical perspective. Any observed pattern of trade can be exactly accommodated, and this pattern is independent of the elasticity of substitution.

The Armington composite is given by:

$$Q_{is} = \left(\sum_r \lambda_{irs} q_{irs}^\rho \right)^{1/\rho}$$

One degree of freedom (ρ) – given benchmark prices \bar{p}_{irs} we can assign values λ_{irs} such that

$$\min \sum_r \bar{p}_{irs} q_{irs} \quad \text{s.t.} \quad Q_{is} = 1$$

has the solution $q_{irs} = \bar{q}_{irs}$.



Goods are differentiated by firm, and net utility of the composite commodity reflects both the number of firms (variety) and output per firm:

$$Y_r = \left(\sum_{i=1}^{N_r} x_{ir}^{1-1/\sigma} \right)^{\sigma/(\sigma-1)} = N_r^{1/\sigma} X_r$$

where

N_r is the number of firms operating in region r ,

x_{ir} is output of the i th firm,

x_r is output of a representative firm and

X_r is the resource cost of output which with symmetry is

$$X_r = \sum_{i=1}^{N_r} x_{ir} = N_r x_r$$

Like the Krugman model, goods in the BRF model are differentiated by region of origin, but not all goods from region r are sold in all regions s . The net utility of goods is given by:

$$Y_{rs} = \left(\sum_{i=1}^{N_{rs}} x_{irs}^{1-1/\sigma} \right)^{\sigma/(\sigma-1)} = N_{rs}^{1/\sigma} X_{rs}$$

where

σ is the elasticity of substitution between varieties

N_{rs} is the number of firms from region r supplying region s ,

x_{irs} is output of the i th firm and

x_{rs} is output a representative firm and

X_{rs} is the resource cost of goods supplied from region r in region s . As above, with symmetry:

$$X_{rs} = \sum_{i=1}^{N_{rs}} x_{irs} = N_{rs} x_{rs}$$

Service provision through *commercial presence* involves a locally-established affiliate, subsidiary, or representative office of a foreign-owned and -controlled company, and within the model, the supply by firms from region r to region s through FDI is portrayed by a calibrated Leontief aggregate:

$$Y_{irs} = \bar{Y}_{irs} \min \left[\frac{E_{irs}}{\bar{E}_{irs}}, \frac{D_{irs}}{\bar{D}_{irs}} \right]$$

in which

E_{irs} represents *cross-border provision* of i sector services from region r delivered in region s , and

D_{irs} represents *commercial presence* provision of services through the employment of domestic factors (e.g., British bankers work for Deutsche Bank in London).



In the model, cross-border provision of FDI-related services depends on intermediate service inputs (X_{irs}) and FDI capital (K_{irs})

$$E_{irs} = f(X_{irs}, K_{irs})$$

As a shorthand representation of the competitive section process in the BRF model, technology $f(\cdot)$ is calibrated to base year trade flows and an assumption of the price elasticity of bilateral supply.

Reduced Form Productivity Effects (HMT)

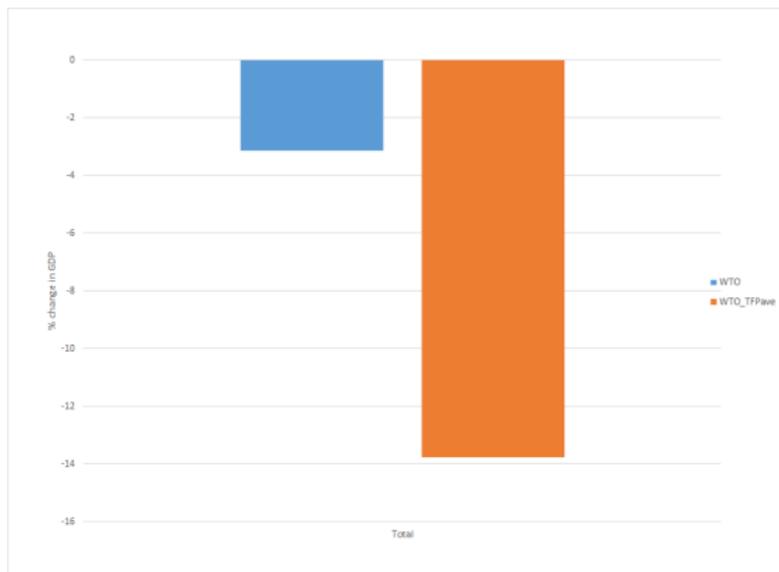
- Elasticity of *aggregate* productivity with respect to trade flows equals 0.3:

$$\hat{\phi} = \left(\frac{\sum_j M_j + X_j}{\sum_j \bar{M}_j + \bar{X}_j} \right)^{0.3}$$

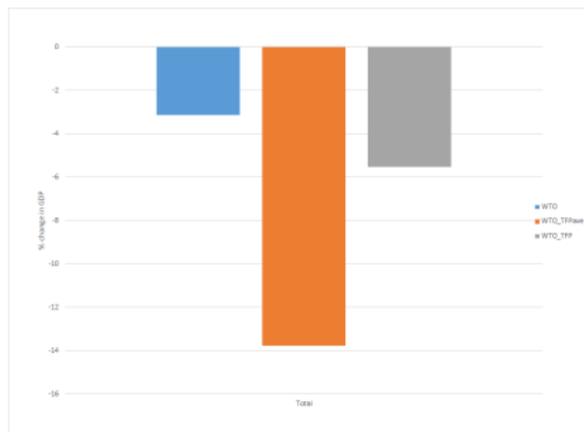
- Elasticity of *sectoral* productivity with respect to trade flows equals 0.3:

$$\phi_i = \left(\frac{M_i + X_i}{\bar{M}_i + \bar{X}_i} \right)^{0.3}$$

Aggregate Productivity Effects

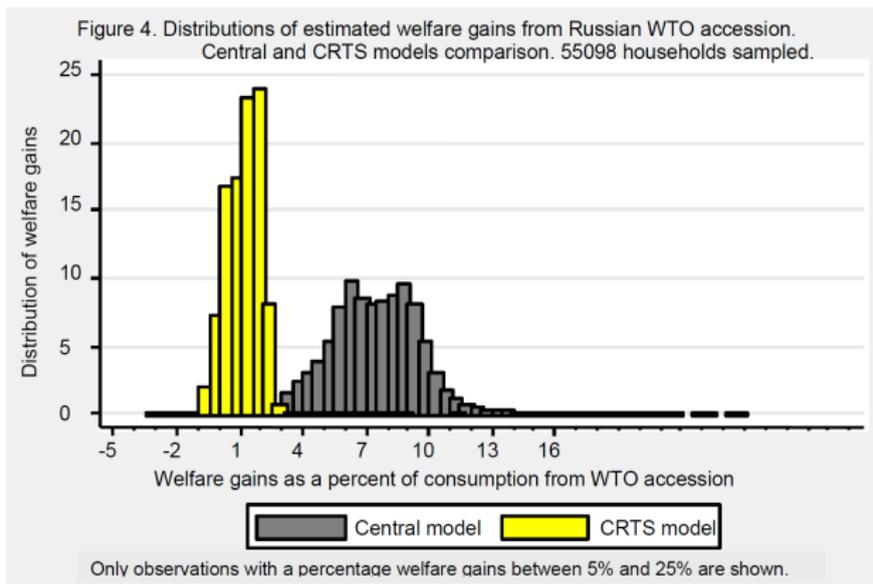


Sensitivity: Sectoral Productivity Effects



Key insight: the impacts of reduced form productivity “kickers” may be fragile and depend on details of the implementation. Productivity impacts are better investigated in a structural framework.

Tarr and Rutherford, *JIE* 75(1), 2008





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Regions, goods, and factors used in this application



Regions:		Goods		Factors:	
EUR	EU-27 plus	<u>CRTS Structure</u>		LAB	Unskilled Labor
USA	U.S.A	AGR	Agricultural Crops		
CHN	China	ENR	Energy	TEC	Technicians and Professionals
CAN	Canada	<u>IRTS Structure</u>			
MEX	Mexico	MTC	Meat and Dairy Prod.	CLK	Clerks
B_A	Brazil & Argentina	OFP	Other Food Prod.	MGR	Managers and Officials
KOR	S. Korea	I.S	Iron and Steel		
OECD	Rest of OECD	MVH	Motor Vehicles	SRV	Services workers
ROW	Rest of World	OME	Machinery and Equipment		
		MFR	Other Manufactured Goods	CAP	Capital
		SER	Services	LND	Land
				RES	Resource

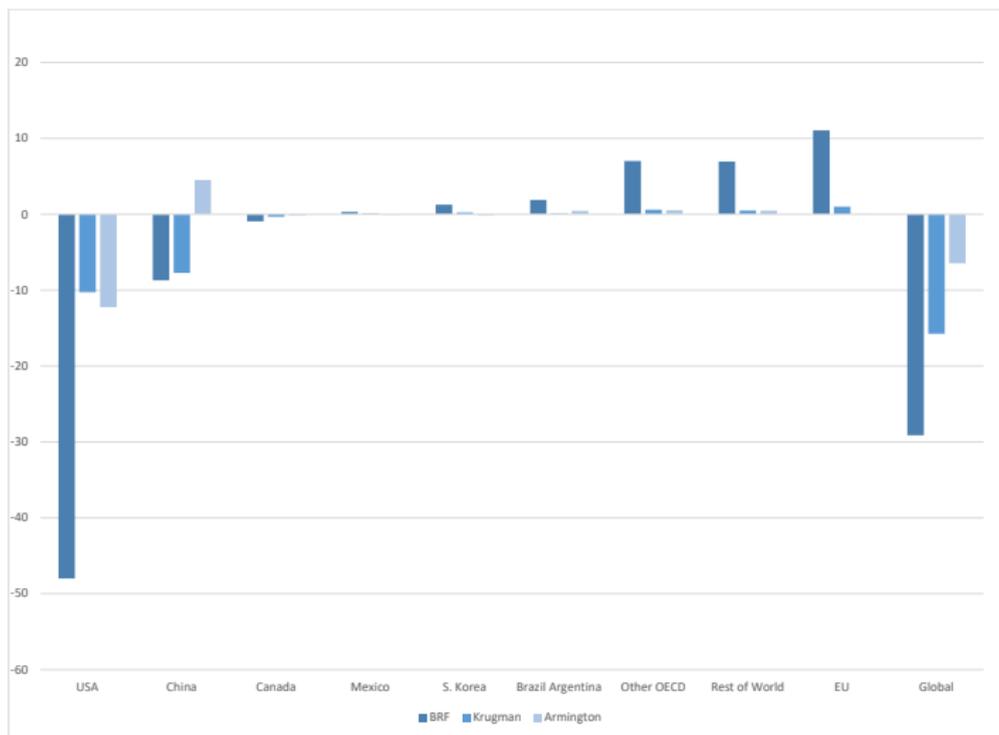
Trade-War Tariffs Applied in Model



<u>USA Import Tariffs (%):</u>								
	Agri.	Meat Dairy	Proces. Food	Engy.	Iron Steel	Motor Vehc.	Mach. Equip.	Othr. Mfg.
Exporter:								
EU					18.4			0.1
China				17.3	13.2	3.2	15.6	2.3
Canada					19.5			0.7
S. Korea					VER			0.0
Mexico					20.6			0.1
Brazil & Argentina					VER			0.3
Rest of World					10.6			0.1
Other OECD					16.4			0.0

<u>Tariffs on USA Exports (%):</u>								
	Agri.	Meat Dairy	Proces. Food	Engy.	Iron Steel	Motor Vehc.	Mach. Equip.	Othr. Mfg.
Importer:								
EU	1.1		5.6		7.2	0.0	0.6	1.1
China	22.7	13.7	12.7	20.8	1.5	21.3	1.7	2.6
Canada	0.0	0.6	2.4		17.6		0.2	0.9
Mexico	0.4	4.4	2.4		6.2		0.1	0.0
Rest of World	0.2	0.0	0.0		0.0	0.0	0.0	0.0
Other OECD	0.2		0.0	1.2			0.0	0.2

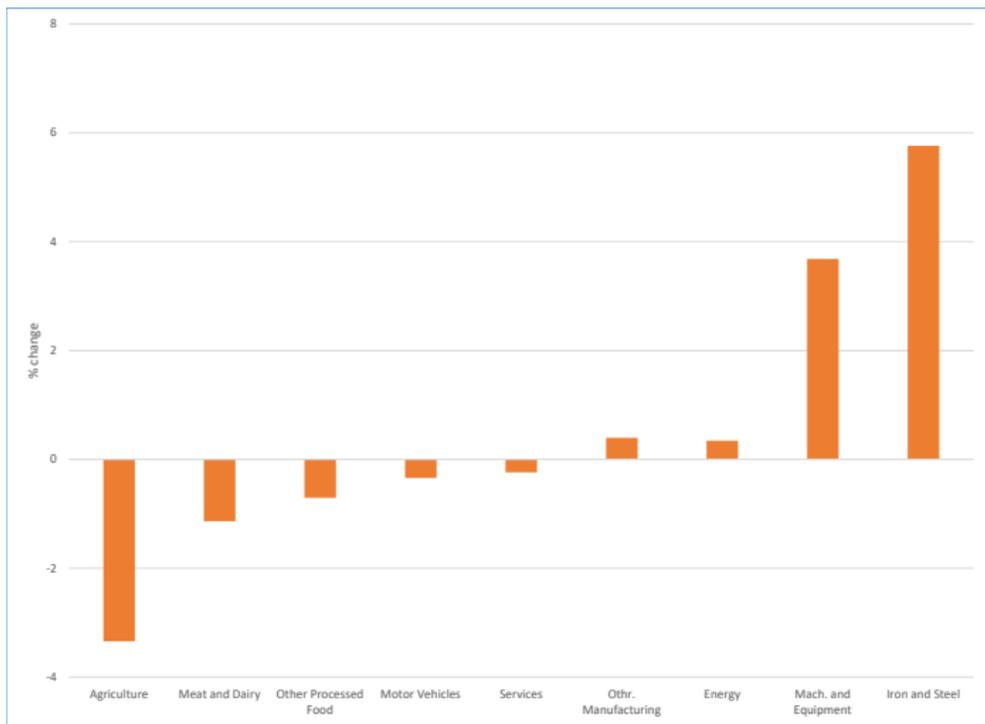
Trade War: Welfare Impacts (EV \$B)



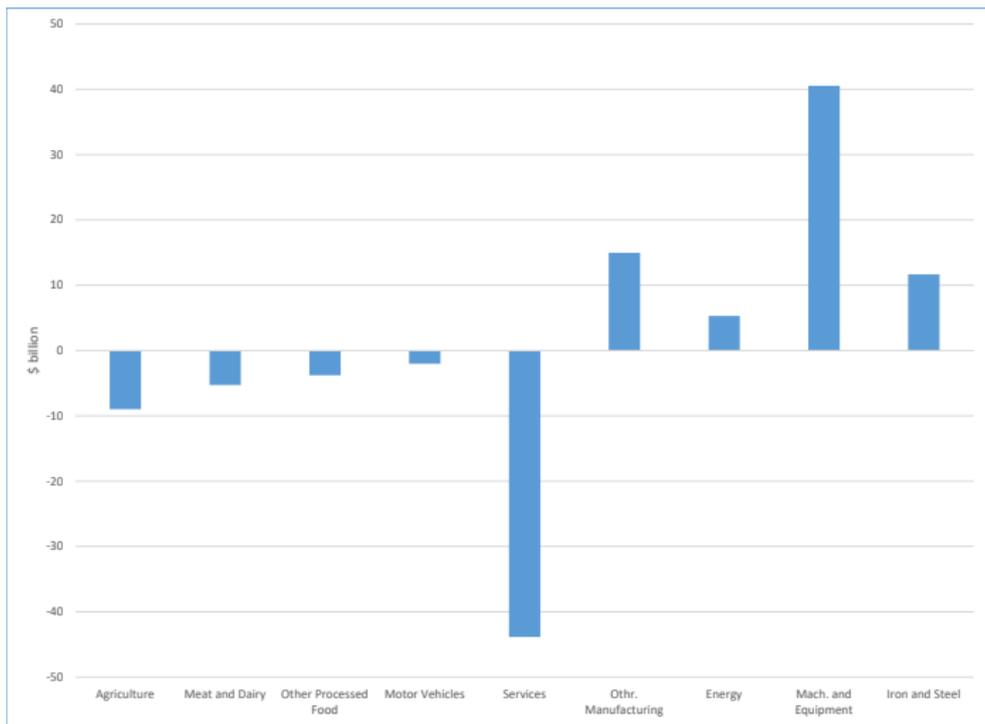
Trade War: Welfare impacts across model structures

	Benchmark GDP (\$B)	Benchmark Cons. (\$B)	Equivalent Variation (\$B)			Equivalent Variation (%)		
			BRF	Krg	Arm.	BRF	Krg.	Arm.
EU	18,220	10,844	11.1	1.0	0.0	0.10	0.01	0.00
USA	15,545	10,897	-48.0	-10.3	-12.2	-0.44	-0.09	-0.11
Rest of World	13,569	7,723	7.0	0.5	0.5	0.09	0.01	0.01
Other OECD	9,399	5,628	7.0	0.6	0.6	0.12	0.01	0.01
China	7,562	2,815	-8.7	-7.7	4.5	-0.31	-0.27	0.16
Brazil & Argentina	3,033	1,848	1.9	0.1	0.4	0.10	0.01	0.02
Canada	1,780	980	-0.9	-0.3	-0.1	-0.09	-0.03	-0.01
S. Korea	1,202	634	1.3	0.2	-0.1	0.20	0.04	-0.01
Mexico	1,170	763	0.3	0.1	0.0	0.04	0.01	0.00

Trade War: U.S. Output Impacts by sector (%)



Trade War: U.S. Output Impacts by sector (\$)



Trade War: U.S. Real GDP impacts decomposed



	Benchmark (\$B)	Change (\$B)	Change (%)
Expenditures			
Consumption	10,897	-48.0	-0.4
Investment	2,875	32.2	1.1
Government	2,568	-5.2	-0.2
Net Exports (X-M)	-795	-3.3	0.4
Total	15,545	-24.4	-0.2
Income by Sector			
Agriculture	142	-6.6	-4.7
Meat and Dairy	121	-1.2	-1.0
Other Processed Food	248	-1.3	-0.5
Energy	542	0.1	0.0
Iron and Steel	74	5.5	7.5
Motor Vehicles	162	-1.1	-0.7
Mach. and Equipment	560	15.6	2.8
Manufacturing	1,530	5.8	0.4
Services	12,141	-41.1	-0.3
Consumption	25	-0.1	-0.4
Investment	0	0.0	-2.1
Government	0	0.0	-2.2
Total	15,545	-24.4	-0.2

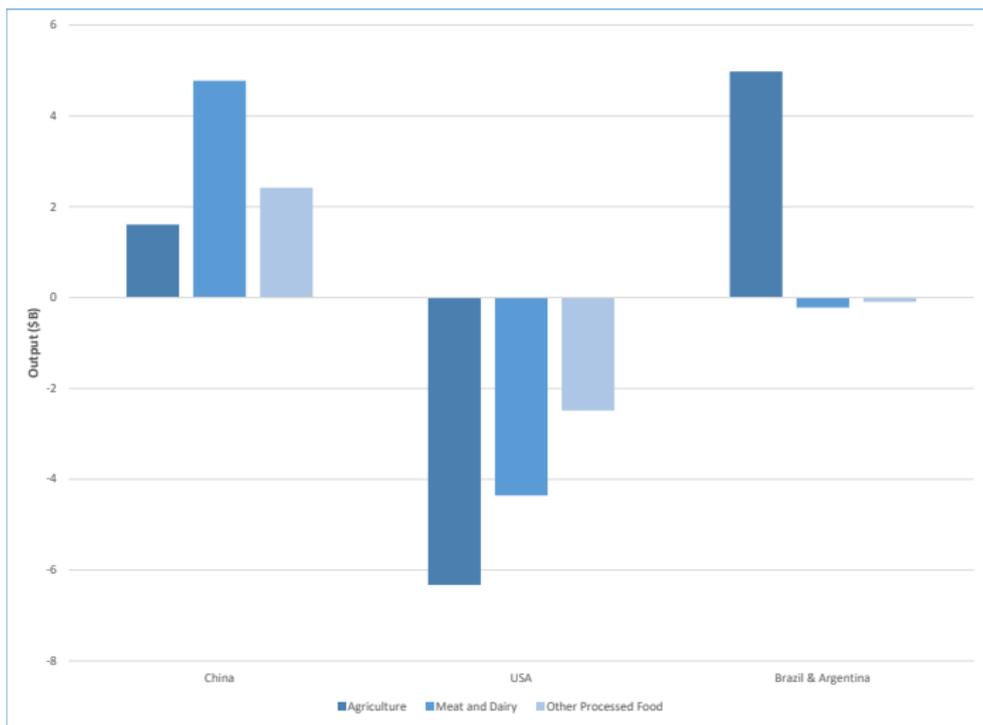
Trade War: U.S. Real GDP impacts decomposed (cont.)

	Benchmark (\$B)	Change (\$B)	Change (%)
Income by Function			
Unskilled Labor	1,846	-5.7	-0.3
Technicians and Professionals	857	-4.0	-0.5
Clerks	1,148	-5.2	-0.5
Managers and Officials	4,513	-20.5	-0.5
Services workers	654	-3.0	-0.5
Capital	2,618	-12.2	-0.5
Land	53	-4.3	-8.0
Resource	81	-0.3	-0.3
Factor tax revenue	1,415	-5.0	-0.4
Sales tax on domestic	107	0.4	0.3
Sales tax on imports	15	-0.1	-0.7
Output tax revenue	651	-0.5	-0.1
Tariff revenue (crts)	1	0.0	2.4
Tariff revenue (irts)	258	18.2	7.0
Export tax revenue (crts)	1	0.0	0.2
Export tax revenue (irts)	5	0.0	-0.2
Net multinational receipts	1,320	17.9	1.4
Total	15,545	-24.4	-0.2

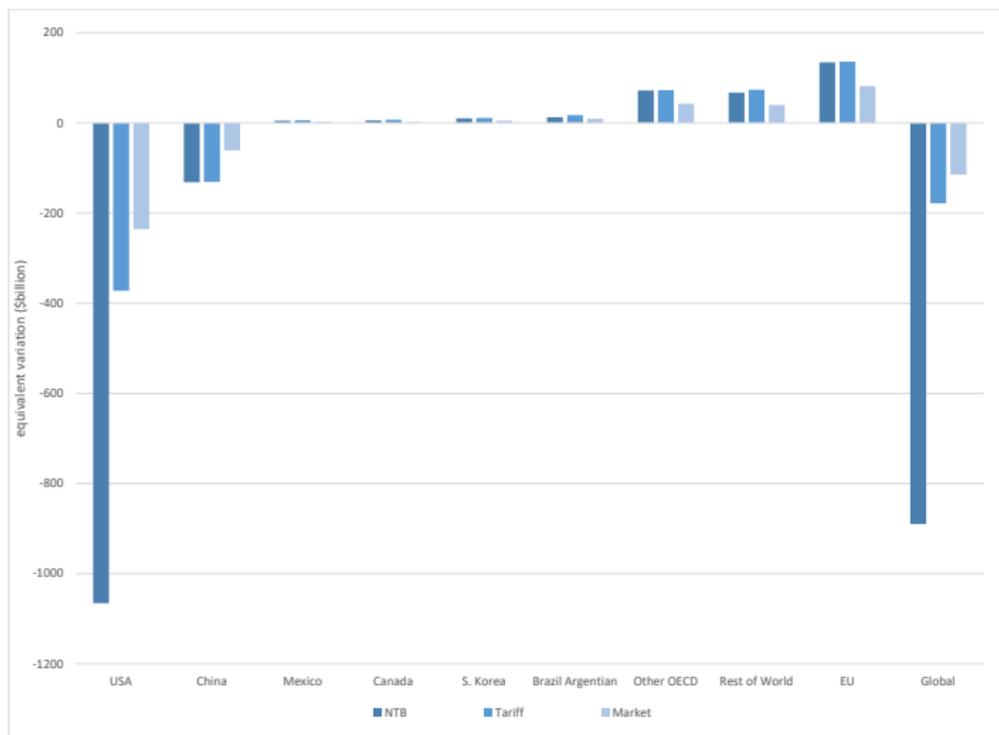
China's NTB food-security scenario: Welfare impacts

	Benchmark GDP (\$B)	Benchmark Cons. (\$B)	20% NTBs on the US		20% NTBs on the US -10% NTB on Brazil & Argentina	
			EV (\$B)	EV (%)	EV (\$B)	EV (%)
EU	18,220	10,844	-1.6	-0.01	0.1	0.00
USA	15,545	10,897	-2.4	-0.02	-1.0	-0.01
Rest of World	13,569	7,723	-1.5	-0.02	-0.6	-0.01
Other OECD	9,399	5,628	-0.6	-0.01	0.2	0.00
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Brazil & Argentina	3,033	1,848	0.2	0.01	1.2	0.06
Canada	1,780	980	0.1	0.01	0.2	0.02
S. Korea	1,202	634	-0.1	-0.02	0.1	0.02
Mexico	1,170	763	0.0	0.00	0.1	0.01

China Food-Security Scenario



Balanced US-China trade policy options (EV \$B)





- i. Contribution to policy debate: disruptive trade policies represent a high cost approach to non-economic objectives (e.g. food imports and risks of dependency)
- ii. Structural sensitivity analysis: after adopting a consistent set of parameters across the models we generally find larger welfare impacts in the bilateral representative firms structure.