Trade Adjustment Dynamics and the Welfare Gains from Trade

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- Today: Quantify the gains from a change in tariffs in a dynamic model where the macro-dynamics arise from micro-dynamics
  - Transitions substantially increase gains from liberalization

Overview

- Develop GE model with producer level export dynamics
- General model of fixed-variable trade *cost* technology
  - Fixed startup and continuation cost
  - Stochastic iceberg cost that falls with time in the market
- Estimate exporting technology
- Estimate the gains from trade

Are trade dynamics important for welfare? Yes.

- Micro trade dynamics
  - Need time, resources, and luck to become an efficient exporter
  - Model: 2 years to turn profit, 5 years to break even
- Micro dynamics generate macro dynamics
  - Gradual trade growth; consumption overshooting
- Micro dynamics matter for welfare
  - Gain 1.5X larger than sunk-cost model
  - Gain 2.8X larger than no-micro-dynamics model
- Key tradeoff: accumulating varieties vs. exporters

Overview

- Micro exporter dynamics
- Model
- Parameters
- Results
  - Estimates of export technology
  - Transition dynamics after fall in tariffs

Micro exporter facts

1. Not all plants export (22% in US)

2. Exporters are relatively large (5x larger)

3. Exporting is persistent (83% survival)

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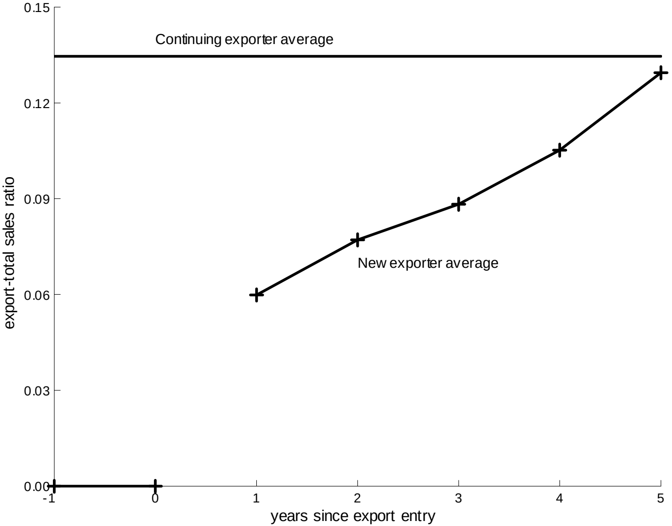
4. New exporters start with low *export intensity*

$$\text{exs}_{it} = \text{exports}_{it}/\text{total sales}_{it}$$

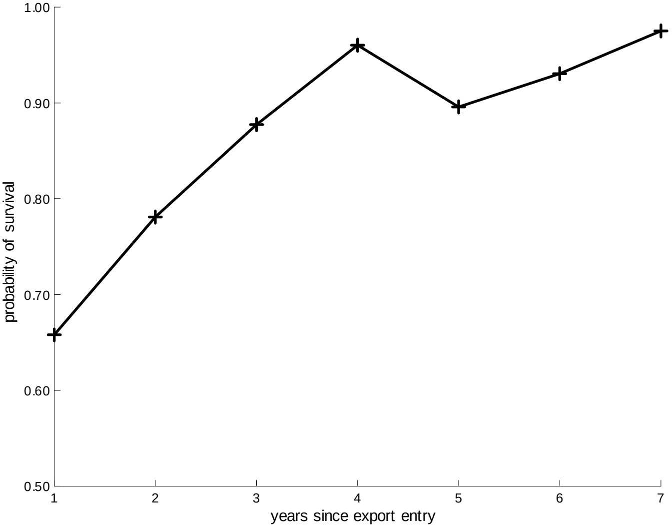
5. New exporters take time (5yrs) to become like average exports

6. New exporters have high exit rates

Export intensity of Colombian exporters (Ruhl & Willis, 08)



Survival probability of Colombian new exporters (Ruhl & Willis, 08)



Model

- General equilibrium, infinite horizon, 2 country $\{H, F\}$ model
- Idiosyncratic uncertainty, no aggregate uncertainty
- Heterogeneous plants producing differentiated tradable goods
  - Monopolistic competitors
  - Fixed export costs: startup and continuation
  - Plants are created: endogenous mass of firms
- Exporter life cycle: time to build demand/lower marginal export costs
- Final C/I good combines available differentiated tradables

Model

- Mass N_t, N_t^* differentiated H & F intermediates
- Each variety produced by 1 domestic-owned establishment
  - Idiosyncratic technology shocks: z, $\phi(z'|z)$
  - Fixed export cost: $f = \{f_H, f_L\}$ (paid in labor)
  - Iceberg costs: $\xi = \{\xi_L, \xi_H, \infty\}$
  - Measure of establishments: $\varphi_{i,t}(z, \xi, f)$

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  - Measure of establishments: $\varphi_{i,t}\left(z, \xi, f\right)$
- Free entry: hire f_E workers draw $\phi_E\left(z\right)$ in $t+1$
- Exogenous survival: $n_s\left(z\right)$
- Timing: fixed costs paid 1 period in advance

Exporting technology

- A nonexporter
  - In current period: $\xi = \infty$
  - Can pay $f = f_H$ to begin exporting next period
  - If so, in next period: draw ξ' w prob. $\rho_\xi(\xi'|\infty)$

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- Our model: $\xi_H > \xi_L$, $f_H > f_L$
  - Das, Roberts, Tybout (2007): $\xi_H = \xi_L$, $f_H > f_L$
  - Ghironi and Melitz (2005): $\xi_H = \xi_L$, $f_H = f_L$
  - Krugman (1980) w/heterogeneity: $\xi_H = \xi_L$, $f_H = f_L = 0$

Consumer's problem

$$V_{C,0} = \max_{\{C_t, B_t, K_{t+1}\}} \sum_{t=0}^{\infty} \beta^t U(C_t)$$

$$C_t + K_{t+1} + Q_t \frac{B_t}{P_t} \leq W_t L_t + R_t K_t + (1-\delta) K_t + \Pi_t + T_t + \frac{B_{t-1}}{P_t},$$

- P_t, W_t denote price level & real wage
- Π_t sum of home country profits, T_t lump sum gov't transfers
- Foreign problem is analogous; foreign variables denoted by *

$$\begin{aligned} Q_t &= \beta \frac{U_{C,t+1}}{U_{C,t}} = \beta \frac{U^*_{C,t+1}}{U^*_{C,t+1}}, \\ 1 &= \beta \frac{U_{C,t+1}}{U_{C,t}} (R_{t+1} + 1 - \delta) = \beta \frac{U^*_{C,t+1}}{U^*_{C,t}} \left(R^*_{t+1} + 1 - \delta\right) \end{aligned}$$

Competitive final good producers

- Combine domestic and imported intermediates, produce goods for
  - Consumption
  - Investment
  - Input into production by domestic firms

$$D_t = \left[\int_s y^d_{H,t}(s)^{\frac{\theta-1}{\theta}} \varphi_{H,t}(s)\, ds + \int_s y^d_{F,t}(s)^{\frac{\theta-1}{\theta}} \varphi_{F,t}(s)\, ds \right]^{\frac{\theta}{\theta-1}}$$

$$D_t = C_t + I_t + \int_s x(s) \varphi_{H,t}(s)\, ds$$

Tradable producers

- Individual state is $s = (z, \xi, f)$
- Production Technology: $y_t(s) = e^z \left[k_t(s)^\alpha \, l_t(s)^{1-\alpha} \right]^{1-\alpha_x} x(s)^{\alpha_x}$
- Profit, $\Pi_t(s)$, is

$$\max_{P_H, P_H^*, l, k, x} P_{H,t}(s)\, y_{H,t}(s) + P_{H,t}^*(s)\, y_{H,t}^*(s) - W_t l_t(s) - R_t k_t(s) - P_t x_t(s)$$

$$\text{s.t. } \; y_t(s) = y_{H,t}^d(s) + (1+\xi)\, y_{H,t}^{d*}(s),$$

Export decision

$$V_t\left(z,\xi,f\right)=\max\left\{V_t^1\left(z,\xi,f\right),V_t^0\left(z,\xi,f\right)\right\}$$

$$\begin{aligned}V_t^1\left(z,\xi,f\right)=&\max\Pi_t\left(z,\xi,f\right)-W_tf\\&+n_s\left(z\right)Q_t\sum_{\xi'\in\{\xi_L,\xi_H\}}\int_{z'}V_{t+1}\left(z',\xi',f_L\right)\phi\left(z'|z\right)dz'\rho_\xi\left(\xi'|\xi\right)\end{aligned}$$

$$\begin{aligned}V_t^0\left(z,\xi,f\right)=&\max\Pi_t\left(z,\xi,f\right)\\&+n_s\left(z\right)Q_t\int_{z'}V_{t+1}\left(z',\infty,f_H\right)\phi\left(z'|z\right)dz'\end{aligned}$$

- With 3 iceberg costs there are three marginal firm types

Free entry

- Hire f_E workers to enter

- Draw technology $\phi_E(z)$, produce in $t+1$

$$V_t^E = -W_t f_E + Q_t E V_t(z, \infty, f_H) \phi_E(z) \leq 0$$

$\Rightarrow N_{TE,t}$ new establishments

Calibration: aggregates

Parameter		Value
σ	IES	2
δ	Capital Depreciation	0.10
β	Discounting	0.96
θ	Elasticity of Subst. (Broda & Weinstein)	5
τ	Tariff (Anderson and van Wincoop)	0.1
α_x	MFR Gross Output/VA = 2.8	0.81
α	Labor share of income = 66%	0.13

Calibration: establishments

- Target usual plant-level moments: participation rate, starter rate, etc.
- Export technology: $\{\xi_L, \xi_H\}, \{\rho(\xi_H|\xi_H), \rho(\xi_L|\xi_L), \rho(\xi_H|\infty)\}$

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  - $\rho(\xi_H|\infty) = 1$
  - $\rho(\xi_H|\xi_H) = \rho(\xi_L|\xi_L) = \rho_\xi$

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- Micro-dynamic moments
  1. Initial export intensity 1/2 of avg. intensity (Ruhl&Willis 08)
  2. 5 years to reach avg export intensity (Ruhl&Willis 08)

Calibration: establishments & exporters

A. Exporter dynamics & characteristics:

1. Overall participation rate = 22.3 (92 Census of Mfrs.)

2. Stopper rate = 17 (ASM)

3. Initial export intensity 1/2 of avg. intensity (Ruhl&Willis 08)

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B. Establishment dynamics & heterogeneity:

5. Entrant 5-yr survival 37 (Dunne et al. 89)

6. Birth labor share =1.5 (Davis, et al. 96)

7. Exit labor share = 2.3 (Davis, et al. 96)

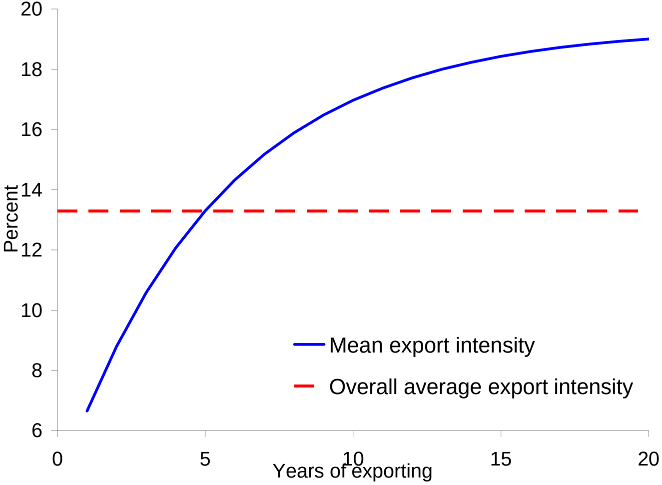
8. Establishment and employment distribution (92 Census)

Benchmark estimate of the exporting technology

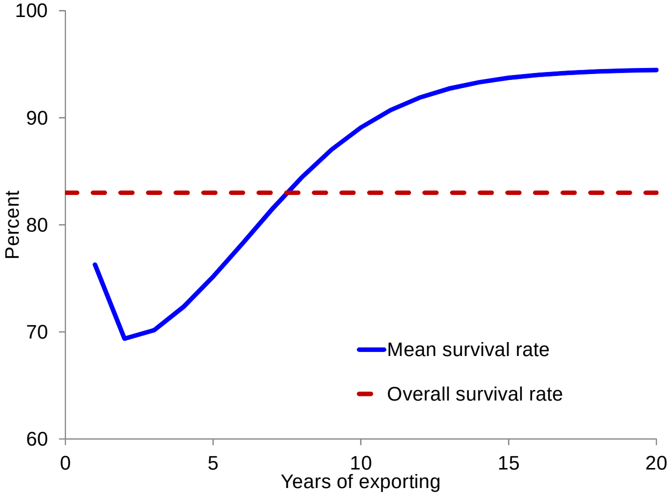
- Entry cost 40% larger than continuation cost: $f_H/f_L = 1.4$
- High iceberg cost 62% larger than low iceberg cost (1.72 vs. 1.07)
- Iceberg cost very persistent: $\rho\left(\xi_H|\xi_H\right) = 0.92$

Common parameters		
	Benchmark	Sunk-cost
f_H/f_E	0.038	
f_L/f_E	0.027	
ξ_H	1.718	
ξ_L	1.070	
ρ_ξ	0.916	

Export intensity

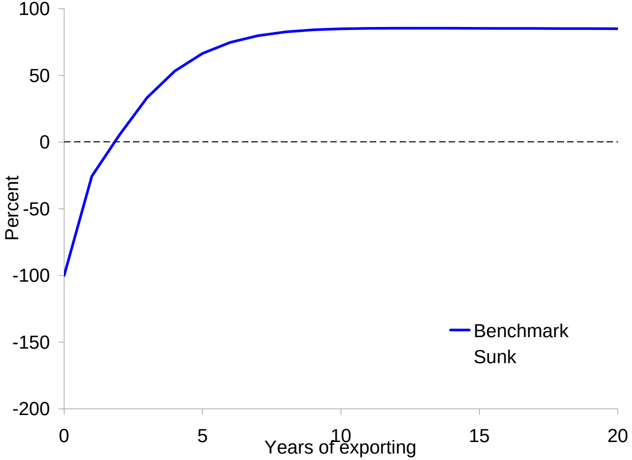


1-year survival rate (not targeted)



Profits (net/entry cost) of marginal starters

$$\left(E\pi_{x,t} - f\right)/f_H$$



- Many new exporters exit before turning a profit.

Alternative model: Sunk cost export technology

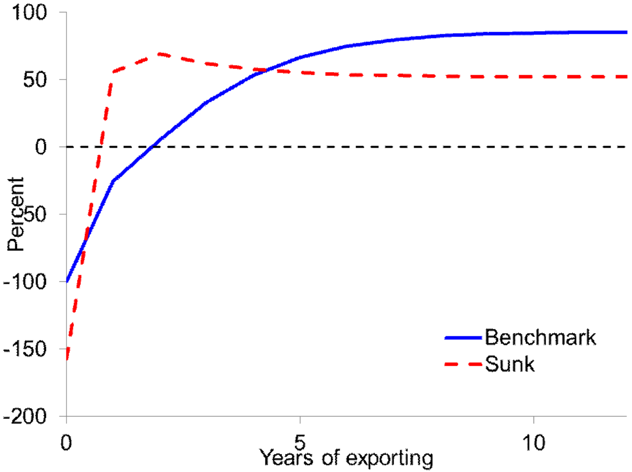
- Restriction: $\xi_H = \xi_L$

	Benchmark	Sunk-cost
f_H/f_E	0.038	0.058
f_L/f_E	0.027	0.015
ξ_H	1.718	1.430
ξ_L	1.070	1.430
ρ_ξ	0.916	1.000

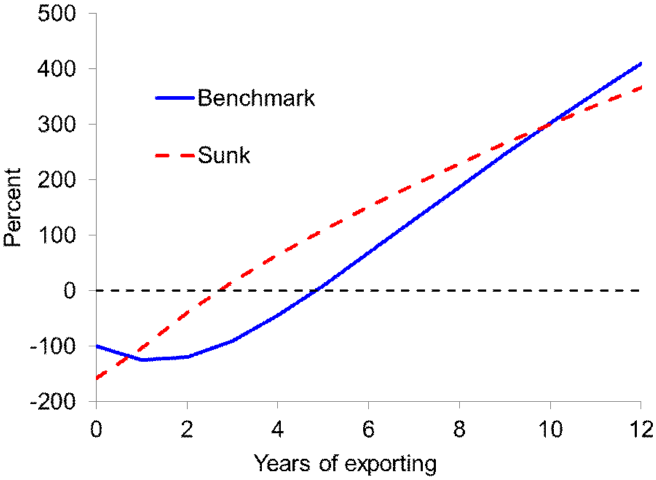
- $f_H/f_L = 3.9$
- In benchmark model, high survival rate arises because producers don't want to go through growth process again — not sunk costs.

Profits (net/entry cost) of marginal starters

$$\left(E\pi_{x,t} - f\right) / f_H^{bench}$$



Cumulative profits of marginal starters



3 experiments

1. Benchmark: $\xi_H > \xi_L$, $f_H > f_L$
2. Sunk cost: $\xi_H = \xi_L$, $f_H > f_L$
3. No cost: $\xi_H = \xi_L$, $f_H = f_L = 0$

- Consider unanticipated global tariff reduction, $\tau = 0.1 \to \tau = 0$

Aggregate export dynamics

- Useful to look at dynamics of trade elasticity

$$\varepsilon_t = -\frac{\ln\left(IMD_t/IMD_{-1}\right)}{\ln\left(\left(1+\tau_t\right)/\left(1+\tau_{-1}\right)\right)}. \tag{1}$$

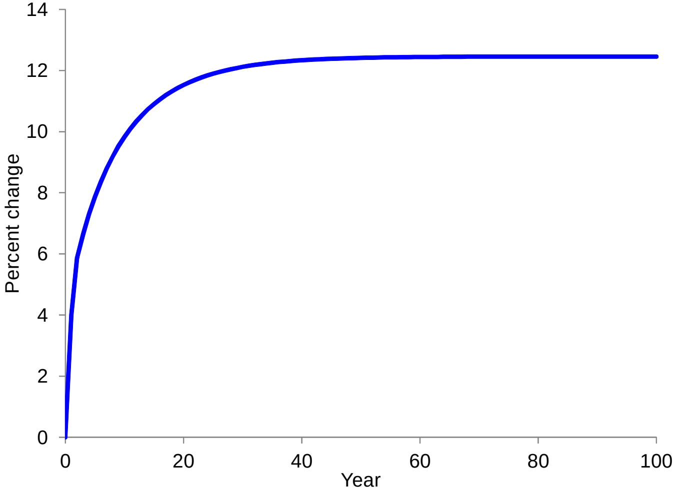
where

$$IMD_t = \frac{\left(1+\tau_t\right)\int_s P_{F,t}\left(s\right) y_{F,t}\left(s\right) \varphi_{F,t}\left(s\right) ds}{\int_s P_{H,t}\left(s\right) y_{H,t}\left(s\right) \varphi_{H,t}\left(s\right) ds}. \tag{2}$$

- Short-run elasticity is $\theta - 1$

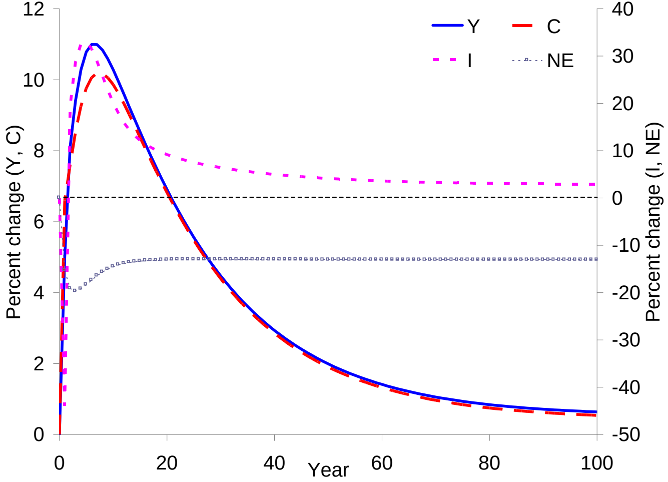
Dynamics following elimination of 10 percent tariff

Trade elasticity



Dynamics following elimination of 10 percent tariff

Aggregate dynamics



The benchmark model

Change	Benchmark	Sunk-cost	No-cost
Welfare gain	6.30		
Avg. trade elasticity ($\bar{\varepsilon}_t$)	10.2		
SS. Consumption	0.42		
SS. Trade elasticity	11.5		

$$\bar{\varepsilon}_t = (1-\beta)\sum_{t=0}^{\infty}\beta^t\varepsilon_t.$$

Source of overshooting

- With capital accumulation overshooting is surprising
- Tariffs lead to an overaccumulation of establishments relative to free trade steady state
- These establishments can be converted at a low cost to exporters

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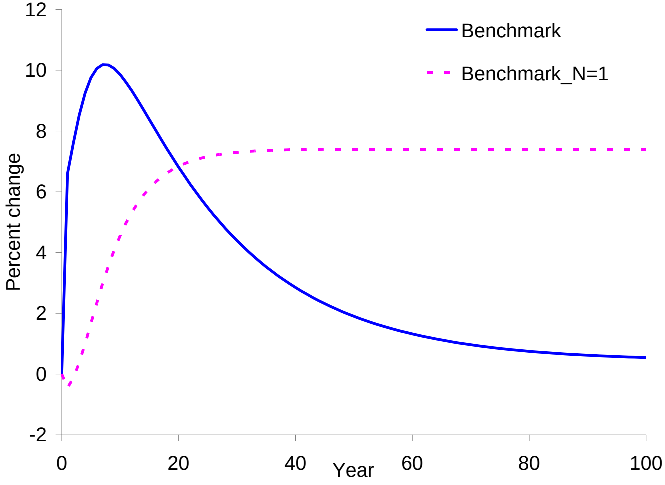
- Plant creation dynamics key to overshooting
- Experiment: force $N_t = 1$

Dynamics following elimination of 10 percent tariff

Aggregate Output



The sunk-cost model

- Literature has focused on sunk costs as a source of persistent exporting
- Sunk cost model misses out on aspects of new exporter dynamics.
- Ask: How well does this simpler dynamic model of exporter approximate trade/welfare predictions of the benchmark model?

The sunk-cost model

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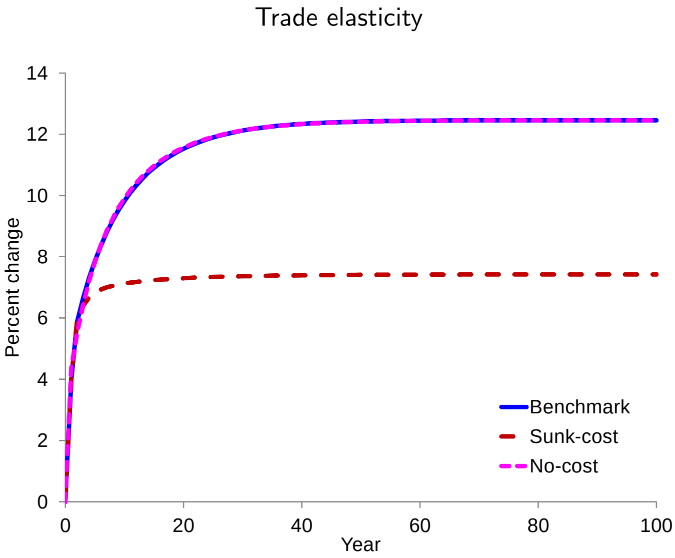
- Sunk cost model misses out on aspects of new exporter dynamics.
- Ask: How well does this simpler dynamic model of exporter approximate trade/welfare predictions of the benchmark model?
- Answer: Not so good on trade, pretty good on consumption/welfare


Trade elasticity
Percent change
Year
Benchmark
Sunk-cost
No-cost
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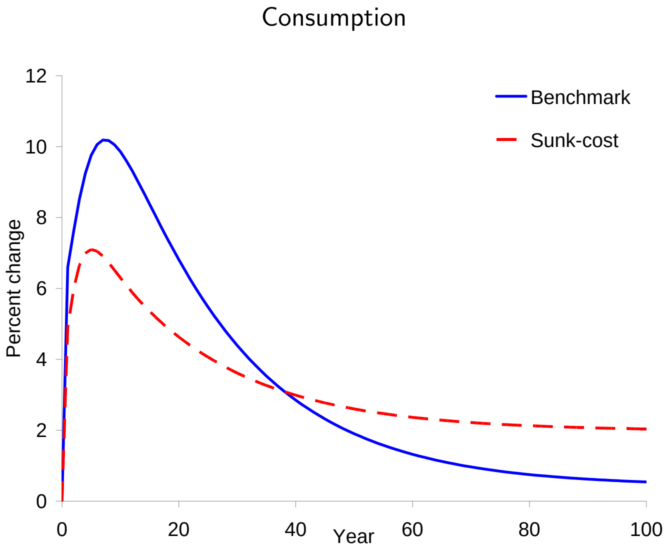
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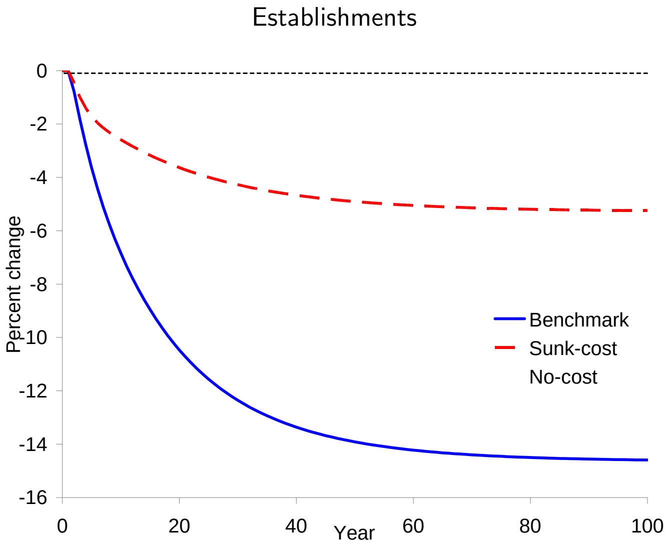
Establishments
Percent change
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The sunk-cost model

Change	**Benchmark**	**Sunk-cost**	**No-cost**
Welfare gain	6.30	4.75	
Avg. trade elasticity ($\bar{\varepsilon}_t$)	10.2	6.9	
SS. Consumption	0.42	1.98	
SS. Trade elasticity	11.5	7.2	

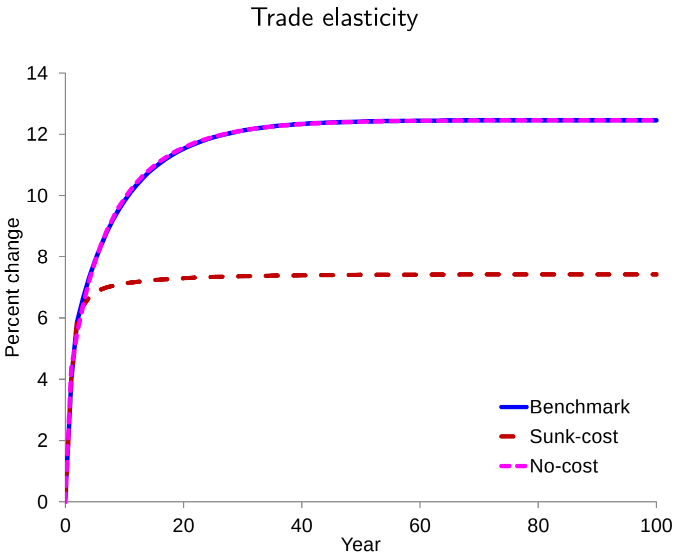
$$\bar{\varepsilon}_t = (1-\beta)\sum_{t=0}^{\infty}\beta^t \varepsilon_t.$$

How important is endogenous exporting?

- Krugman (1980): all firms export

- Requires two main changes

  1. Change θ to get LR trade elasticity
  2. Add adjustment friction to get dynamics of trade elasticity



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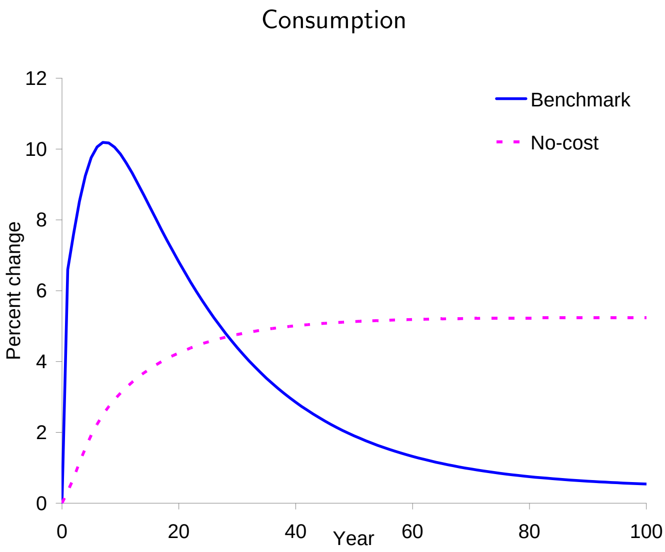

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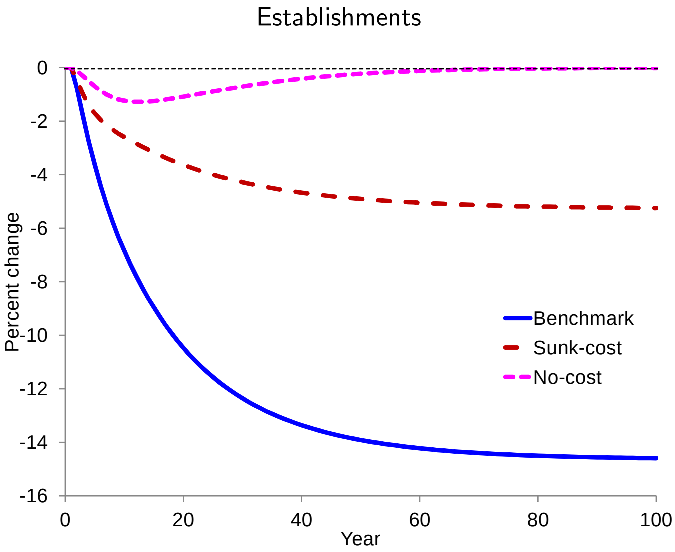
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Year
Benchmark
Sunk-cost
No-cost

Modified Krugman (1980) model

Change	**Benchmark**	**Sunk-cost**	**No-cost**
Welfare gain	6.30	4.75	2.34
Discounted trade elasticity	10.2	6.9	10.2
Consumption	0.42	1.98	3.93
Trade elasticity	11.5	7.2	11.5