Markups, Production Relocation, and the Gains from Trade

Hamid Firooz[1] Gunnar Heins[2]

[1]North Carolina State University

[2]University of Florida

Teaching Slides

July 22, 2025

Introduction

- ✓ International distribution of firm profits is a conterversial aspect of globalization
  - "Developing countries lose $2 for every $1 gained." (Guardian)
- ✓ The role of markups and profits is becoming more and more important (De Loecker et al. (2020) for US and other countries)
- ? Little is known about how the distribution of profits change by trade
- ? And how this affects welfare consequences of trade
- → We fill this gap by incorporating country- and sector-specific markups into a quantitative multi-sector GE trade model
- *Q.* How does distribution of import and export profits look like? How does it change by trade? Welfare consequences?

Motivation

- Estimate import demand elasticities for 1200+ sectors, separately for 30 countries
- Look at average inverse elasticity (related to profits in our model)

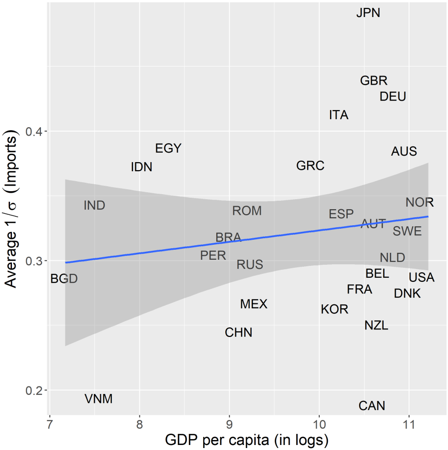


Figure: Imports

Motivation

- Estimate import demand elasticities for 1200+ sectors, separately for 30 countries
- Look at average inverse elasticity (related to profits in our model)

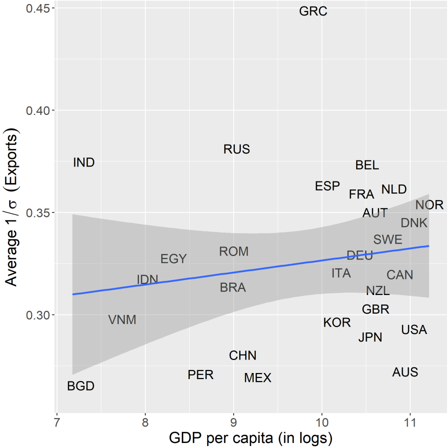
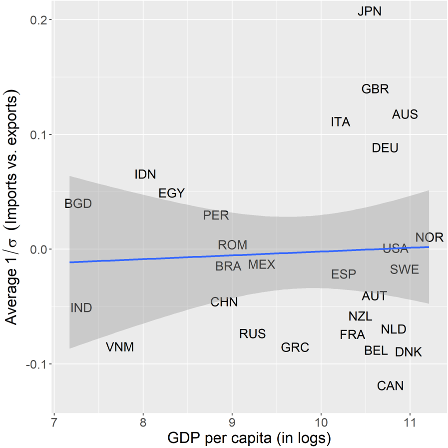


Figure: Exports

Motivation

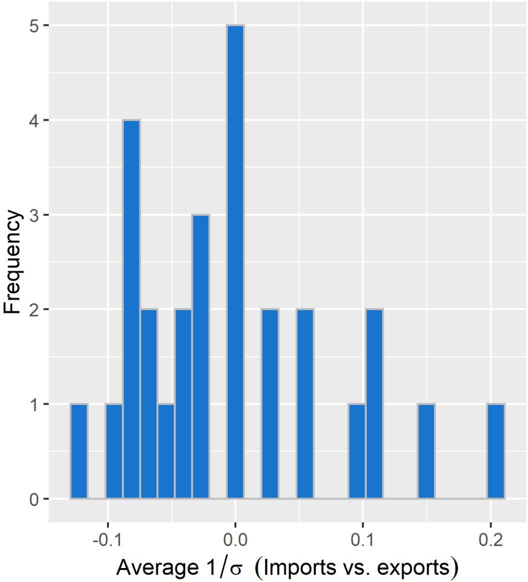
- Estimate import demand elasticities for 1200+ sectors, separately for 30 countries
- Look at average inverse elasticity (related to profits in our model)



Examples

Figure: Imports - Exports

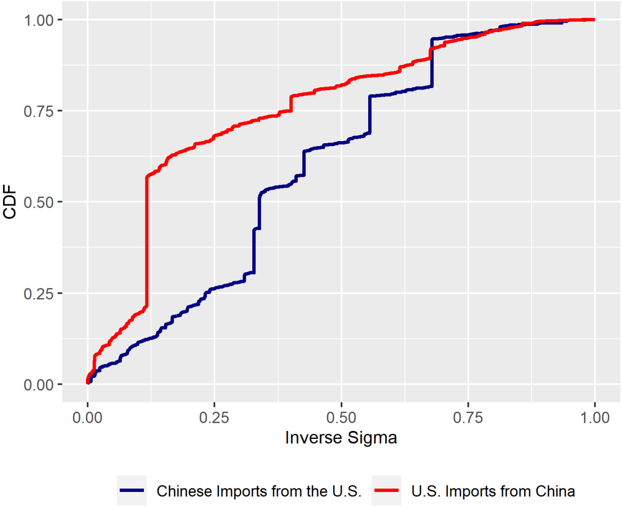
Motivation



Examples

Motivation: U.S.-China Trade War

weighted by trade volumes and tariffs



Examples

What We Do

Embed sector- and country-specific markups into a multi-sector multi-country quantitative trade model

Countries differ in terms of the markups of their imports and exports

We show this has very important qualitative and quantitative implications for welfare consequences of trade

The Main Idea + Results Preview

- Some countries are net exporters of high-markup goods, some are net importers
- When trade barriers ↑: price channel and profit-shifting channel
  - Global trade war: all countries raise all tariffs by 20%
- price channel: ↓ welfare
- profit shifting:
  - Net exporters of high-markup goods: ↓ welfare (welfare loss is magnified)
    - up to 3 times for Belgium, Canada, Vietnam
  - Net importers of high-markup goods: ↑ welfare (welfare loss is mitigated)
    - Germany, Japan, UK gain from a global trade war

Results Preview

- To show the importance of profit shifting, we also use the "perfect competition" variant of our model
- Gains from trade are up to **36%** **larger** for **net exporters of high-markup** goods
  - Belgium, Canada, Vietnam
- Gains from trade are up to **29%** **smaller** for **net importers of high-markup** goods
  - Germany, Japan, UK
- The factual U.S.-China trade war
  - Perfect competition: both countries lose by 0.03-0.06%
  - Baseline: **U.S. loses by 0.07%, China gains by 0.01%**
  - U.S. tariffs on low-markup sectors; China on high-markup
- A counterfactual U.S.-China trade war
  - What if U.S. (China) imposes tariffs on high- (low-) markup goods?
  - Perfect competition: both countries lose
  - Baseline: U.S. gains by 0.003%, China loses by 0.11%

Literature

1. ***Quantitative trade theory:*** Eaton and Kortum (2002); Caliendo and Parro (2015); Costinot, Donaldson, and Komunjer (2012); Arkolakis, Costinot, and Rodriguez-Clare (2012)

   Contribution: add country- and sector-specific markups + ACR formula doesn't hold due to profit shifting

2. ***Profit shifting:*** Spencer and Brander (1983); Ossa (2014); Lashkaripour and Lugovskyy (2020)

   Contribution: add country- and sector-specific markups + within-industry productivity heterogeneity

3. ***US-China trade war:*** Fajgelbaum et al. (2020); Amiti et al. (2019); Waugh (2019); Flaaen and Pierce (2019)

   Contribution: profit shifting has crucial quantitative and qualitative implications

4. ***Estimating trade and substitution elasticities:*** Feenstra (1994); Broda and Weinstein (2006); Soderbery (2015); Simonovska and Waugh (2014); Caliendo and Parro (2015)

   Contribution: large scale estimation for 1200+ sectors and 30 countries

Presentation Outline

1. A 2×2 Model
2. The Quantitative Model
3. Data and Estimation
4. Counterfactual Exercises

A 2×2 Model

- 2 countries in the world, Home and Foreign (by *)
- 2 sectors H, L in each country

$$U = Q_L^{\alpha_L} Q_H^{\alpha_H} \quad ; \alpha_L + \alpha_H = 1$$

$$U^* = Q_L^{*\ \alpha_L^*} Q_H^{*\ \alpha_H^*} \quad ; \alpha_L^* + \alpha_H^* = 1$$

- Sectors differ in their elasticity of substitution between their varieties:

$$Q_i = (\int q(\nu)^{\frac{\sigma_i - 1}{\sigma_i}} d\nu)^{\frac{\sigma_i}{\sigma_i - 1}} \quad ; i = L, H$$

$$Q_i^* = (\int q^*(\nu)^{\frac{\sigma_i - 1}{\sigma_i}} d\nu)^{\frac{\sigma_i}{\sigma_i - 1}} \quad ; i = L, H$$

- Each variety ν is sourced from the lowest-price supplier across the world.

Technology

- CRS technology to produce each variety using labor only
- Productivities: A_L, A_H in Home; A_L^*, A_H^* in Foreign
- Foreign: productivity of all best producers in L is 1, in H is $A_H^* > 1$
- Key Ass. 1: Production technology is proprietary
- Key Ass. 2: Stage 1: producers pay fixed costs f_d and f_x to serve Home and Foreign ($f_d = f_x = f$ for now); stage 2: firms set prices.
- Hence, the lowest-cost producer charges the optimal Dixit-Stiglitz markup $\frac{\sigma_i}{\sigma_i - 1}$
- Note: the price that the lowest-cost producer charges may be larger than the other producer's marginal cost, but the other producer does not have an incentive to enter

Equilibrium: Closed Economy

Normalize wages to 1

$$I = L - 2f + \frac{\alpha_L I}{\sigma_L} + \frac{\alpha_H I}{\sigma_H} \Rightarrow I = \frac{L - 2f}{1 - (\frac{\alpha_L}{\sigma_L} + \frac{\alpha_H}{\sigma_H})}$$

$$I^* = L - 2f + \frac{\alpha_L^* I^*}{\sigma_L} + \frac{\alpha_H^* I^*}{\sigma_H} \Rightarrow I^* = \frac{L - 2f}{1 - (\frac{\alpha_L^*}{\sigma_L} + \frac{\alpha_H^*}{\sigma_H})}$$

Equilibrium: Free Trade

- We consider an equilibrium in which $1 < w^* < A_H^*$ (normalize Home wage to 1)

- Home produces all varieties of sector L only, and Foreign produces all varieties in sector H only.

$$I = L - 2f + \frac{\alpha_L I}{\sigma_L} + \frac{\alpha_L^* I^*}{\sigma_L}$$

$$I^* = w^*(L - 2f) + \frac{\alpha_H I}{\sigma_H} + \frac{\alpha_H^* I^*}{\sigma_H}$$

- Profit shifts to Foreign country

- Trade balance: $\alpha_H I = \alpha_L^* I^*$

- Combined with income equations:

$$w^* = \frac{\alpha_H}{\alpha_L^*} \frac{\frac{\sigma_L}{\sigma_L - 1}}{\frac{\sigma_H}{\sigma_H - 1}}$$

Gains from Trade Liberalization

What happens to Home's welfare after trade?

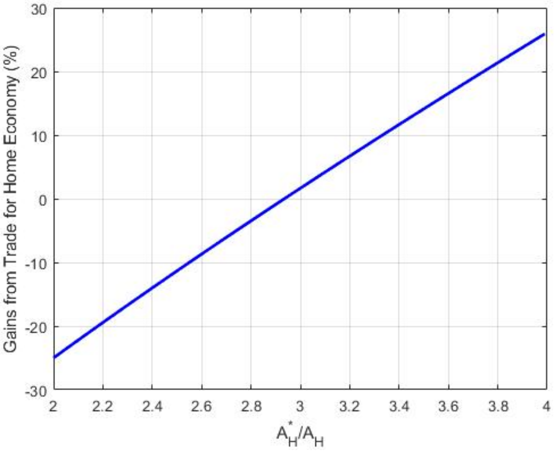
$$\frac{U_{trade}}{U_{aut}} = \underbrace{\frac{\sigma_L}{\sigma_L - 1}(1 - (\frac{\alpha_L}{\sigma_L} + \frac{\alpha_H}{\sigma_H}))}_{\text{profit-shifting channel}} \times \underbrace{(\frac{A_H^*}{A_H w^*})^{\alpha_H}}_{\text{price channel}}$$

- Welfare ↑ since price index ↓
  - Its size depends on how large $\frac{A_H^*}{A_H w^*}$ is
- Welfare ↓ due to profit shifting

Proposition: The country that specializes in producing high-markup goods always gains from trade. However, the country that specializes in low-markup products gains if and only if its partner's productivity in the high-markup sector is large enough.

Gains from Trade Liberalization

(in free trade eq, $w^* = 2$)



Presentation Outline

Environment

Static GE

Based on Eaton and Kortum (2002), Caliendo and Parro (2015) with one important modification: incorporate markups

N countries indexed by i, n

K sectors indexed by k (2-digit HS)

J sub-sectors within each sector indexed by $j(k)$ (4-digit HS)

Labor endowment in each country L_n (the sole factor of production)

Trade frictions: ad valorem tariffs and iceberg cost

Preferences

Cobb-Douglas over K sectors (HS2)

$$U_n = \Pi_{k=1}^{K} Q_n^{k\ \alpha_n^k}\ , \qquad \sum_{k=1}^{K} \alpha_n^k = 1 \quad \forall n \in \{1, ..., N\}$$

Sector k is a CES aggregate of sub-sectors (HS6)

$$Q_n^k = [\sum_{j=1}^{J(k)} q_n^{j(k)\ \frac{\sigma_n^k - 1}{\sigma_n^k}}]^{\frac{\sigma_n^k}{\sigma_n^k - 1}}$$

Each sub-sector $j(k)$ is a CES aggregate over a continuum of varieties ω (infinitesimal)

$$q_n^{j(k)} = [\int r_n^{j(k)}(\omega)^{\frac{\sigma_n^{j(k)} - 1}{\sigma_n^{j(k)}}} d\omega]^{\frac{\sigma_n^{j(k)}}{\sigma_n^{j(k)} - 1}}$$

Each variety ω is sourced from the lowest-price producer across the world

Trade Frictions and Technology

Trade is subject to ad valorem tariffs $t_{in}^{j(k)}$ and iceberg cost $d_{in}^{j(k)}$

$$\tau_{in}^{j(k)} = d_{in}^{j(k)}(1 + t_{in}^{j(k)})$$

(Feenstra and Romalis, 2014; Caliendo and Parro, 2015)

CRS technology to produce variety ω in country n

$$q_n^{j(k)}(\omega) = z_n^{j(k)}(\omega) l_n^{j(k)}(\omega)$$

$z_n^{j(k)}$ is the best productivity drawn from Frećhet with location parameter $T_n^{j(k)}$ and shape parameter $\theta^{j(k)}$

Key: production technology is proprietary

Product Market Structure

- Variety ω in sub-sector $j(k)$ in country n is sourced from the lowest-price producer across the world.

- An important modification to EK and CP. Stage 1: producers pay fixed costs f_d and f_x to serve domestic and foreign markets; stage 2: firms set prices.

- Hence, the lowest-cost producer charges the optimal Dixit-Stiglitz markup $\frac{\sigma_n^{j(k)}}{\sigma_n^{j(k)}-1}$

$$p_n^{j(k)}(\omega) = (\frac{\sigma_n^{j(k)}}{\sigma_n^{j(k)} - 1}) \times \min_i \{ \frac{w_i \tau_{in}^{j(k)}}{z_i^{j(k)}(\omega)} \}$$

Prices and Trade Shares

- Lower-tier (HS6) price index:

$$P_n^{j(k)} = A_n^{j(k)} [\sum_{i=1}^{N} T_i^{j(k)} (w_i \tau_{in}^{j(k)})^{-\theta^{j(k)}}]^{\frac{-1}{\theta^{j(k)}}}$$

where $A_n^{j(k)}$ is a constant including the markup $\frac{\sigma_n^{j(k)}}{\sigma_n^{j(k)}-1}$

- Trade shares:

$$\frac{X_{in}^{j(k)}}{X_n^{j(k)}} \equiv \pi_{in}^{j(k)} = \frac{T_i^{j(k)} (w_i \tau_{in}^{j(k)})^{-\theta^{j(k)}}}{\sum_{h=1}^{N} T_h^{j(k)} (w_h \tau_{hn}^{j(k)})^{-\theta^{j(k)}}}$$

- Expenditures:

$$X_n^{j(k)} = \alpha_n^k I_n (\frac{P_n^{j(k)}}{\mathcal{P}_n^k})^{1-\sigma_n^k}$$

Total Income

- Income:

$$I_n = \overbrace{w_n L_n}^{\text{wage bill}} + \overbrace{Y_n}^{\text{profit}} + \overbrace{R_n}^{\text{tariff revenue}} + \overbrace{D_n}^{\text{trade deficit}}$$

- Profit Y_n equals:

$$\sum_{k=1}^{K}\sum_{j=1}^{J(k)}\sum_{i\neq n}\left(\frac{\pi_{ni}^{jk}X_i^{jk}}{\sigma_i^{j(k)}(1+t_{ni}^{jk})} - \pi_{ni}^{jk} f_x w_n\right) + \sum_{k=1}^{K}\sum_{j=1}^{J(k)}\left(\frac{\pi_{nn}^{jk}X_n^{jk}}{\sigma_n^{j(k)}} - \pi_{nn}^{jk} f_d w_n\right)$$

- Tariff revenue:

$$R_n = \sum_{k=1}^{K}\sum_{j=1}^{J(k)}\sum_{i=1}^{N}\frac{t_{in}^{j(k)}}{(1+t_{in}^{j(k)})}\pi_{in}^{j(k)}X_n^{j(k)}$$

- Trade deficits:

$$\sum_{k=1}^{K}\sum_{j=1}^{J(k)}\sum_{i=1}^{N}\frac{\pi_{in}^{j(k)}X_n^{j(k)}}{(1+t_{in}^{j(k)})} - D_n = \sum_{k=1}^{K}\sum_{j=1}^{J(k)}\sum_{i=1}^{N}\frac{\pi_{ni}^{j(k)}X_i^{j(k)}}{(1+t_{ni}^{j(k)})}$$

Solving for Equilibrium

- Parameters that we need: $d_{in}^{j(k)}, T_n^{j(k)}$, $\theta^{j(k)}, \sigma_n^k, \sigma_n^{j(k)}$
- Get rid of $d_{in}^{j(k)}, T_n^{j(k)}$: solving the model in changes using "hat algebra" (Dekle, Eaton, and Kortum (2008)); $\hat{x} := \frac{x'}{x}$
- We estimate $\theta^{j(k)}, \sigma_n^k, \sigma_n^{j(k)}$: $>$ 36,000 parameters

Equilibrium in Changes ("Hat Algebra")

$$\hat{P}_n^{j(k)} = [\sum_{i=1}^{N} \pi_{in}^{j(k)} (\hat{w}_i \hat{\tau}_{in}^{j(k)})^{-\theta^{j(k)}}]^{\frac{-1}{\theta^{j(k)}}} \quad , \quad \hat{\pi}_{in}^{j(k)} = [\frac{\hat{w}_i \hat{\tau}_{in}^{j(k)}}{\hat{P}_n^{j(k)}}]^{-\theta^{j(k)}}$$

$$X_n^{\prime j(k)} = \alpha_n^k I_n^{\prime} \frac{\hat{P}_n^{j(k)\ 1-\sigma_n^k} X_n^{j(k)}}{\sum_{l=1}^{J(k)} \hat{P}_n^{l(k)\ 1-\sigma_n^k} X_n^{l(k)}}$$

$$I_n^{\prime} = \hat{w}_n w_n L_n + Y_n^{\prime} + R_n^{\prime} + D_n$$

$$Y_n^{\prime} = \sum_{k=1}^{K} \sum_{j=1}^{J(k)} \sum_{i \neq n} (\frac{\pi_{ni}^{\prime jk} X_i^{\prime jk}}{\sigma_i^{j(k)} (1 + t_{ni}^{\prime jk})} - \pi_{ni}^{\prime jk} f_x \hat{w}_n w_n) + \sum_{k=1}^{K} \sum_{j=1}^{J(k)} (\frac{\pi_{nn}^{\prime jk} X_n^{\prime jk}}{\sigma_n^{j(k)}} - \pi_{nn}^{\prime jk} f_d \hat{w}_n w_n)$$

$$R_n^{\prime} = \sum_{k=1}^{K} \sum_{j=1}^{J(k)} \sum_{i=1}^{N} \frac{t_{in}^{\prime j(k)}}{(1 + t_{in}^{\prime j(k)})} \pi_{in}^{\prime j(k)} X_n^{\prime j(k)}$$

we use a loop over $\hat{w}$; each loop solves a 36,000 $\times$ 36,000 system of equations to find expenditures $X_n^{\prime j(k)}$

Solving the Model

We first estimate $\theta^{j(k)}, \sigma_n^{j(k)}, \sigma_n^k$ to solve the model

The model exactly matches the 2015 data

We use our model to solve for a "counterfactual" equilibrium with no trade deficits

Use our model-implied data as the baseline data

Welfare

Welfare:

$$W_n = \frac{I_n}{\mathcal{P}_n}$$

Welfare decomposition:

$$\hat{W}_n - 1 = \underbrace{(\frac{\hat{w}_n}{\hat{\mathcal{P}}_n} - 1)\frac{w_n L_n}{I_n}}_{\text{wage contribution}} + \underbrace{(\frac{\hat{Y}_n}{\hat{\mathcal{P}}_n} - 1)\frac{Y_n}{I_n}}_{\text{profit contribution}} + \underbrace{(\frac{\hat{R}_n}{\hat{\mathcal{P}}_n} - 1)\frac{R_n}{I_n}}_{\text{tariff rev. contribution}}$$

Presentation Outline

Data

- UN Comtrade: bilateral trade data from 1995-2015
  - 6-digit HS
  - 30 countries, from poorer to richer
- GTAP 8: domestic expenditures
- WITS: tariffs
- Peterson Institute for International Economics: U.S.-China tariff war (the first 3 waves, i.e., until September 2019)
- ILO: wage bill
- OECD and UNCTAD data on multinationals
  - share of multinationals in each sector-country
  - share of an investor country in a recipient country
- ORBIS firm-level data for cross-validating $\sigma_n^{j(k)}$

Estimation: Trade Elasticities $\theta^{j(k)}$

- We follow Caliendo and Parro (2015):

$$\ln\left(\frac{X_{ni}^{j(k)} X_{ih}^{j(k)} X_{hn}^{j(k)}}{X_{in}^{j(k)} X_{hi}^{j(k)} X_{nh}^{j(k)}}\right) = -\theta^{j(k)} \ln\left(\frac{\tilde{t}_{ni}^{j(k)} \tilde{t}_{ih}^{j(k)} \tilde{t}_{hn}^{j(k)}}{\tilde{t}_{in}^{j(k)} \tilde{t}_{hi}^{j(k)} \tilde{t}_{nh}^{j(k)}}\right) + \tilde{\epsilon}_{ihn}^{j(k)},$$

- Estimates are in line with Caliendo and Parro (2015), Simonovska and Waugh (2014), and Eaton and Kortum (2002)

	Median	1st Quartile	3rd Quartile
θ^j	3.27	1.93	4.44
θ^j-CEPII (robustness)	8.09	5.66	12.47

- θ-CEPII by Fontagne, Guimbard and Orefice (2019)

Estimation: Elasticities of Substitutions σ_n^k, $\sigma_n^{j(k)}$

- We use Soderbery (2015)'s method which modifies Broda and Weinstein (2006) and Feenstra (1994)
- Estimate import demand elasticities at HS2 (σ_n^k) and HS4 level ($\sigma_n^{j(k)}$)
- Separately for 1200+ HS4 sectors and 30 countries: $> 36,000$ parameters Country-Level Estimates HS4 Variations
- Estimates are statistically different across countries:
  - take a country pair; around 70% of estimates are statistically different (at 95% level)
- Horizontal supply curves?
  - 66% of inverse supply elasticities are statistically not different from 0
  - median is 0.04
- Soderbery (2015) vs BW Monte Carlo experiment

Fixed Costs

- Calibrate f_d and f_x to the findings in Edmond, Midrigan, and Xu (2015)
  - total domestic fixed costs paid equaling 0.26% of domestic profits
  - total export fixed costs paid as a fraction of export profits being equal to 3.3%
  - match the cross-country average of these measures
- Robustness
  - infinitesimal fixed costs
  - symmetric fixed costs (i.e., $f_d = f_x$)
  - values of f_d and f_x being three times larger
  - fixed costs being proportional to destination market size

Supporting Evidence Using Cross-Country Firm-Level Data

- Markups implied by demand elasticities are key in this paper
- ORBIS firm-level data for 8 European countries in our sample
- 3 ways to cross-validate σ

1. Construct cross-firm average (median) of profit margin
   - sale/(wage bill+material cost + capital cost)
   - correlation between model-implied markups and data-driven profit margin across sector-country: 41%
2. Estimate De Loecker and Warzynski (2012) firm-level markups
   - correlation between model-implied markups and data-driven markups across sector-country: 38%
3. Labor share
   - correlation between model-implied markups and data-driven labor share across sector-country: -35%

Presentation Outline

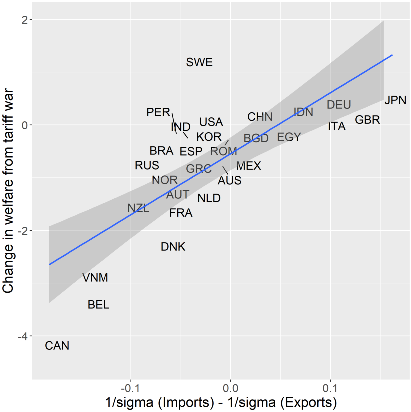
1. A 2×2 Model
2. The Quantitative Model
3. Data and Estimation
4. Counterfactual Exercises

2 Variants of Our Model

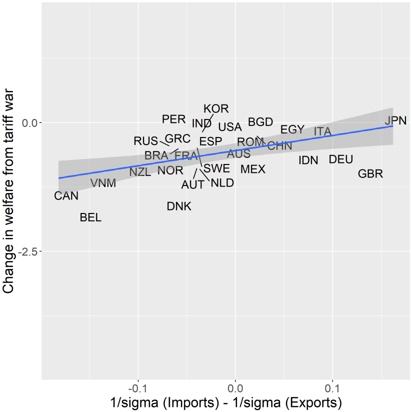
- To emphasize the role of profit shifting, we also use the "perfect competition" variant of our model
- "perfect competition": like Eaton and Kortum (2002) and Caliendo and Parro (2015), firms earn no profit
- We match this model to the same data, and use the same trade and substitution elasticities

A Global Tariff War

- All countries raise all import tariffs by 20 percentage points

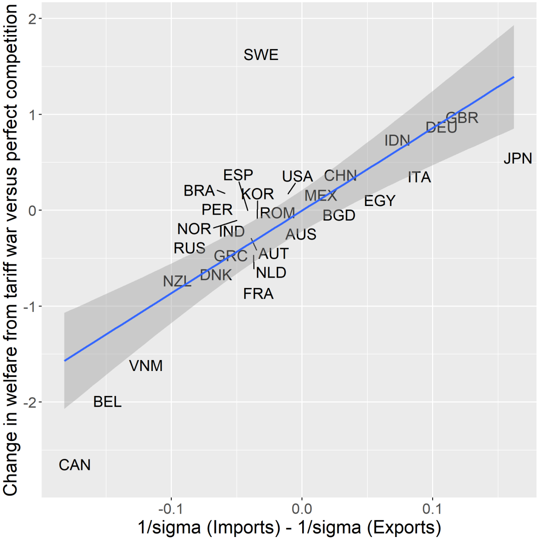


(a) Baseline Model



(b) Perfect Competition

A Global Tariff War



product mix

Figure: Baseline vs Perfect Competition

A Global Tariff War

Countries	Baseline Model				Perfect Competition Model		
	welfare	wage	profit	tariff	welfare	wage	tariff
Belgium	-3.549	-3.123	-3.888	3.463	-1.673	-5.188	3.515
Canada	-4.327	-3.213	-3.984	2.870	-1.568	-4.505	2.937
Germany	0.237	-1.355	0.010	1.582	-0.545	-2.115	1.571
Japan	0.324	-0.242	0.233	0.333	-0.112	-0.444	0.333
New Zealand	-1.411	-1.429	-1.201	1.219	-0.791	-2.018	1.227
Norway	-0.908	-1.608	-1.154	1.854	-0.806	-2.662	1.856
Vietnam	-2.729	-1.924	-2.507	1.701	-1.002	-2.732	1.730
UK	0.261	-1.440	-0.169	1.870	-0.799	-2.655	1.856
USA	-0.090	-0.454	-0.256	0.620	-0.251	-0.869	0.618

- PC model: All countries lose
- Baseline: UK, Germany and Japan gain
- Welfare loss is up to 3 times (Canada) or one-third (U.S.)
- Wage and tariff rev. roughly cancel out ⇒ profit has large explanatory power
- Changes in trade volumes are almost the same in the 2 models
- ACR formula does not hold due to profit shifting

Global Tariff War: Role of Productivity Dispersion θ

- Higher $\theta \Rightarrow$ lower prod. dispersion $\Rightarrow$ profit shifting is even more important.
- If θ's were about 50% larger:

Countries	Baseline Model				Perfect Competition Model		
	welfare	wage	profit	tariff	welfare	wage	tariff
Belgium	-7.074	-1.891	-6.133	0.950	-2.132	-3.124	0.993
Canada	-6.840	-2.165	-5.523	0.848	-2.093	-2.979	0.887
UK	1.786	-0.971	2.189	0.568	-1.243	-1.796	0.552

- Under estimated θ's:

Countries	Baseline Model				Perfect Competition Model		
	welfare	wage	profit	tariff	welfare	wage	tariff
Belgium	-3.549	-3.123	-3.888	3.463	-1.673	-5.188	3.515
Canada	-4.327	-3.213	-3.984	2.870	-1.568	-4.505	2.937
UK	0.120	-1.200	0.065	1.255	-0.917	-2.163	1.246

Extensions & Robustness

- Incorporating multinationals
- Infer σ using the De Loecker and Warzynski (2012) markups
- Using CEPII trade elasticities
- Our framework vs. Krugman-type models
  - Krugman-type models like Ossa (2014) impose $\theta = \sigma - 1$
  - This limits profit shifting
  - Our estimates: corr bw σ and θ is almost 0
  - Our welfare results are 2-3 times larger than those where we impose $\theta = \sigma - 1$

The Factual U.S.-China Tariff War

Countries	Baseline Model				Perfect Competition Model		
	welfare	wage	profit	tariff	welfare	wage	tariff
China	0.013	-0.065	0.037	0.041	-0.056	-0.097	0.041
USA	-0.066	-0.059	-0.088	0.081	-0.032	-0.113	0.081

- PC model:
  - real wage ↓ ⇒ both countries lose
  - U.S. welfare loss of 0.03% similar to Fajgelbaum et al. (2020)
- Baseline model: China gains; U.S. welfare loss doubles. Why?
  - real profit
  - U.S. imposes tariffs on low-markup goods (avg inverse elasticity 0.26)
  - China imposes tariffs on high-markup goods (avg inverse elasticity 0.33) CDF
- Changes in trade volumes are identical across the 2 models

Counterfactual U.S.-China Tariff War 1

- What if the U.S. imposes tariffs on its high-markup sectors, while China imposes tariffs on its low-markup sectors?
- The same $ value is taxed by U.S. and China as observed in the factual war

Countries	Baseline Model				Perfect Competition Model		
	welfare	wage	profit	tariff	welfare	wage	tariff
China	-0.106	-0.054	-0.101	0.049	-0.033	-0.082	0.049
USA	0.003	-0.045	0.027	0.021	-0.064	-0.085	0.021

- Baseline model: China loses; U.S. gains. Why?
  - U.S. imposes tariffs on high-markup goods (avg inverse elasticity 0.52)
  - China imposes tariffs on low-markup goods (avg inverse elasticity 0.23)
- Changes in trade volumes are identical across the 2 models

Counterfactual U.S.-China Tariff War 2

Given China's tariffs observed in the tariff war, what if the U.S. imposes tariffs on its high-markup sectors?

Countries	Baseline Model				Perfect Competition Model		
	welfare	wage	profit	tariff	welfare	wage	tariff
China	-0.048	-0.046	-0.046	0.044	-0.025	-0.070	0.044
USA	-0.062	-0.044	-0.050	0.032	-0.053	-0.085	0.032

- U.S. could have done better in this war!
- This way puts more pressure on China

The Gains from Trade

The absolute value of welfare changes (%) as we move from the observed trade data in 2015 to autarky

Countries	Baseline Model				Perfect Competition Model		
	welfare	wage	profit	tariff	welfare	wage	tariff
Belgium	27.801	13.398	13.933	0.469	22.341	21.870	0.471
Canada	23.701	12.430	10.928	0.344	17.352	17.007	0.344
Germany	7.328	6.029	1.020	0.279	9.753	9.474	0.279
Japan	0.773	1.052	0.341	0.062	1.996	1.934	0.063
New Zealand	10.463	6.613	3.660	0.190	9.480	9.290	0.190
Vietnam	16.158	8.507	6.983	0.667	12.563	11.894	0.669
UK	8.395	6.202	1.874	0.319	11.842	11.523	0.320
USA	3.592	1.877	1.619	0.096	3.701	3.605	0.095

- PC model underestimates GT for net exporter of high markups: Belgium, Canada, New Zealand, Vietnam
- PC model overestimates GT for net importer of high markups: Germany, Japan, UK

The Gains from Trade

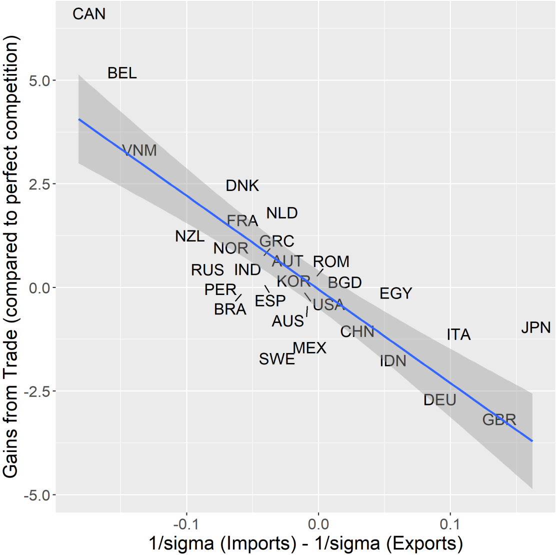


Figure: Baseline vs. Perfect Comp.

Conclusion

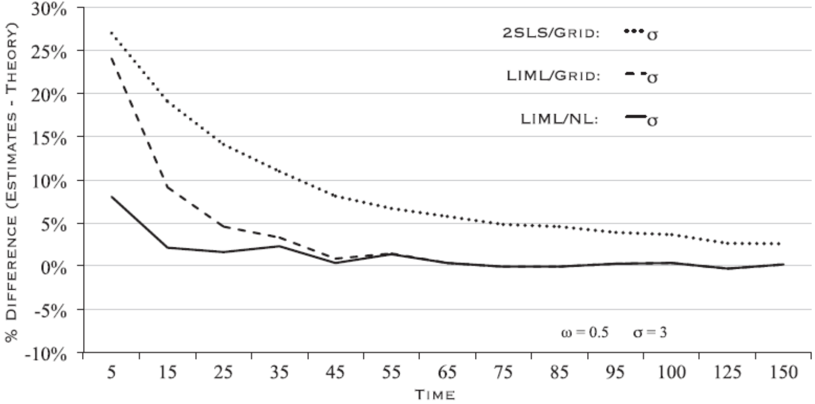
- We embed sector- and country-specific markups into a quantitative trade model
- Profit shifting has quantitatively and qualitatively important policy implications
  - Welfare loss from global trade war is up to **3 times**
  - US loss from the US-China war is **2 times**, while China gains
- Arkolakis, Costinot, and Rodriguez-Clare (2012) formula doesn't apply: share of profits change by trade
- What if markups are variable and also firm-dependent? A companion work by Firooz, Heins, and Mathur (2024), in which we add oligopoly

HS6 σ	Median	1st Quart.	3rd Quart.	Share statistically significant	Share statistically different from U.S. σ
Australia	2.06	1.35	4.74	79.60	58.22
Austria	3.09	1.60	7.24	85.35	67.74
Bangladesh	2.90	1.54	7.67	88.80	79.16
Belgium	3.01	1.76	8.21	88.70	66.67
Brazil	2.59	1.59	5.37	84.08	65.06
Canada	4.74	2.01	15.10	91.13	68.31
China	2.76	1.71	5.68	85.11	64.04
Denmark	2.28	1.53	5.92	84.88	74.24
France	2.80	1.62	6.55	86.27	66.03
Germany	2.23	1.39	5.05	86.61	71.57
Greece	2.28	1.51	4.37	79.97	54.28
India	2.64	1.61	6.29	90.07	68.00
Indonesia	2.32	1.56	4.25	88.42	65.51
Italy	2.02	1.39	3.81	84.23	58.22
Japan	1.98	1.35	4.09	83.17	71.26
Rep. of Korea	2.87	1.63	5.24	84.12	66.66
Mexico	3.22	1.78	6.67	85.42	69.99
Netherlands	2.85	1.56	6.20	84.51	60.63
New Zealand	2.88	1.61	6.73	84.75	63.74
Norway	2.31	1.61	3.53	77.68	53.65
Peru	2.65	1.63	5.46	77.72	66.03
Romania	2.38	1.54	4.85	83.49	68.00
Russia	2.43	1.60	5.15	84.51	73.03
Vietnam	6.80	2.48	16.06	88.75	73.91
Spain	2.65	1.74	4.64	86.72	62.16
Sweden	2.76	1.51	8.69	86.22	58.44
Egypt	2.15	1.50	4.43	83.64	72.00
United Kingdom	1.85	1.38	3.53	81.73	61.76
USA	2.07	1.47	6.11	87.26	-

back

Soderbery (2015) vs Broda and Weistein (2006)

A Monte Carlo experiment reported in Soderbery (2015)



back

Variations in HS4 Elasticities

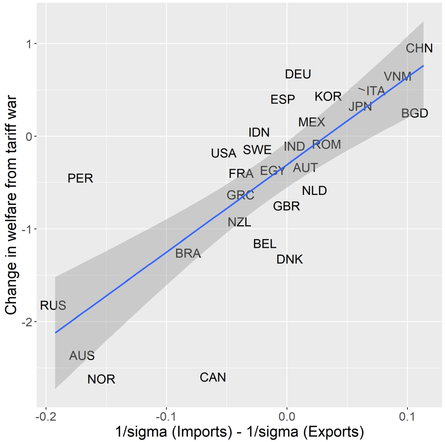
Variation in HS4 import demand elasticities $\sigma_n^{j(k)}$:

- product FE: 25% (standard vs differentiated)
- country FE: 12% (rich vs poor)
- rest is product-country specific factors

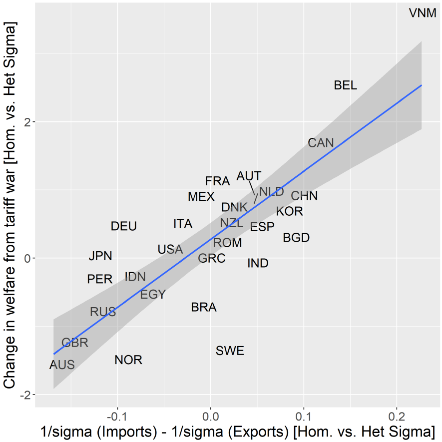
back

The Role of Cross-Country Heterogeneity in $\sigma_n^{j(k)}$ & σ_n^k

What if we use U.S.-based estimates for all countries (global war)?



(a) Homogeneous Elasticities (product mix only)



(b) Heterogeneous Elasticities (product mix+country-product factors)

The Role of Cross-Country Heterogeneity in $\sigma_n^{j(k)}$ & σ_n^k

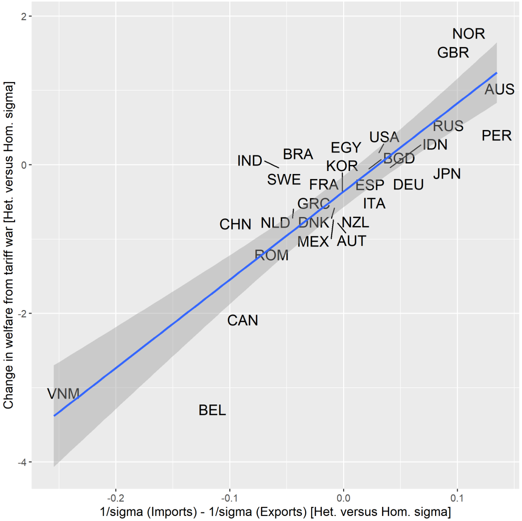
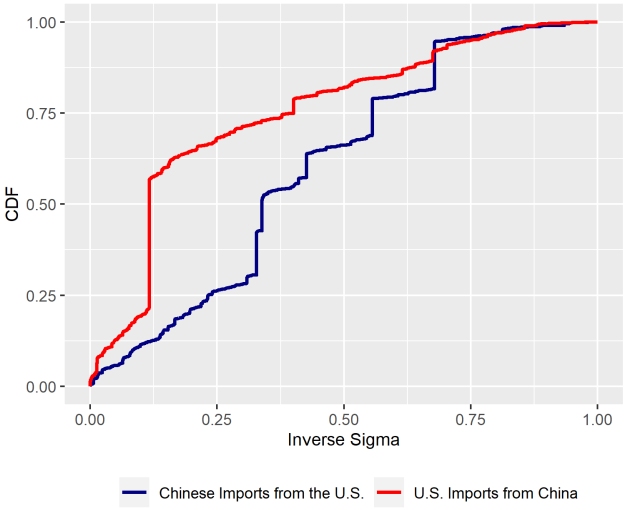


Figure: Heterogeneous versus Homogeneous Elasticities (country-product factors only)

back

U.S.-China Trade War

weighted by trade volumes and tariffs



back