International Trade and Macro: Exporter life cycles

Model and Trade Costs

1. Focus on how models have been used to recover trade costs across time, industries, and countries.

Model outline

1. Basic Model (Das et al., 2007; Alessandria and Choi, 2007; Alessandria and Choi, 2014b; Alessandria and Choi, 2014a)
2. Relaxing the trade cost assumptions (Ruhl and Willis, 2017; Alessandria et al., 2021; Alessandria and Avila, 2020)
3. Customer accumulation (Fitzgerald et al., 2016; Piveteau, 2021; Ruhl and Willis, 2017; Rodrigue and Tan, 2019; McCallum, 1995; Steinberg, 2021)
    - Sunk-cost models get many things right; imply large sunk costs
    - Miss on the dynamic trajectories of exporters

- How does the exporter life cycle change our estimates of trade costs?

Micro-Dynamics: Successes, Failures, and Fixes

- Basic model captures exporter cross-section and dynamics, but what about other features?

1. **Employment & Sales Growth w Changes in Export Status**
   - Growth rates vary w/Δ in status: Bernard and Jensen (1999)

2. **Export Persistence at Longer Horizons**
   - Frequent re-entry: Roberts and Tybout (1997); Bernard and Jensen (2004)

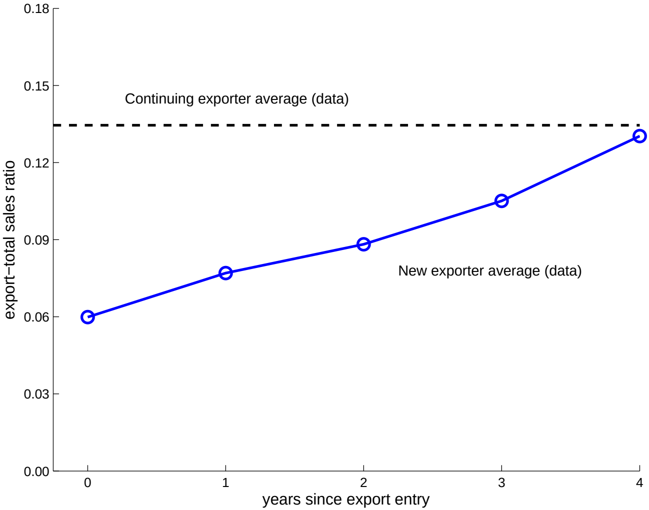
3. **New Exporter Growth**
   - Export intensity grows w/time in market: Ruhl and Willis (2017)

- Will focus on models of #3 today.

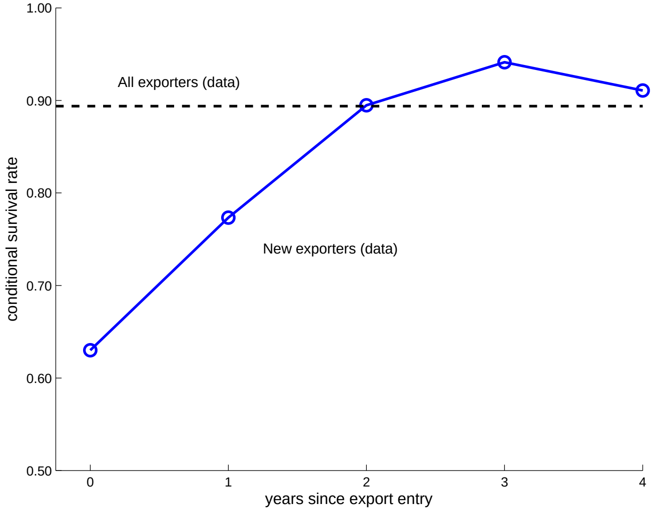
The discrete nature of entry

- Model: fixed entry cost induces a discrete choice between exporting and not exporting
- Evidence from export volume
  - 70–80 percent of plants export nothing
  - Initial growth is discrete
  - Smooth adjustment afterward
- Evidence from export persistence
  - 89 percent of plants exporting in t export in $t + 1$
  - New exporter survival much lower
- Robust to industry, cohort effects (in paper)

Average export to total sales ratio



Conditional survival rate



The discrete nature of entry

- Compare these dynamics to a standard PE sunk-cost model
  - Shocks to firm productivity and exchange rates (ϵ, Q)
  - Fixed cost and sunk-cost to export (f_0, f_1)
- Start with a "standard calibration"

Estimation preliminaries

- Quarterly model; aggregate to yearly to compare to data
- Parameters that can be set without solving the model

Parameter	Value	Target
r (annual)	0.109	Average observed interest rate
ρ_Q	0.826	Real effective exchange rate
σ_Q	0.036	Real effective exchange rate
α_N	0.450	Labor share of income
α_K	0.550	Plant-level returns to scale
θ	5.0	Elasticity of substitution

Parameters to estimate

Parameter	Description
ρ_ϵ	Idiosyncratic shock persistence
σ_ϵ	Idiosyncratic shock std
f_0	Export entry cost
f_1	Export continuation cost
C^*	Foreign demand scale

- Parameter vector: $\phi = (\rho_\epsilon, \sigma_\epsilon, f_0, f_1, C^*)$
- Choose parameters to solve:

$$L(\phi) = \min_{\phi} (m_s(\phi) - m_d)' W (m_s(\phi) - m_d),$$

Identification

- Idiosyncratic shock process $(\rho_\epsilon, \sigma_\epsilon)$ mostly determine
  - Size distribution of plants: std(employment)/mean(employment)
  - Serial correlation of plant sales (remove plant and time effects)

$$\log y_{i,t} = \gamma_i + \delta_t + \beta \log y_{i,t-1} + \nu_{i,t},$$

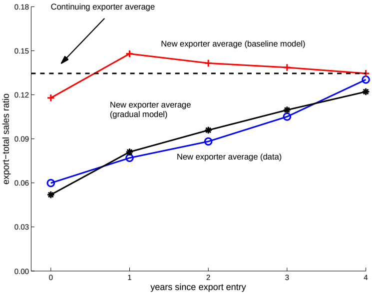
- Continuation cost and entry cost
  - Entry and exit rates
- Foreign demand scale
  - Average export-sales ratio

Estimates

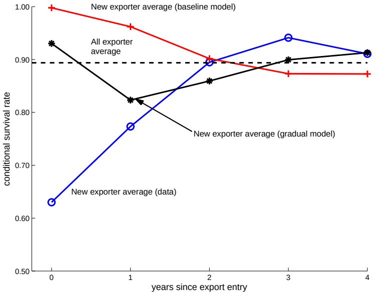
	f_0	f_1	C^*	σ_ϵ	ρ_ϵ
Baseline	0.961 (0.102)	0.047 (0.005)	0.146 (0.010)	0.116 (0.011)	0.873 (0.023)

- Entry and continuation costs in units of median plant sales
  - Export entry almost 1 year's sales
- What drives this result?
  - Discrete nature of entry front-loads profits
  - Autocorrelation of shocks makes first few years great
  - Need large entry costs to offset high value of exporting

New exporter dynamics



(a) Export-sales ratio



(b) Conditional survival rate

- Export sales growth too discrete
- Survival rates counterfactual

Slow growth in export demand

- Standard model is “too discrete”
- Modify export demand to be conditional on exporter age, a

$$c_j^*(a) = \gamma(a) \left(\frac{p_j^*(a)}{P^*} \right)^{-\theta} C^*$$

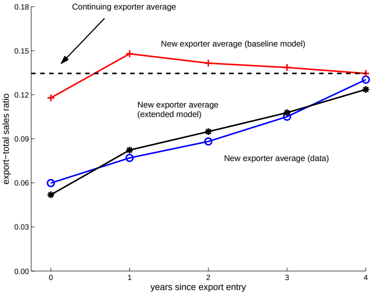
$$\gamma(a) = \begin{cases} \gamma_0 + \gamma_1 \times a & \text{if } a = 0, \ldots, 21 \\ 1 & \text{if } a > 21. \end{cases}$$

- Estimate γ_0 and γ_1 to match slow growth in data
- I-O literature: demand, not supply key for new firms (Foster, Haltiwanger, Syverson 2012)

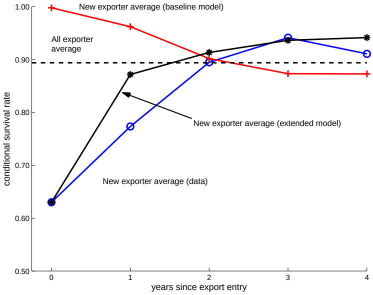
Decreasing export hazard

- Gradual demand model will not capture survival rates
- AR(1) nature of shocks still drive exit
- Need "bad" plants to enter
- With probability ζ_L, $f_0 = 0$; with probability $1 - \zeta_L$, $f_0 = f_H$
- Estimate ζ_L to match first year survival rate (0.63)

New exporter dynamics



(a) Export-sales ratio

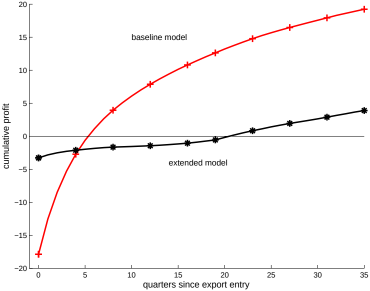


(b) Conditional survival rate

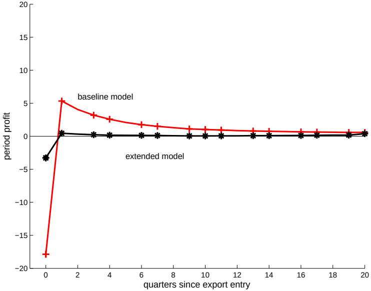
Estimates

	f_0	f_1	C^*	σ_ϵ	ρ_ϵ	γ_0	γ_1	ζ_L
Baseline	0.961	0.047	0.146	0.116	0.873			
	(0.102)	(0.005)	(0.010)	(0.011)	(0.023)			
Gradual	0.286	0.064	0.198	0.116	0.873	0.258	0.024	
	(0.126)	(0.008)	(0.019)	(0.011)	(0.023)	(0.082)	(0.006)	
Extended	0.590	0.057	0.185	0.116	0.873	0.278	0.026	0.009
	(0.479)	(0.006)	(0.017)	(0.011)	(0.023)	(0.146)	(0.009)	(0.003)

Average new exporter profits



(a) Cumulative profits



(b) Flow profits

Export intensity dynamics

- With CES, the export-sales ratio is

$$exs(z, \hat{\xi}) = \frac{(\tau \xi \hat{\xi})^{1-\sigma}}{1 + (\tau \xi \hat{\xi})^{1-\sigma}}$$

- Ruhl and Willis (2017) assume firm enters at ξ_0 and then ξ_a is falling with age, deterministically build export market by continuing to pay f_1
- Alessandria et al. (2021) assume firm enters at $\xi_0 = \xi_H > \xi_L$ and then Markov transition between states; build market share by continuing to pay f_1 but investment is risky
- This pushes more of the export access investment into the future, so need smaller f_0
- Not terribly sophisticated models, but useful when embedding the model into GE with aggregate uncertainty

Export intensity dynamics: Other approaches

- Accumulate customers or build habit (Drozd and Nosal, 2012; Fitzgerald et al., 2016; Piveteau, 2021; Rodrigue and Tan, 2019; Steinberg, 2021)

Customer-acquisition models of exporter dynamics

- Demand for firm's product depends on price (p), trade cost (τ), and customer base (m):

$$d(p, m; \tau) = (p\tau)^{-\theta} m^{\alpha}$$

  - α governs diminishing returns to having more customers

- Firms heterogeneous in productivity (z)

- Assume constant-markup pricing so that flow profits from exporting given by

$$\pi(z, m; \tau) \propto (z/\tau)^{1-\theta} m^{\alpha}$$

- Firm's problem: choose to export/not export to maximize PDV of profits—and possibly, choose how many customers to acquire

- Q: How to model customer aquisition?

Customer-acquisition models of exporter dynamics

- Fitzgerald et al. (2019, 2021): Quadratic adjustment cost
- Piveteau (2020): Word-of-mouth
- Steinberg (2021): Dynamic version of Arkolakis (2010)
- Customer acquisition in other contexts
  - Arkolakis (2010), EKK (2011): static models of how/why exporter distribution varies across bilateral trade relationships
  - Drozd-Nosal (2021): pricing to market, int'l macro puzzles

Fitzgerald et al. (2019, 2021)

- Pay sunk cost s to start exporting with $\underline{\mathrm{m}}$ initial customers (exogenous)
- Pay fixed cost f to continue exporting; if not, lose all customers
- Customer base depreciates at rate δ, grows by investment a

$$m' = (1 - \delta)m + a$$

- Cost of investment:

$$c(m, a) = a + \phi a^2 / m$$

- Dynamic program (V^0: potential exporter, V^1: incumbent):

$$V^0(z) = \max\left\{\mathbb{E}V^0(z'), \pi(z, \underline{\mathrm{m}}; \tau) - s + \mathbb{E}V^1(z', \underline{m})\right\}$$

$$V^1(z) = \max\{\mathbb{E}V^0(z'), \max_m[\pi(z, (1 - \delta)m + a; \tau) - f - c(m, a) + \mathbb{E}V^1(z', (1 - \delta)m + a)]\}$$

Piveteau (2020)

- Pay sunk cost s to start exporting with $\underline{\text{m}}$ initial customers (exogenous)
- Pay fixed cost f to continue exporting; if not, lose all customers
- Customer base growth depends on sales and size of current customer base ("word of mouth")

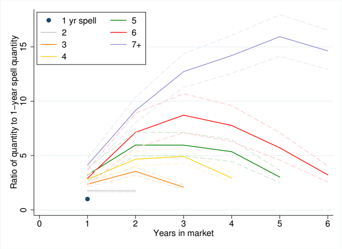
$$m' = 1 - \{1 - \eta_1(1-\psi)pd(p, m; \tau) - \eta_2(1-\psi)m\}^{\frac{1}{1-\psi}} \in (0,1)$$

- No cost of investment (in paper firm can also grow customer base by charging lower prices, and therefore selling more than under constant-markup pricing)

$$V^0(z) = \max\left\{\mathbb{E}V^0(z'), \pi(z, \underline{\text{m}}; \tau) - f + \mathbb{E}V^1(z', \underline{\text{m}})\right\}$$
$$V^1(z) = \max\left\{\mathbb{E}V^0(z'), \pi(z, m'; \tau) - s + \mathbb{E}V^1(z', m')\right\}$$

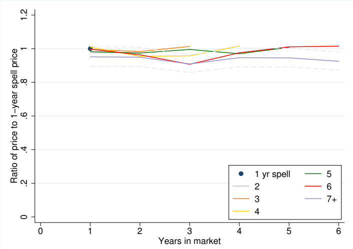
New exporter trajectories

Figure 1: Estimated quantity trajectories



(a) Exports

Figure 2: Estimated price trajectories



(b) Prices

Cross-destination dynamics

- Brazilian data (but similar everywhere)
- Export are concentrated
  - Large firms serving many markets
  - New entrants to a market sell less than incumbents and exit more frequently
- Use cross-destination variation to identify costs
  - Easy markets (large, rich, close): Lower turnover, more successful entry
  - Hard markets (small, poor, far): Higher turnover, harder to break into
- Successful exporters sell more on entry and have more post-entry growth

Steinberg (2021): market penetration dynamics

- No sunk or fixed costs, initial customer base endogenous
- Customer base evolves according to $m' = n + o$, where
  - $n \in [0, 1 - m]$: new customers attracted
  - $o \in [0, m]$ old customers retained
- Attraction/retention costs depend on current customer base:

$$a_n(m, n) = \frac{L^{\alpha_n}(1 - m)^{\beta_n}}{\psi_n(1 - \gamma_n)} \left[1 - \left(\frac{1 - m - n}{1 - m}\right)^{1-\gamma_n}\right]$$

$$a_o(m, o) = \frac{L^{\alpha_o} m^{\beta_o}}{\psi_o(1 - \gamma_o)} \left[1 - \left(\frac{m - o}{m}\right)^{1-\gamma_o}\right]$$

- Given current customer base m, cost of getting to m' given by

$$f(m, m') = \min_{n,o} \{a_n(m, n) + a_o(m, o)\} \quad \text{s.t.} \quad 0 \leq n \leq 1-m, \quad 0 \leq o \leq m,$$

Steinberg (2021): dynamic program

Value function:

$$V(z,m) = \max_{m'} \left\{ \pi(z,m') - f(m,m') + \frac{\delta(z)}{1+R} \mathbb{E}\left[V(z',m')|x,z\right] \right\}$$

Solution:

$$\underbrace{f_2(m,m')}_{\text{marginal cost}} \geq \underbrace{\tilde{\pi} z^{\theta-1}}_{\text{marginal profit}} - \underbrace{\frac{\delta(z)}{1+R}\mathbb{E}\left[f_1(m',m'')|z\right]}_{\mathbb{E}[\downarrow] \text{ in future exporting cost}}$$

- If $m = 0$, enter if $z \geq \underline{z}$:

$$f_2(0,0) = \tilde{\pi}\underline{z}^{\theta-1} - \frac{\delta(z)}{1+R}\mathbb{E}\left[f_1(0,m'')|z\right]$$

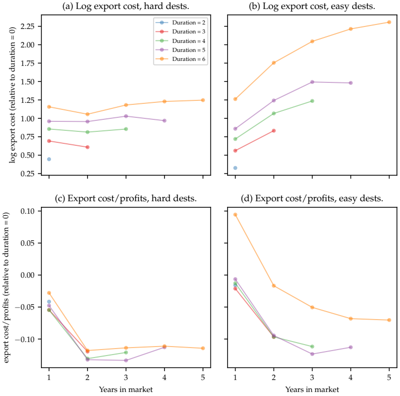
- If $m > 0$, exit if $m \leq \underline{m}(z)$:

$$f_2(\underline{m}(z),0) = \tilde{\pi} z^{\theta-1} - \frac{\delta(z)}{1+R}\mathbb{E}\left[f_1(0,m'')|z\right]$$

Steinberg (2021): key properties

- $f_2(m, 0) > 0$: marginal cost of serving a single customer strictly positive $\Rightarrow$ entry + exit
- $f_{22}(m, m') > 0$: MC increasing in size of new customer base $\Rightarrow$ concentration
- $f_{21}(m, m') < 0$: MC decreasing in size of initial customer base $\Rightarrow$ new exporter dynamics
  - $f_2(0, m') > f_2(m, m')$: Entrant's MC curve higher than incumbent's $\Rightarrow$ entrants start small then grow
  - $f_2(0, 0) > f_2(m, 0)$: Entrant's MC of acquiring single new customer higher than incumbent's MC of keeping single old customer $\Rightarrow$ exit rate $\downarrow$ in m

Steinberg (2021): Calibrated exporting costs



Levels:

- Hard dests: flat w/ time in a market
- Easy dests: ↑ w/ time in a market
- Higher for more successful exporters

Relative to profits:

- ↓ w/ time in a market
- More pronounced ↓ in easy dests.
- $f_2(m, m')/(LY)$ ↓ in L, Y ⇒ variation in exporter dynamics across markets

More models…

- Fixed/sunk costs change with number of destinations served (Albornoz et al., 2012; Albornoz et al., 2016; Morales et al., 2019)
- Fixed costs of importing and exporting are linked (Kasahara and Lapham, 2013)
- Development (Fernandes et al., 2016; Araujo et al., 2016)

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