

Gravity with History: On Incumbency Effects in Aggregate Trade

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Motivation

- Countries open up to trade gradually over time
- Sequential trade opening may create advantage for incumbent firms
 - E.g., exit probability negatively correlated with market tenure
- RQ: How does the history of trade liberalizations shape trade flows today?
 - ⇒ Focus on timing of trade liberalizations & aggregate impact

Overview and Main Findings

- Introduce incumbency effects into dynamic variant of Melitz (2003) model
 - Nests canonical (static) version as a special case
- Basic idea:
 - Incumbency effects $\Rightarrow$ fewer exit and hence entry upon trade liberalization
 - Incumbency effects can therefore lead to path dependence in international trade (Baldwin 1988, Alessandria et al 2021)
- Main findings:
 - Derive gravity equation $\Rightarrow$ trade not only impacted by trade frictions today, but by incumbency effects (history)
 - Can help explain 'home bias' in international trade and long lasting effects of historic events on trade (e.g. Colonial Ties, Iron Curtain)
 - Supportive evidence on main mechanism using data on average firm sales

Literature

Dynamic gravity

Allen & Donaldson (2020), Caliendo et al (2020), Buera and Oberfield (2020), Atkin et al (2021)

Incumbency effects in trade

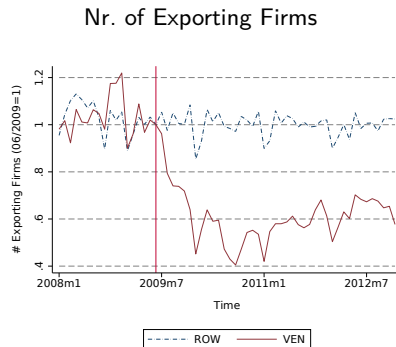
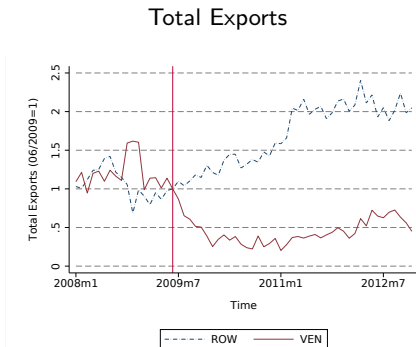
Baldwin (1988), Baldwin & Krugman (1989), Dixit (1989), Constantini & Melitz (2007), Das et al. (2007), Burstein & Melitz (2013), Eaton et al. (2014), Fitzgerald et al. (2016), Ruhl and Willis (2017), Alessandria & Choi (2014), Alessandria et al. (2014), Impullitti et al. (2013), Alessandria et al (2021)

Outline

- 1 Introduction
- 2 Motivating Fact
- 3 Theory
- 4 Empirics
- 5 Conclusion
- 6 Appendix

Motivating Fact: Firm tenure and exit

- Are firms with higher tenure less likely to exit a market in response to a shock (controlling for size)?
 - ⇒ Colombian firm-product-destination level exports (1994–2013)
 - ⇒ 2009 negative shock on exports to Venezuela Colombian firm-product-destination level exports (1994–2013)



Motivating Fact: Firm tenure and exit

- Exit regression:

$$y_{fp} = \lambda_{fp}'\alpha + \mathbf{x}_{fp}'\beta + \mathbf{d}_{pq} + \mathbf{d}_f + \epsilon_{fp} ,$$

y_{fp} 1 if firm f stops exporting product p in response to shock and 0 otherwise

λ_{fp} set of tenure dummies

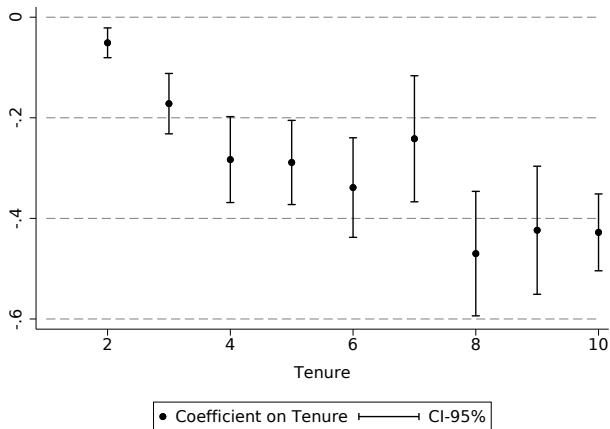
$\mathbf{x}_{fp}$ log sales (with product-sales quintile specific coefficient)

$\mathbf{d}_{pq}$ product-sales quintile FE

$\mathbf{d}_f$ firm FE

Motivating Fact: Firm tenure and exit

Figure: Firm Exit in Response to Venezuela Shock



Simple Example (i/ii)

- Textbook Melitz model with CES preferences
 - Two perfectly symmetric countries
 - No variable trade cost: $\tau = 1$
 - Fixed market access cost f (same home and abroad)
- $\Rightarrow \frac{X_{ij}}{X_j} = \frac{1}{2}$

Simple Example (ii/ii)

- Suppose f decreasing with tenure: αf after t periods, $\alpha \in (0, 1)$
- Countries start out under autarky, and open up to trade after t periods.

- Domestic firms will continue serving home market if

$$\pi_{ii}^v(\varphi) \geq \alpha f$$

$$\Rightarrow \pi_{ii}^v(\varphi_d) = \alpha f,$$

where $\pi_{ii}^v(\cdot)$ are variable profits

- Foreign firms will enter if (myopic, for simplicity)

$$\pi_{ji}^v(\varphi_x) = f.$$

- This implies:

$$\left(\frac{\varphi_d}{\varphi_x} \right)^{\sigma-1} = \alpha, \quad \sigma > 1$$

$\Rightarrow$ Selection into exporting and home bias.

Model (i/iii)

Dynamic Melitz-Chaney model

- I countries, indexed by $i, j \in \mathcal{I}$
 - exporter i , importer j
- Each populated by a continuum of infinitely lived households, L_i .

Preferences:

$$U_i = \sum_{t=0}^{\infty} (\beta)^t C_i^t$$

$$C_i^t = \left[\int_{\omega \in \Omega_i^t} q_i^t(\omega)^{(\sigma-1)/\sigma} d\omega \right]^{\sigma/(\sigma-1)}, \quad \sigma > 1.$$

Model (ii/iii)

- Monopolistic competition
- Firm productivities Pareto distributed

$$G(\varphi) = 1 - \left(\frac{\varphi}{\underline{\varphi}} \right)^{-\theta}, \quad \text{for } \varphi \geq \underline{\varphi}$$

- Fixed market access cost: $f_{ij}^t(\lambda) = f_{ij} w_i^t f(\lambda)$
 - f_{ij} units of domestic labor paid in every period serving market j
 - Equip workers with resources invested in CES aggregator
 - $f(\lambda) \geq 1$ and $f'(\cdot) \leq 0$, where λ is market tenure

Model (iii/iii)

- Free entry: Fixed entry cost paid as perpetual annuity of f_{ei} units of domestic labor
- Market entry and exporting forward-looking (not anticipating trade shocks):
 - Let $\tilde{f}_{ij}^t(\lambda)$ denote an annuity with time t present value equal to stream of fixed market access costs
 - Analogous for $\tilde{f}_{ei}^t$ and $\tilde{\pi}_{ij}^{v,t}$ ► Definition
 - Zero-profit cutoff condition for firms with tenure λ

$$\tilde{\pi}_{ij}^{v,t}(\varphi_{ij}^{\lambda,t}) = \tilde{f}_{ij}^t(\lambda)$$

- Free-entry condition

$$\sum_{j \in \mathcal{I}} \int_{\varphi_{ij}^{0,t}}^{\infty} \left[\left(\frac{\varphi}{\varphi_{ij}^{0,t}} \right)^{\sigma-1} - 1 \right] \tilde{f}_{ij}^t(0) g(\varphi) d\varphi \begin{cases} \leq \tilde{f}_{ei}^t & \text{if } M_{ei}^t = 0 \\ = \tilde{f}_{ei}^t & \text{if } M_{ei}^t > 0 \end{cases}$$

Equilibrium

Lemma (1)

For a given mass of firms, aggregate expenditure in country i is a constant-over-time multiple of the wage rate

► Aggr. Expenditure

Lemma (2)

Let there be a trade shock at time t . Then firm sales, prices, wages, and interest rates adjust at time t and are then constant over time.

Equilibrium

Lemma (3)

All firms are born at $t = 0$. The mass of entrants in country i is

$$M_{ei}^0 = \frac{L_i}{f_{ei}} \frac{\tilde{f}(0)(\sigma - 1)}{(\sigma - 1) \left[(\theta + 1)\tilde{f}(0) - 1 \right] + \theta},$$

where

$$\tilde{f}(0) := \left[\sum_{\lambda=0}^{\infty} f(\lambda) \left(\frac{1}{1+r} \right)^{\lambda} \right] \frac{r}{1+r}.$$

► Details

Gravity with Sequential Trade Opening

Proposition

For any history of trade liberalizations, suppose that at time t there is a shock to the trade environment. Then bilateral trade shares are

$$\frac{X_{ij}^t}{X_j^t} = \frac{\frac{L_i}{f_{ei}} (\tau_{ij}^t)^{-\theta} (w_i^t)^{\frac{\sigma-1-\sigma\theta}{\sigma-1}} (f_{ij} \tilde{f}(\hat{\lambda}_{ij}^t))^{\frac{\sigma-1-\theta}{\sigma-1}}}{\sum_{k \in \mathcal{I}} \frac{L_k}{f_{ek}} (\tau_{kj}^t)^{-\theta} (w_k^t)^{\frac{\sigma-1-\sigma\theta}{\sigma-1}} (f_{kj} \tilde{f}(\hat{\lambda}_{kj}^t))^{\frac{\sigma-1-\theta}{\sigma-1}}} \quad \forall i, j,$$

- $\hat{\lambda}_{ij}^t$: incumbency effect for trade from i to j

Gravity Regression

- Log trade flows are additively separable into exporter-specific terms, importer-specific terms, bilateral (fixed and variable) trade costs, and a bilateral tenure term

$$\log(X_{ij}) = \overbrace{\log\left(\frac{L_i}{f_{ei}}(w_i)^{\frac{\sigma-1-\sigma\theta}{\sigma-1}}\right)}^{\equiv E_i} + \overbrace{\log\left(X_j \left[\sum_{k \in \mathcal{I}} \frac{L_k}{f_{ek}}(\tau_{kj})^{-\theta}(w_k)^{\frac{\sigma-1-\sigma\theta}{\sigma-1}}(f_{kj}\tilde{f}(\lambda_{kj}))^{\frac{\sigma-1-\theta}{\sigma-1}}\right]^{-1}\right)}^{\equiv M_j} \\ - \left[\overbrace{\theta \log(\tau_{ij})}^{TC_{var}} + \overbrace{\frac{\theta - (\sigma - 1)}{\sigma - 1} \log(f_{ij})}^{TC_{fix}} + \overbrace{\frac{\theta - (\sigma - 1)}{\sigma - 1} \log(\tilde{f}(\lambda_{ij}))}^{history} \right].$$

Gravity Regression

- Can be estimated using a standard gravity regression with
 - Exporter and importer FEs
 - Proxies for bilateral trade frictions
 - New: Additional tenure effect
- Exploit two historic events
 - Colonial Ties
 - Iron Curtain
- Control for whether pair of countries had 'Colonial Ties' and for whether pair of countries was separated by 'Iron Curtain'
- Estimate using data from the Atlas of Economic Complexity and CEPII

[▶ details](#)

Gravity Regression

	Main Specification		Robustness			
	(1)	(2)	(3)	(4)	(5)	(6)
Sep. by Iron Curtain	-0.572*** (0.096)	-0.628*** (0.099)	-0.572*** (0.090)	-0.553*** (0.087)	-0.930*** (0.142)	-0.418*** (0.124)
Colonial Ties	0.781*** (0.095)	0.534*** (0.096)	0.507*** (0.096)	0.497*** (0.098)	0.949*** (0.232)	0.935*** (0.240)
Baseline Controls		✓	✓	✓	✓	✓
Tariffs & NTMs			✓	✓		
CIF/FOB Ratio				✓		
Comext Data					✓	✓
Mean of Dep. Var.	2.469	2.682	2.742	2.918	2.347	2.024
Adj. R-squared	0.737	0.765	0.782	0.796	0.802	0.799
Nr. of Observations	19,847	17,153	16,195	14,511	6,954	6,849

Notes. Standard errors clustered at both the importer and exporter level are reported in parentheses. All regressions include importer and exporter fixed effects.

* significant at 10%-level; ** significant at 5%-level; *** significant at 1%-level.

Revealed Changes in Incumbency Effects

- Tight connection between the fixed costs of serving a market and the average firm sales in that market

$$\bar{r}_{ij}^t = \frac{\sigma\theta}{\theta - (\sigma - 1)} f_{ij} w_i^t \tilde{f}(\hat{\lambda}_{ij}^t),$$

- Log differences

$$\Delta \log [\bar{r}_{ij}^t] = \Delta \log [w_i^t] + \Delta \log [\tilde{f}(\hat{\lambda}_{ij}^t)] \quad \forall (i, j) \in \mathcal{I} \times \mathcal{I}$$

- Change in *incumbency effect* revealed through change in average firm sales
- Theory predicts: Incumbency effect becomes less important for trade from i to j in response to a positive trade shock

Revealed Changes in Incumbency Effects

- Consider large tariff cut (top quartile) between i and j
- Compare evolution of average firm sales from i to j to evolution of average firm sales from $k \neq i$ to j (Restrict k 's to countries with non-negative tariff changes)
- Estimation equation

$$\Delta^2 \log [\bar{r}_{ij,g}^{t+2}] = \phi \times \mathbb{1}[\text{Tariff Cut in the Top Quartile from } t \text{ to } t+1]_{ij,g} + E_{i,g}^{t+2} + M_{i,g}^{t+2} + \varepsilon_{ij,g}^{t+2},$$

- $\Delta^2 \log [\bar{r}_{ij,g}^{t+2}] := \log [\bar{r}_{ij,g}^{t+2}] - \log [\bar{r}_{ij,g}^t]$: log-change from t to $t+2$ in average firm sales from i to j in sector g
- $E_{i,g}^{t+2}$, $M_{i,g}^{t+2}$: exporter-sector-year and importer-sector-year FEs
- Estimate at 2-digit HS level using unbalanced panel for 1997 to 2014 from Exporter Dynamics Database and from WITS

Revealed Changes in Incumbency Effects

Dep. Var.: Log-Change in Av. Firm Sales from t to $t+2$					
Control Group: No Tariff Cuts from $t-1$ to $t+2$					
	Main Specification			Robustness	
				90% Wins.	Pair-Year FE
1[Tariff Cut]	0.098*** (0.016)	0.089*** (0.016)	0.075** (0.033)	0.059** (0.026)	0.063 (0.072)
Sector-Year FE	✓				
Exp-Sector-Year FE		✓	✓	✓	✓
Imp-Sector-Year FE			✓	✓	✓
Mean of Dep. Var.	0.094	0.093	0.091	0.090	0.089
Adj. R-squared	0.023	0.081	0.091	0.100	0.106
Nr. of Observations	191,979	187,429	151,694	151,694	145,762

Notes. Standard errors clustered at the exporter-sector, importer-sector, and exporter-importer levels are reported in parentheses.

* significant at 10%-level; ** significant at 5%-level; *** significant at 1%-level.

Conclusion

- Accounting for sequential trade liberalization in gravity models is important
- Delay in becoming integrated into global economy may have long-lasting effects
- Less exit by domestic firms after trade liberalizations relative to standard model
- Contribute to our understanding of home bias (and 'missing' gains from trade)

Appendix: Inter-temporal Optimization

► Main text

Inter-temporal optimization yields:

$$1 = \beta \mathbb{E}_t \left[(1 + r_i^t) \frac{P_i^t}{P_i^{t+1}} \right].$$

Appendix: Aggregate Expenditure

► Main text

Aggregate expenditure:

$$X_i^t = \frac{\sigma}{\sigma - 1} w_i^t \left[L_i - \sum_{s=0}^t \left[M_{ei}^s \left[f_{ei} + \int_{\varphi \in \Phi} \sum_{j \in \mathcal{I}^t(i, s, \varphi)} f_{ij} g(\varphi) d\varphi \right] \right] \right].$$

Appendix: Aggregate Expenditure

► Main text

- Lemmata 1 and 2 imply that entry and market-access costs are exogenously given multiples of the wage rate

$$\begin{aligned}\tilde{f}_{ei}^t &= f_{ei} w_i^t \\ \tilde{f}_{ij}^t(0) &= f_{ij} w_i^t \tilde{f}(0),\end{aligned}$$

where

$$\tilde{f}(0) := \left[\sum_{\lambda=0}^{\infty} f(\lambda) \left(\frac{1}{1+r} \right)^{\lambda} \right] \frac{r}{1+r}.$$

is an ‘annuity’ for the tenure-dependent multiplier of market-access costs, evaluated at the equilibrium interest rate $r := \frac{1}{\beta} - 1$.

- $\Rightarrow$ allows solving for the mass of entering firms analogous to canonical Melitz model.

Appendix: Annuity

► Main text

$$\tilde{f}_{ei}^t := \left(f_{ei} \sum_{\varsigma=t}^{\infty} \mathbb{E}_t [w_i^{\varsigma} R_i^{t,\varsigma}] \right) \left(\sum_{\varsigma=t}^{\infty} \mathbb{E}_t [R_i^{t,\varsigma}] \right)^{-1}$$

$$\tilde{f}_{ij}^t(\lambda) := \left(f_{ij} \sum_{\varsigma=t}^{\infty} f(\lambda + (\varsigma - t)) \mathbb{E}_t [w_i^{\varsigma} R_i^{t,\varsigma}] \right) \left(\sum_{\varsigma=t}^{\infty} \mathbb{E}_t [R_i^{t,\varsigma}] \right)^{-1},$$

Appendix: Iron Curtain (i/i)

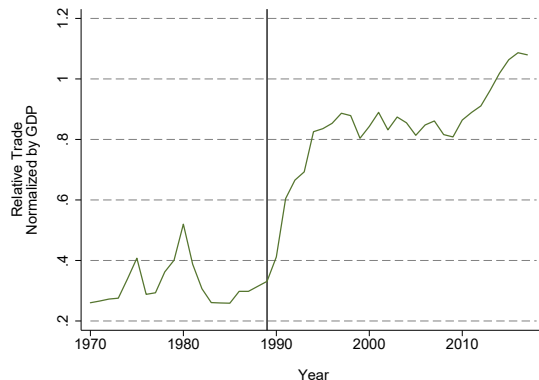
[▶ Main text](#)

Figure: Average Trade Flows between OECD and Iron Curtain Countries relative to Average Intra-OECD Trade – (OECD members that joined before 1991)