Import Liberalization as Export Destruction? Evidence from the United States

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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: Good?

- Import protection is harmful
  - Raises costs and makes firm less competitive on global markets [Intermediate input channel]
- Import protection may support industrial development
  - Import protection is export promoting as higher domestic sales raise industry productivity (Krugman 1984) [Economies of scale channel]

Research Question

How scale economies shape the effect of trade policy?

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 the economies of scale channel quantitatively important?
  - Does it matter for the overall welfare effect?

Talk outline

1. Trade model with scale economies

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2. Estimate impact of import liberalization on US exports

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1. Trade model with scale economies
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3. Calibrate trade model
4. Quantify effect of import liberalization 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

$$X_{ni,s} = \Gamma_0 \underbrace{\varphi_{ni,s}}_{\text{trade openness}} \underbrace{T_{i,s}^{\epsilon-1} \left(\frac{Y_{i,s}}{c_{i,s}^{\sigma} f_{i,s}} \right)^{\frac{\epsilon-1}{\sigma-1}}}_{\text{exporter supply}} \underbrace{X_{n,s} P_{n,s}^{\epsilon-1}}_{\text{importer demand}}$$

→ Trade elasticity $\epsilon - 1$ and Scale elasticity $\frac{1}{\sigma-1}$

→ Exports increasing in output with

Output elasticity = 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

Structural gravity

Output

Output of country i in sector s is

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

→ Real market potential is the sum across markets of real demand $X_{n,s} P_{n,s}^{\epsilon-1}$ weighted by bilateral trade openness $\varphi_{ni,s}$

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 $\Longrightarrow$ Higher output

Output

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

→ With scale economies, increase in real market potential raises industry productivity due to love of variety $\Longrightarrow$ Higher exports

Import liberalization

- Fall in US barriers to Chinese imports raises $\varphi_{US-China,s}$:

  Higher $\varphi_{US-China,s}$ ⇒ Lower US price index ⇒ Lower US RMP

Import liberalization

- Fall in US barriers to Chinese imports raises $\varphi_{US-China,s}$:

  Higher $\varphi_{US-China,s}$ $\Rightarrow$ Lower US price index $\Rightarrow$ Lower US RMP

Proposition

Holding constant 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 there are increasing returns to scale at the sector level*
(ii) The magnitude of the elasticity of exports to import openness is strictly increasing in the output elasticity

$\longrightarrow$ Proposition holds in broad class of models with scale economies, e.g. external economies of scale, endogeneous technology investment, Melitz-Pareto firm heterogeneity

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

- **Direct exposure to PNTR**

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

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

Data

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- **Input cost shock**

$$CostShock_s = -(I - \Gamma_U)^{-1}\Gamma_U NTRGap$$

where Γ_U is the US input-output matrix in 1997

Data

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- **IO Exposure**

$$IOExposure = -(I - \Gamma_U)^{-1}\Gamma_U \tilde{I}$$

where $\tilde{I}$ is a vector of ones

Data

- **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: Reduced-form

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

- 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

Event study

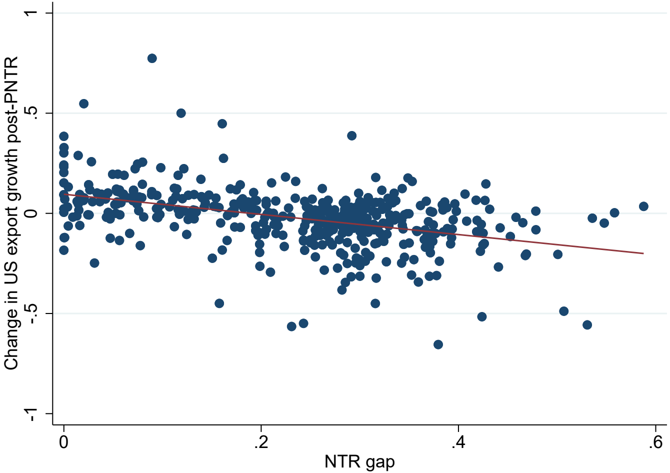
Empirical specification: Structural

Estimate output elasticity by instrumenting output growth with NTR gap

$$\Delta \log X^t_{ni,s} = \delta_{ni,s} + \delta^t_{ni} + \delta^t_{n,s} + \alpha_3 US_i \times \Delta \log Y^t_{U,s} + \alpha_4 Post^t \times US_i \times CostShock_s + \beta Post^t \times US_i \times Z_s + \epsilon^t_{ni,s}$$

- Model implies $\alpha_3 = \frac{\epsilon - 1}{\sigma - 1}$ output elasticity
- Instrument $US_i \times \Delta \log Y^t_{U,s}$ 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

PNTR & US export growth



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

Empirical findings

- Export destruction → PNTR reduced US export growth in industries with higher NTR gaps

  ⇒ Evidence of the **economies of scale channel**

- Export creation → PNTR boosted US export growth in industries with greater input cost reductions

  ⇒ Evidence of the **input cost channel**

- Scale economies: output elasticity is estimated to be positive and significantly different from zero

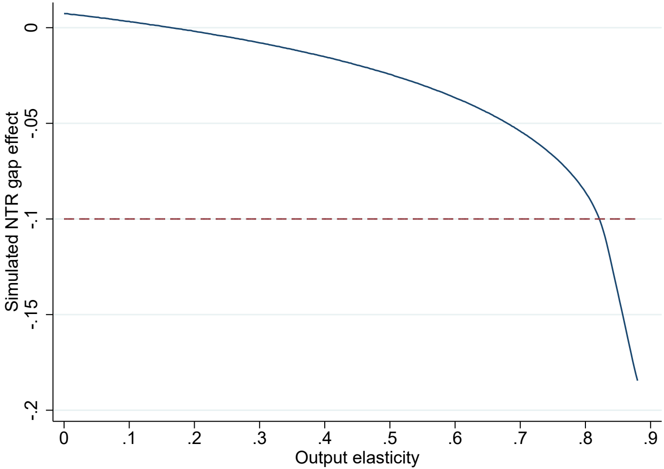
- Estimates do not account for general equilibrium effects of PNTR that are absorbed by fixed effects

Reduced-form Results Structural Results Robustness

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 $\hat{\varphi}_{US-China,s}$ 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)
- Solve using exact hat algebra

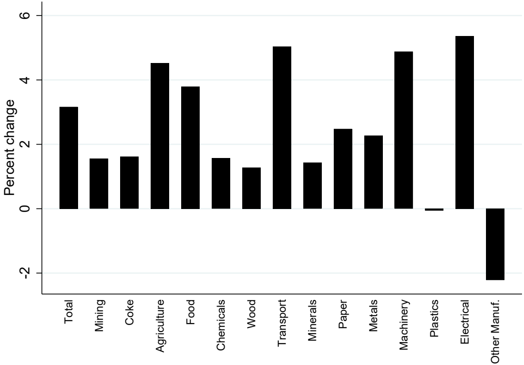
Output elasticity



Calibrated output elasticity equals 0.821

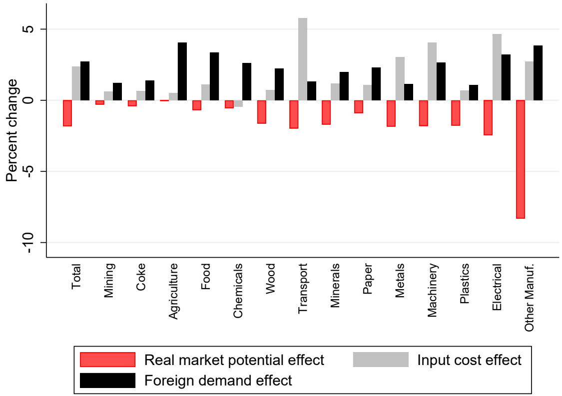
Impact of PNTR on US exports

- Exports relative to GDP increase by 3.2%
- Export growth positive for most sectors, but negative in most exposed sectors



US GDP is numeraire. NTR gap increasing from left to right.
Textiles and Leather are not shown

Export decomposition



Welfare

	Real expenditure	Real income: Total	Real income: *ACR effect*	Real income: *Specialization effect*	Nominal wage relative to US
		Panel A: Calibrated model			
US	0.087	0.068	*0.22*	*-0.15*	n/a
China	1.1	0.87	*1.90*	*-1.0*	6.0
Rest of world	0.014	0.013	*0.017*	*-0.0036*	0.52
		Panel B: No scale economies			
US	0.11	0.10	0.10	*n/a*	n/a
China	0.72	0.59	0.59	*n/a*	3.9
Rest of world	-0.0094	-0.0094	-0.0094	*n/a*	0.35

- US real income increases by 0.068 %
- US gains around 30 % smaller with scale economies

Welfare Decomposition Alternative calibrations

Summary

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Summary

1. Is import liberalization export destroying within industries, all else equal?
   - Yes, evidence for scale economies in US production
2. Is the economies of scale channel quantitatively important?
   - Yes, it magnifies changes in trade
3. Does it matter for the overall welfare effect?
   - Yes, it lowers the overall gains

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

$\Rightarrow$ Aggregation technology leads to industry-level scale economies through love of variety

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Production

- Constant marginal cost of production: $c_{i,s}/T_{i,s}$
  - $T_{i,s}$ denotes technology
  - $c_{i,s}$ is the unit cost of input bundle

$$c_{i,s} = (w_i)^{\gamma_{i,s}} \prod_{v} (P_{i,v})^{\gamma_{i,sv}}, \qquad \gamma_{i,s} + \sum_{v} \gamma_{i,sv} = 1$$

with w_i wage and $P_{i,v}$ sector v price index

- Free entry with entry cost $f_{i,s} c_{i,s}$

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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)
  - ⇒ Shocks to real market potential do not affect exports

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

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Reduced-form results

Dependent variable	Δ Log Exports								
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
Post x US x NTRGap	-0.094	-0.23	-0.30	-0.29	-0.25	-0.14	-0.24	-0.19	-0.10
	(0.020)	(0.040)	(0.042)	(0.043)	(0.046)	(0.044)	(0.044)	(0.051)	(0.044)
Post x US x CostShock			-0.39	-0.39	-0.47	-0.21	-0.37	-0.56	-0.31
			(0.082)	(0.083)	(0.087)	(0.093)	(0.085)	(0.090)	(0.092)
Post x US x IOExposure				0.0031	0.0018	0.00018	0.0013	-0.00098	-0.0029
				(0.0021)	(0.0023)	(0.0020)	(0.0023)	(0.0024)	(0.0021)
Post x US x Input Intensity						0.24			0.16
						(0.039)			(0.038)
Post x US x Skill Intensity							-0.22		-0.22
							(0.039)		(0.036)
Post x US x Capital Intensity								0.021	0.024
								(0.0065)	(0.0063)
Fixed effects									
Importer-exporter-industry	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Importer-exporter-period	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Importer-industry-period	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry sample	Goods	Goods	Goods	Goods	Manuf.	Manuf.	Manuf.	Manuf.	Manuf.
Observations	1,069,951	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	0.50

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Robustness

→ Threat to identification

- Unobserved US-technology shock HS6
- Competition in third markets Third market

→ Additional Robustness

- Variable definitions Definition
- Sample composition Sample

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Structural results

Dependent variable	Δ Log Exports		
	(a)	(b)	(c)
US x Δ Log Output	0.66	0.98	0.74
	(0.20)	(0.24)	(0.41)
Post x US x CostShock		-0.81	-0.55
		(0.16)	(0.20)
		First Stage	
Post x US x NTRGap	-0.30	-0.25	-0.14
	(0.048)	(0.043)	(0.051)
Kleibergen-Paap F-statistic	37.6	34.1	7.5
Fixed effects	Yes	Yes	Yes
Industry controls			
Input-output exposure	No	Yes	Yes
Input, skill and capital intensity	No	No	Yes
Observations	1,011,530	1,011,530	1,010,551

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Descriptive statistics

Panel A: Summary statistics

	Mean	Median	Std. dev.	Min.	Max.	Observations
NTRGap	0.23	0.26	0.13	0	0.59	444
CostShock	-0.14	-0.14	0.06	-0.29	-0.03	444
IOExposure	1.19	0.37	2.07	0.00	15.13	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	IOExposure	Input Intensity	Skill Intensity
NTRGap					
CostShock	-0.43				
IOExposure	-0.17	0.08			
Input Intensity	-0.30	-0.33	0.13		
Skill Intensity	-0.06	0.13	-0.02	-0.21	
Capital Intensity	-0.47	0.35	0.36	0.18	0.21

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Alternative variable definitions

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	-0.056	-0.081	-0.089	-0.15	-0.11
	(0.047)	(0.031)	(0.030)	(0.033)	(0.057)	(0.047)
Post x US x CostShock	-0.30	-0.25	-0.16	-0.38	-0.11	-0.14
	(0.10)	(0.071)	(0.049)	(0.11)	(0.14)	(0.17)
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

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Sample composition

Dependent variable	Δ Log Exports							
	Only US exports	OECD & Non-OECD exporters	All exporters & importers	Trim sample on NTR gap	Drop textiles & apparel industries	China shock	Expenditure shock	Expenditure shock & final demand share
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
Post x US x NTRGap	-0.17	-0.088	-0.098	-0.17	-0.096	-0.11	-0.10	-0.10
	(0.054)	(0.043)	(0.041)	(0.062)	(0.049)	(0.046)	(0.045)	(0.044)
Post x US x CostShock	-0.30	-0.28	-0.27	-0.39	-0.16	-0.33	-0.31	-0.21
	(0.10)	(0.093)	(0.091)	(0.096)	(0.11)	(0.093)	(0.091)	(0.094)
US x ChinaShock						0.63		
						(0.99)		
Post x US x ExpenditureShock							0.020	-0.092
							(0.052)	(0.066)
Post x US x Final								0.040
								(0.016)
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	IV	OLS	OLS
Kleibergen-Paap F-stat.						12.1		
Observations	69,003	1,762,374	1,978,551	931,509	903,938	998,539	1,010,551	1,010,551
R-squared	0.42	0.48	0.48	0.51	0.50		0.50	0.50

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Third market competition

Dependent variable	Δ Log Exports			
Sample	NAICS industries		HS 6-digit products	
	Initial China import share in destination	Δ China import share in destination	Initial China import share in destination	Δ China import share in destination
	(a)	(b)	(c)	(d)
Post x US x NTRGap	-0.12	-0.11	-0.050	-0.051
	(0.049)	(0.049)	(0.022)	(0.021)
Post x US x China Market Share	0.0032	-0.31	0.032	0.0094
	(0.077)	(0.60)	(0.033)	(0.20)
Post x US x NTRGap x China Market Share	0.33	0.72	-0.028	-0.014
	(0.25)	(1.91)	(0.094)	(0.57)
Fixed effects	Yes	Yes	Yes	Yes
Industry controls	Yes	Yes	No	No
Observations	1,010,551	1,010,551	3,031,300	3,031,300
R-squared	0.50	0.50	0.53	0.53

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HS 6-digit sectors

Dependent variable	Δ Log Exports			
	US exports only	OECD exporters	OECD exporters, within NAICS industries	OECD exporters, within NAICS manufacturing industries
	(a)	(b)	(c)	(d)
Post x US x NTRGap	-0.082	-0.054	-0.045	-0.051
	(0.013)	(0.014)	(0.020)	(0.020)
Fixed effects				
Importer-exporter-sector	Yes	Yes	Yes	Yes
Importer-exporter-period	Yes	Yes	Yes	Yes
Importer-sector-period	No	Yes	Yes	Yes
NAICS industry-exporter-period	No	No	Yes	Yes
Observations	363,775	3,658,798	3,172,658	3,031,300
R-squared	0.36	0.52	0.53	0.53

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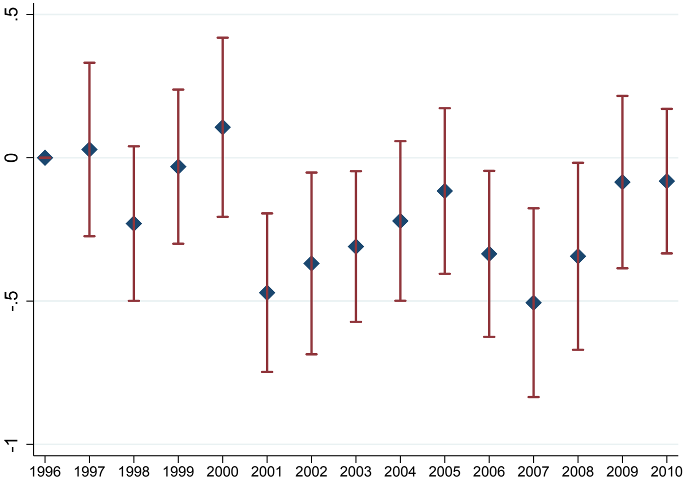
Event study

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



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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 $\hat{\varphi}_{US-China,s} = \exp\left(7 \times \alpha_5 \times NTRGap_s\right)$

PNTR shock

Dependent variable	Δ Log Trade				
	(a)	(b)	(c)	(d)	(e)
Post x US Importer x China Exporter x NTRGap	0.43	0.41	0.33	0.39	0.54
	(0.13)	(0.14)	(0.14)	(0.15)	(0.40)
Post x US Importer x China Exporter x NTRGap Squared					-0.24
					(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

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Welfare decomposition

Real income change

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

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

$\Rightarrow$ Specialization effect only exists because of scale economies

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Alternative calibrations

	Baseline	No scale economies	No input-output linkages	Scale economies in services	23 sectors	Heterogeneous elasticities
	(a)	(b)	(c)	(d)	(e)	(f)
Total exports	3.2	2.5	3.2	3.2	3.4	3.0
of which: Real market potential effect	*-1.8*	*n/a*	*-0.17*	*-2.4*	*-1.7*	*-1.4*
Input cost effect	*2.4*	*0.53*	*n/a*	*3.1*	*2.3*	*2.7*
Foreign demand effect	*2.7*	*1.9*	*3.4*	*2.6*	*2.9*	*1.8*
Simulated NTR gap effect	-0.10	0.0075	-0.079	-0.10	-0.098	-0.071
Goods output	-0.55	-0.36	-0.36	-0.61	-0.49	-0.25
Services output	0.11	0.075	0.12	0.12	0.13	0.054
Real income	0.068	0.10	0.037	0.10	0.071	0.027
of which: ACR effect	*0.22*	0.10	*0.067*	*0.24*	*0.19*	*0.13*
Specialization effect	*-0.15*	*n/a*	*-0.030*	*-0.14*	*-0.11*	*-0.10*

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