Estimating the Regional Impact of Tariff Changes: Application to the United States

Robert Feenstra
University of California, Davis and NBER

Chang Hong
US International Trade Commission

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Introduction

- Work on the "China shock" (Autor, Dorn & Hanson, ADH, 2013, 2016) has led to a growing interest in the *regional impacts of trade policies*
- ADH estimate the impact of China using a "shift-share" approach; which can also apply to the analysis of *tariff changes* (ADH, 2024; Blanchard, Bown and Chor, 2022)
- Others (e.g. Caliendo, Dvorkin & Parro, 2019) use a quantitative model
- It is desirable to have a *regression-based empirical approach*
- Our goal is to use a *state-level dataset* and a *translog model for state import demand* to estimate the state-level impact of tariff changes
  - *We will construct the change in consumer surplus, producer surplus and overall welfare assuming that tariff revenue is distributed on a per-capita basis.*

Brief Conclusions

- Over **2002-17**, we find that 28 states benefitted from reduced tariffs (due to FTA's), with national welfare gains of $5.8 billion or $50 per household in 2017.
- These national gains were eliminated by the tariff increases over **2017-2022**, with national losses rise to $103-132 per household in 2022, but nearly 25 states still gain.
- National losses are some less over the shorter period **2017-2019**, and are $57-108 per household in 2019, and nearly 25 states still gain.
- These estimates of the national losses from tariff increases are *lower* than found in other studies for the 2017-19 period

Literature Review

Impact of the rise in Section 201/232/301 tariffs over 2017-2019 on US welfare:

- Fajgelbaum, Goldberg, Kennedy and Khandelwal (2020a,b) welfare cost:

Per Household $2016

End-of-year tariff	ToT gain, No retaliation	ToT gain, With retaliation	No ToT gain or retaliation
2018	4	-56	-131
2019	-129	-194	-378

- Amiti, Redding and Weinstein (2019a,b):
  - **Monthly welfare costs** in 2018, ΔW = -\$64/HH; **Dec. cost x12** = -\$132/HH
  - Annual welfare cost in 2019 using May 2019 tariffs, ΔW = -\$620/HH
- Except for monthly estimate, these authors are answering the question: *"what is the welfare cost if the **end-of-year** tariffs had been applied throughout the year?"*
- In contrast, we are interested in the annual cost reflecting the phase-in of tariffs and provisions under which firms do not face higher tariffs.

Sources of tariff data

- Fajgelbaum, et al. (2020a,b) and Amiti et al. (2019a,b) statutory HS10 tariffs obtained from the U.S. International Trade Commission
- This study uses import and “calculated duties” data from U.S. Census.

"Calculated duties" are provided by importer

DEPARTMENT OF HOMELAND SECURITY
U.S. Customs and Border Protection

OMB APPROVAL NO. 1651-0022
EXPIRATION DATE 03/31/2025

ENTRY SUMMARY

1. Filer Code/Entry Number	2. Entry Type	3. Summary Date	4. Surety Number	5. Bond Type	6. Port Code	7. Entry Date

8. Importing Carrier	9. Mode of Transport	10. Country of Origin United States of America	11. Import Date
12. B/L or AWB Number	13. Manufacturer ID	14. Exporting Country United States of America	15. Export Date

16. I.T. Number	17. I.T. Date	18. Missing Docs	19. Foreign Port of Lading	20. U.S. Port of Unlading

21. Location of Goods/G.O. Number	22. Consignee Number	23. Importer Number	24. Reference Number

25. Ultimate Consignee Name *(Last, First, M.I.)* and Address	26. Importer of Record Name *(Last, First, M.I.)* and Address
Street	Street
City State Zip	City State Zip

27. Line No.	28. Description of Merchandise			32. A. Entered Value B. CHGS C. Relationship	33. A. HTSUS Rate B. AD/CVD Rate C. IRC Rate D. Visa Number	34. Duty and IR Tax	
	29. A. HTSUS No. B. AD/CVD No.	30. A. Gross Weight B. Manifest Qty.	31. Net Quantity in HTSUS Units			Dollars	Cents

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- Fajgelbaum, et al. (2020a,b) and Amiti et al. (2019a,b) statutory HS10 tariffs obtained from the U.S. International Trade Commission
- This study uses import and "calculated duties" data from U.S. Census, with includes for each HS10 the following Rate Provisions:

- Items entered into warehouse of FTZ – duty n.a.
- U.S. Virgin Islands – No duty calculated
- Free as supplies for certain vessels and aircraft
- Free for 9817.00.92, 9817.00.94, 9817.00.96
- Free for HS chapter 99
- **Column 2 rates apply***
- **Chapter 99 rates apply – Duty reported***
- Chapter 99 rates apply – No duty calculated

Free status for HS chapters 01-97

Free items import under HS 9813.00.0520

Free for HS chapter 98, subchapter VII

Free by legislation – GSP, NAFTA, USMCA, Civil Air

General Rates apply*

Special NAFTA, USMCA, Israel or APTA rates*

Special rates for HS chapters 01-97

*** duties > 0**

Sources of tariff data: China

- Fajgelbaum, et al. (2020a,b) and Amiti et al. (2019a,b) statutory HS10 tariffs obtained from the U.S. International Trade Commission
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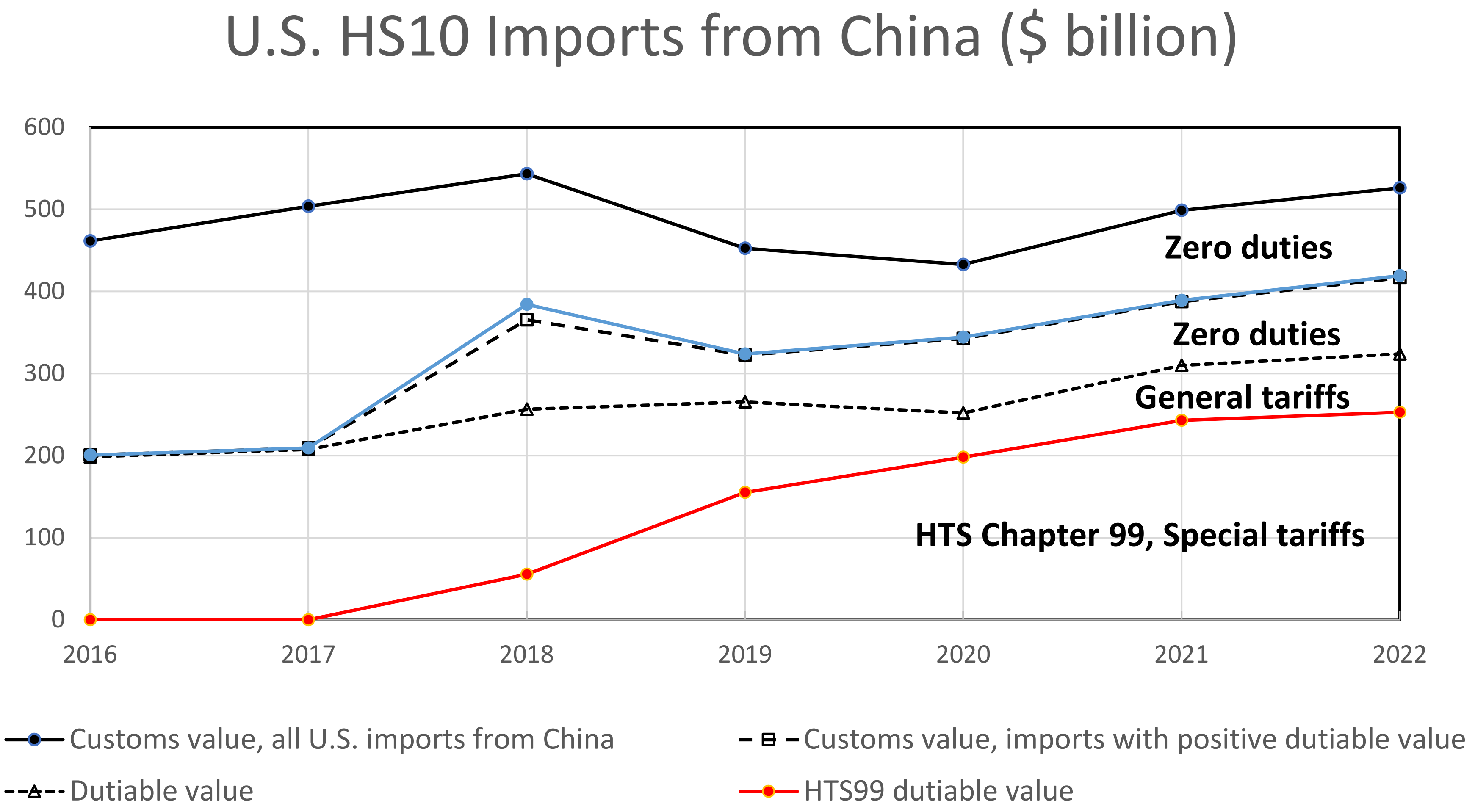
*** duties > 0**

General and HTS99 duties for China imports



Literature Review (cont'd)

- *De Minimus* imports, Fajgelbaum and Khandelwal (2024), ~$50 bill
- Product exclusions:
- Soumaya Keynes (FT, 11/15/24), Bown (2021): 4% of targeted China imports excluded
- Chor, Grant and Li (2024): 16% of targeted China imports excluded, $8.4 bill. They point out that 90 full-time staff were employed by the USTR to administer the product exclusions!
- Cox (2024), who analyzed product exclusions in steel and aluminum
- Miscellaneous Tariff Bill (2016-2020): Allowed for tariff suspension or reductions by application to the USITC. Used especially in chemicals.

Sources of tariff data (China imports)

- This study uses import and "collected duties" data from U.S. Census, with includes for each HS10 the following "Rate Provisions":

	Value of imports from China imports ($bill)	
	2019	**2022**
• **Free status for HS chapters 01-97**	**$178.1**	**$186.8**
• **Special rates for HS 01-97**	**4.2**	**4.6**
• Free items import under HS 9813.00.0520 (Temporary import)	0.00	0.14
• Free for 9817.00.92, 9817.00.94, 9817.00.96	1.1	1.7
• Free by Legislation – GSP, NAFTA, USMCA, Civil Air, etc.	0.88	1.0
• General Rates apply*	102.8	56.4
• Chapter 99 rates apply – Duty reported*	155.1	252.7
• **Free for HS chapter 99**	**7.3**	**13.3**
• **Chapter 99 rates apply – No duty calculated**	**3.1**	**9.3**
Total with no duties	**$194.7**	**$217.0**

* duties > 0

Calculating tariffs within HS10

Start with "Chapter 99 rates apply – Duty reported", then for HS10 tariffs:

$$\tau_{jt}^{h,99} = \frac{\text{HTS99 duty}}{\text{HTS99 Dutiable value}} = \text{Statutory tariff}$$

Calculating tariffs within HS10

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An "ideal" tariff to use at the HS10 level is a CES aggregate over three tariffs:

$$LM_{ch,t}^{h} = \left[s_{ch,t}^{h,no} + s_{ch,t}^{h,gen}(1+\tau_{ch,t}^{h,gen})^{\sigma-1} + s_{ch,t}^{h,99}(1+\tau_{ch,t}^{h,99})^{\sigma-1}\right]^{1/(\sigma-1)}, \ \ t=2019,2022$$

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We have implemented this for **US imports from China, 2017-19 or 2022.**

With **σ** =10 Then welfare costs rise to \$108/HH in 2019 and \$132 in 2022

As $\sigma \rightarrow \infty$ Then $LM_{ch,t}^{h} \rightarrow \tau_{jt}^{h,99}$ provided that $s_{jt}^{h,99} > 0.$ Then costs rise to \$262/HH in 2019 and \$264 in 2022 (eliminates *phasing-in* period)

For all other products

- We use a CES aggregate using the HS6 tariff (from **state-level** data):

tariff-excluded and included products

$$\tau_{jt}^{h,no} = 0 \qquad \tau_{jt}^{h,d} = \frac{\text{calculated duty } in\ HS6\ h}{\text{Dutiable value } in\ HS6\ h}$$

This is correct if either the *general duty or HTS99 duty is zero.*

For all other products

- We use a CES aggregate using the HS6 tariff:

$$LM_{j,t}^{h} = \left[s_{j,t}^{h,no} + s_{j,t}^{h,d}(1+\tau_{j,t}^{h,d})^{\sigma-1}\right]^{1/(\sigma-1)}$$

This is correct if either the *general duty or the HTS99 duty is zero.*

σ = 0

$$LM_{j,t}^{h} = \frac{\text{calculated duty } for\ U.S.\ imports\ from\ j\ in\ HS6\ h}{\text{Customs value } of\ imports\ from\ j\ in\ HS6\ h}$$

Original benchmark calculation ($57/HH and $103/HH)

σ = 2.5, 5

Welfare cost rises by $10 - $20/HH in 2019 or 2022

For all other products

- We use a CES aggregate using the HS6 tariff:

$$LM_{j,t}^{h} = \left[s_{j,t}^{h,no} + s_{j,t}^{h,d}(1+\tau_{j,t}^{h,d})^{\sigma-1}\right]^{1/(\sigma-1)}$$

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Original benchmark calculation ($57/HH and $103/HH)

σ = 10

Welfare costs rise to $108/HH in 2019 and $132 in 2022.

σ→∞

$LM_{j,t}^{h} \rightarrow \tau_{jt}^{h,d}$ provided $s_{jt}^{h,d} > 0$. Along with China $LM_{ch,t}^{h}$ then costs rise to $262/HH in 2019 and $264 in 2022

Other reasons our welfare costs are lower

- We use a **Compensating Variation** formula to compute the welfare cost of the tariff, leading to a Tornqvist index using a *simple average* of initial and final-periods import values.

Fajgelbaum et al. (2020a,b) use an **Equivalent Variation** formula based on *initial period imports:*

$$EV_t^M = \boldsymbol{q}_{t-1}^{M\prime} \Delta \boldsymbol{p}_t^M = \widetilde{\boldsymbol{M}}_{t-1}^{\prime} \Delta \boldsymbol{\tau}_t^M \text{ for small country}$$

This leads to a *Laspeyres-type upward bias* in the welfare cost.

Adds ~$73/HH in 2019 (2022) so welfare cost becomes $335/HH ($340/HH)

- This still does not account for product exclusions with $s_{jt}^{h,d}$ or $s_{ch,t}^{h,99} = 0$. If we use statutory tariffs for these products, like Fajgelbaum et al. and Amiti et al., then with $\sigma \to \infty$ we can get close to the welfare costs of $620/HH.

Outline for rest of talk

- Brief overview of the state-level Freight Analysis Framework (FAF) data, used to obtain import shares of apparent consumption
- Detail of the translog model of import demand
- Associated measures of consumer and producer surplus and state welfare
- Estimates for the United States
- Explain the difference with Amiti et al. and Fajgelbaum et al.

Freight Analysis Framework (FAF) dataset

Relies on the Commodity Flow Survey for domestic flows, and Census data on imports and exports (not used), supplemented with additional information for ag and mining

Notation: sectors n = 1,…,N *and* N = 42 sectors

States i,j = 1,…,50 and Foreign regions i,j = 51,…,R and R = 58

s_{ijt}^{n} = expenditure share in state i for purchases from region j, sector n

t = 2002, 2007, 2012, 2017-2022 (9 years)

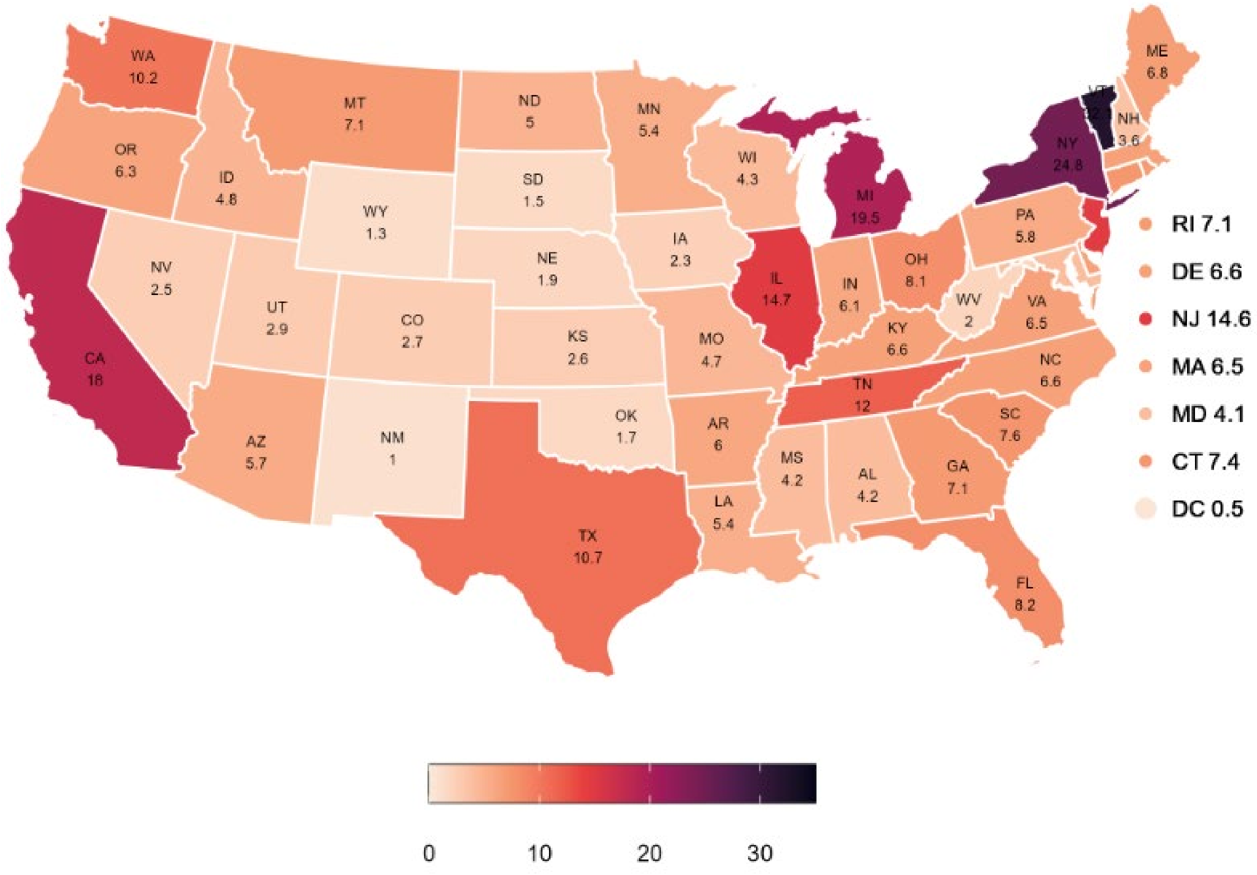
For *domestic or import shares*, we have:

$$s_{ijt}^{n} = \frac{State\ imports\ from\ j\ to\ i, in\ sector\ n}{(foreign\ imports + internal + interstate\ shipments, sector\ n)}$$

i = 1,…,50 and j = 1,…. 58

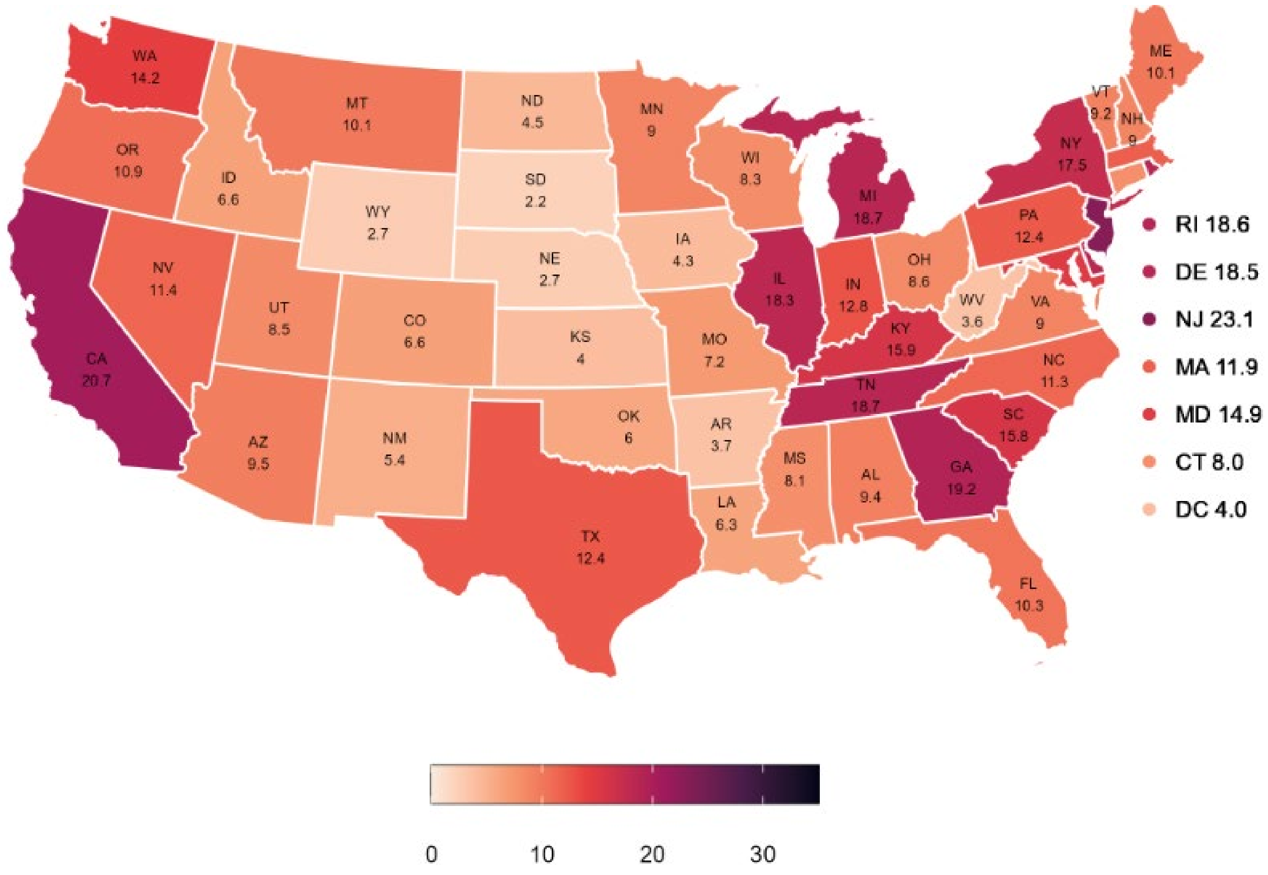
Foreign import shares: Total all Sectors

1997



Simple state average: 8.6 %
Nationwide total rate: 10.6 %

2022



Simple state average: 10.3 %
Nationwide total rate: 13.2 %

Standard Classification of Transported Goods

Sector	Description	% expenditure 2022	Sector	Description	% expenditure 2022
1	Live animals/fish	1.11%	22	Fertilizers	0.48%
2	Cereal grains	1.30	23	Chemical prods.	2.26
3	Other ag prods.	2.03	24	Plastics/rubber	4.09
4	Animal feed	1.07	25	Logs	0.08
5	Meat/seafood	2.17	26	Wood prods.	1.66
6	Milled grain prods.	1.15	27	Newsprint/paper	0.71
7	Other foodstuffs	3.78	28	Paper articles	0.81
8	Alcoholic beverages	1.45	29	Printed prods.	0.71
9	Tobacco prods.	0.39	30	Textiles/leather	3.06
10	Building stone	0.04	31	Nonmetal min. prods.	1.37
11	Natural sands	0.06	32	Base metals	3.06
12	Gravel	0.12	33	Articles-base metal	2.48
13	Nonmetallic minerals	0.13	34	Machinery	5.37
14	Metallic ores	0.15	35	Electronics	8.13
15	Coal	0.12	36	Motorized vehicles	6.76
16	Crude petroleum	2.41	37	Transport equip.	0.88
17	Gasoline	5.58	38	Precision instruments	2.03
18	Fuel oils	5.06	39	Furniture	1.62
19	Coal-n.e.c.	5.29	40	Misc. mfg. prods.	4.24
20	Basic chemicals	1.64	41	Waste/scrap	0.38
21	Pharmaceuticals	6.48	42	Mixed freight	8.31

Construction of FAF Sector-Region Tariffs

(1) Simple average of HS6 tariffs τ_{ct}^{h} in each FAF sector *n* and region *j*, with *h* = HS6 code, *c* = country code and $(h, c) \in H_{jt}^{n}$

(2) Duties paid/Custom value, which is weighted ave. of tariffs

$$\tau_{jt}^{n} \equiv \sum_{(h,c)\in H_{jt}^{n}} \frac{\tau_{ct}^{h}}{\left|H_{jt}^{n}\right|}, \quad j = 51, \ldots, 58, \tag{1}$$

$$\tau 2_{jt}^{n} \equiv \frac{\sum_{(h,c)\in H_{jt}^{n}} \widetilde{M}_{ct}^{h} \tau_{ct}^{h}}{\underbrace{\sum_{(h,c)\in H_{jt}^{n}} \widetilde{M}_{ct}^{h}}_{\widetilde{M}_{jt}^{n}}} = \sum_{(h,c)\in H_{jt}^{n}} \left(\frac{\widetilde{M}_{ct}^{h}}{\widetilde{M}_{jt}^{n}}\right) \tau_{ct}^{h}, \tag{2}$$

Passthrough of Sector Tariffs to Import prices

Table 3: Passthrough of Sectoral Tariffs

Dependent variable: Unit-values of imports	**2002-2022 period**		**2007-2022 period**	
	(1) Simple avg. Tariff	(2) Import-weighted avg. Tariff	(3) Simple avg. Tariff	(4) Import-weighted avg. Tariff
ln(1+ τ_{jt}^{n})	0.778***	0.198	0.990***	0.546***
	(0.245)	(0.169)	(0.241)	(0.170)
Observations	115,916	115,916	101,932	101,932
R-squared	0.795	0.795	0.811	0.811
year FE	Y	Y	Y	Y
state-country-sector FE	Y	Y	Y	Y

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.10

Pass-through of Sector Tariffs to State Prices

- Treat the US as a small country with complete pass-through to import prices.
- Do not use $\tau 2_{jt}^{n}$ except for the measurement of tariff revenue.

- We also need to estimate the pass-though to state-state prices:

$$\Delta \ln UV_{ijt}^{n} = \beta_1 \Delta \ln T_{it}^{n} + \beta_2 \Delta \ln T_{jt}^{n} \quad \text{for} \quad i, j = 1, \dots, 50 \qquad (3)$$

where

$$\ln T_{it}^{n} \equiv \frac{1}{R_{it}^{n*}} \sum_{k \in J_{it}^{n*}} \ln(1 + \tau_{kt}^{n}), \quad i = 1, \dots, 50, \quad J_{it}^{n*} \subseteq \{51, \dots, 58\}$$

Obtain:

$$\Delta \ln \hat{p}_{ijt}^{n} \equiv \Delta \widehat{UV}_{ijt}^{n} = 0.50 \Delta \ln T_{it}^{n} + 1.72 \Delta \ln T_{jt}^{n} \text{ for } j \in J_i^{n} \backslash J_i^{*n}, \text{ states}$$

allowing for *year* and *ijn* fixed effects.

Translog System

In state *i*, the total expenditure across all sectors needed to obtain utility U_{it} is

$$E_{it} = E_i[e_i^1(p_{it}^1), \ldots, e_i^N\left(p_{it}^N\right), U_{it}], \quad i = 1,\ldots,50.$$

The sub-expenditure functions $e_{it}^n = e_i^n(p_{it}^n)$ act like *sectoral prices*. We assume that these have a *translog functional form*:

$$\ln e_{it}^n = \alpha_0 + \sum_{j=1}^R \alpha_{ij}^n \ln p_{ijt}^n + \frac{1}{2}\sum_{j=1}^R \sum_{k=1}^R \gamma_{jk}^n \ln p_{ijt}^n \ln p_{ikt}^n, \text{ with } \gamma_{jk}^n = \gamma_{kj}^n,$$

Simplify the translog function with symmetry of the γ_{jk}^n parameters

$$\gamma_{jj}^n = -\frac{\gamma^n(R-1)}{R} < 0, \quad \gamma_{jk}^n = \frac{\gamma^n}{R} > 0 \text{ , for } j \neq k \text{ with } j, k = 1,\ldots,R.$$

Translog System

- Translog system allows for zero imports at finite reservation prices, as often occurs in state-level (foreign or domestic) sector imports.
- Following Feenstra and Weinstein (2017), we solve for their reservation prices and substitute this solution back into the *other* share equations.

Then the share of *domestic or foreign* imports to state *i* from region *j* becomes:

$$s_{ijt}^n = \alpha_{ij}^n + \overline{\alpha_{it}^n} - \gamma^n(\ln p_{ijt}^n - \overline{\ln p_{it}^n}), \quad i = 1,\ldots,50,\ j \in J_{it}^n$$

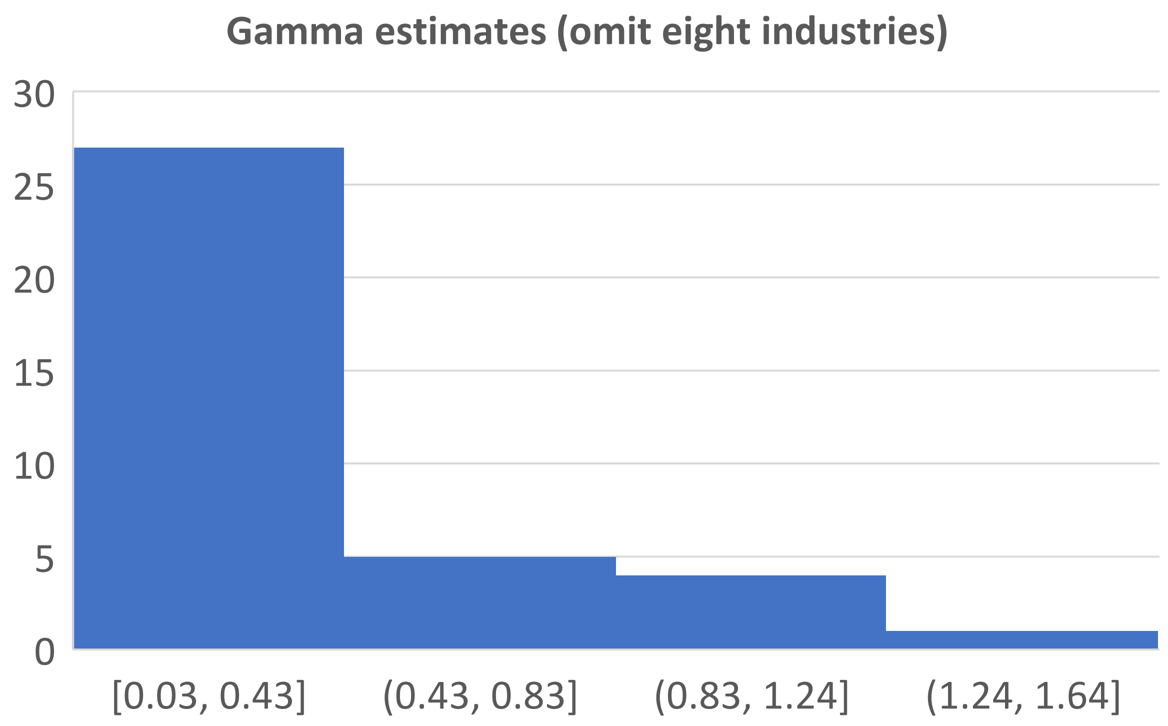
with: $\overline{\ln p_{it}^n} \equiv \sum_{j \in J_{it}^n} \frac{1}{R_{it}^n} \ln p_{ijt}^n$ $\quad J_{it}^n$ set of *states & foreign* countries with $s_{ijt}^n > 0$

- Double-difference the share equation:

$$\Delta s_{ijt}^n - \Delta s_{ikt}^n = -\gamma^n\left(\Delta \ln p_{ijt}^n - \Delta \ln p_{ikt}^n\right) + u_{ijt}^n, \quad i = 1,\ldots,50,\ \ j \in J_i^n$$

Estimation of Translog Parameters

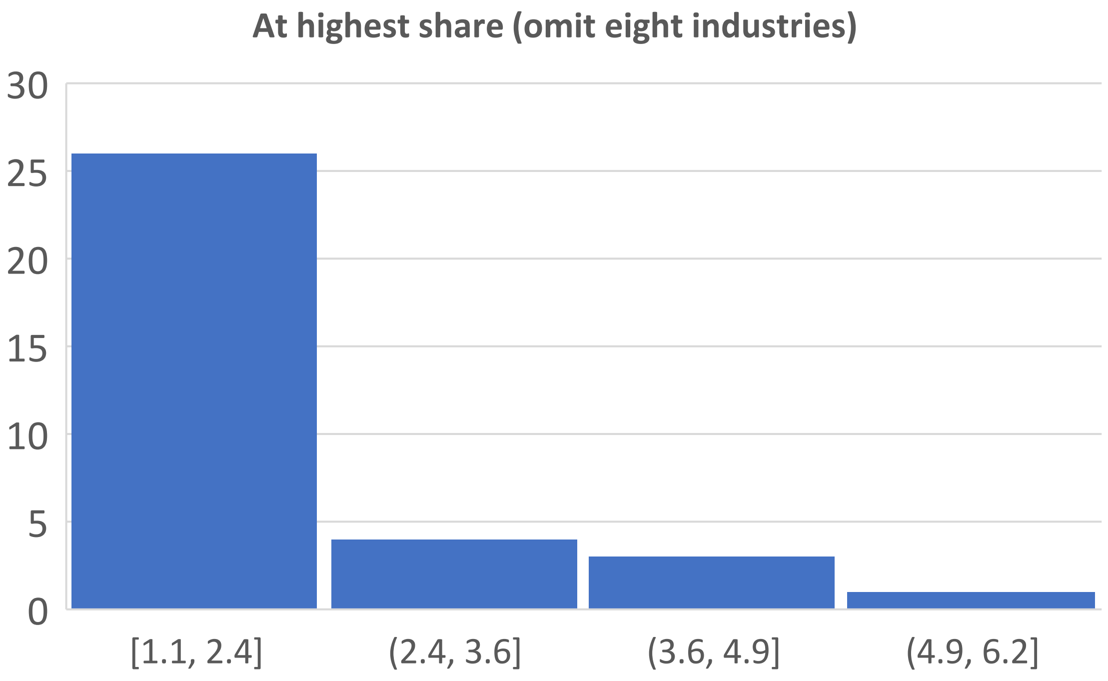
Estimation follows Feenstra and Weinstein (2017). 17 out of 42 sectors do not converge to a value for γ^n, and in these case we implement a grid search over (0,5]. Eight sectors hits the upper bound γ^n=5 which implies a homogeneous good with high elasticity of demand.

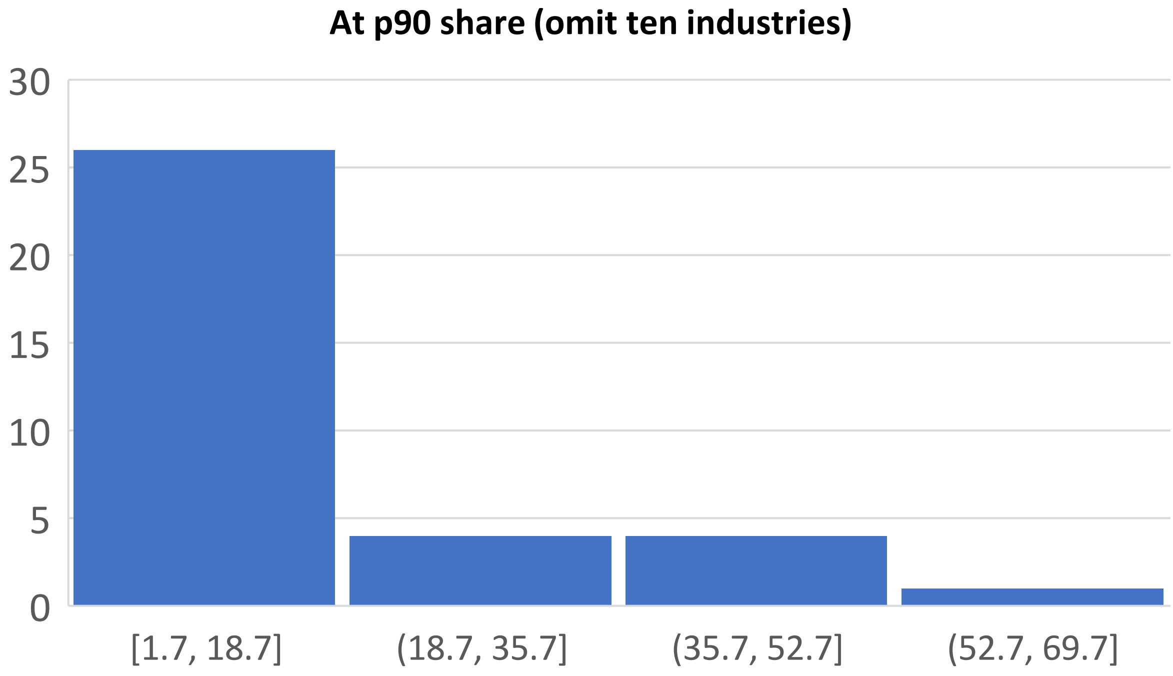


Import Demand Elasticities

Tariff elasticity:

$$\frac{d\ln s_{ijt}^n}{d\ln(1+\tau_{jt}^n)} = 1 + \frac{d\ln q_{ijt}^n}{d\ln(1+\tau_{jt}^n)} = -\frac{\gamma^n}{s_{ijt}^n} \quad \Rightarrow \quad -\frac{d\ln q_{ijt}^n}{d\ln(1+\tau_{jt}^n)} = \left(1+\frac{\gamma^n}{s_{ijt}^n}\right)$$





Consumer Surplus

Solve for $\ln e_{it}^{n} - \ln e_{it-1}^{n}$ from translog to obtain a **compensating variation**:

$$CV_{it} \approx -V_{it} + CV_{it}^{M} + CV_{it}^{D}, \qquad \text{i} = 1, \ldots 50,$$

with V_{it} reflecting the welfare effect of new and disappearing varieties (Feenstra and Weinstein, 2017). Letting J_i^{*n} denote the "common" foreign countries then:

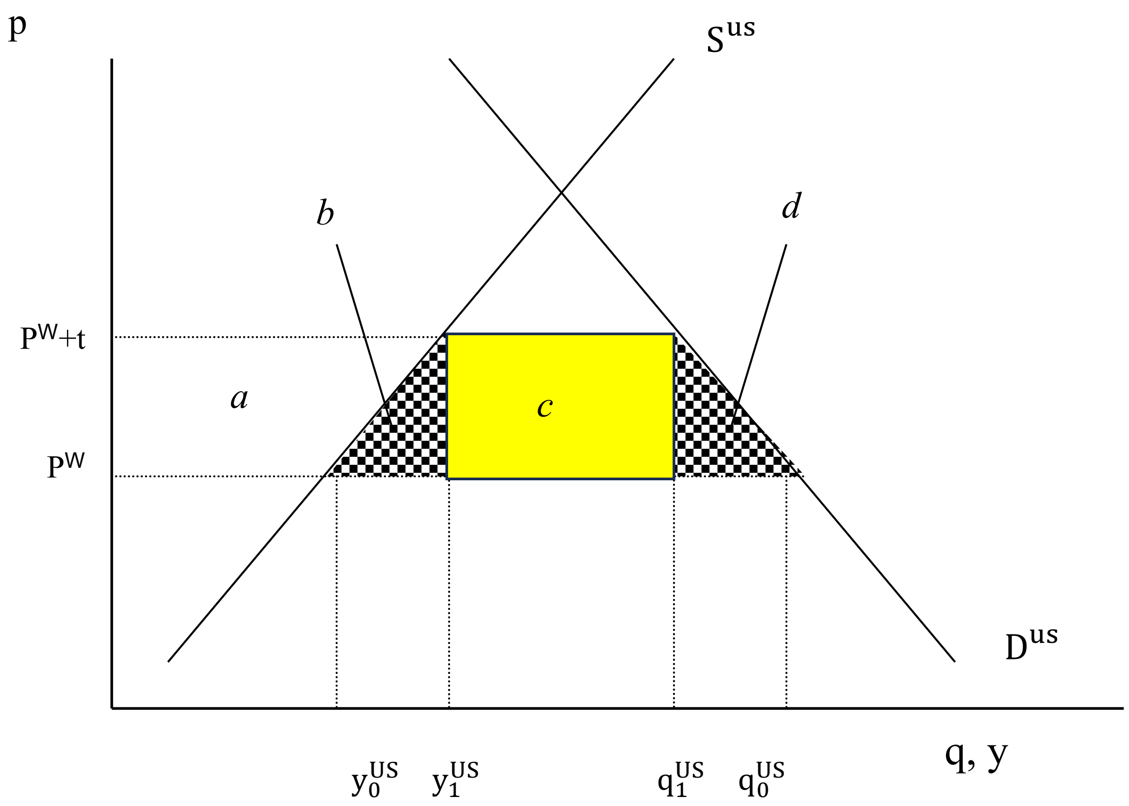
$$CV_{it}^{M} = \sum_{n=1}^{N} \bar{E}_i^n \sum_{j \in J_i^{*n}} \tfrac{1}{2}(s_{ijt}^n + s_{ijt-1}^n)\, \Delta\ln(1+\tau_{jt}^n) \quad \text{(sum FAF sectors)}$$

$$CV_{it}^{D} = \sum_{n=1}^{N} \bar{E}_i^n \sum_{j \in J_i^{n} \setminus J_i^{*n}} \tfrac{1}{2}(s_{ijt}^n + s_{ijt-1}^n)\, \Delta\ln \widehat{UV}_{ijt}^n \quad \text{(sum FAF, state UV)}$$

$CV_{it}^{M} + CV_{it}^{D}$ is like conventional *consumer surplus* area *(a+b+c+d).* Actually measure:

$$CV_{it}^{M} = \bar{M}_i \sum_{(h,c) \in H_i^n} \tfrac{1}{2}(s_{ict}^h + s_{ict-1}^h)\, \Delta\ln LM_{ct}^h \qquad \text{(using LM HS6)}$$

Example: National Welfare



Producer Surplus

The *change in the return to fixed factors* in sector *n* is *(ignoring exports)*:

$$\Delta\Pi_{it} = \sum_{n\in 1}^{N}\sum_{j=1}^{50} \bar{Y}_{ji}^{n}\left(\ln p_{jit}^{n} - \ln p_{jit-1}^{n}\right)$$

with: $Y_{ij}^{n} = E_{it}^{n} s_{ijt}^{n},\ Y_{ijt-1}^{n} = E_{it-1}^{n} s_{ijt-1}^{n},$ and then: $\bar{Y}_{ij}^{n} = \frac{\bar{E}_{i}^{n}}{2}(s_{ijt}^{n} + s_{ijt-1}^{n})$.

For the sectoral prices we use the *predicted* unit-values, and then:

$$\Delta\Pi_{it} = \Delta PS_{j}^{D}$$

with: $\Delta PS_{j}^{D} = \sum_{n=1}^{N}\sum_{i\in I_{j}^{n}} \frac{\bar{E}_{i}^{n}}{2}(s_{ijt}^{n} + s_{ijt-1}^{n})\Delta \ln \widehat{UV}_{ijt}^{n}$.

This is like conventional *producer surplus* area *a*, including sales to other states.

State welfare

Assume that *tariff revenue is distributed on a per-capita basis.* Then:

$$\Delta W_{it} = \left(\frac{\bar{L}_i}{\bar{L}_{US}}\right)\Delta B_t - CV_{it} + \Delta\Pi_{it}$$

Summing across states: $\Delta W_t \approx \Delta B_t + \sum_{i=1}^{50}\left(V_{it} - CV_{it}^{M}\right)$

The per-capita distribution of tariff revenue makes a **big difference to states!**

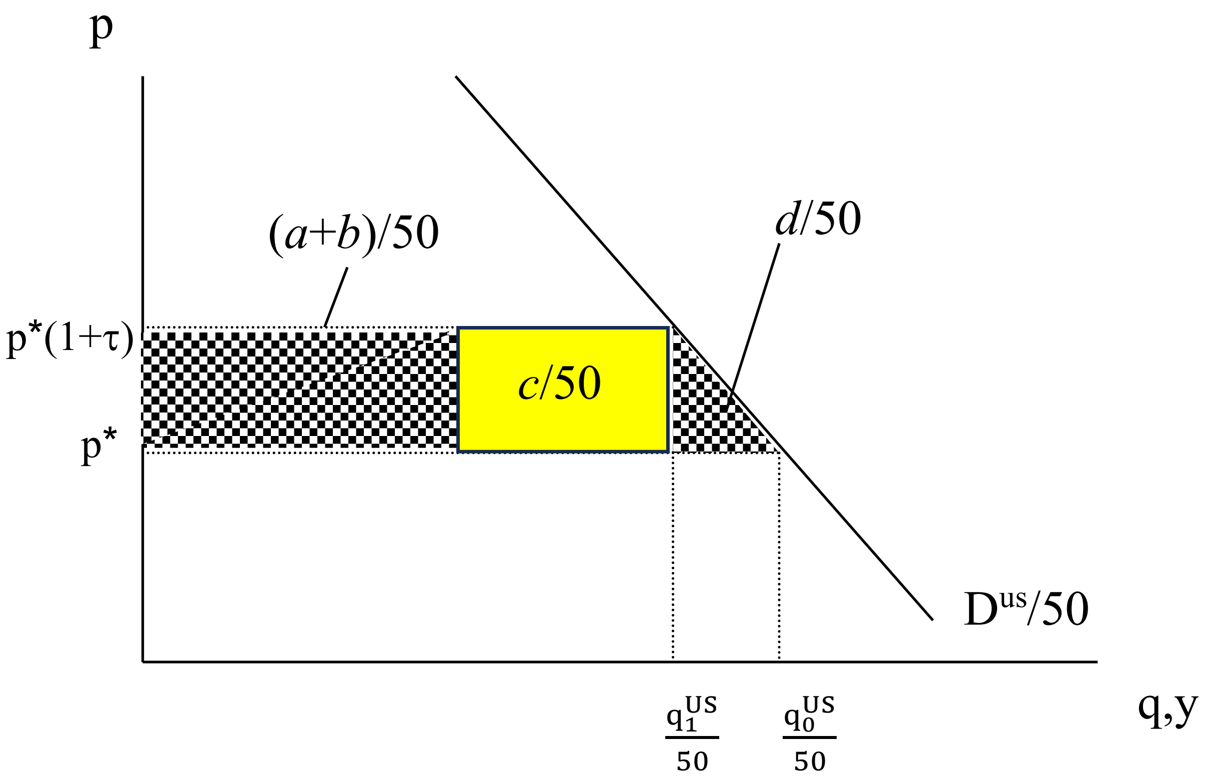
Examples:

(a) State with no production

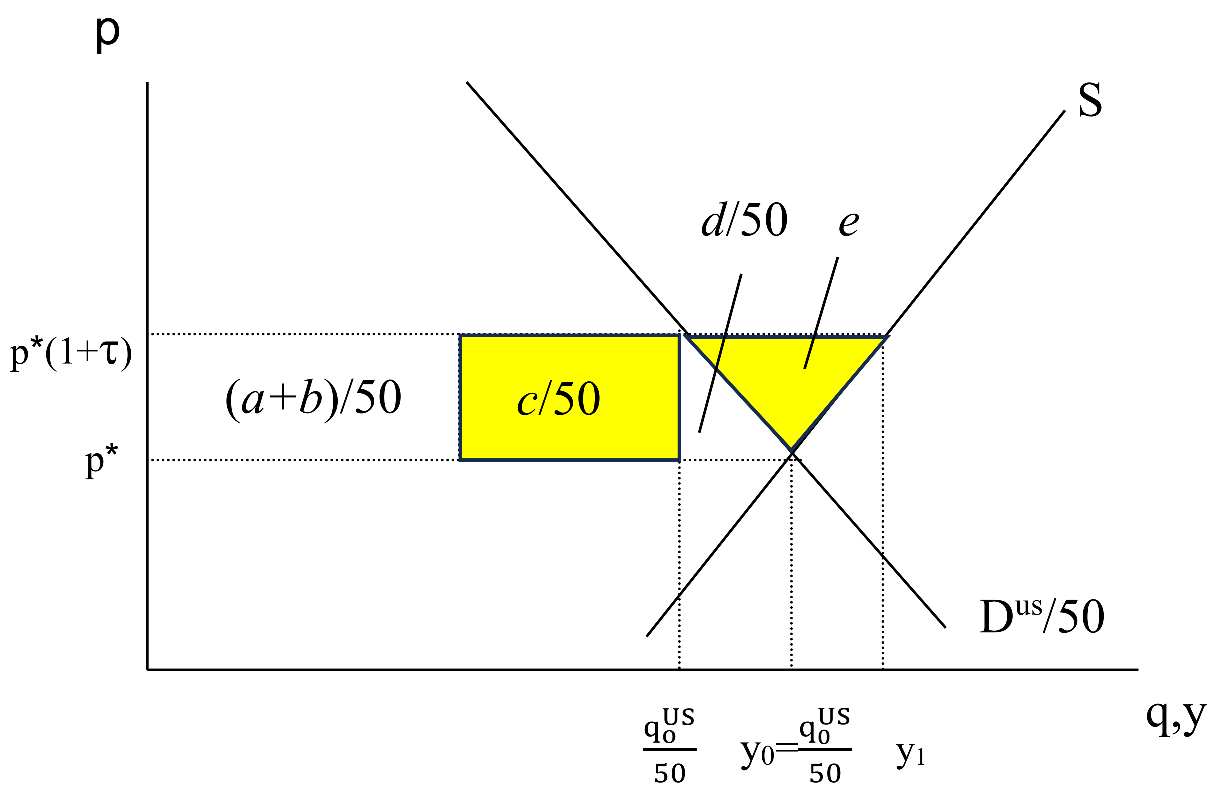
(b) State with production (e.g. sufficient for own demand without tariff)

Assume equal-sized states for simplicity.

State welfare without Production



State welfare with production



US Consumer Surplus Change (orig. benchmark)

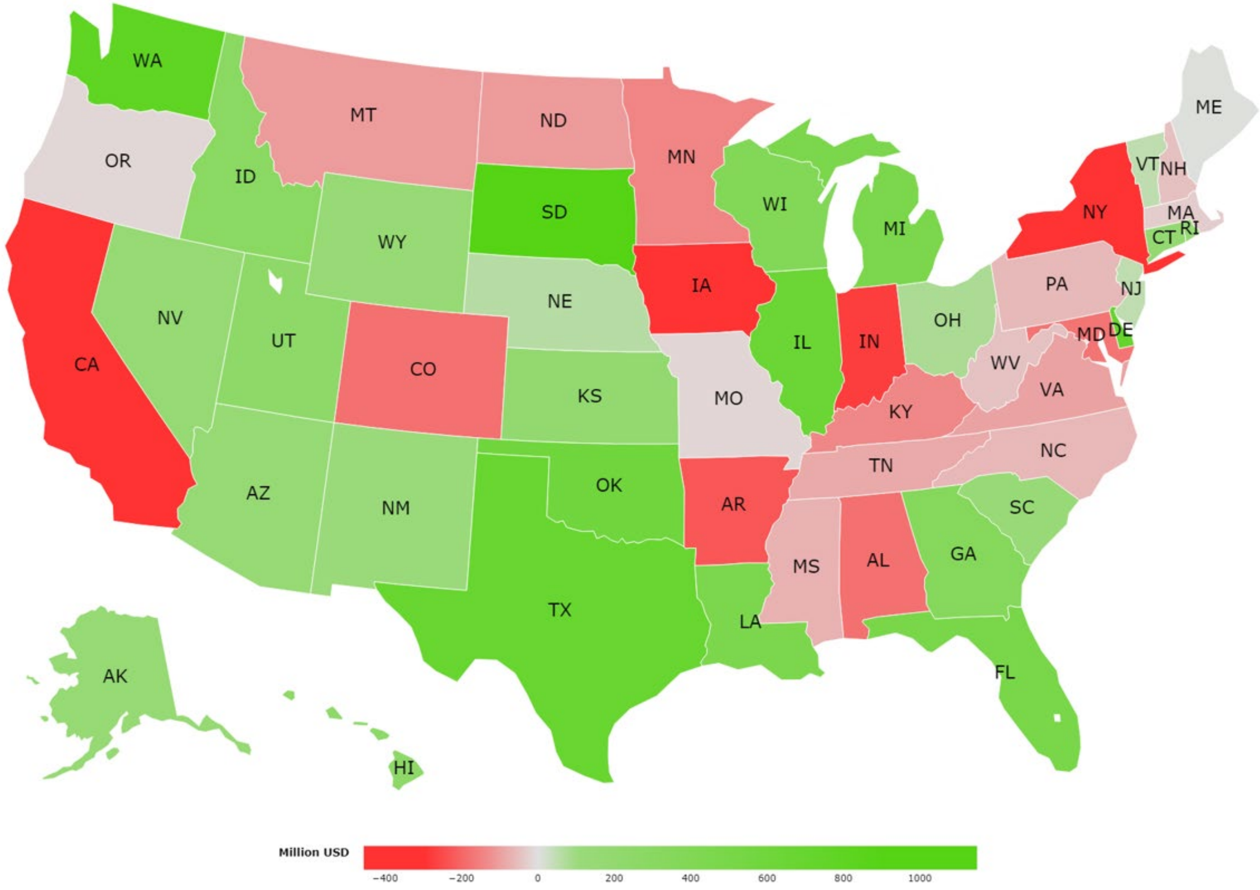
Tariffs Used:	V ($ bill)	$-CV^D$ ($ bill)	$-CV^M$ ($ bill)	–CV ($ bill)	–CV/HH ($2017)	States with –CV>0
2002-2017						
1. $\frac{Duty}{Customs\ \ value}$	7.0	38.4	3.0	48.7	416	50
20017-2022						
2. $\frac{Duty}{Customs\ \ value}$	-0.5	-221.1	-43.6	-265.3	-2,104	0
3. and $t_{2022} \geq t_{2017}$	-0.5	-221.1	-45.0	-266.6	-2,115	0
20017-2019						
4. $\frac{Duty}{Customs\ \ value}$	-0.3	-177.1	-35.0	-212.5	-1,698	0
5. and $t_{2019} \geq t_{2017}$	-0.3	-177.1	-36.1	-213.6	-1,706	0

US Producer Surplus and Welfare Change

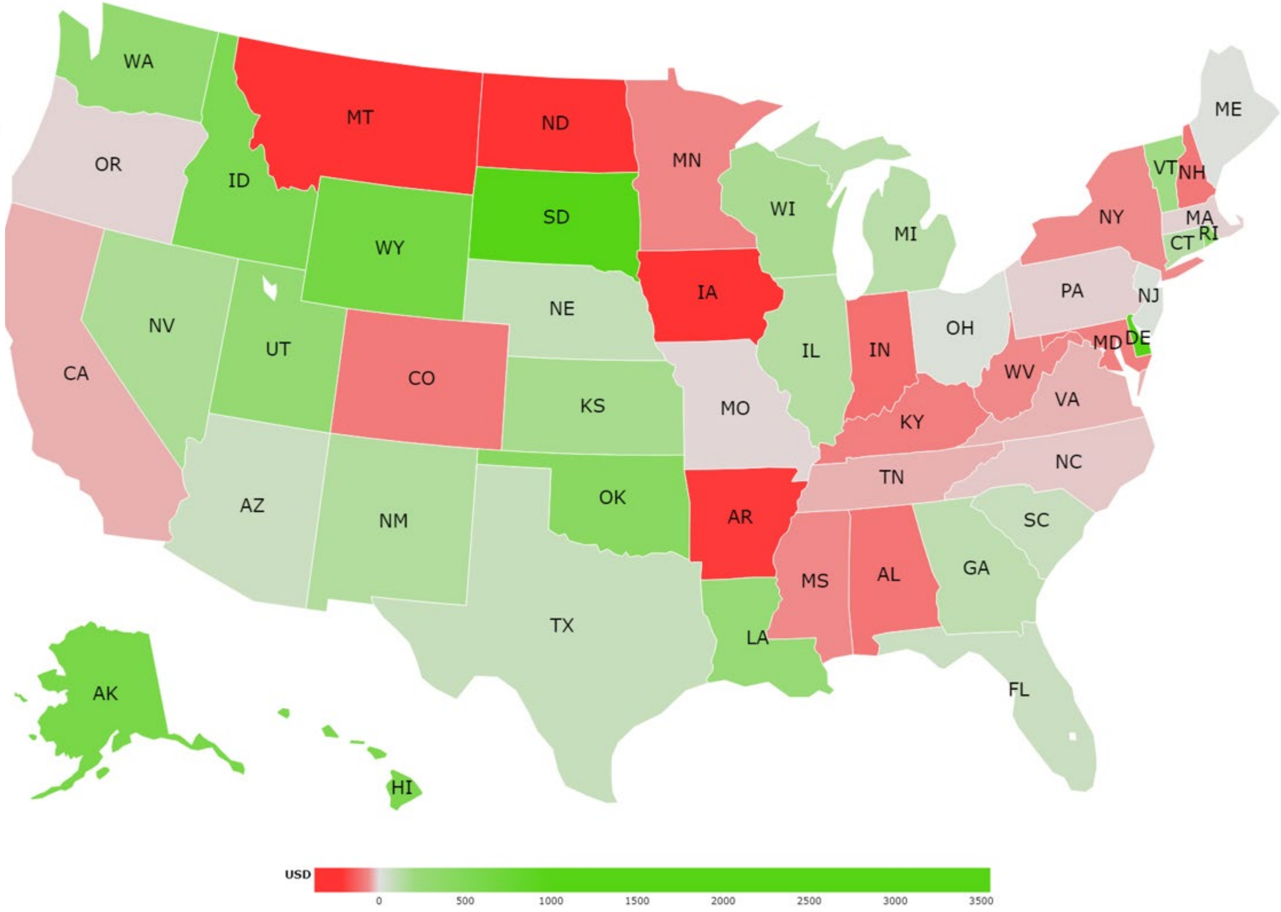
Tariffs used	ΔPS^D (\$ bill)	States with $\Delta PS^D > 0$	ΔB (\$ bill)	ΔW (\$ bill)	$\Delta W/HH$ (\$2017)	States with $\Delta W > 0$
2002-2017						
1. $\frac{Duty}{Customs\ \ value}$	-38.4	1	-4.2	5.8	50	28
2017-2022						
2. $\frac{Duty}{Customs\ \ value}$	221.1	50	32.5	-11.7	-93	28
3. and $t_{2022} \geq t_{2017}$	221.1	50	32.6	-13.0	-103	25
2017-2019						
4. $\frac{Duty}{Customs\ \ value}$	177.1	50	29.2	-6.2	-50	25
5. and $t_{2019} \geq t_{2017}$	177.1	50	29.7	-7.1	-57	25

Map of State Welfare Change (2002-2017)

Total



Per Household

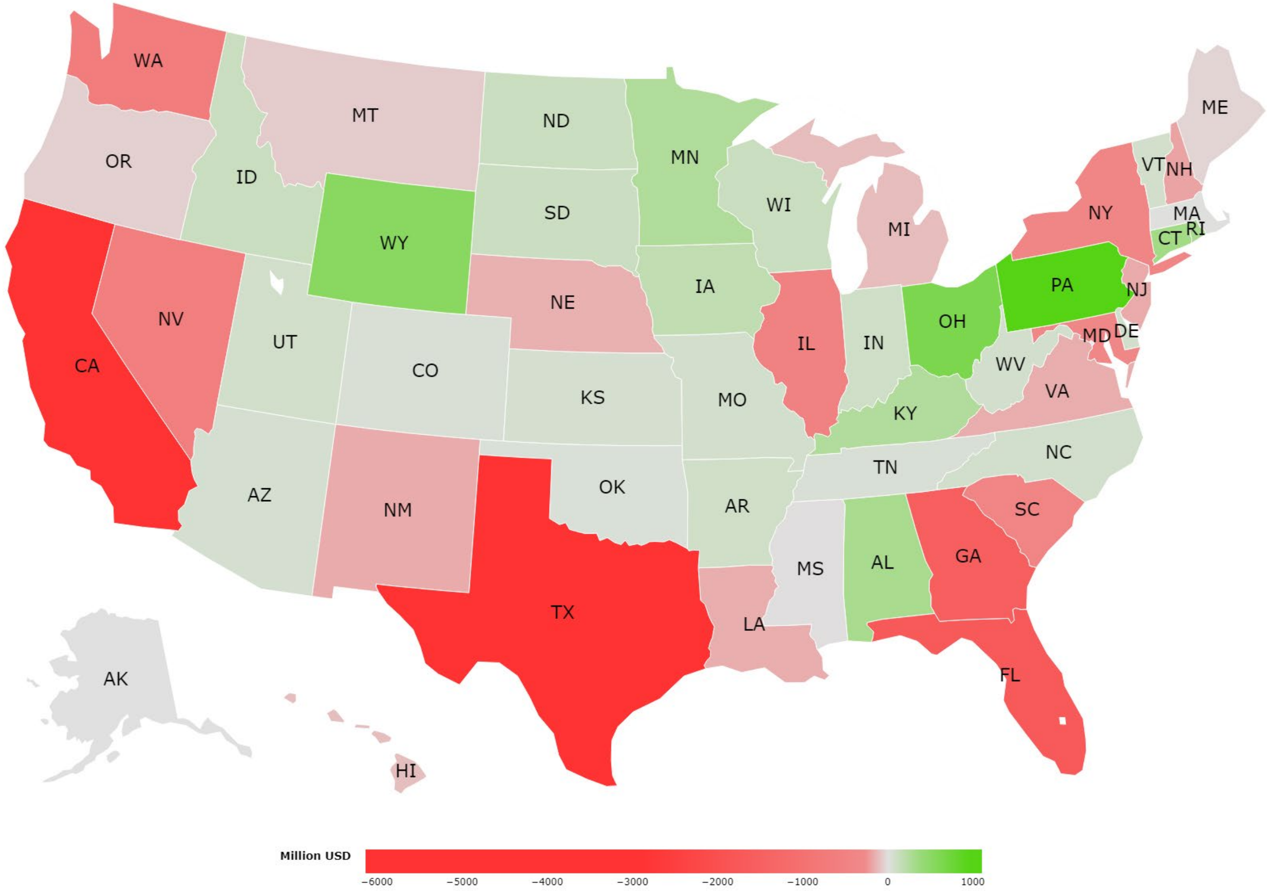


National Welfare: $5.8 billion

National Welfare/HH: $50

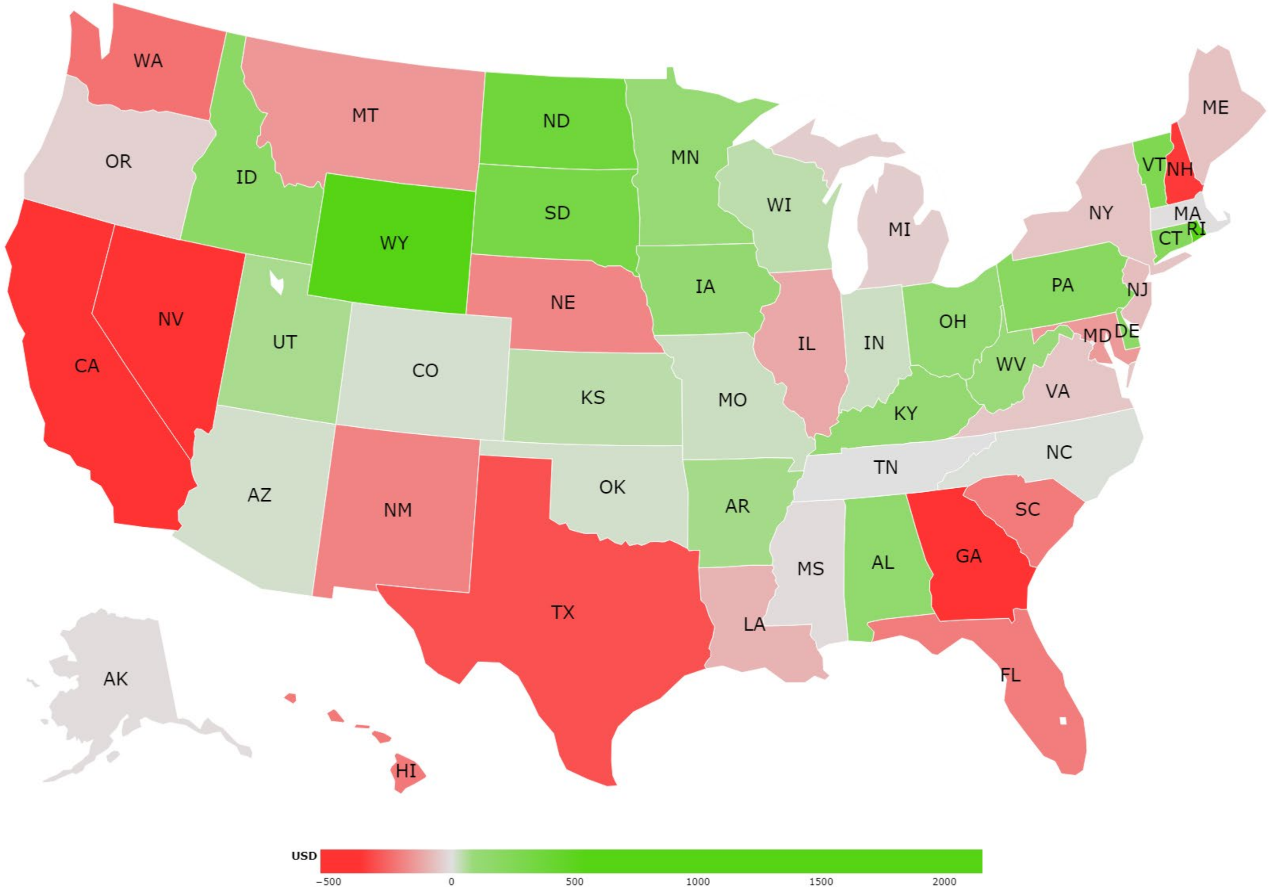
Map of State Welfare Change (2017-2022)

Total



National Welfare: -$13 billion

Per Household



National Welfare/HH: - $103

Tariff revenue

Change in tariff revenue is estimated by summing over state-sectors:

$$\sum_{n=1}^{N}\sum_{i=1}^{50}\sum_{j=51}^{58} \bar{E}_i^n \Delta\left(\tau 2_{jt}^n \hat{s}_{ijt}^n/(1+\tau 2_{jt}^n)\right)$$

with

$$\Delta\left(\tau 2_{jt}^n\, \hat{s}_{ijt}^n/(1+\tau 2_{jt}^n)\right) \equiv \left(\Delta\frac{\tau 2_{jt}^n}{1+\tau 2_{jt}^n}\right)\frac{1}{2}\left(\hat{s}_{ijt}^n+\hat{s}_{ijt}^n\right)+\frac{1}{2}\left(\frac{\tau 2_{jt-1}^n}{1+\tau 2_{jt-1}^n}+\frac{\tau 2_{jt}^n}{1+\tau 2_{jt}^n}\right)\Delta\hat{s}_{ijt}^n$$

Tariff revenue

Change in tariff revenue is estimated by summing over state-sectors:

$$\sum_{n=1}^{N}\sum_{i=1}^{50}\sum_{j=51}^{58}\bar{E}_i^n \Delta\left(\tau 2_{jt}^n \hat{s}_{ijt}^n/(1+\tau 2_{jt}^n)\right)$$

with

$$\Delta\left(\tau 2_{jt}^n\, \hat{s}_{ijt}^n/(1+\tau 2_{jt}^n)\right) = \left(\Delta\frac{\tau 2_{jt}^n}{1+\tau 2_{jt}^n}\right)\frac{1}{2}\left(s_{ijt}^n + s_{ijt-1}^n\right) + \frac{1}{2}\left(\frac{\tau 2_{jt-1}^n}{1+\tau 2_{jt-1}^n} + \frac{\tau 2_{jt}^n}{1+\tau 2_{jt}^n}\right)\Delta\hat{s}_{ijt}^n$$

using actual share in period t (enough parameters in translog)

Tariff revenue

Change in tariff revenue is estimated by summing over state-sectors:

$$\sum_{n=1}^{N}\sum_{i=1}^{50}\sum_{j=51}^{58} \bar{E}_i^n \Delta\left(\tau 2_{jt}^n \hat{s}_{ijt}^n/(1+\tau 2_{jt}^n)\right)$$

with

$$\Delta\left(\tau 2_{jt}^n \hat{s}_{ijt}^n/(1+\tau 2_{jt}^n)\right)$$
$$= \left(\Delta \frac{\tau 2_{jt}^n}{1+\tau 2_{jt}^n}\right)\frac{1}{2}(s_{ijt}^n + s_{ijt-1}^n) - \frac{1}{2}\left(\frac{\tau 2_{jt-1}^n}{1+\tau 2_{jt-1}^n} + \frac{\tau 2_{jt}^n}{1+\tau 2_{jt}^n}\right)\hat{\gamma}^n\left(\Delta \ln \hat{p}_{ijt}^n - \overline{\Delta \ln \hat{p}_i^n}\right)$$

substituting from estimated translog

Tariff revenue

Change in tariff revenue is estimated by summing over state-sectors:

$$\sum_{n=1}^{N}\sum_{i=1}^{50}\sum_{j=51}^{58}\bar{E}_i^n\Delta\left(\tau 2_{jt}^n\hat{s}_{ijt}^n/(1+\tau 2_{jt}^n)\right)$$

With

$$\Delta\left(\tau 2_{jt}^n\,\hat{s}_{ijt}^n/(1+\tau 2_{jt}^n)\right)$$
$$=\left(\Delta\frac{\tau 2_{jt}^n}{1+\tau 2_{jt}^n}\right)\frac{1}{2}(s_{ijt}^n+s_{ijt-1}^n)-\frac{1}{2}\left(\frac{\tau 2_{jt-1}^n}{1+\tau 2_{jt-1}^n}+\frac{\tau 2_{jt}^n}{1+\tau 2_{jt}^n}\right)\hat{\gamma}^n\left(\Delta\ln(1+\tau_{jt}^n)-\overline{\Delta\ln\hat{p}_i^n}\right)$$

using the small country assumption

Tariff revenue

Change in tariff revenue is estimated by summing over state-sectors:

$$\sum_{n=1}^{N}\sum_{i=1}^{50}\sum_{j=51}^{58} \bar{E}_i^n \Delta\left(\tau 2_{jt}^n \hat{s}_{ijt}^n/(1+\tau 2_{jt}^n)\right)$$

With

$$\Delta\left(\tau 2_{jt}^n\, \hat{s}_{ijt}^n/\left(1+\tau 2_{jt}^n\right)\right) =$$

$$= \left(\Delta\frac{\tau 2_{jt}^n}{1+\tau 2_{jt}^n}\right)\frac{1}{2}\left(s_{ijt}^n + s_{ijt-1}^n\right) - \frac{1}{2}\left(\frac{\tau 2_{jt-1}^n}{1+\tau 2_{jt-1}^n} + \frac{\tau 2_{jt}^n}{1+\tau 2_{jt}^n}\right)\hat{\gamma}^n\left(\Delta \ln LM_{jt}^h - \overline{\Delta \ln \hat{p}_i^n}\right)$$

using the Lloyd-Moulton index (and also for the final term)

Additional detail for 2017-2022

Tariffs used	Value for σ	CV^M ($ bill)	EV^M ($ bill)	ΔB ($ bill)	ΔW ($ bill)	$\Delta W/HH$ ($)	States with $\Delta W>0$
1. $\frac{Duty}{Customs \;\; value}$ with $t_{2017} \leq t_{2019}$	0	-45.0		32.6	-13.0	-103	25
2. $LM^{h}_{ch,t}$ index	5	-46.3		32.0	-14.9	-118	24
3. $LM^{h}_{ch,t}$ index	10	-47.5		31.4	-16.6	-132	23
4. and use EV^M	10		-55.0	31.4	-24.1	-191	15
5. $\tau^{h,99}_{ch,t}, \tau^{h,d}_{jt}$	1,000		-72.6	30.3	-42.8	-340	10

Additional detail for 2017-2019

Tariffs used	Value for σ	CV^M ($ bill)	EV^M ($ bill)	ΔB ($ bill)	ΔW ($ bill)	$\Delta W/HH$ ($)	States with $\Delta W>0$
1. $\frac{Duty}{Customs\ \ value}$							
with $t_{2017} \leq t_{2019}$	0	-36.1		29.3	-7.1	-57	25
2. $LM_{j,t}^{h}$ index	5	-38.1		28.8	-9.6	-77	25
3. $LM_{ch,t}^{h}$ index	10	-41.4		28.2	-13.5	-108	23
4. and use EV^M	10		-47.7	28.2	-18.0	-159	20
5. $\tau_{ch,t}^{h,99}, \tau_{jt}^{h,d}$	1,000		-67.8	26.2	-42.0	-335	12

Additional detail for 2017-2019

Tariffs used	Value for σ	CV^M ($ bill)	EV^M ($ bill)	ΔB ($ bill)	ΔW ($ bill)	$\Delta W/HH$ ($)	States with $\Delta W>0$
1. $\frac{Duty}{Customs\ \ value}$ with $t_{2017} \leq t_{2019}$	0	-36.1		29.3	-7.1	-57	25
2. $LM_{j,t}^{h}$ index	5	-38.1		28.8	-9.6	-77	25
3. $LM_{ch,t}^{h}$ index	10	-41.4		28.2	-13.5	-108	23
4. and use EV^M	10		-47.7	28.2	-18.0	-159	20
5. $\tau_{ch,t}^{h,99}, \tau_{jt}^{h,d}$	1,000		-67.8	26.2	-42.0	-335	12
6. Stat. t (HS6 ave.)	+∞		-89.0	8.4	-80.9	-646	4
7. Stat. t (HS6 max)	+∞		-90.3	8.2	-82.5	-659	3

Conclusions

- Used several data sources:
  - FAF database, Tariff data and State level HS6 trade from the Census
  - Combine these in a translog framework to obtain the change ins CS, PR and W, assuming that tariff revenue is distributed on a per-capita basis
- The tariffs (esp. on China) implemented beginning in 2017 were more "porous" than previously recognized. The Census data allows us to infer the extent of HTS99 products not subject to the tariffs – and also the phase-in-in of tariffs – quite easily.
- Nationally, there is a per-household *gain* of $50 in 2002-2017 and a *loss* of $57-108 over 2017-2019 and $103-132 over 2017-2022. Higher estimates can be obtained.
- One-half of states gain in welfare 2002-17 and nearly one-half still gain over 2017-19 and 2017-22. The fact that there is a *national loss* from the tariffs is not reflected in the *number* of states gaining and losing, which depends on *intra-state* trade patterns.