ECON G6905

Topics in Trade

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Fall 2025, Week 13

Outline of today

- Basics of commercial policy (instruments, agreements, implementation)
- Economic analysis of tariffs: incidence, passthrough, terms of trade
- Optimal tariffs in theory
- Recent empirical work on recent trade policy

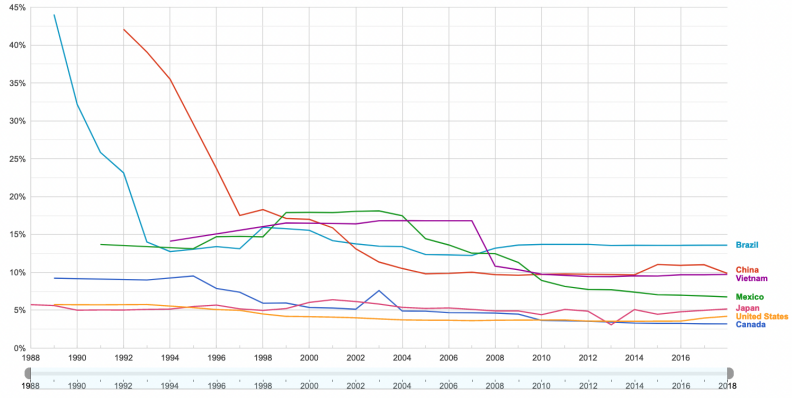
Last-class reminders: assignment 4 (see Courseworks) and final exam

Instruments of commercial policy

- An import tariff is a tax: a customs duty on an imported good
- Most tariffs are *ad valorem* (a percentage of the price) tariffs $p = p^*(1 + t)$
- *Specific* (per unit) tariffs more common in agriculture (& history) $p = p^* + t$
- Export subsidy is a payment to domestic producers for each unit exported $p = p^*(1 + s)$

Recent evolution of average tariff rates

Tariff rate - Simple mean - most favored nation



Trade agreements and the GATT/WTO system

- Since WWII, multilateral trading system has been governed by General Agreement on Tariffs and Trade (GATT) → World Trade Organization (WTO)
- Its non-discrimination principles are "national treatment" and "most favored nation"
- GATT Article XXIV allows countries to form customs unions or free-trade areas covering most goods. Bhagwati (2005): "central principle of nondiscrimination has been virtually destroyed... PTAs, which the architects of the GATT thought would be minor exceptions, have now swallowed up the trading system"
- Even MFN isn't reliably applied (Pakistan exempts Israel, India; India on Pakistan; US v Russia and Belarus)
- Countries negotiate bound rates, not applied rates (India and Turkey have lots of headroom; China and US have little water in the tariffs)
- WTO negotiations have stalled since Doha round died in 2008

The contents of trade agreements

- Preferential Trade Agreement (PTA): reduces trade barriers between members

  e.g. US-Colombia, US-Korea FTAs
- Free Trade Area (FTA): members eliminate formal trade barriers

  e.g. NAFTA, ASEAN (Association of Southeast Asian Nations)
- Customs Union (CU): FTA + common external tariff

  e.g. Mercosur (Common Southern Market)
- Common market: CU + free movement of services, capital and labor

  e.g. European Economic Community (EEC)
- Single market: Common market + harmonized economic policies

  e.g. European Union

Classification of goods

- Harmonized System (HS): Developed by the World Customs Organization, used by more than 200 countries as basis for collection of customs duties and international trade statistics
- First six digits of HS product codes are international standards
- Member countries establish further digits – US has 8 digits for customs duties and 10 digits for statistical collection
- Product classification is more important than you might expect
  - "Problems with ambiguity in product description, differing classifications among importing countries, and frequent changes in guidance were the most frequently cited product classification challenges." (TR/KPMG 2016)
  - "The new tariffs apply only to wine in bottles of 2 liters or less. Steiner's company is importing wine in 20- or 40-foot shipping containers, with a giant pouch inside. Think of the world's largest wine-in-a-box." (NPR 2019)

Also see Armen Khederlarian's lecture on tariff definitions and customs data

Reading Chapter 61 of the 2011 US HTS

excerpt from 2011 Harmonized Tariff Schedule, Ch 61: "Articles of apparel and clothing accessories, knitted or crocheted"

Heading/ Subheading	Stat. Suf-fix	Article Description	Unit of Quantity	Rates of Duty		
				1		2
				General	Special	
6104		Women's or girls' suits, ensembles, suit-type jackets, blazers, dresses, skirts, divided skirts, trousers, bib and brace overalls, breeches and shorts (other than swimwear), knitted or crocheted:				
		Suits:				
6104.13		Of synthetic fibers:				
6104.13.10	00	Containing 23 percent or more by weight of wool or fine animal hair (444)	No. . . . . kg	Free		54.5%
6104.13.20	00	Other (644)	No. . . . . kg	14.9%	Free (BH,CA,CL, IL,JO,MA,MX,OM, P,PE,SG) 8% (AU)	72%
6104.19		Of other textile materials:				
		Of artificial fibers:				
6104.19.10	00	Containing 23 percent or more by weight of wool or fine animal hair (444)	No. . . . . kg	8.5%	Free (BH,CA,CL, IL,JO,MA,MX,OM, P,PE,SG) 7.6% (AU)	54.5%
6104.19.15	00	Other (644)	No. . . . . kg	Free		72%

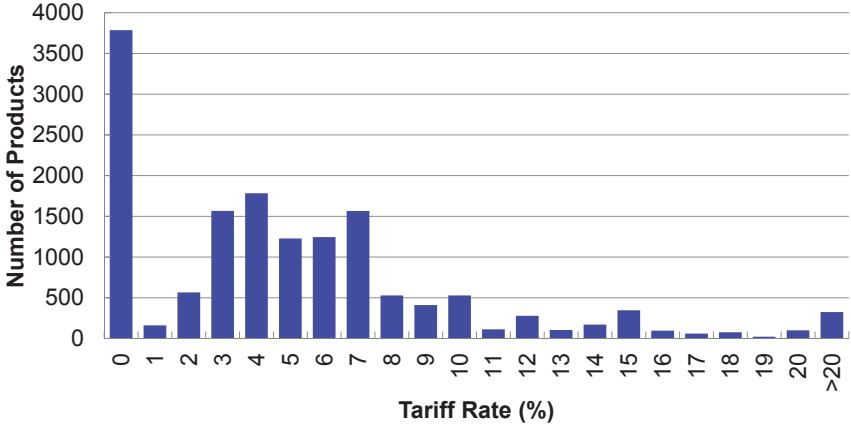
- Column 1 "general" means most favored nation (MFN) rate
- Column 2 lack normal trade relations (Cuba, North Korea)

Reading Chapter 61 of the US HTS

Heading/ Subheading	Stat. Suf- fix	Article Description	Unit of Quantity	Rates of Duty 1 General	Rates of Duty 1 Special	Rates of Duty 2
6103		Men's or boys' suits, ensembles, suit-type jackets, blazers, trousers, bib and brace overalls, breeches and shorts (other than swimwear), knitted or crocheted:				
6103.10		Suits:				
6103.10.10	00	Of wool or fine animal hair (443)	No. kg	38.8¢/kg + 10%	Free (BH,CA, CL,IL,JO,MA,MX, P,PE,SG) 8% (AU) 27.1¢/kg + 7% (OM)	77.2¢/kg + 54.5%
		Of synthetic fibers:				
6103.10.20	00	Containing 23 percent or more by weight of wool or fine animal hair (443)	No. kg	60.3¢/kg + 15.6%	Free (BH,CA,CL, IL,JO,MA,MX,OM, P,PE,SG) 8% (AU)	77.2¢/kg + 54.5%
6103.10.30	00	Other (643)	No. kg	28.2%	Free (BH,CA,CL, IL,JO,MA,MX,OM, P,PE,SG) 8% (AU)	72%
		Of other textile materials:				
		Of artificial fibers:				
6103.10.40	00	Containing 23 percent or more by weight of wool or fine animal hair (443)	No. kg	Free		77.2¢/kg + 54.5%
6103.10.50	00	Other (643)	No. kg	Free		72%

- Tariff engineering: "There's a reason your Columbia shirt has a tiny pocket near your waistline"
- Verifying declared classifications: "A Meat Grinder for Fabric" (NPR 2011)
- "In Apparel, All Tariffs Aren't Created Equal", NYT 2007

Variation in US import tariffs (2009 rates)



- Tariff peaks are unusually high tariffs. Examples of US tariff peaks: light trucks (25%), wool sweaters (16%), tuna (35%), leather (20%)
- Japan's rice tariff is 402 yen/kg. Could smuggle rice as sushi?

Misclassification and tax evasion

Ray Fisman and Shang-Jin Wei - Tax Rates and Tax Evasion: Evidence from "Missing Imports" in China (*JPE* 2004):

Tax evasion, by its very nature, is difficult to observe. We quantify the effects of tax rates on tax evasion by examining the relationship in China between the tariff schedule and the "evasion gap," which we define as the difference between Hong Kong's reported exports to China at the product level and China's reported imports from Hong Kong. Our results imply that a one-percentage-point increase in the tax rate is associated with a 3 percent increase in evasion. Furthermore, the evasion gap is negatively correlated with tax rates on closely related products, suggesting that evasion takes place partly through misclassification of imports from higher-taxed categories to lower-taxed ones, in addition to underreporting the value of imports.

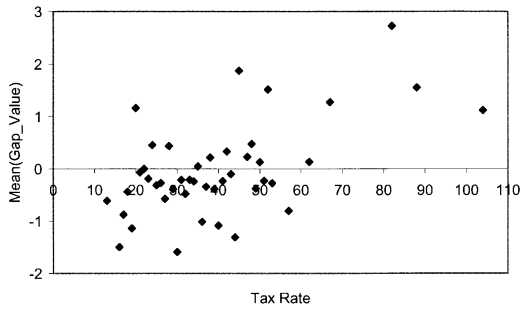


FIG. 3.—Relationship between mean(gap_value) and tax rates, 1998

The U.S.-China Trade Battle Spawns a New Era of Tariff Dodges

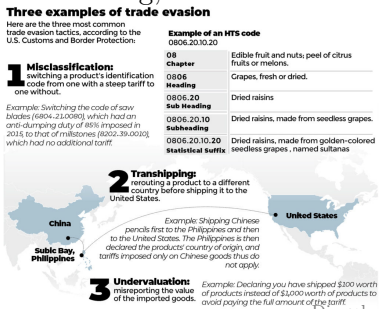
Switching around the 18,927 codes that identify imported goods is an increasingly popular way some Chinese exporters are ducking American tariffs

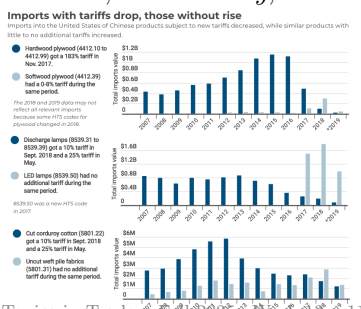
Tax avoidance and evasion in the recent trade war

"Delta Skirts Trump Tariffs by Sending Airbus Jets on Tour", 17 Nov 2020

sidestepping millions of dollars in US tariffs on European jetliners by initially routing them far outside the country to such places as Amsterdam, Tokyo and El Salvador.... The Delta strategy rests on language that classifies planes as used once they've flown for any reason other than testing and delivery. Tariffs on new-plane imports then don't apply, even if the aircraft are soon flying to the US.

Dian Zhang, "The Game of Numbers", *USA Today*, 31 Aug 2019





Rules of origin in preferential trade deals

- PTAs like NAFTA, CUs like EU, and GSP schemes like AGOA must define goods' origins so only imports from partners are eligible for lower tariff rates
- With imported intermediate inputs, "where" was a good made? Rules of origin
- Rules of origin can discourage firms from buying intermediates imported from the most efficient suppliers
- Manufacturers in developing economies say ROOs are most troublesome non-tariff barrier
- Preference utilization: only 37% of EU exports to Canada pay CETA tariffs; 50% for Thai exporters; very low within COMESA
- NAFTA's final-goods ROOs reduced Mexican imports of intermediate goods from non-NAFTA sources more in goods that had stricter ROOs and larger preference margins [US govt guide to NAFTA qualifying]
- AGOA's weak rules of origin led Chinese textile manufacturers to exploit AGOA-eligible countries as transshipment corridors
- See my blog post for details

Trade-policy uncertainty

Uncertainty about US tariffs on China depressed Chinese exports

- "Column two" tariff rates for exporting nations without normal trade relations (NTR): Cuba and North Korea
- China granted permanent NTR by joining WTO in 2001, eliminating annual legislative approval. Reduction in policy uncertainty increased China's exports to US 22%-30% (Limao and Handley 2013)
- US employment declined in manufacturing industries with bigger gap between column 1 and 2 tariff rates (Pierce and Schott 2016)

Studies of other uncertainty:

- Threats of anti-dumping duties reduce exports (Crowley, Song, Meng 2017)
- Negative correlation between world trade growth and policy uncertainty (Constantinescu, Ruta, Mattoo 2019)

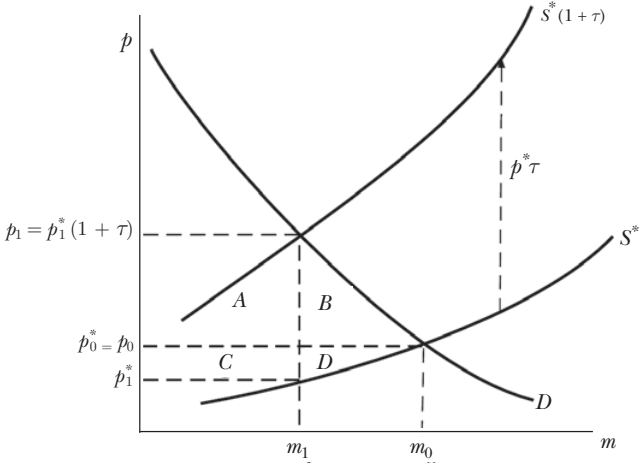
Can anyone think of a contemporary source of trade-policy uncertainty?

Raising tariffs above MFN levels

WTO agreements allow temporary tariffs exceeding MFN bounds:

1. *Countervailing duties* to negate foreign government subsidies
2. *Anti-dumping duties* are remedy for material injury when foreign exporters sell below cost or home-market price
3. *National safeguards*: WTO agreement allows "safeguard actions" to protect a specific domestic industry from an *unforeseen* increase of imports of any product which is causing, or which is likely to cause, serious injury to the industry. No need to show that a country is competing unfairly or dumping

Partial-equilibrium analysis of tariffs in competitive model



Consumers lose $A + B$.
Tariff revenue is $A + C$.
Deadweight loss is $B + D$.
Foreigners lose $C + D$.
Home gains $C - B$.

Perfectly elastic export supply curve makes $C = D = 0$ and full passthrough of tariff to import price.

Domestic consumers and foreign exporters each bear some of the burden of the tax, in proportions depending on the elasticities of supply and demand.

Unilateral optimal tariff (partial-equilibrium analysis)

The optimal unilateral tariff is the inverse of the foreign export supply elasticity

- Write the foreign export supply curve in inverse form as $p = p^*(m)$
- The cost of imports is $m \cdot p^*(m)$, so the marginal cost of imports is

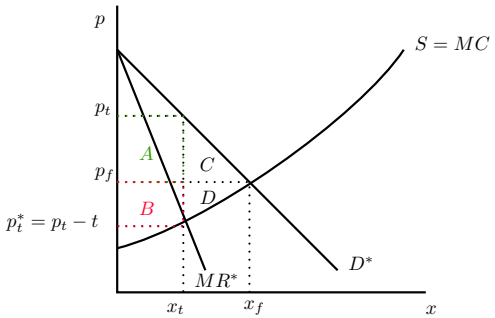
$$p^*(m) + m\left[\frac{dp^*(m)}{dm}\right] > p^*(m)$$

- Rewrite as $\text{MC} = p^*(m)\left[1 + \frac{1}{\zeta^*}\right]$, where ζ^* is export supply elasticity
- Because $p = p^*(m)(1+\tau)$, where τ is the (ad valorem) tariff rate on imports, the optimal tariff that equates $p = \text{MC}$ is

$$\tau = \frac{1}{\zeta^*}$$

- For a small open economy, $\zeta^* = \infty$

Optimal export taxes (partial-equilibrium, competitive model)



t is not ad valorem in this diagram

- Optimal tax equates marginal revenue to marginal cost
- Write inverse demand for Home exports as $p^* = p^*(x)$
- Revenue is $x \cdot p^*(x)$, so marginal revenue is $p^*(x) + x\left[\frac{dp^*(x)}{dx}\right]$
- Marginal revenue, rewritten, is $p^*(x)\left[1 + \frac{1}{\varepsilon^*}\right]$, where ε^* is foreign import demand elasticity
- Assume marginal cost is p
- $p^* = p(1+t)$, where t is the ad valorem export tax rate
- Equating $p^*(x)\left[1 + \frac{1}{\varepsilon^*}\right]$ to $p = p^*(x)/(1+t)$ means the optimal export tax is $t = \frac{-1}{\varepsilon^*+1}$
- For a small open economy, $\varepsilon^* = -\infty$

Tariffs in general equilibrium

Lerner's symmetry theorem (1936): An import tariff and an export tax are equivalent in their consequences!

- Suppose goods X and Y have world prices P_X^* and P_Y^*, domestic prices P_X and P_Y, there are no trade costs, and Home imports X
- Import tariff of t: $P_X = P_X^*(1+t)$ (and $P_Y = P_Y^*$) $\Rightarrow \frac{P_X}{P_Y} = (1+t)\frac{P_X^*}{P_Y^*}$
- Export tax of t: $P_Y^* = P_Y(1+t)$ (and $P_X = P_X^*$) $\Rightarrow \frac{P_X}{P_Y} = (1+t)\frac{P_X^*}{P_Y^*}$
- Intuition 1: Taxing imports makes their domestic production more attractive, drawing resources away from export production
- Intuition 2: If trade is balanced, reducing total imports must reduce total exports
- Intuition 3: $S - I = X - M$ so an import tariff that doesn't alter intertemporal decision $(S - I)$ doesn't alter the trade balance

An economy-wide import tax should not be analyzed through a one-good, partial-equilibrium diagram. See Costinot and Werning (2019) for a modern treatment.

Competitive models: Optimal tariffs manipulate the terms of trade

- Consider Home using trade taxes to set international (Foreign's) prices
- Recall revenue and expenditure functions from Dixit and Norman (1980)
- Foreign's net import demands are $m^* = e^*_{p^*}(p^*, u^*) - r^*_{p^*}(p^*, v^*)$ with $p^* \cdot m^*(p^*) = 0$. Foreign's net exports are $-m^*$.
- Home's utility from its imports is $u = \phi(m)$ at $m = -m^*(p^*)$ with $p \propto \phi_m(m)$
- Trade taxes are $t = p - p^*$ but there is one numeraire in each country, so import vs export labels are still arbitrary
- A price change $\mathrm{d}p^*$ spurs foreign net supply change $\mathrm{d}m = -m^*_{p^*}(p^*)\mathrm{d}p^*$
- Change in home utility is $\mathrm{d}u = \phi_m(m)\mathrm{d}m = -\phi_m(-m^*)m^*_{p^*}(p^*)\mathrm{d}p^* = -\alpha p \cdot m^*_{p^*}(p^*)\mathrm{d}p^*$

Competitive models: Optimal tariffs manipulate the terms of trade

$$\mathrm{d}u = \phi_m(m)\mathrm{d}m = -\phi_m(-m^*)m^*_{p^*}(p^*)\mathrm{d}p^* = -\alpha p \cdot m^*_{p^*}(p^*)\mathrm{d}p^*$$

- Optimal tariffs FOC is $p^T m^*_{p^*}(p^*) = 0$, aka $(p^* + t)^T m^*_{p^*}(p^*) = 0$
- One interpretation: Differentiate the trade-balance condition $p^{*T} m^*(p^*) = 0$

$$p^{*T} m^*_{p^*}(p^*) + m^{*T} = 0 \implies p^{*T} m^*_{p^*}(p^*) = -m^{*T}$$

- Thus the optimal tariffs FOC is

$$t^T m^*_{p^*}(p^*) = m^{*T}$$

"This looks like a formula involving the elasticity of the foreign offer curve." (DN p.152)

- With two goods (pick common numeraire with no tax), write FOC as

$$\frac{t}{p^*} p^* m^*_{p^*}(p^*) = m^* \implies \frac{t}{p^*} = \frac{1}{p^* m^*_{p^*}(p^*)/m^*}$$

so the percentage tariff is the inverse of Foreign's supply elasticity

Trade policy and income redistribution

- Tariffs are inferior to lump sum taxes or indirect commodity taxes, so trade policy is third-best instrument
- "When the home country cannot improve its terms of trade, there is still no role for tariffs; domestic redistribution is better achieved by means of commodity taxation." (DN80 p.175)
- Rodrik (1995): "Saying that trade policy exists because it serves to transfer income to favored groups is a bit like saying Sir Edmund Hillary climbed Mt. Everest because he wanted to get some mountain air."
- Adao, Becko, Costinot, Donaldson (2025): "Why is Trade Not Free? A Revealed Preference Approach". "Redistributive trade protection accounts for about a third of US tariff variation... mostly driven by differences in welfare weights across sectors of employment." (See footnote 7 on others taxes.)

Tariffs in single-sector CES Armington model

$$p_{ij} = Y_i \tau_{ij}(1+t_{ij})/Q_i$$

$$\phi_{ij} \equiv \tau_{ij}(1+t_{ij})$$

$$X_{ij} = \frac{(Y_i \phi_{ij}/Q_i)^{-\epsilon}}{\sum_l (Y_l \phi_{lj}/Q_l)^{-\epsilon}} E_j$$

$$E_j = Y_j + T_j = Y_j + \sum_i \frac{t_{ij}}{1+t_{ij}} X_{ij}$$

$$\pi_j \equiv \sum_i \lambda_{ij} \in (0,1)$$

$$\hat{C}_j = \left(\frac{1-\pi_j}{1-\pi_j'} \right) \hat{\lambda}_{jj}^{-1/\epsilon}$$

π_j denotes the share of tariff revenues in country j's total expenditure

Unilaterally optimal tariffs in single-sector CES Armington model

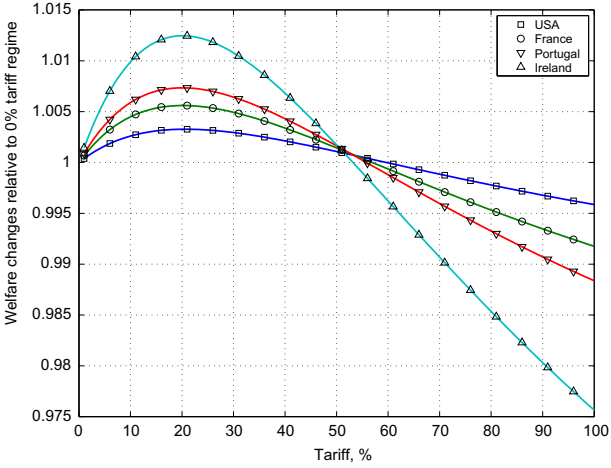
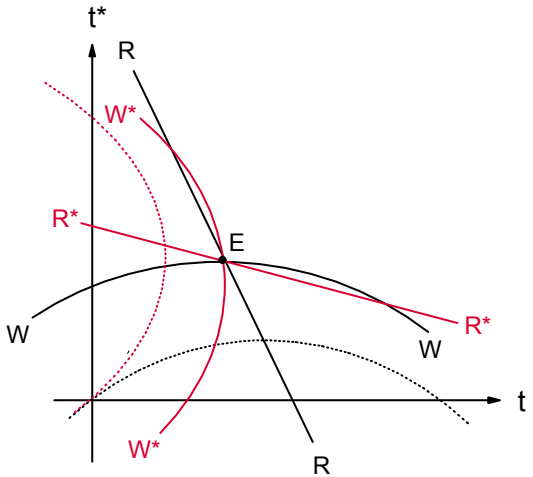


Figure 4.1 Welfare Changes Associated with a Unilateral Tariff in the Country Imposing the Tariff. (Trade elasticity $\varepsilon = 5$. Data are from WIOD in 2008.)

- Costinot and Rodriguez-Clare (2014) compute unilaterally optimal tariffs starting from $t = 0$
- Gros (1987): optimal tariff is $t_j = 1/(\epsilon\lambda_{jj})$ with two countries
- $\lambda_{jj} \approx 1 \implies t_j = 1/5$

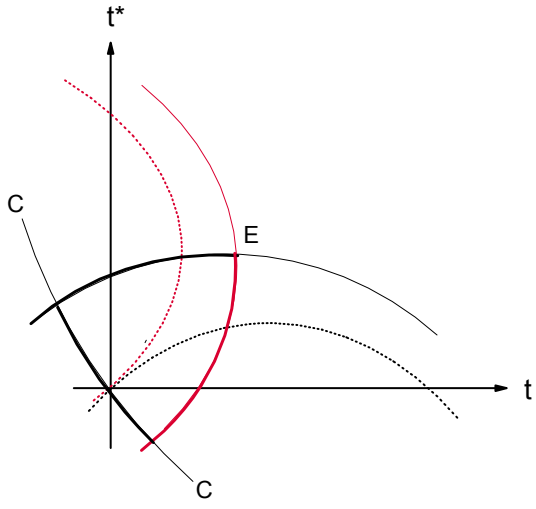
Nash equilibrium tariffs in a two-good competitive model



- Johnson (1953): Static game played by welfare-maximizing governments
- Home chooses t to maximize $W(t, t^*)$
- Foreign chooses t^* to max $W^*(t, t^*)$
- WW is Home's iso-welfare curve
- RR is Home's best-response function
- Nash equilibrium is point E

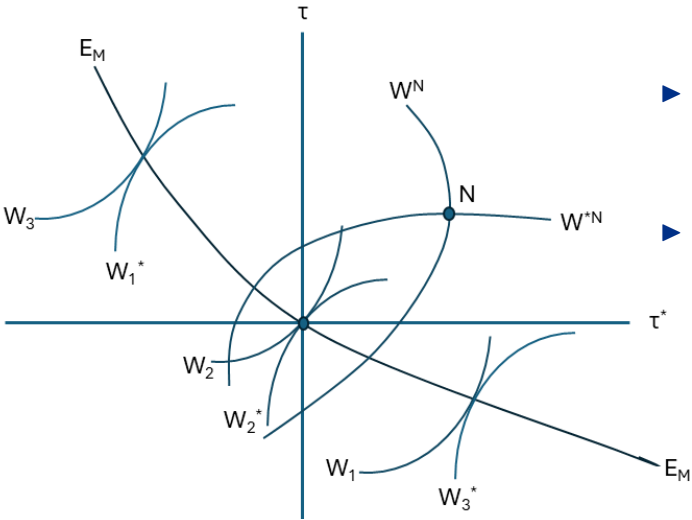
Grossman (2016), Figure 1

Efficient tariffs and international cooperation



- Each country's optimal tariff is a beggar-thy-neighbor policy raising its own welfare at expense of other country and global efficiency
- There is a CC locus of Pareto-superior points (that involve lower tariff for both countries: trade liberalization)
- The Mayer (1981) locus of efficient points is $1 = (1 + t)(1 + t^*)$

Efficient tariffs and international cooperation

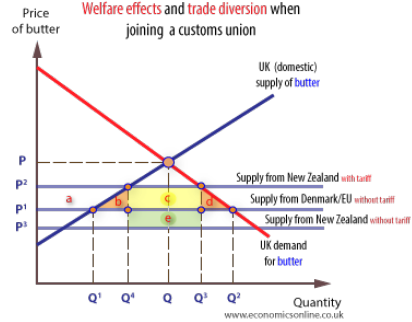


- The Mayer (1981) locus of efficient points is $1 = (1 + t)(1 + t^*)$
- Krugman (1997): "This 'optimal tariff' argument, however, plays almost no role in real-world disputes over trade policy." (cf. Bagwell Staiger 2011)

Preferential trade agreements: Trade creation and trade diversion

- Starting from a non-discriminatory tariff, suppose Home reduces its tariff on one foreign country and not the other
- Trade creation: Substitution from domestic supply to imports because of tariff decrease
- Trade diversion: Substitution from least-cost foreign supplier to less-taxed foreign supplier
- Trade diversion reduces welfare if tariff revenue loss exceeds in consumer surplus gain

See my 2021 blog post for example of confusion



Before the UK joined the EU it had a ***common tariff*** on all **butter** imports, and bought from low cost New Zealand (at price P^2, including the tariff). After it joins the EU it can benefit from tariff free imports from Denmark and other EU producers, at price P^1. It gains consumer surplus of a + b + c + d, and UK dairy farmers lose producer surplus of a; the loss of tariff revenue from imports from New Zealand is c + e. There will be a ***net loss from trade diversion*** in joining the EU if b + d *(the net gain in consumer surplus)* is less than e *(the loss of tariff revenue from New Zealand imports)*. A ***net gain from trade diversion*** would arise if b + d is greater than e.

Recent empirical work on recent trade policy

Irwin (2019): "Perhaps surprisingly, few studies provide direct empirical evidence on whether changes in a country's tariffs affect its import prices."

Today, I'll describe two papers:

- Flaaen, Hortacsu, Tintelnot (2020): "The Production Relocation and Price Effects of US Trade Policy: The Case of Washing Machines"
- Fajgelbaum, Goldberg, Kennedy, Khandelwal (2020): "The Return to Protectionism"

You should also look at

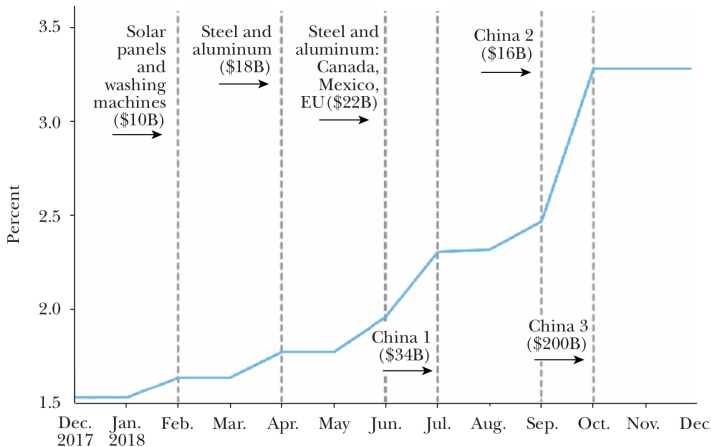
- Amiti, Redding, Weinstein (2019): "The Impact of the 2018 Tariffs on Prices and Welfare"
- Cavallo, Gopinath, Neiman, Tang (2021): "Tariff Pass-Through at the Border and at the Store: Evidence from US Trade Policy"

  Passthrough to import prices is 0.95 and to retail prices is 0.04

  US export prices to China fell by 1/3 of retaliatory tariff rate

Context: US tariffs of 2018

Trade war launched in January 2018 with US import duties of 30 percent on solar panels and duties of 20–50 percent on washing machines. Plot of average US tariff rate:



Amiti, Redding, Weinstein (2019) Figure 3

Flaaen, Hortacsu, Tintelnot (2020) on washing machines

Series of US import restrictions on washing machines

- Antidumping duties against Korea and Mexico in 2012
- Antidumping duties against China in 2016
- Safeguard tariffs against all exporting countries in 2018

Substantial data for this final good:

- Domestic prices at the model level by week
- Other appliances by the same brands as control group
- Trade flows of final goods and intermediate inputs

Flaaen, Hortacsu, Tintelnot (2020): Main findings

Production relocation affects magnitude and sign of tariff elasticity of prices

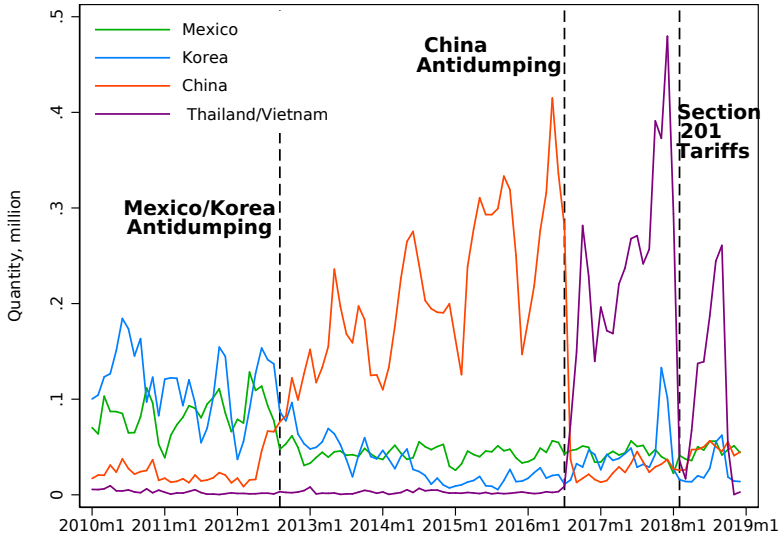
- 2012: Production shifted from Korea to China; large *decline* in US laundry equipment CPI
- 2016: Production shifted from China to Vietnam and Thailand; little change in US import prices
- 2018: Production shifts to the United States; large price increases

Findings also highlight the importance of

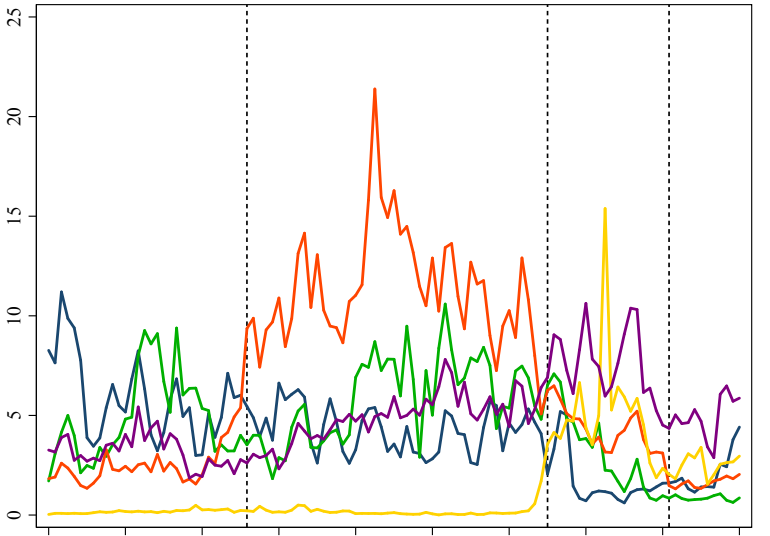
- price changes of complementary goods
- price changes of domestic producers with stable market shares

Estimate consumer cost to be ∼820,000 USD per job created from 2018 safeguard tariffs (net of tariff revenues)

U.S. imports of washing machines by country



Korea exports of washing machine parts rose after offshoring



Third-country effects: Canadian and Korean imports

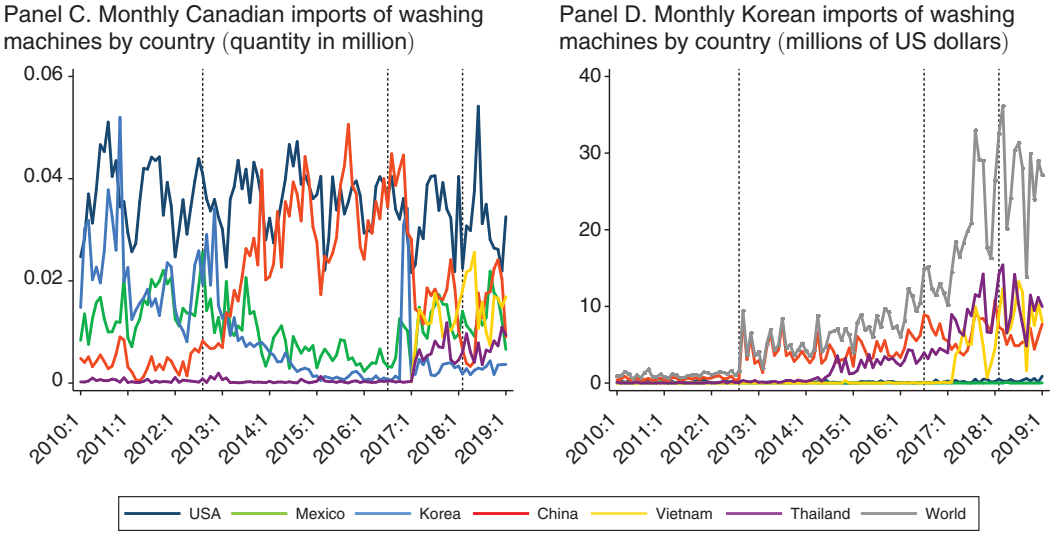


FIGURE 1. TRADE FLOWS OF WASHING MACHINES AND WASHING MACHINE PARTS

Lower import prices from China and southeast Asia

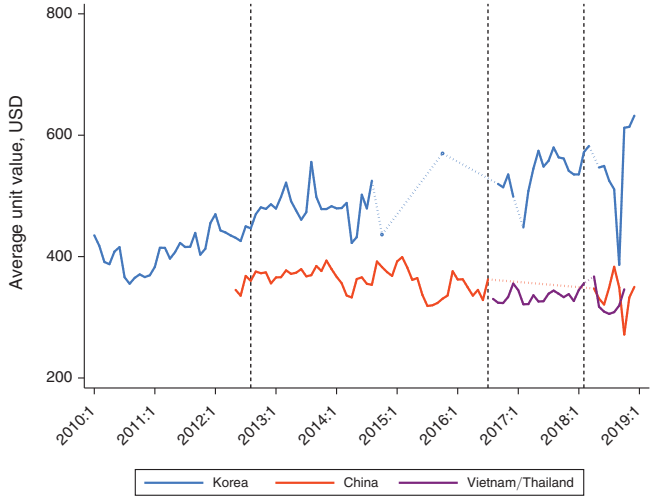


Figure 3. Average Unit Values (Exclusive of Tarifes and Duties) by Production Location

Retail price data

Gap Intelligence collects data from retailers in 22 US metro areas:

- Weekly panel at retailer-brand-model level from March 3, 2013 to Dec 31, 2018
- 5 major household appliances: washers, dryers, ranges, dishwashers, and refrigerators
- Variables: retail price, availability, date of first appearance, product characteristics (capacity, color, energy efficiency rating, etc.)

Sample restrictions:

- 5 major brands: LG, Samsung, Whirlpool, Maytag, and G.E.
- 5 national retailers: JC Penney, Best Buy, Lowe's, Sears, and Home Depot
- For laundry machines, exclude machines with both washing and drying functions
- Start from mid July 2014

Price regression

$$p_{irt} = \lambda_{C(i)t} + \mathbf{X}_i\beta + b_{B(i)C(i)} + \sum_{a=2}^{25} \alpha^a_{C(i)} \mathbf{1}(\text{age}_{it} = a) + \gamma_r + \epsilon_{irt}.$$

- i - model, r - retailer, t - time (measured by week)
- $C(i)$ - product category (washer, dryer,...)
- $B(i)$ - brand (Samsung, Whirlpool, ...)
- $\mathbf{X}_i$ - vector of characteristics of model i
- $\lambda_{C(i)t}$ - product category week fixed effect
- $b_{B(i)C(i)}$ - brand and product category specific fixed effect
- γ_r - retailer fixed effect.
- age_{it} - age of a product measured in months.
- Baseline specification: with model characteristics as controls

Time fixed effects from log price regression, CPI for laundry equipment

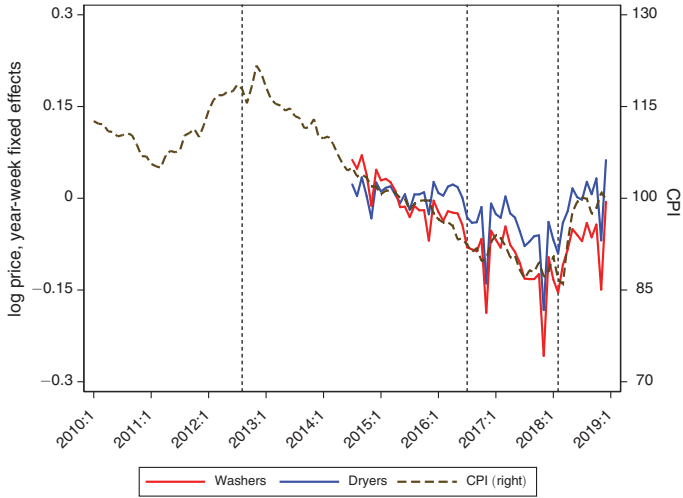


FIGURE 4. TIME FIXED EFFECTS FROM LOG PRICE REGRESSION, CPI FOR LAUNDRY EQUIPMENT

Estimating the price effects of import restrictions

- Prices changes may be driven by other factors (e.g., changes in steel price, aggregate demand changes for appliances)
- Use ranges as the omitted category (similar steel content and import share to washers)

$$p_{irt} = \lambda^{d}_{C(i)t} + \mathbf{X}_i\beta + b_{B(i)C(i)} + \sum_{a=2}^{25} \alpha^{a}_{C(i)} \mathbf{1}(\text{age}_{it} = a) + \gamma_r + \ell_t + \epsilon_{irt}.$$

Price changes around China antidumping duties and safeguard tariffs

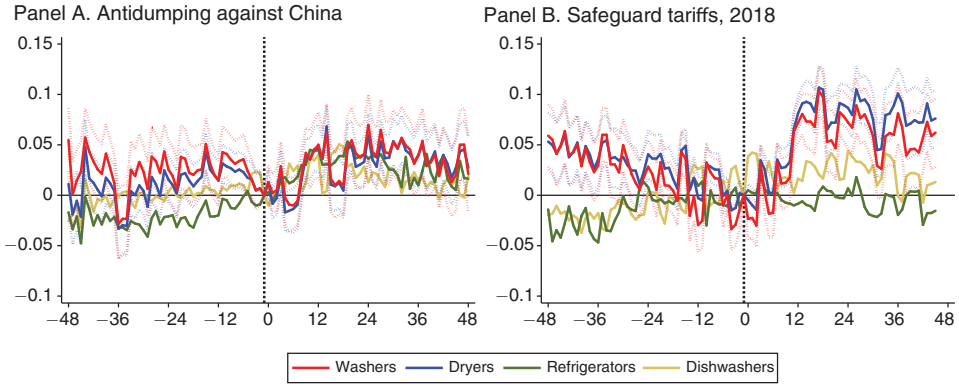


FIGURE 5. PRICE EFFECTS OF SAFEGUARD TARIFFS AND ANTIDUMPING DUTIES AGAINST CHINA

Notes: These figures report the regression coefficients $\lambda_{C(i)t}$ from equation (2). In panel A the estimates are relative to the week of July 17, 2016, and in panel B the estimates are relative to the week of January 28, 2018. The dotted lines denote 95 percent confidence intervals for the coefficient estimates for washers and dryers, based on standard errors clustered by model.

Price effect accounting for differential pre-trend

Table 1—Difference-in-Difference Estimates: Price Effects of Washing Machine Tariffs

	Antidumping against China				Safeguard tariffs 2018			
	4-month (1)	8-month (2)	4-month (3)	8-month (4)	4-month (5)	8-month (6)	4-month (7)	8-month (8)
Washers	0.026	0.034	0.046	0.058	0.109	0.115	0.110	0.119
	(0.015)	(0.017)	(0.012)	(0.013)	(0.014)	(0.018)	(0.011)	(0.012)
Dryers	0.016	0.023	0.033	0.047	0.111	0.114	0.112	0.119
	(0.012)	(0.014)	(0.009)	(0.010)	(0.013)	(0.017)	(0.009)	(0.009)
Refrigerators	0.025	0.008	0.039	0.028	0.001	−0.035	−0.002	−0.018
	(0.010)	(0.013)	(0.007)	(0.007)	(0.010)	(0.015)	(0.006)	(0.007)
Dishwashers	0.012	−0.006	0.035	0.024	−0.010	−0.021	−0.012	−0.017
	(0.013)	(0.014)	(0.008)	(0.008)	(0.012)	(0.018)	(0.007)	(0.009)
Model characteristics	✓	✓			✓	✓		
Model FE			✓	✓			✓	✓
Observations	1,637,298		1,637,298		1,637,298		1,637,298	

Notes: The table reports estimates for $\Delta^{4m}_{event}\bar{p}_C$ and $\Delta^{8m}_{event}\bar{p}_C$ defined in equation (3) and the text below it. The right hand side of equation (3) is a linear combination of the estimates from equation (2). Standard errors in parentheses.

With safeguards, all (domestic and imported) brands raised prices

Table 2—Difference-in-Difference Estimates: Brand-Specific Price Effects of Washing Machine Tariffs

	Washers		Dryers		Refrigerators		Dishwashers	
	4-month	8-month	4-month	8-month	4-month	8-month	4-month	8-month
Antidumping against China								
Whirlpool	−0.031	−0.034	−0.034	−0.003	0.007	−0.012	−0.030	−0.046
	(0.028)	(0.036)	(0.025)	(0.034)	(0.017)	(0.024)	(0.021)	(0.028)
Maytag	0.142	0.190	0.114	0.148	0.031	−0.014	0.012	−0.011
	(0.044)	(0.053)	(0.037)	(0.046)	(0.049)	(0.053)	(0.043)	(0.048)
LG	0.010	−0.011	−0.008	−0.036	0.042	0.036	0.012	−0.024
	(0.039)	(0.049)	(0.029)	(0.042)	(0.028)	(0.042)	(0.058)	(0.069)
Samsung	0.083	0.057	0.093	0.060	0.116	0.030	0.026	−0.054
	(0.041)	(0.050)	(0.036)	(0.041)	(0.037)	(0.044)	(0.061)	(0.070)
G.E.	−0.002	0.024	−0.017	−0.018	−0.015	−0.008	0.012	0.011
	(0.018)	(0.024)	(0.017)	(0.023)	(0.016)	(0.022)	(0.015)	(0.018)
Safeguard tariffs, 2018								
Whirlpool	0.174	0.129	0.175	0.142	0.008	−0.029	0.041	−0.001
	(0.033)	(0.037)	(0.028)	(0.033)	(0.023)	(0.029)	(0.024)	(0.032)
Maytag	0.146	0.137	0.169	0.201	0.030	0.148	0.018	0.009
	(0.035)	(0.050)	(0.031)	(0.047)	(0.028)	(0.048)	(0.029)	(0.058)
LG	0.081	0.131	0.082	0.125	0.040	0.022	0.136	0.158
	(0.022)	(0.031)	(0.020)	(0.028)	(0.021)	(0.030)	(0.036)	(0.072)
Samsung	0.153	0.175	0.104	0.099	0.008	−0.071	−0.016	0.054
	(0.031)	(0.039)	(0.028)	(0.035)	(0.021)	(0.028)	(0.024)	(0.050)
G.E.	0.072	0.051	0.123	0.108	−0.035	−0.064	−0.052	−0.066
	(0.023)	(0.031)	(0.023)	(0.030)	(0.017)	(0.026)	(0.017)	(0.029)

Notes: The table reports results analogous to Table 1, based on separate estimates for each brand. Specifically, first equation (4) is estimated (with model characteristics as controls) and then a linear combination of these estimates is used to compute the left hand side of equation (3), separately for each brand and product category. Figure D3 in the online Appendix displays the corresponding weekly price estimates by brand. Standard errors are in parentheses.

Why did the price of dryers increase?

Residential washing machines are typically sold jointly (often, as paired models) with clothes dryers

- Roughly three-quarters of the washers have a matched dryer model (often with either gas or electric versions).
- Focusing solely on the electric models, in over 85 percent of our weekly observations, these matched models report the *exact same dollar price*
- Price correlation between these matched models is over 0.95, while the correlation of price changes is 0.82.
- The Pearson rank correlation of sales for a brand's washer and dryers in a given retailer ranges from 0.9 to 0.95, depending on the retailer, while the correlation is typically lower (0.3–0.9) for other appliances pairs.

Why the increase in prices by domestic producers?

- Textbook competitive model: rising marginal costs as domestic producers expand their market shares
- But domestic producers' market shares remained stable from 2017-2018
- More likely: brands have market power, ability to raise prices
- Industry exhibits an HHI above 2000, classified by DOJ as "moderately concentrated"

Cost (to consumers) per job created

- Costs to consumers increased by about 1.5 billion USD on an annual basis
- About 82 million USD of tariff revenue collected
- Company reports of increase in domestic employment attributed to this policy of about 1,800 workers
- Annual cost to consumers of roughly 820,000 USD per job created (after netting out the collected tariff revenues).

Fajgelbaum, Goldberg, Kennedy, and Khandelwal (2020)

What were the effects on trade volumes and prices?

- Use tariffs to identify import demand and export supply elasticities

What were the aggregate and regional impacts on the US economy?

- Embed elasticities in G.E. model and compute impacts of trade war

Main results:

1. Imports of targeted varieties: -31.7%
2. Tariffs completely passed through to tariff-inclusive import price
3. Consumer loss: -.27% GDP

   Aggregate effect -.04% GDP
4. Higher import protection in electorally competitive counties

   Republican counties most negatively affected due to retaliation

Event Study

Compare trends of targeted varieties relative to untargeted varieties:

$$\ln y_{igt} = \alpha_{ig} + \alpha_{gt} + \alpha_{it} + \sum_{j=-6}^{3} \beta_{0j} \mathbf{1}\left(\text{event}_{ig} = j\right) + \beta_{1j} \mathbf{1}\left(\text{event}_{ig} = j\right) \times \text{target}_{ig} + \epsilon_{igt}$$

- Fixed effects: variety (α_{ig}), product-time (α_{gt}), country-time (α_{it})
- cluster: country, HS8

Event date:

- $ig \in$ targeted products: assign date of tariff implementation
- $ig \notin$ targeted products:
  - assign earliest event date within NAICS4
  - if no NAICS4, use: NAICS3, NAICS2, or February 2018

Event study: US importers paid the tariffs

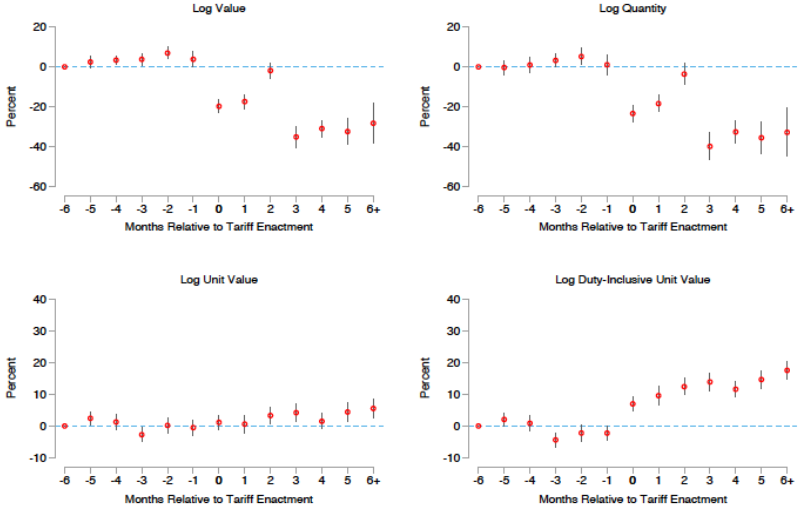


Figure from Fajgelbaum, Goldberg, Khandelwal, Kennedy (2019)

US demand system

Nested CES demand within tradeable sector

- By origin within imports of a product
- Across imported products
- Between imports and domestic

Tiers:

- Bottom: HS10 Import demand: $m_g = \left(\sum_i a_{ig}^{\frac{1}{\sigma}} m_{ig}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}$
- Middle: 4-digit NAICS import demand: $M_s = \left(\sum_{g \in \mathcal{G}_s} a_{Mg}^{\frac{1}{\eta}} m_g^{\frac{\eta-1}{\eta}} \right)^{\frac{\eta}{\eta-1}}$
- Upper: sector demand: $C_s + I_s = \left(A_{Ds}^{\frac{1}{\kappa}} D_s^{\frac{\kappa-1}{\kappa}} + A_{Ms}^{\frac{1}{\kappa}} M_s^{\frac{\kappa-1}{\kappa}} \right)^{\frac{\kappa}{\kappa-1}}$

Variety-level import demand and export supply curves

- Imports and exports of product g from country i:

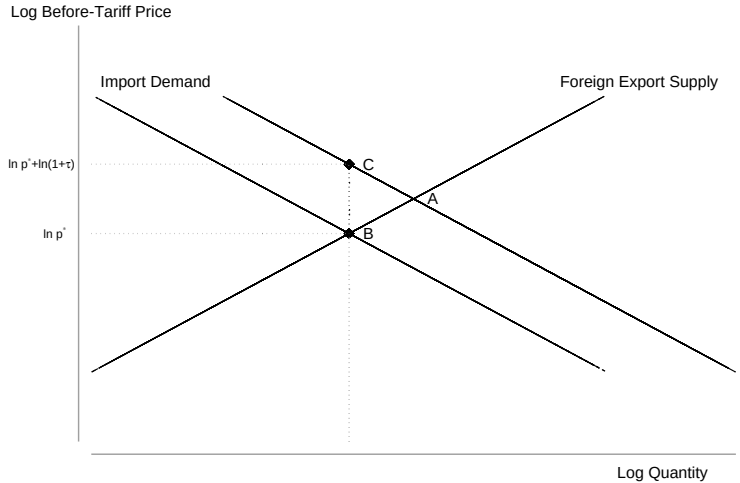
$$m_{igt} = A_{igt}\left(\left(1+\tau_{igt}\right)p^*_{igt}\right)^{-\sigma}$$
$$p^*_{igt} = z^*_{igt} m_{igt}^{\omega^*}$$

- Estimate:

$$\Delta \ln m_{igt} = \alpha^M_{gt} + \alpha^M_{it} + \alpha^M_{is} - \sigma \Delta \ln\left(\left(1+\tau_{igt}\right)p^*_{igt}\right) + \varepsilon^M_{igt}$$
$$\Delta \ln p^*_{igt} = \alpha^X_{gt} + \alpha^X_{it} + \alpha^X_{is} + \omega^* \Delta \ln m_{igt} + \varepsilon^X_{igt}$$

- Instrument both the duty-inclusive price p_{igt} in equation (8) and imports m_{igt} in equation (9) using τ_{igt}
- τ_{igt} identifies both elasticities if uncorrelated with supply/demand shocks (Romalis 2007, Zoutman, Gavrilova, and Hopland 2018)

Intuition for two elasticities from one tax



A denotes the pre-tariff equilibrium. If the tariff increases, import demand falls.
B denotes the price the exporter receives.
C denotes the price the importer pays.

Variety-level elasticites: $\sigma = 2.53$, $\omega^* = -0.002$

TABLE IV

VARIETY IMPORT DEMAND (σ) AND FOREIGN EXPORT SUPPLY (ω^*)

	$\Delta \ln p^*_{igt} m_{igt}$ (1)	$\Delta \ln m_{igt}$ (2)	$\Delta \ln p^*_{igt}$ (3)	$\Delta \ln p_{igt}$ (4)	$\Delta \ln p^*_{igt}$ (5)	$\Delta \ln m_{igt}$ (6)
$\Delta \ln(1+\tau_{igt})$	-1.52^{***}	-1.47^{***}	0.00	0.58^{***}		
	(0.18)	(0.24)	(0.08)	(0.13)		
$\Delta \ln m_{igt}$					-0.00	
					(0.05)	
$\Delta \ln p_{igt}$						-2.53^{***}
						(0.26)
Product × time FE	Yes	Yes	Yes	Yes	Yes	Yes
Country × time FE	Yes	Yes	Yes	Yes	Yes	Yes
Country × sector FE	Yes	Yes	Yes	Yes	Yes	Yes
1st-stage F					36.5	21.2
Bootstrap CI					[−0.14,0.10]	[1.75,3.02]
R^2	0.13	0.13	0.11	0.11	0.00	—
N	2,993,288	2,454,023	2,454,023	2,454,023	2,454,023	2,454,023

Notes. Table reports the variety-level import responses to import tariffs. Columns (1)–(4) report import values, quantities, before-duty unit values, and duty-inclusive unit values regressed on the statutory tariff rate. Column (5) reports the foreign export supply curve IV regression, $\hat{\omega}^*$, from equation (9); the first stage is column (2). Column (6) reports the import demand curve IV regression, $\hat{\sigma}$, from equation (8); the first stage is column (4). All regressions include product-time, country-time, and country-sector fixed effects. The coefficient in column (4) is not 1 plus the coefficient in column (3) because the duty inclusive unit value is constructed using actual duties collected by U.S. customs data. Standard errors are clustered by country and HS-8. 90% bootstrap confidence intervals are constructed from 1,000 samples. Significance: * 0.10, ** 0.05, *** 0.01. Sample: monthly variety-level import data from 2017:1 to 2019:4.

Other elasticities

- Aggregate tariffs to product and sector level to estimate upper nests
- Across imported HS-10 products: $s_{Mgt} = a_{Mg} \left(\frac{p_{Mg}}{P_{Ms}} \right)^{1-\eta}$
  - Estimate $\hat{\eta}$=1.53 (*se* 0.27)
  - Targeted product imports fall 2.5%
  - No impact of tariffs on product-level import price indexes
- Between imports and domestic in 4-digit NAICS: $\frac{P_{Ms} M_s}{P_{Ds} D_s} = \frac{A_{Ms}}{A_{Ds}} \left(\frac{P_{Ms}}{P_{Ds}} \right)^{1-\kappa}$
  - Estimate $\hat{\kappa}$= 1.19 (*se* 0.49)
  - Targeted sector imports fall 0.2%
- Variety-level exports: $x_{ig} = a^*_{ig} \left(\left(1 + \tau^*_{ig} \right) p^X_{ig} \right)^{-\sigma^*}$
  - Estimate $\hat{\sigma^*}$=1.04 (*se* 0.32)
  - Targeted variety exports fall 9.9%

Aggregate impacts

$$-\mathbf{m}'\Delta\mathbf{p}^M + \mathbf{x}'\Delta\mathbf{p}^X + \Delta R = EV \quad \text{(Dixit \& Norman 80)}$$

- Neoclassical model (static, flexible prices, immobile labor)
- US demand
  - Cobb-Douglas over 88 traded sectors, 1 non-traded sector
  - Within sector: CES (σ, η, κ) over products and countries
- US supply
  - Cobb-Douglas in labor and capital (fixed), intermediate inputs (may adjust)
  - 3,067 US counties
- Trade partners
  - Movements along variety-level demand (σ^*) and supply (ω^*) curves
- Matched to 2016 County Business Patterns, I-O tables, trade

Import prices

$$\hat{p}_{ig} = \frac{\omega^*}{1+\omega^*\sigma}\left(\hat{E}_s + (\kappa-1)\,\hat{P}_s + (\eta-\kappa)\,\hat{P}_{Ms} + (\sigma-\eta)\,\hat{p}_{gM}\right) + \frac{1}{1+\omega^*\sigma}\frac{d\tau_{ig}}{1+\tau_{ig}}$$
$$\approx \frac{d\tau_{ig}}{1+\tau_{ig}}$$

Implies:

- $\mathbf{m}'\Delta\mathbf{p}^M$= -.27% of GDP
- import share of GDP (15%) $\times$ targeted share of imports (13%) $\times$ avg. tariff increase (14%)

Export prices

$$\hat{p}_{ig}^X = \hat{p}_s = \frac{1}{\Phi_s}\left(\widehat{\text{DomExp}}_s + \widehat{\text{Tariff}}_s + \hat{Cost}_s\right)$$

$$\widehat{\text{DomExp}}_s \equiv \frac{P_{Ds}D_s}{p_sQ_s}\hat{E}_s$$

$$\widehat{\text{Tariff}}_s \equiv (\kappa - 1)\sum_{g\in\mathcal{G}_s}\sum_{i\in\mathcal{I}}\frac{P_{Ds}D_s}{p_sQ_s}\frac{p_{ig}m_{ig}}{E_s}\frac{d\tau_{ig}}{1+\tau_{ig}} - \sigma^*\sum_{g\in\mathcal{G}_s}\sum_{i\in\mathcal{I}}\frac{p_{Dg}x_{ig}}{p_sQ_s}\frac{d\tau_{ig}^*}{1+\tau_{ig}^*}$$

$$\widehat{\text{Cost}}_s \equiv \frac{\alpha_{I,s}}{\alpha_{K,s}}\hat{\phi}_s + \sum_{r\in\mathcal{R}}\frac{p_sQ_{sr}}{p_sQ_s}\frac{\alpha_{L,s}}{\alpha_{K,s}}\hat{w}_{sr}$$

$$\Phi_s \equiv \frac{1-\alpha_{K,s}}{\alpha_{K,s}} + \frac{P_{Ds}D_s}{p_sQ_s}\frac{P_{Ds}D_s}{E_s} + \frac{P_{Ds}D_s}{p_sQ_s}\left(1 - \frac{P_{Ds}D_s}{E_s}\right)\kappa + \left(1 - \frac{P_{Ds}D_s}{p_sQ_s}\right)\sigma^*$$

$\mathbf{x}'\Delta\mathbf{p}^X = 0.05\%$ of GDP = export share of GDP (7%) $\times$ export price increase (0.7%)

Aggregate impacts

$$\underbrace{-\mathbf{m}'\Delta\mathbf{p}^M}_{EV^M} + \underbrace{\mathbf{x}'\Delta\mathbf{p}^X}_{EV^X} + \Delta R = EV$$

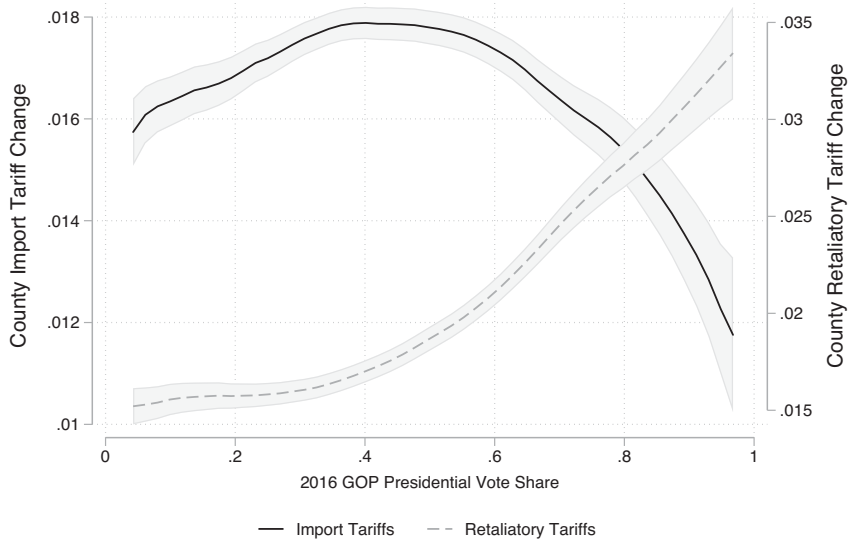
TABLE VIII

AGGREGATE IMPACTS

	EV^M (1)	EV^X (2)	ΔR (3)	EV (4)
2018 trade war				
Change ($ b)	−51.0	9.4	34.3	−7.2
	[−54.8,−47.2]	[4.1,15.6]	[32.3,36.1]	[−14.4,0.8]
Change (% GDP)	−0.27	0.05	0.18	−0.04
	[−0.29,−0.25]	[0.02,0.08]	[0.17,0.19]	[−0.08,0.00]
2018 U.S. tariffs and no retaliation				
Change ($ b)	−50.9	16.6	34.8	0.5
	[−52.9,−49.0]	[13.2,20.3]	[32.8,36.5]	[−4.0,5.7]
Change (% GDP)	−0.27	0.09	0.19	0.00
	[−0.28,−0.26]	[0.07,0.11]	[0.18,0.20]	[−0.02,0.03]

Notes. Table reports the aggregate impacts in column (4) and the decomposition into EV^M, EV^X, and tariff revenue (ΔR) in columns (1)–(3). The top panel reports the effects from the 2018 trade war. The bottom panel simulates a hypothetical scenario where trade partners do not retaliate against U.S. tariffs. The first row in each panel reports the overall impacts of each term in billions of US$. The third row scales by 2016 GDP. These numbers are computed using the model described in Section V with $\{\hat{\sigma} = 2.53, \hat{\eta} = 1.53, \hat{\kappa} = 1.19, \hat{\omega}^* = -0.00, \hat{\sigma}^* = 1.04\}$. Bootstrapped 90% confidence intervals based on 1,000 simulations of the estimated parameters are reported in brackets.

US tariffs, retaliation, and 2016 GOP presidential vote share



Wrapping up

- The final exam is in-person on Monday, December 15
- Thanks for taking the class!