Trade and Growth Redux

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Two questions

1. What are the welfare gains from trade in the data? Where do they stand against trade models?
2. What are the causal effects of trade on income?

- But identification is difficult.

Summary of Findings

- Average welfare gains of 29.2–35.4% from trade for 171 countries

- GFT estimates align between the Krugman model and the Melitz model with multiple sectors, intermediate goods, and homogeneous or heterogeneous firms.

Summary of Findings

- As openness increases by 1%p, real GDP per capita increases by 1.11% to 1.47%.
- Income elasticity is smaller than previous findings (Felbermayr and Gröschl, 2013; Feyrer, 2019; Frankel and Romer, 1999).

Literature Review

- Costinot and Rodríguez-Clare (2014)
  - GFT numbers vary across classes of computable general equilibrium trade models.
  - Their goodness of fit in time series has been rather poor.
  - Don’t know which model fits the data.

Literature Review

- Frankel and Romer (1999)
  - Use 1985 cross-sectional data
  - Introduce an instrumental variable (IV) based on a gravity regression of bilateral trade on geographical components
  - Large effects, but the statistical significance is marginal.
  - IV suffers from the violation of exclusion restriction (Rodríguez and Rodrik, 2000)

Literature Review

- Panel data with time-varying IV
  - Felbermayr and Gröschl (2013): Exogenous variations in natural disasters in foreign countries
  - Feyrer (2019): Effective geographical distance is time varying as improvements in aircraft technology increases airborne shipments relative to sea-borne shipments.

Contributions

- Use the ACR equation (Arkolakis, Costinot, and Rodríguez-Clare, 2012) as an estimator to empirically get GFTs and evaluate quantitative trade models
- Provide new evidence on income elasticity with a new time-varying IV

ACR Framework

- In a one-sector model, welfare depends on domestic sales sh are (DSS, π) and trade elasticity (ε)

$$\Delta \ln(w) = \frac{1}{\varepsilon} \Delta \ln(\pi) .$$

- Income elasticity is dictated by $\varepsilon = [-10, -5]$.

→ Very small income elasticity of 0.2 at most.

ACR Framework

- Adding intermediate goods in the one-sector model

$$\Delta \ln(w) = \frac{1}{\varepsilon\beta} \Delta \ln(\pi) \text{ under perfect competition;}$$

$$\Delta \ln(w) = \frac{1}{\varepsilon\beta - (1-\beta)\left(\frac{\varepsilon}{\sigma-1}+1\right)+(1-k)} \Delta \ln(\pi) \text{ under monopolistic competition}$$

β: share of intermediate goods in marginal costs
σ: elasticity of substitution between goods
k: share of intermediate goods in fixed entry costs

ACR Framework

- Income elasticity can be large depending on models.
- The extent of the effects of trade on income is an empirical question.
- Reduced-form results are valuable in evaluating various quantitative trade models.

Identification Strategy

- ACR equation as a reduced-form equation

$$\ln(GDPPC_{it}) = \alpha + \beta \ln(DSS_{it}) + \theta_i + \theta_t + u_{it}$$

where DSS=(GDP-exports)/GDP or 1-import penetration ratio

- Also, consider openness: (imports+exports)/GDP
  - Alternatively, use 'real openness' (Alcalá and Ciccone, 2004)

Endogeneity of Trade

- Omitted variable problem
  - Time invariant factors: geography, historical ties …
  - Time-varying factors: policy reforms, productivity spillovers …
- Reverse causality
- Address endogeneity using a time-varying IV

Time-varying Instrument

- Based on the Head-Ries index of bilateral trade integration (Eaton et al., 2011; Egger et al., 2019)
- A gravity equation of i's imports from j

$$X_{ijt} = K_{ijt}\gamma_{jt}\delta_{it}$$

- Some operations

$$\frac{X_{ijt}}{X_{iit}} = \frac{K_{ijt}\gamma_{jt}\delta_{it}}{K_{iit}\gamma_{it}\delta_{it}} = \frac{K_{ijt}\gamma_{jt}}{K_{iit}\gamma_{it}}.$$

- Do the same for X_{jit} and get bilateral trade costs

$$K_{ijt}K_{jit} = \frac{X_{ijt}}{X_{iit}}\frac{X_{jit}}{X_{jjt}}.$$

Time-varying Instrument

- Aggregate over all partner countries

$$\lambda_{it} = \sum_{j \neq i} K_{ijt} K_{jit} = \sum_{j \neq i} \frac{X_{ijt}}{X_{iit}} \frac{X_{jit}}{X_{jjt}}.$$

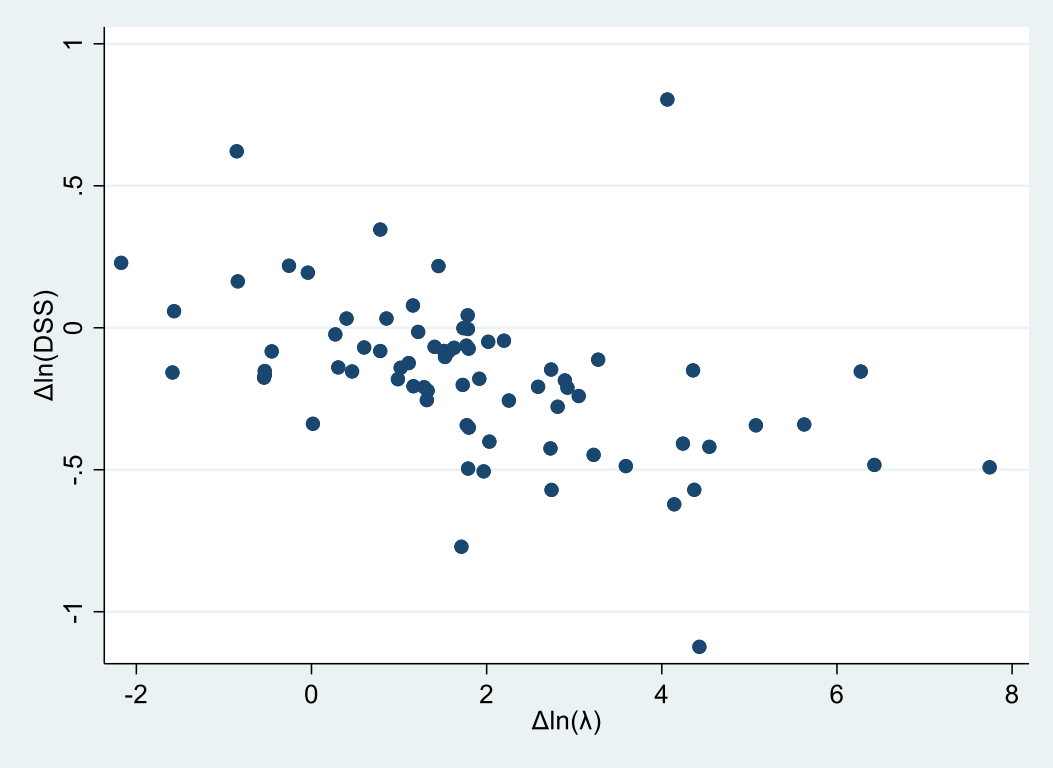
- This is the inverse of multilateral trade costs. → λ_{it} is (negatively) correlated with DSS.
- Country-specific time-varying variation is removed! → λ_{it} is exogenous.

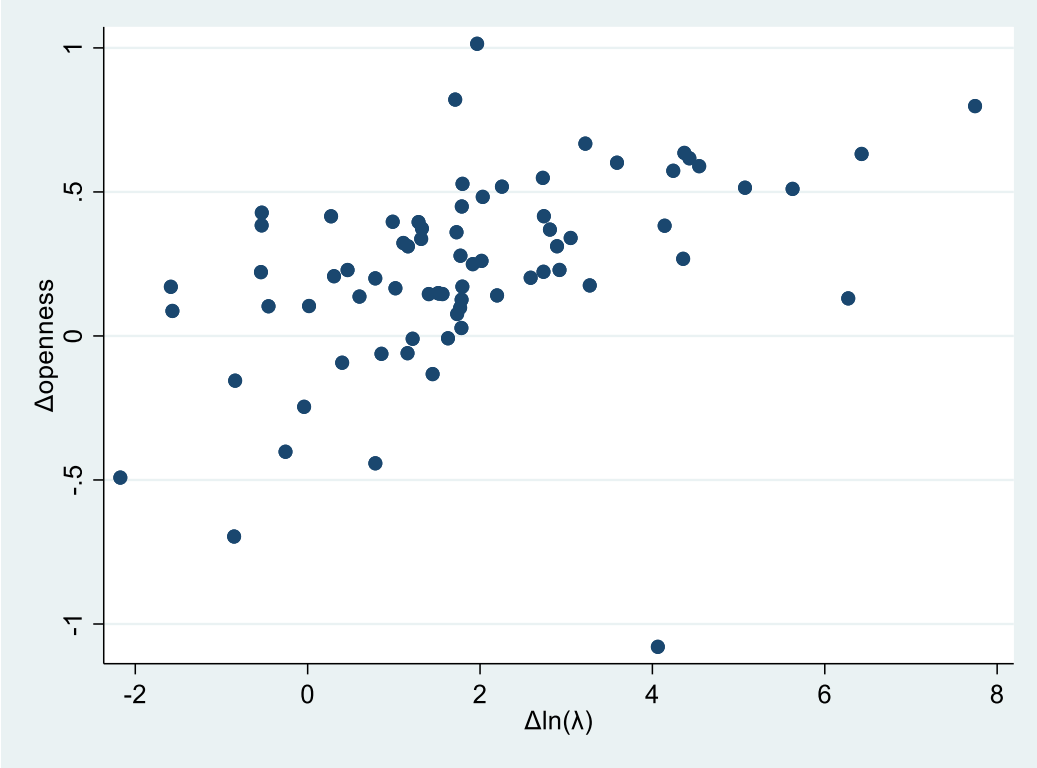
Data Overview

- Unbalanced panel for 183 countries over 70 years(1950–2019)
- Use every 5 year observations; 15 time points

- Income data from PWT
- Trade data from PWT and IMF DOTS

First Pass: IV and DSS (Openness)





Results - DSS

- OLS: coefficient: -0.24
- IV: coefficient: -0.76 to -0.85
  - Cf. A one-sector model, income elasticity = [-0.2, -0.1]
- First-stage F-stat > 50 → strong instrument

Results on domestic sales share

	OLS	TSLS		TSLS	
		1st stage	2nd stage	1st stage	2nd stage
	(1)	(2)	(3)	(4)	(5)
ln(DSS)	-0.244***		-0.757***		
	(0.066)		(0.162)		
ln(λ)		-0.096***		-0.086***	
		(0.013)		(0.014)	
ln(1-imp. pen. ratio)					-0.848***
					(0.199)
Observations	1,908	1,908	1,908	1,908	1,908
R^2	0.568	0.242		0.230	
Partial R^2		0.200		0.180	
Countries	176	176	176	176	176
First-stage F statistic			51.4		39.0
Country fixed effect	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes

GFT Estimates

- Apply estimated elasticities to get GFTs
- Average GFTs for the full sample (171 countries): 29.2-35.4%

- Average GFTs for 31 countries of Costinot and Rodríguez-Clare (2014): 33-36.2%
- Costinot and Rodríguez-Clare's counterfactual predictions: 4.3-41.1%
- Reduced-form estimates sit between the Krugman model and the Melitz model

GFT Comparison (selected)

	Prediction from quantitative trade models				Reduced-form evidence	
	One sector	Multiple sector with intermediates				
		PC	MC (Krugman)	MC (Melitz)	GFT1	GFT2
Country	(1)	(2)	(3)	(4)	(5)	(6)
Brazil	1.5	6.4	9.7	12.7	10.8	12.4
Canada	3.8	29.5	33.0	39.8	24.2	28.0
China	2.6	11.2	28.0	77.9	14.2	14.9
Germany	5.8	45.0	42.0	44.8	35.5	37.0
Spain	3.1	17.5	24.4	30.5	26.4	27.9
France	3.0	16.8	25.8	32.1	24.1	27.5
United Kingdom	3.2	22.4	22.2	23.5	23.6	27.2
Indonesia	2.9	11.6	11.2	14.6	13.9	15.9
India	2.4	8.6	9.5	11.7	13.5	16.9
Italy	8.0	38.9	28.1	29.1	23.8	24.9
Japan	1.7	3.5	20.7	32.7	13.2	14.7
Republic of Korea	4.3	11.4	44.1	70.2	30.2	32.4
Netherlands	3.3	18.6	24.3	28.4	63.1	69.0
Russian Federation	2.4	30.7	-2.1	-7.1	21.5	19.1
Slovakia	7.6	50.5	78.6	96.4	70.0	78.4
Sweden	5.1	23.6	36.6	45.8	35.6	38.2
United States	1.8	8.0	8.6	10.3	8.9	12.0
Average	4.3	27.6	33.3	41.1	33.0	36.2

Results - Openness

- OLS: 0.32
- IV: 1.11 (nominal openness), 1.47 (real openness)
- Previous findings
  - Frankel and Romer (1999) 1.97–2.96
  - Felbermayr and Gröschl (2013) 1.25–1.76
  - Feyrer (2019) 1.8–5.5

- Income elasticities are rather smaller and more precisely esti mated.
- The IV is quite strong.

Results on openness

	OLS	TSLS		TSLS	
		1st stage	2nd stage	1st stage	2nd stage
	(1)	(2)	(3)	(4)	(5)
Nominal openness	0.322***		1.113***		
	(0.086)		(0.185)		
ln(λ)		0.065***		0.049***	
		(0.006)		(0.007)	
Real openness					1.471***
					(0.284)
Observations	1,907	1,907	1,907	1,907	1,907
R^2	0.564	0.325		0.181	
Partial R^2		0.197		0.066	
Countries	176	176	176	176	176
First-stage F statistic			105.4		50.9
Country fixed effect	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes

Robustness Checks

- First-difference models → much smaller effects
- Different real GDP series → similar results
- Shorter periods (1950-2008) → similar results
- Balanced panel (but smaller obs.) → much larger effects
- Control for region (region×year FE) → similar coefficients

First-difference Estimation

	OLS	TSLS		OLS	TSLS	
		1st stage	2nd stage		1st stage	2nd stage
	(1)	(2)	(3)	(4)	(5)	(6)
Δln(DSS)	-0.054*		-0.249***			
	(0.028)		(0.089)			
Δln(λ)		-0.080***			0.052***	
		(0.014)			(0.006)	
ΔNominal openness				0.031		0.379***
				(0.048)		(0.107)
Observations	1,707	1,707	1,707	1,706	1,706	1,706
R^2	0.083	0.127		0.077	0.155	
Partial R^2		0.113			0.125	
Countries	176	176	176	176	176	176
First-stage F statistic			32.9			87.1
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes

Conclusion

- Take the ACR equation as an estimating equation
- Introduce a new time-varying instrument
- Reduced-form GFT evidence provides guideline for quantitative trade models
- Income elasticities are a bit smaller than previous findings