Import Liberalization as Export Destruction? Evidence from the United States

Holger Breinlich
Surrey

Elsa Leromain
Louvain

Dennis Novy
Warwick

Thomas Sampson
LSE

July 2021

Import protection & exports

"The idea that a protected domestic market gives firms a base for successful exporting is one of those heterodox arguments, common in discussions of international trade, which are incomprehensible in terms of standard models yet seem persuasive to practical men."

Paul Krugman, 1984

Import protection & exports

- Krugman (1984) develops model in which import protection is export promoting
- Higher domestic sales raise productivity due to scale economies $\rightarrow$ increased exports
- Import liberalization can be welfare reducing if scale economies differ across sectors (Venables 1987, Kucheryavyy et al. 2020)
- Alternative view: import protection raises costs and makes firms less competitive on global markets

This paper

- Use normalization of US trade relations with China (PNTR) to study effect of import liberalization on exports
- Address three questions
  - Is import liberalization export destroying within industries, all else equal?
  - Is net effect of import liberalization export destroying at industry level?
  - How did import liberalization from PNTR affect welfare?

Results preview

- Lower US export growth after PNTR in industries more exposed to greater Chinese import competition $\Rightarrow$ export destruction mechanism exists
- But PNTR also boosted exports by reducing intermediate input costs
- Quantitative analysis finds PNTR raised exports relative to GDP for most industries, but exports fell in industries with greatest direct exposure to PNTR
- Gains from PNTR are positive for US, but lower than in model without scale economies because of negative specialization effect

Talk outline

1. Trade model with scale economies
2. Estimate impact of PNTR on US exports
3. Calibrate trade model
4. Quantify effect of PNTR on US exports & welfare

Model

- Generalize Krugman (1980) to include
  - Many countries n, i and sectors s
  - Tradable intermediate inputs and input-output linkages between sectors as in Caliendo and Parro (2015)
  - Iceberg bilateral trade costs $\tau_{ni,s}$
  - Elasticity of substitution $\sigma > 1$ between varieties from the same country, $\epsilon > 1$ between varieties from different countries
- Model generates industry-level scale economies through love of variety

Model details

Exports

Exports of country i to importer n in sector s satisfy

$$X_{ni,s} = \Gamma_0 \varphi_{ni,s} T_{i,s}^{\epsilon-1} \left(\frac{Y_{i,s}}{c_{i,s}^{\sigma} f_{i,s}} \right)^{\frac{\epsilon-1}{\sigma-1}} X_{n,s} P_{n,s}^{\epsilon-1}$$

where: Γ_0 constant, $\varphi_{ni,s} = \tau_{ni,s}^{1-\epsilon}$ bilateral openness, $T_{i,s}$ technology, $Y_{i,s}$ output, $c_{i,s}$ unit cost of input bundle, $f_{i,s}$ fixed entry cost, $X_{n,s}$ expenditure, $P_{n,s}$ price index

- Trade elasticity $\epsilon - 1$, scale elasticity $\frac{1}{\sigma-1}$
- Exports increasing in output with output elasticity $\frac{\epsilon-1}{\sigma-1}$ = Trade elasticity x Scale elasticity
- Exports do not depend on output if there are no scale economies, i.e. if $\sigma \to \infty$
- Lower unit input costs $c_{i,s}$ increase exports

Output

Output of country i in sector s is

$$Y_{i,s} = \Gamma_0^{\frac{\sigma-1}{\sigma-\epsilon}} T_{i,s}^{\frac{(\sigma-1)(\epsilon-1)}{\sigma-\epsilon}} \left(\frac{1}{c_{i,s}^{\sigma} f_{i,s}} \right)^{\frac{\epsilon-1}{\sigma-\epsilon}} \underbrace{\left(\sum_n \varphi_{ni,s} X_{n,s} P_{n,s}^{\epsilon-1} \right)^{\frac{\sigma-1}{\sigma-\epsilon}}}_{\text{Real market potential}}$$

- Countries that face lower trade costs to access larger markets have higher real market potential $\rightarrow$ higher output
- With scale economies, increase in real market potential raises industry productivity due to love of variety $\rightarrow$ higher exports

Structural gravity

Import liberalization

- Fall in US barriers to Chinese imports due to PNTR raises $\varphi_{UC,s}$
- Higher $\varphi_{UC,s} \rightarrow$ lower US price index $\rightarrow$ lower US real market potential

Import liberalization

- Fall in US barriers to Chinese imports due to PNTR raises $\varphi_{UC,s}$
- Higher $\varphi_{UC,s} \rightarrow$ lower US price index $\rightarrow$ lower US real market potential

Proposition

For given foreign outcomes, domestic input costs and domestic expenditure
(i) Import liberalization reduces exports to all destinations by decreasing the domestic industry's real market potential if and only if the scale elasticity is strictly positive
(ii) The magnitude of the elasticity of exports to import openness is strictly increasing in the output elasticity

- Proposition holds in broad class of trade models with scale economies, e.g. external economies of scale, Melitz-Pareto, endogenous innovation

PNTR

- PNTR increased US openness to Chinese imports by reducing tariff uncertainty (Pierce & Schott 2016)
- Industries with greater reductions in uncertainty saw faster growth in imports from China after PNTR (Handley & Limão 2017)
- Measure exposure to PNTR as the NTR gap between non-NTR and NTR tariffs
- Study whether US export growth declined following PNTR in industries with higher NTR gaps

Data

- NTR gap

$$NTRGap_s = \log\left(1 + \text{Non-NTR tariff}_s\right) - \log\left(1 + \text{NTR tariff}_s\right)$$

  Tariffs from Feenstra et al. (2002), average across 8 digit products to obtain NTR gap for 6 digit NAICS industries

- Input cost shock

$$CostShock_s = -\sum_v \gamma_{U,sv} NTRGap_v$$

  where $\gamma_{U,sv}$ is US input-output coefficient in 1997

- Trade: CEPII BACI database for bilateral trade flows starting in 1995
- Industry variables: NBER manufacturing database and BEA Input-Output tables for 1997

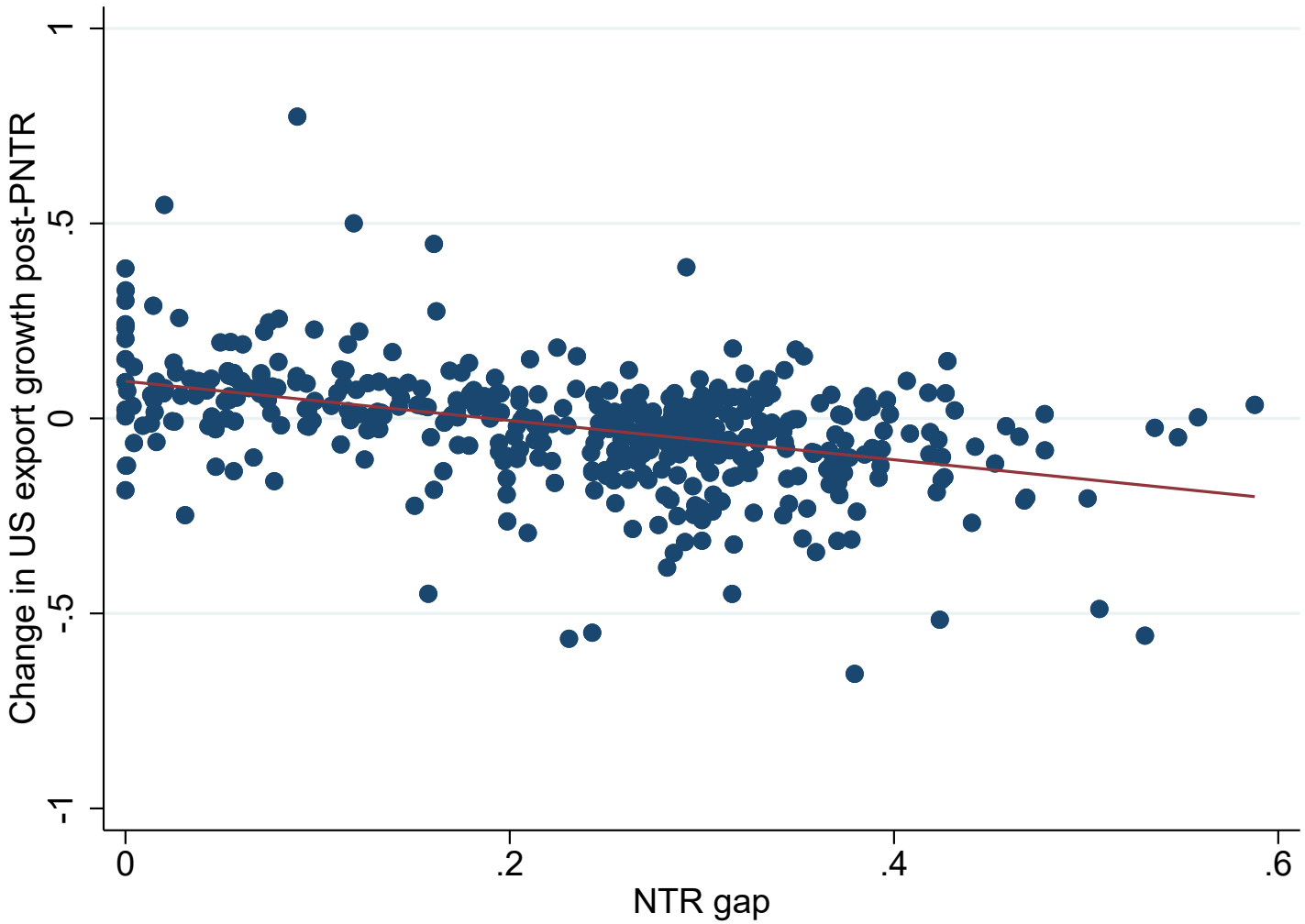
Descriptive statistics

Empirical specification

$$\Delta \log X_{ni,s}^{t} = \delta_{ni,s} + \delta_{ni}^{t} + \delta_{n,s}^{t} + \alpha_1 Post^{t} \times US_i \times NTRGap_s + \alpha_2 Post^{t} \times US_i \times CostShock_s + \beta Post^{t} \times US_i \times Z_s + \epsilon_{ni,s}^{t}$$

- Two periods: pre-PNTR 1995-2000, post-PNTR 2000-07
- Dependent variable: annualized export growth from *i* to *n* in industry *s*
- δ fixed effects. $Post^t$, US_i dummy variables
- Z_s includes industry capital, skill and input intensity. Controls for export growth shocks correlated with these characteristics
- Sample: OECD exporters, 141 importers not including US and China, 444 industries

PNTR & US export growth



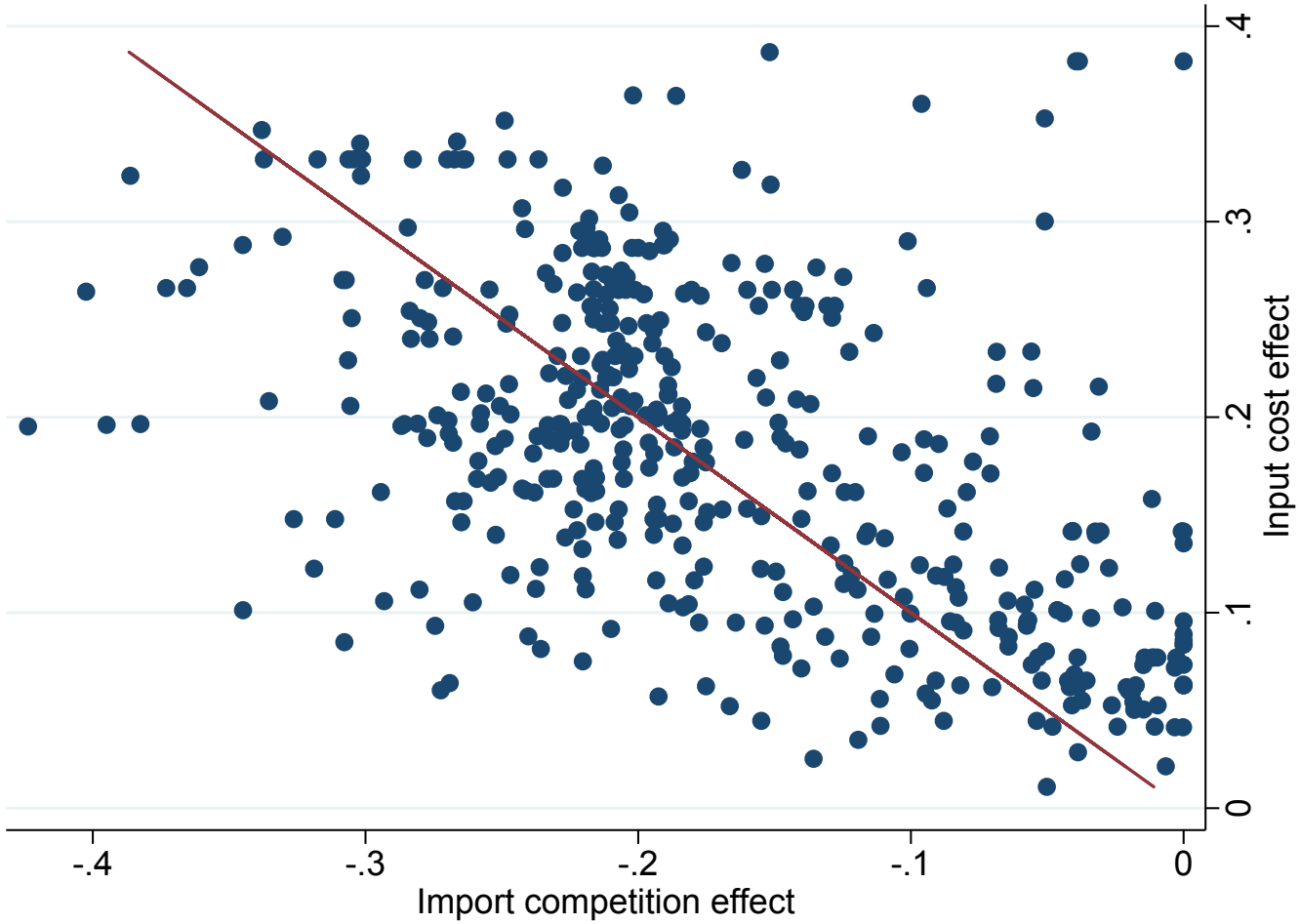
US export growth 2000-07 relative to 1995-2000 for NAICS goods industries

Estimation results

Dependent variable	Δ Log Exports							
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
Post x US x NTRGap	-0.094	-0.23	-0.29	-0.25	-0.12	-0.25	-0.21	-0.10
	(0.020)	(0.040)	(0.045)	(0.049)	(0.045)	(0.045)	(0.055)	(0.045)
Post x US x CostShock			-0.44	-0.53	-0.16	-0.44	-0.65	-0.32
			(0.14)	(0.14)	(0.14)	(0.13)	(0.14)	(0.14)
Post x US x Input Intensity					0.27			0.19
					(0.037)			(0.038)
Post x US x Skill Intensity						-0.24		-0.22
						(0.039)		(0.037)
Post x US x Capital Intensity							0.017	0.019
							(0.0065)	(0.0062)
Fixed effects								
Exporter-industry-importer	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Importer-exporter-period	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Importer-industry-period	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry sample	Goods	Goods	Goods	Manuf.	Manuf.	Manuf.	Manuf.	Manuf.
Observations	1,069,951	1,069,951	1,069,951	1,010,551	1,010,551	1,010,551	1,010,551	1,010,551
R-squared	0.25	0.50	0.50	0.50	0.50	0.50	0.50	0.50

Robustness Event study HS 6 digit

Import competition vs input costs



Estimated impact of PNTR on US exports. Net effect negative for 41 percent of industries

Structural estimation

Estimate output elasticity by instrumenting output growth with NTR gap

$$\Delta \log X_{ni,s}^{t} = \delta_{ni,s} + \delta_{ni}^{t} + \delta_{n,s}^{t} + \alpha_3 US_i \times \Delta \log Y_{U,s}^{t} + \alpha_4 Post^{t} \times US_i \times CostShock_s + \beta Post^{t} \times US_i \times Z_s + \epsilon_{ni,s}^{t}$$

- Model implies $\alpha_3 = \frac{\epsilon - 1}{\sigma - 1}$ output elasticity
- Instrument $US_i \times \Delta \log Y_{U,s}^{t}$ with $Post^{t} \times US_i \times NTRGap_s$
- Relevance of instrument requires NTR gap to affect change in US output growth between pre and post periods

Structural results

Dependent variable	Δ Log Exports				
	(a)	(b)	(c)	(d)	(e)
US x Δ Log Output	0.66	1.10	0.78	1.33	1.27
	(0.20)	(0.29)	(0.45)	(0.32)	(0.62)
Post x US x CostShock		-1.20	-0.74	-1.29	-0.98
		(0.30)	(0.33)	(0.33)	(0.46)
			First Stage		
Post x US x NTRGap	-0.30	-0.23	-0.13	-0.24	-0.13
	(0.048)	(0.044)	(0.051)	(0.045)	(0.054)
Kleibergen-Paap F-statistic	37.6	27.8	6.6	26.8	5.9
Fixed effects	Yes	Yes	Yes	Yes	Yes
Industry controls	No	No	Yes	No	Yes
Exporter sample	OECD	OECD	OECD	US	US
Observations	1,011,530	1,011,530	1,010,551	69,054	69,003

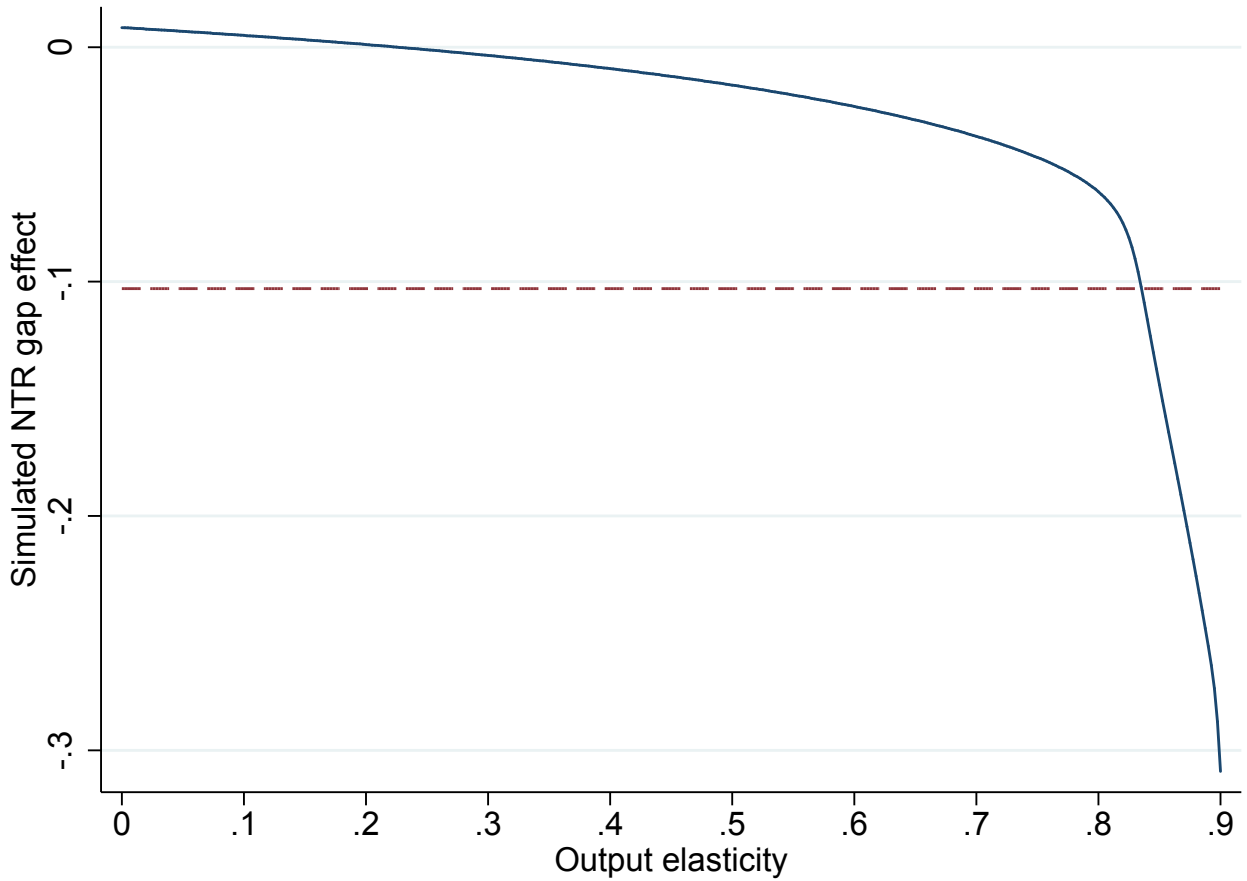
Empirical findings

- Export destruction $\rightarrow$ PNTR reduced US export growth in industries with higher NTR gaps
  - 13 percentage point decline for industry at 75th vs 25th percentile of NTR gap distribution
- Export creation $\rightarrow$ PNTR boosted US export growth in industries with greater input cost reductions
  - 14 percentage point increase for industry at 75th vs 25th percentile of input cost shock distribution
- Scale economies: output elasticity is estimated to be positive and not significantly different from one
- Estimates do not account for general equilibrium effects of PNTR that are absorbed by fixed effects

Quantitative analysis

- Quantify impact of PNTR on US exports and welfare
- Calibrate trade model with scale economies
  - WIOT data for 2000, 12 economies, 24 sectors
  - Estimate $\hat{\varphi}_{UC,s}$ from effect of NTR gap on US imports from China
    Details
  - Set trade elasticity to five (Head & Mayer 2014)
  - No scale economies in services (Costinot & Rodríguez-Clare 2014, Bartelme et al. 2019)
- Calibrate output elasticity to match estimated impact of NTR gap on US manufacturing exports

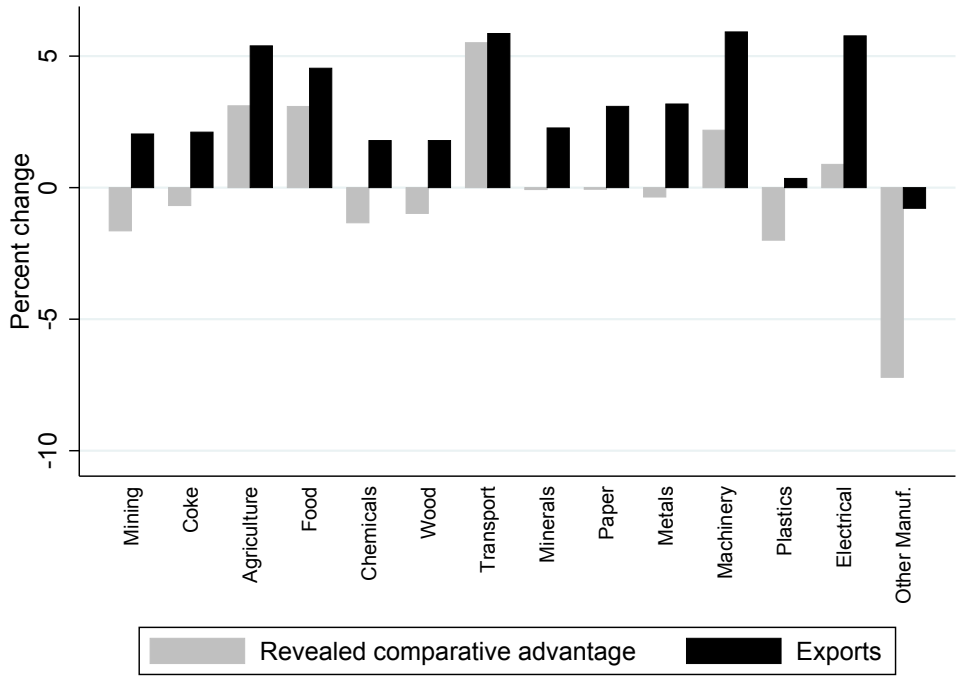
Output elasticity



Calibrated output elasticity equals 0.835

Impact of PNTR on US exports

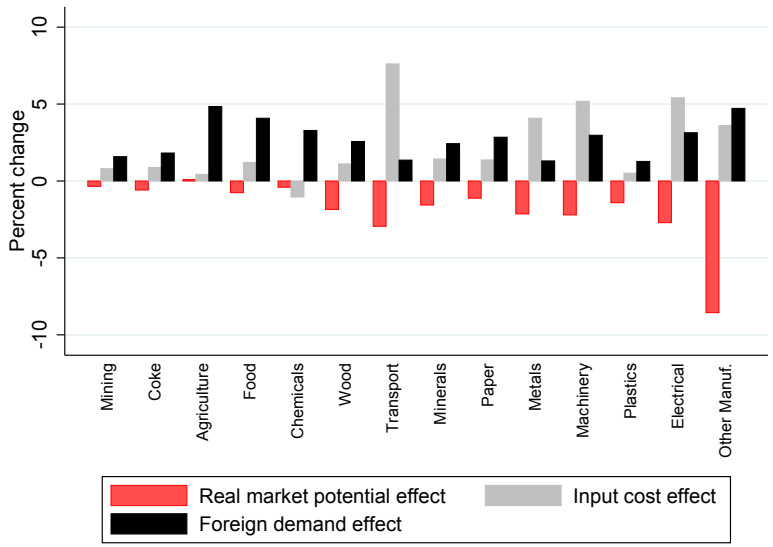
- Exports relative to GDP increase by 3.6%
- Export growth positive for most sectors, but negatively correlated with NTR gap and negative in most exposed sectors



US GDP is numeraire. NTR gap increasing from left to right.
Textiles: exports −35%, revealed comparative advantage −45%

Export decomposition

$$\widehat{EX}_{U,s} = \underbrace{\left(\widehat{RMP}_{U,s}\right)^{\frac{\epsilon-1}{\sigma-\epsilon}}}_{\text{Real market potential}} \times \underbrace{\left(\hat{c}_{U,s}\right)^{-\frac{\sigma(\epsilon-1)}{\sigma-\epsilon}}}_{\text{Input cost}} \times \underbrace{\sum_{n\neq U} \chi_{nU,s}\hat{X}_{n,s}\hat{P}_{n,s}^{\epsilon-1}}_{\text{Foreign demand}}$$



- Without scale economies, export growth lower at 2.5% (weaker input cost effect) and weakly positively correlated with NTR gap

Table Sectoral liberalization

Welfare

	Real income			
	Total	*ACR effect*	*Specialization effect*	Nominal wage relative to US
Panel A: Calibrated model				
US	0.08	*0.31*	*-0.23*	n/a
China	0.47	*3.20*	*-2.65*	6.1
Rest of world	0.04	*0.04*	*-0.01*	0.6
Panel B: No scale economies				
US	0.10	*0.10*	*n/a*	n/a
China	0.59	*0.59*	*n/a*	3.9
Rest of world	-0.01	*-0.01*	*n/a*	0.3

- Scale economies reduce US gains from PNTR because negative Venables specialization effect more than offsets additional ACR gains from increased openness
- Chinese gains around six times larger than US gains because China smaller economy

Welfare decomposition

Summary

1. Is import liberalization export destroying within industries, all else equal?
   - Yes, find Krugman mechanism operates
2. Is net effect of import liberalization export destroying at industry level?
   - PNTR: no for most industries, yes for industries with greatest NTR gaps
   - Sector-specific liberalization: yes within industries, no across industries
3. How did import liberalization from PNTR affect welfare?
   - Reallocation of production from goods to services induced negative specialization effect for US, but positive overall impact

Preferences & demand

- Representative consumer has Cobb-Douglas preferences across sectors with expenditure shares $\beta_{n,s}$
- Homogeneous monopolistically competitive firms produce differentiated varieties
- Varieties aggregated competitively to make non-tradable final goods using nested CES aggregator

$$Q_{n,s} = \left[\sum_i \left(\int_{\omega \in \Omega_{i,s}} q_{ni,s}(\omega)^{\frac{\sigma-1}{\sigma}} d\omega \right)^{\frac{\sigma}{\sigma-1}\frac{\epsilon-1}{\epsilon}} \right]^{\frac{\epsilon}{\epsilon-1}}$$

where $Q_{n,s}$ final good output, $\Omega_{i,s}$ set of differentiated varieties produced in i, $q_{ni,s}(\omega)$ quantity of variety ω from i used in n

- Final goods used for consumption and as intermediate inputs
- Aggregation technology leads to scale economies through love of variety

Back

Production

- Constant marginal cost of production $c_{i,s}/T_{i,s}$ where $T_{i,s}$ denotes technology
- Unit cost of input bundle

$$c_{i,s} = (w_i)^{\gamma_{i,s}} \prod_v \left(P_{i,v}\right)^{\gamma_{i,sv}}, \qquad \gamma_{i,s} + \sum_v \gamma_{i,sv} = 1$$

- w_i wage, $P_{i,v}$ sector v price index
- $\gamma_{i,s}$ value-added share of production costs
- $\gamma_{i,sv}$ share of intermediates from sector v in sector s production costs
- Free entry with entry cost $f_{i,s}c_{i,s}$

Back

Structural gravity

- Trade satisfies structural gravity equation (Head & Mayer 2014), can be written as

$$X_{ni,s} = \phi_{ni,s} \frac{Y_{i,s}}{RMP_{i,s}} X_{n,s} P_{n,s}^{\epsilon-1}$$

  where $RMP_{i,s}$ denotes real market potential

- Output $Y_{i,s}$ is proportional to real market potential in models without scale economies (Armington, Eaton & Kortum 2002)
  - $\Rightarrow$ Shocks to real market potential do not affect exports

- With scale economies elasticity of output to real market potential is greater than one

Back

Descriptive statistics

Panel A: Summary statistics

	Mean	Median	Std. dev.	Min.	Max.	Observations
NTRGap	0.23	0.26	0.12	0	0.59	444
CostShock	-0.08	-0.08	0.04	-0.17	0.00	444
Input Intensity	0.50	0.49	0.12	0.19	0.85	384
Skill Intensity	0.28	0.26	0.11	0.05	0.69	384
Capital Intensity	4.31	4.25	0.87	2.31	7.27	384

Panel B: Correlations

	NTRGap	CostShock	Input Intensity	Skill Intensity
NTRGap				
CostShock	-0.52			
Input Intensity	-0.30	-0.19		
Skill Intensity	-0.06	0.06	-0.21	
Capital Intensity	-0.47	0.40	0.18	0.21

Back

Robustness checks

Dependent variable	Export growth					
	PNTR in 2001	Pierce-Schott NTR gap	Handley-Limão NTR gap	PPML	Total exports OLS	Total exports PPML
	(a)	(b)	(c)	(d)	(e)	(f)
Post x US x NTRGap	-0.11	-0.053	-0.084	-0.087	-0.15	-0.10
	(0.047)	(0.032)	(0.031)	(0.033)	(0.060)	(0.049)
Post x US x CostShock	-0.35	-0.27	-0.18	-0.44	0.020	-0.098
	(0.15)	(0.11)	(0.077)	(0.16)	(0.24)	(0.27)
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry controls	Yes	Yes	Yes	Yes	Yes	Yes
Aggregation of exports	Bilateral	Bilateral	Bilateral	Bilateral	Total	Total
Estimator	OLS	OLS	OLS	PPML	OLS	PPML
Observations	1,019,305	1,010,551	1,010,551	1,010,551	17,573	17,573
R-squared	0.50	0.50	0.50	0.02	0.63	0.01

Back

Robustness checks

Dependent variable	Δ Log Exports							
	Only US exports	OECD & Non-OECD exporters	All exporters & importers	Trim sample on NTR gap	Drop textiles & apparel industries	Expenditure shock	Expenditure shock & final demand share	China shock
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
Post x US x NTRGap	-0.17	-0.087	-0.097	-0.18	-0.098	-0.095	-0.093	-0.11
	(0.055)	(0.043)	(0.041)	(0.064)	(0.050)	(0.045)	(0.043)	(0.047)
Post x US x CostShock	-0.32	-0.29	-0.27	-0.45	-0.13	-0.32	-0.16	-0.38
	(0.16)	(0.14)	(0.14)	(0.15)	(0.15)	(0.14)	(0.14)	(0.14)
Post x US x ExpenditureShock						0.050	-0.10	
						(0.053)	(0.067)	
Post x US x Final							0.050	
							(0.016)	
US x ChinaShock								0.80
								(1.01)
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Estimator	OLS	OLS	OLS	OLS	OLS	OLS	OLS	IV
Kleibergen-Paap F-stat.								11.9
Observations	69,003	1,762,374	1,978,551	931,509	903,938	1,010,551	1,010,551	998,539
R-squared	0.42	0.48	0.48	0.51	0.50	0.50	0.50	

Back

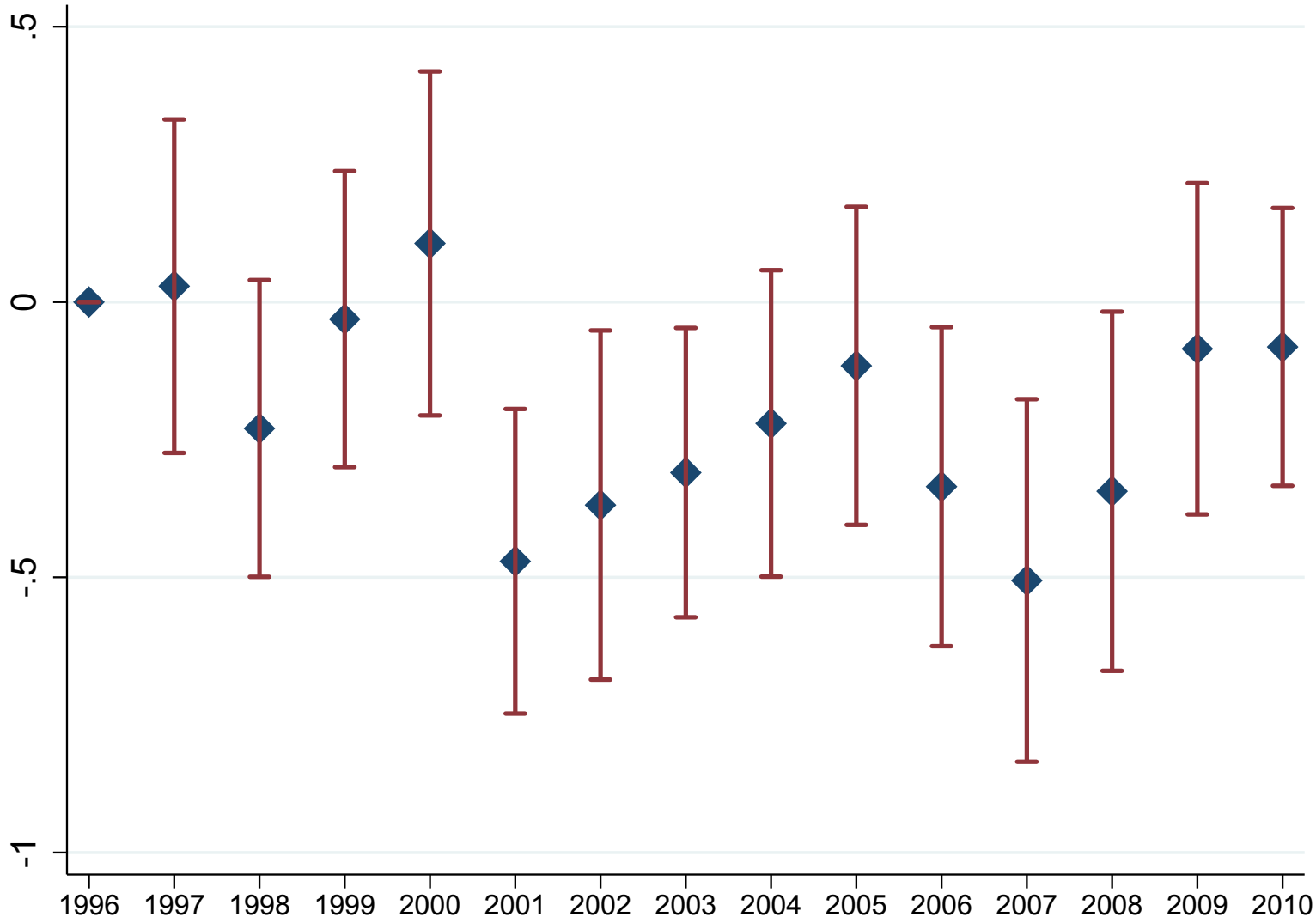
Event study

Estimate

$$\log\left(\frac{X_{i,s}^{t}}{X_{i,s}^{t-1}}\right) = \delta_{i,s} + \delta_{i}^{t} + \delta_{s}^{t} + \sum_{t} \zeta_{t} \times US_{i} \times NTRGap_{s} + \epsilon_{i,s}^{t},$$

- $X_{i,s}^{t}$ denotes country i exports in industry s and year t to all destinations other than US
- Use annual data 1995-2010 for OECD exporters

ζ_t estimates from event study



Back

HS 6 digit sectors

Dependent variable	Δ Log Exports					
	OECD exporters	US exports only	OECD & Non-OECD exporters	All exporters & importers	OECD exporters, within NAICS industries	OECD exporters, within NAICS manufacturing industries
	(a)	(b)	(c)	(d)	(e)	(f)
Post x US x NTRGap	-0.054	-0.082	-0.047	-0.046	-0.045	-0.051
	(0.014)	(0.013)	(0.014)	(0.014)	(0.020)	(0.020)
Fixed effects						
Exporter-sector-importer	Yes	Yes	Yes	Yes	Yes	Yes
Importer-exporter-period	Yes	Yes	Yes	Yes	Yes	Yes
Importer-sector-period	Yes	No	Yes	Yes	Yes	Yes
NAICS industry-exporter-period	No	No	No	No	Yes	Yes
Observations	3,658,798	363,775	5,196,186	5,574,796	3,172,658	3,031,300
R-squared	0.52	0.36	0.50	0.50	0.53	0.53

Back

PNTR shock

Estimate

$$\Delta \log X^t_{ni,s} = \delta_{ni,s} + \delta^t_{ni} + \delta^t_{n,s} + \delta^t_{i,s} + \alpha_5 Post^t \times US_n \times China_i \times NTRGap_s + \epsilon^t_{ni,s}$$

- Calibration assumes PNTR did not affect US openness to China in industry with zero NTR gap
- Set $\hat{\varphi}_{UC,s} = \exp(7 \times \alpha_5 \times NTRGap_s)$

PNTR shock

Dependent variable	Δ Log Trade				
	(a)	(b)	(c)	(d)	(e)
Post x US Importer x China Exporter	0.43	0.41	0.33	0.39	0.54
x NTRGap	(0.13)	(0.14)	(0.14)	(0.15)	(0.40)
Post x US Importer x China Exporter					-0.24
x NTRGap Squared					(0.80)
Fixed effects					
Exporter-industry-importer	Yes	Yes	Yes	Yes	Yes
Importer-exporter-period	Yes	Yes	Yes	Yes	Yes
Importer-industry-period	Yes	Yes	Yes	Yes	Yes
Exporter-industry-period	Yes	Yes	Yes	Yes	Yes
Industry sample	Goods	Goods	Goods	Manuf.	Goods
Importer sample	OECD	OECD	All	OECD	OECD
Exporter sample	All	Non-OECD	All	All	All
Observations	670,445	929,615	1,913,939	616,724	670,445
R-squared	0.55	0.59	0.53	0.55	0.55

Back

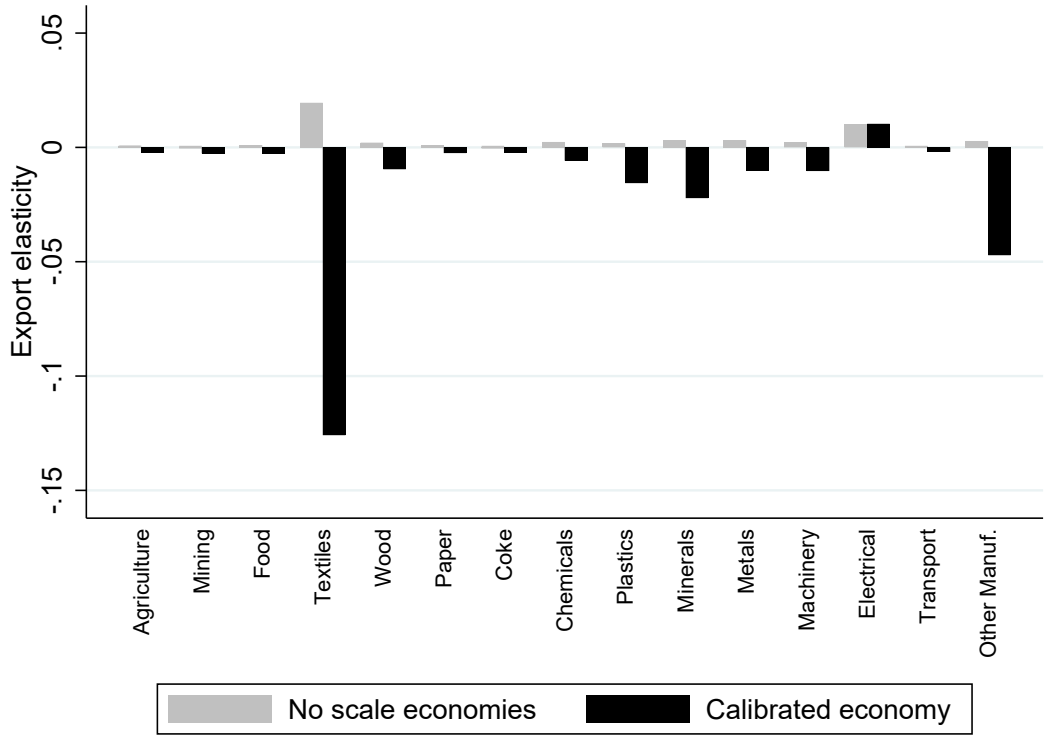
PNTR & trade

	NTR gap group					
	Low	Medium	High	Goods	Services	Total
Panel A: Calibrated model						
Exports	4.1	4.5	1.9	3.5	3.9	3.6
of which: Real market potential effect	*-0.4*	*-2.0*	*-6.3*	*-3.4*	*n/a*	*-2.3*
Input cost effect	*0.9*	*4.3*	*5.5*	*4.4*	*0.1*	*3.0*
Foreign demand effect	*3.7*	*2.3*	*3.3*	*2.8*	*3.8*	*3.1*
Revealed comparative advantage	1.4	2.0	-5.1	-0.7	2.5	n/a
Output	0.3	1.2	-6.1	-0.7	0.1	-0.1
Panel B: No scale economies						
Exports	2.5	2.3	3.2	2.6	2.1	2.5
of which: Real market potential effect	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*
Input cost effect	*0.1*	*0.6*	*1.2*	*0.7*	*0.1*	*0.5*
Foreign demand effect	*2.4*	*1.7*	*2.0*	*1.9*	*2.0*	*1.9*
Revealed comparative advantage	0.4	-0.1	-0.3	-0.1	0.6	n/a
Output	0.3	0.1	-2.2	-0.4	0.1	0.0

Back

Sector-specific liberalization

- Simulate local elasticity of exports to raising US openness to Chinese imports in a single sector
- Liberalization is export destroying within sectors, but export promoting across sectors



Back

Welfare decomposition

Real income change

$$\hat{M}_i = \underbrace{\prod_{s,v} \left(\hat{\lambda}_{ii,v}\right)^{-\frac{\beta_{i,s}\tilde{\gamma}_{i,sv}}{\epsilon_v - 1}}}_{\text{ACR}} \underbrace{\prod_{s,v} \left(\hat{L}_{i,v}\right)^{\frac{\beta_{i,s}\tilde{\gamma}_{i,sv}}{\sigma_v - 1}}}_{\text{Specialization}}$$

$\tilde{\gamma}_{i,sv}$ denotes elements of $(I - A)^{-1}$ where A is adjusted input-output matrix with typical element $\frac{\sigma_s}{\sigma_s - 1}\gamma_{i,sv}$

- Specialization effect only exists because of scale economies
  - Positive when reallocate resources to sectors with strong scale effects and large forward linkages

Back