

# Micro Processes behind Export Growth

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## Understanding bilateral trade flows

- Aggregate bilateral trade flows are reasonably predictable in cross section.
  - Flows are mysteriously small, and borders are mysteriously important, *but*
  - Gravity equations work well in cross section
- Changes in bilateral flows through time are much less so.
  - Relation between exports, market sizes, exchange rates and commercial policy is generally unstable.
  - It's temporal variation that policy makers need to know about.

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## Understanding bilateral trade flows

- Unpredictability may reflect the fact that aggregate flows mask complex micro processes:
  - One-shot entry costs create hysteresis.
    - Repackaging and adapting product for specific destination markets
    - Establishing distribution networks
    - Legal procedures must be mastered.
  - Matching between buyers and sellers involves costly search and learning.
  - Knowledge spillovers can create surges in export activities (self-discovery)

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## Understanding bilateral trade flows

- This talk: explore the role of these micro factors
  - Stylized facts from micro data (especially transactions-level data)
  - Some existing models that capture some of the facts
  - A new search/learning model
  - Brief discussion of policy issues

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## Stylized facts: State dependence

- State dependence (“hysteresis”): temporary changes in the returns to exporting lead to permanent changes in exporter behavior
- Define:
  - $Y_{it}$  = 1 if firm  $i$  exports in period  $t$ ; 0 otherwise
  - $X_{it}$  = vector of observable firm and market characteristics
  - $\varphi_{it}$  = stationary, serially-correlated unobserved error.
- Empirical studies invariably find state dependence (Roberts and Tybout, 1997; Das et al, 2007; Wagner, 2007):

$$P[Y_{it}=1 | X_{it}, \varphi_{it}, Y_{it}=1] > P[Y_{it}=1 | X_{it}, \varphi_{it}, Y_{it}=0]$$

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## Explaining state dependence

- Sunk entry costs (Baldwin and Krugman, 1989; Dixit, 1989)
  - Basic assumptions:
    - Firms face (exogenous) start-up costs when entering foreign markets.
    - Firms face serially-correlated productivity and/or demand shocks, and uncertainty about the future.
  - Implications:
    - Firms enter export markets only when the expected future profit stream exceeds the sunk entry costs.
    - Uncertainty and entry costs create an option value to “staying put.” So once firms have been induced to enter foreign markets, they may not leave when the stimulus is reversed.

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## Explaining state dependence

- Learning by buyers about potential exporters (Rauch and Watson, 2003)
  - Once a supplier's capabilities have been learned, demand for its product has irrevocably changed.
- Learning by exporters about buyers in the destination market (Eaton, et al, in progress).
  - Identifying buyers.
  - Learning about their product's appeal to foreign consumers.

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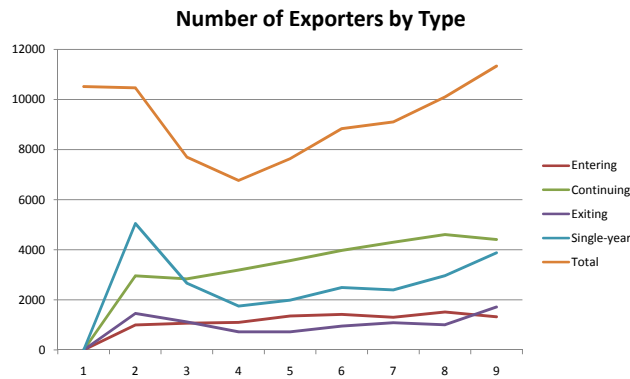
## Other Stylized facts

- Evidence from Colombia (Eaton, Eslava, Kugler and Tybout, forthcoming, and 2008)
  - Population of (legal) Colombian export transactions over the course of a decade (1996-2005).
  - Each transaction has a date, value, product code, firm ID, and destination country.
  - Characterize firm-level patterns of export market entry, exit and growth.
  - Describe geographic patterns of expansion and contraction as firms add or subtract destinations.
- If you like this paper, you might also enjoy: Besedes (2006); Bernard et al (2007)

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## Exporters by durability

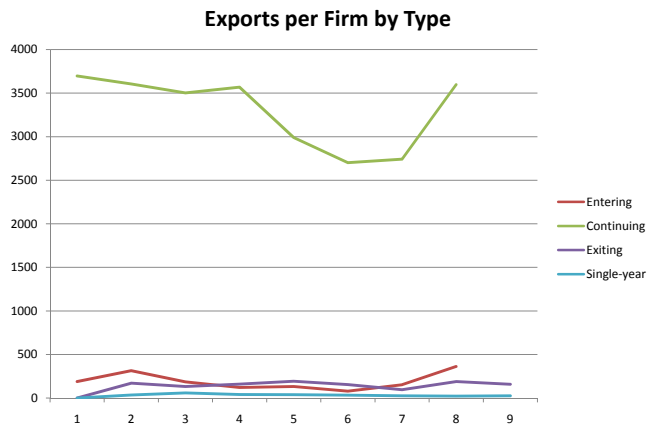


- As a fraction of total exporters, firms that enter a market and immediately exit are important.

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## Exporters by durability



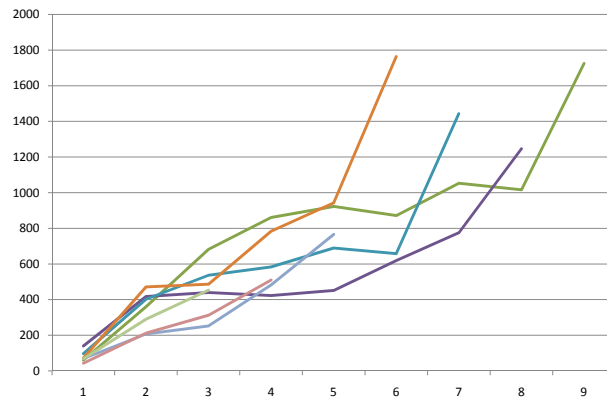
- But as a fraction of total export revenue, brand new exporters don't account for much.

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## Cohort maturation

Exports per Firm by Years in Market



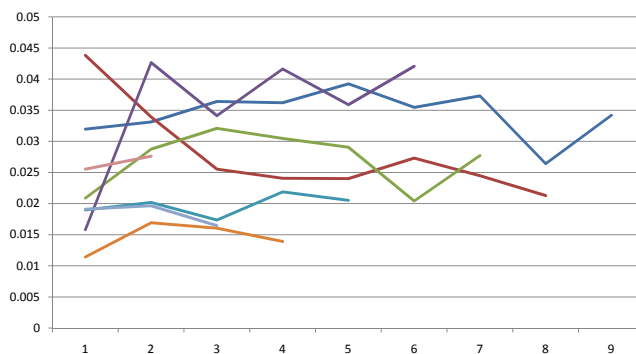
The firms that survive their first year grow exceptionally rapidly.

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## Cohort maturation

Cohort Market Shares by Years Exporting



Hence young cohorts typically gain market share *despite* rapid attrition.

Post-1996 entrants account for about half of cumulative export expansion by 2005.

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## New exporter growth by quintile

		Entry Quintile in $t-1$				
		1	2	3	4	5
Quintile in $t$	1	0.46	0.10	0.02	0.00	0.00
	2	0.11	0.20	0.10	0.04	0.01
	3	0.03	0.09	0.12	0.08	0.03
	4	0.01	0.03	0.06	0.09	0.06
	5	0.01	0.02	0.03	0.05	0.08
	None	0.38	0.56	0.67	0.74	0.82
P(firm in entry cohort $t-1$ start exporting in quintile $x$ )		0.04	0.12	0.22	0.28	0.34

- Although the smallest quintile is the most common entry point, new exporters are spread across the size distribution.
- Starting in the largest quintile (i.e., quintile 1) is a good predictor for survival.

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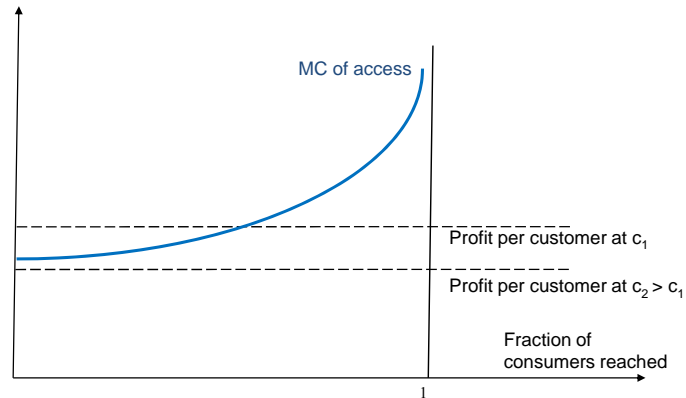
## Interpreting exporter growth/exit patterns

- Unless market entry costs vary dramatically across firms, the prevalence of tiny, temporary exporting episodes is hard to reconcile with sunk cost models.
- Interpretations
  - Low-hanging fruit effects (Arkolakis, 2007 and 2008)
  - Buyer learning and sorting (Rauch and Watson, 2003)
  - Exporter learning effects (Eaton, et al, in progress)

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## Interpreting exporter growth/exit patterns



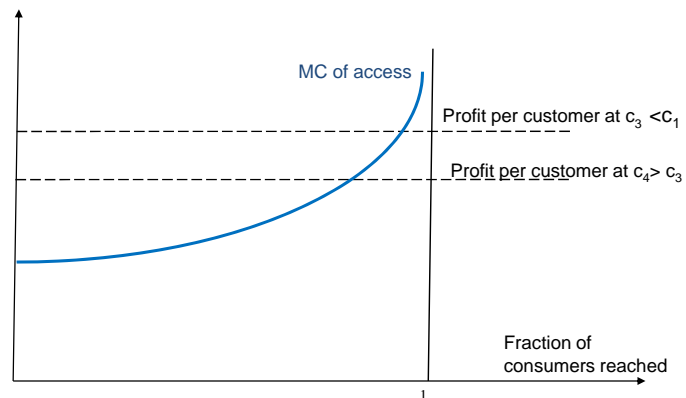
Advertising and low-hanging fruit effects (Arkolakis, 2007 and 2008)

- There are per-customer fixed costs of accessing each foreign buyer.
- In addition, there are increasing marginal costs because the easy ones are reached first.

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## Interpreting exporter growth/exit patterns



Advertising and low-hanging fruit effects, continued

- Firms that are just efficient enough to export are
  - Exit prone (if they receive a negative productivity shock)
  - Prone to rapid expansion (if they receive a positive productivity shock)

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## Interpreting exporter growth/exit patterns

- Starting small in new environment (Rauch and Watson, 2003)
  - Buyers in destination markets pay a fixed search cost to sample from a pool of potential suppliers in exporting countries.
  - Suppliers are heterogeneous in terms of **production costs (observable)** and their **ability to do particular jobs (must be learned)**.
  - After matching with a supplier, buyers learn their ability when they:
    - Sink a relationship-specific investment and learn immediately whether the supplier can do the job. If she can, immediately place a large order.
    - or*
    - Start with a small trial order that generates no profits, and learn the supplier's ability over the course of a significant trial period. *Then* sink an investment if it is warranted.

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## Interpreting exporter growth/exit patterns

- Implications of Rauch and Watson's model
  - The lowest cost suppliers get big orders and relationship-specific investments without a trial period, and their relationships survive relatively frequently.
  - The highest cost suppliers are rejected immediately.
  - Moderate cost suppliers start with a trial order, and either end up being rejected or move on to large orders.

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## Interpreting exporter growth/exit patterns

- Buyer search and learning (Eaton, et al, in progress)
  - Firms pay to search for buyers in each destination market. The more they pay, the greater the probability of meeting a buyer at each point in time.
  - Firms are uncertain about the appeal of their product to consumers in the destination market. They learn its appeal to buyer  $j$  once they match with him, but buyer  $j$ 's tastes and income have an idiosyncratic component.
  - Firms learn about the appeal of their product in the destination market by watching similar exporters make sales in the same market.
  - Firms adjust their search intensity as they learn more about their product's appeal.

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## Interpreting exporter growth/exit patterns

- Implications of Eaton, et al (in progress)
  - Many firms find little interest in their product abroad, and reduce searching intensity or stop altogether.
  - Some firms get positive initial signals and intensify their search efforts. These firms tend to add clients quickly and go through a growth acceleration period.

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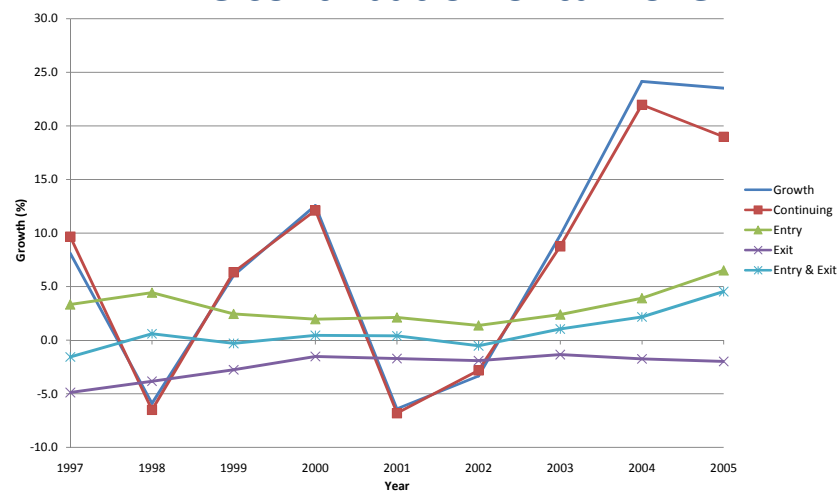
## Margins of Expansion

- Net entry contributes disproportionately to growth during periods of rapid expansion.
- Expansion in a given market by a given firm is approximately half due to extra transactions and half due to larger shipments.

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## The contribution of turnover



- During expansionary periods, turnover is a more important source of growth.

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## The contribution of turnover

- Sunk costs induce a hysteresis band
  - Only large shocks trigger widespread entry
- Market expansion induces firms to start or intensify their search for clients.
  - When returns to a match increase, a large fraction of potential exporters start exploring foreign markets.

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## Destination transitions

		Initial group of destinations (x)							
		None	Others	Neighbors	USA	Neighbors, Others	USA, Other	Neighbors, USA	Neighbors, USA, Others
Final group of destinations (y)	None	0.88	0.63	0.56	0.64	0.12	0.15	0.19	0.04
	Others	0.06	0.27	0.03	0.02	0.10	0.10	0.04	0.03
	Neighbors	0.03	0.02	0.31	0.01	0.09	0.00	0.16	0.02
	USA	0.03	0.01	0.01	0.26	0.00	0.09	0.13	0.01
	Neighbors, Others	0.00	0.04	0.08	0.00	0.56	0.02	0.08	0.16
	USA, Other	0.00	0.03	0.00	0.06	0.01	0.57	0.05	0.08
	Neighbors, USA	0.00	0.00	0.01	0.01	0.01	0.01	0.18	0.02
	Neighbors, USA, Others	0.00	0.01	0.01	0.01	0.11	0.07	0.17	0.65
	P(start exporting to group of destinations x)	0.80	0.07	0.04	0.03	0.03	0.02	0.00	0.01

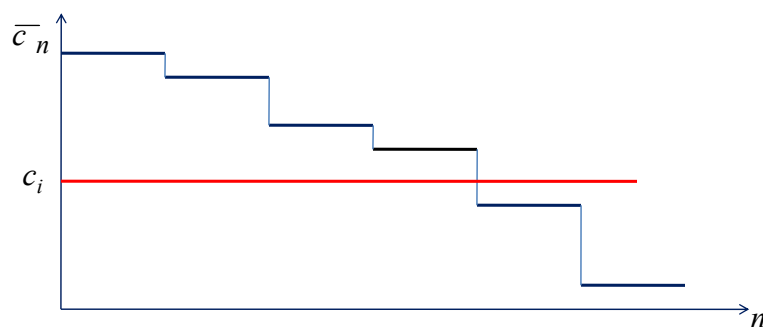
- More likely than not, firms with only one export destination won't be exporting next year.
- Firms add and drop destinations gradually, not in bundles.
- Current destinations are related to prospects for adding markets.

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## Explaining geographic expansion paths

- A hierarchy of markets (Eaton, Kortum and Kramartz, 2005)
  - Markets can be ordered in terms of their attractiveness. The better the firm, the more markets it will go to (Eaton, Kortum and Kramartz, 2005)
  - Destination markets have different cut-off unit cost levels,  $\bar{c}_n$ , that depend upon their size and distance from other markets.



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## Explaining geographic expansion paths

- Firms learn about their product appeal in relatively informative or easy-to-access “trial” markets. Those that get positive signals are encouraged to search more broadly. (Eaton, et al, in progress)

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## Summary of stylized facts

- Persistence in exporting behavior
  - Controlling for firm heterogeneity, exporting decisions exhibit state dependence.
  - Large volume of small scale exporters, most of whom don't persist.
  - Firms with large initial shipments are more likely to continue exporting.
- Growth patterns among survivors
  - New exporters that *do* survive the first year grow very rapidly, eventually show down.
  - Entry by new exporters matters disproportionately during periods of rapid growth.
  - Exporters grow on several margins: frequency of shipments, size of shipments, destination of shipments.
- Geographic expansion paths
  - Firms add and drop markets gradually
  - Current destination market helps predict next destination markets

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## Current profits from an *i-j* match

(Eaton, et al, in progress)

- Exporter  $j$ 's profits from a match with buyer  $i$  at time  $t$  depend upon
  - productivity  $\varphi_{jt}$
  - Product appeal,  $z_j$
  - Idiosyncratic buyer demand component,  $\epsilon_{ij}$
  - exchange rate
  - Price deflators
  - Input prices,
  - Average spending per buyer
- Or, collecting all market-wide variables in  $X_t$ :

$$\pi(X_t, z_j, \epsilon_{ij}, \varphi_{jt}) = X_t \exp(z_j + \epsilon_{ij}) \varphi_{jt}^{\eta-1}$$

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## Present value of an $i$ - $j$ match

(Eaton, et al, in progress)

- Given  $z_j$ , the expected present value of the sequence of shipments associated with an  $i$ - $j$  match is

$$\tilde{\pi}(X_t, z_j, \varphi_{jt})$$

- Special case of a stable macro environment, fixed productivity effect, and constant separation hazard,  $\delta$ :

$$\begin{aligned}\tilde{\pi}(\bar{X}, z_j, \varphi_j) &= \int_0^\infty \int_{-\infty}^\infty e^{-(r+\delta)t} \bar{X} \exp(z_j + \epsilon) \varphi_j^{\eta-1} f_\epsilon(\epsilon) d\epsilon dt \\ &= \frac{\bar{X} \exp(z_j + \sigma_\epsilon^2/2)}{r + \delta} \varphi_j^{\eta-1}\end{aligned}$$

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## Learning about product appeal

(Eaton, et al, in progress)

- Recall that  $\pi(X_t, z_j, \epsilon_{ij}, \varphi_{jt}) = X_t \exp(z_j + \epsilon_{ij}) \varphi_{jt}^{\eta-1}$

After being matched with  $i$  and receiving an order, firm  $j$  can infer a noisy signal of foreign demand for it's product:

$$S_{ij} = z_j + \epsilon_{ij}.$$

- After  $n$  such matches, firm  $i$  has posterior  $N(\hat{z}_j^n, \sigma_n^2)$  where:

$$\hat{z}_j^n = z_j^0 \frac{\sigma_0^{-2}}{\sigma_0^{-2} + n\sigma_\epsilon^{-2}} + \bar{S}_j^n \frac{n\sigma_\epsilon^{-2}}{\sigma_0^{-2} + n\sigma_\epsilon^{-2}}, \quad \sigma_n^2 = (\sigma_0^{-2} + n\sigma_\epsilon^{-2})^{-1}$$

$$\bar{S}_j^n = n^{-1} \sum_{i=1}^n S_{ij}$$

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## Generalized learning

(Eaton, et al, in progress)

- The posterior can easily be generalized to incorporate information from:
  - Sales in home country market
  - Sales in other foreign markets
  - Sales of competing firms exporting similar products to the same foreign market.
- Help explain heightened role of entry during periods of rapid growth.
- Help explain geographic expansion paths.

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## Search and matching

(Eaton, et al, in progress)

- The arrival rate of matches,  $\lambda$ , depends upon seller  $j$ 's spending on search. The cost of search function is:

$$c(\lambda) = b\left(\frac{\lambda}{1-\lambda}\right)^2 + f \cdot 1[\lambda > 0], \quad \lambda \in [0, 1)$$

- A generalized search function allows for reputation effects and/or market saturation:

$$\tilde{\lambda} = \lambda \cdot h(n)$$

where  $h(n) = \frac{M-n}{M}$  or  $h(n) = \frac{n}{M}$ , and  $M$  is the total number of potential buyers.

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## The value of search

(Eaton, et al, in progress)

- After  $n$  matches, the value of search is:

$$\begin{aligned}
 & V(\hat{z}_j^n, n, X_t, \varphi_{jt}) \\
 &= \frac{1}{1+r} \max_{\lambda} \left\{ -c(\lambda) + \lambda \int_z \tilde{\pi}(X_t, z, \varphi_{jt}) dF(z|\hat{z}_n, n) \right. \\
 &+ \int_{X'} \int_{\varphi'} \left[ (1-\lambda)V(\hat{z}_j^n, n, X', \varphi') + \lambda \int_{\hat{z}'} V(\hat{z}', n+1, X', \varphi') d\Phi(\hat{z}'|\hat{z}_j^n) \right] \\
 &\quad \left. \cdot dG(X', \varphi'|X_t, \varphi_{jt}) \right\}
 \end{aligned}$$

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## Some preliminary simulations

(Eaton, et al, in progress)

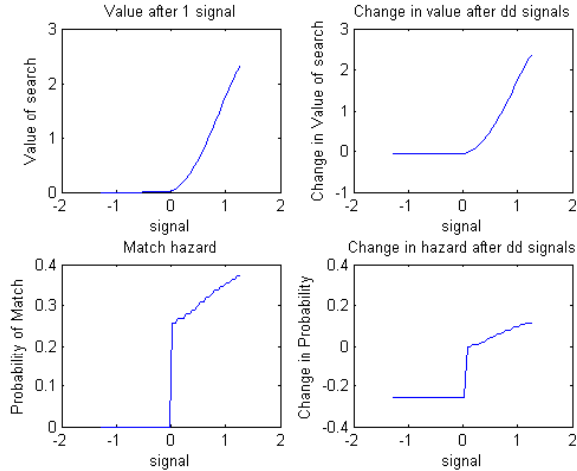
Parameter		Base case	Lower fixed costs
Separation hazard	$\delta$	0.20	0.20
Discount rate	$r$	0.05	0.05
Mean product appeal	$\mu_z$	0.0	0.0
Mean productivity	$\mu_{\varphi}$	1.0	1.0
Mean noise	$\mu_{\varepsilon}$	0.0	0.0
Fixed search cost	$f$	0.04	0.02
Cost function scalar	$b$	0.1	0.1
Profit function scalar	$\bar{\chi}$	0.05	0.05
Variance in noise	$\sigma_{\varepsilon}^2$	0.16	0.16
Variance in product appeal	$\sigma_z^2$	0.09	0.09
Variance in productivity	$\sigma_{\varphi}^2$	0.0	0.0

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## Signals, values and hazards: $f=0.04$

(Eaton, et al, in progress)



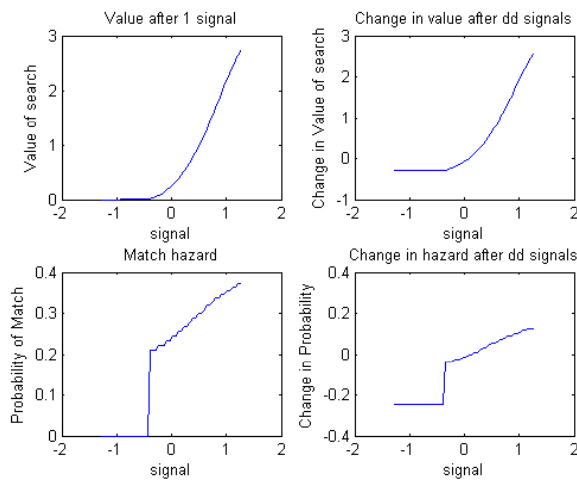
Lower fixed costs reduce the signal threshold below which no search takes place.

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## Signals, values and hazards: $f=0.02$

(Eaton, et al, in progress)

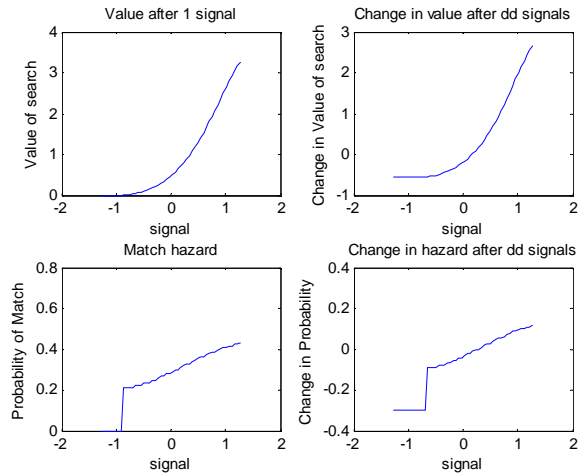


Lower fixed costs reduce the signal threshold below which no search takes place.

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## Signals, values and hazards: with saturation effects

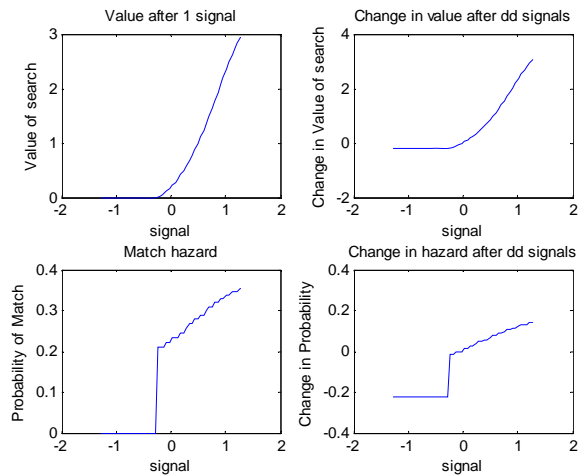


Relative to reputation effects, saturation effects dampen the effects of learning on the return to search.

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## Signals, values and hazards: with reputation effects

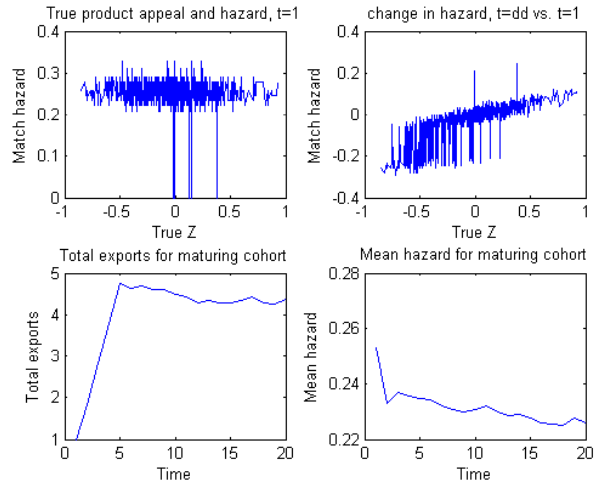


Relative to reputation effects, saturation effects dampen the effects of learning on the return to search.

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## Hazards and export trajectories: $f=0.02$

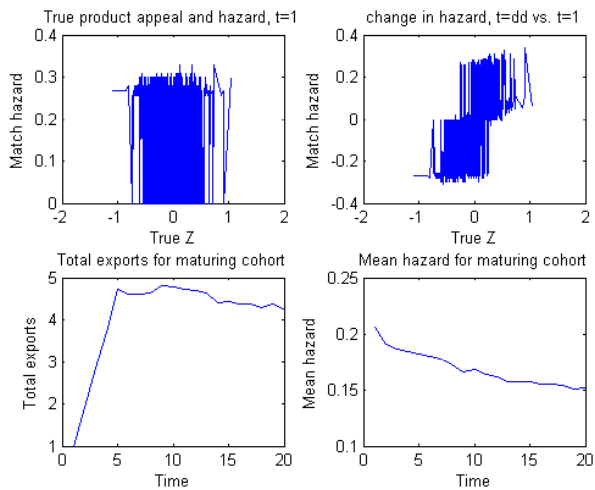


Rapid initial growth for new exporting cohort reflects 2 factors.

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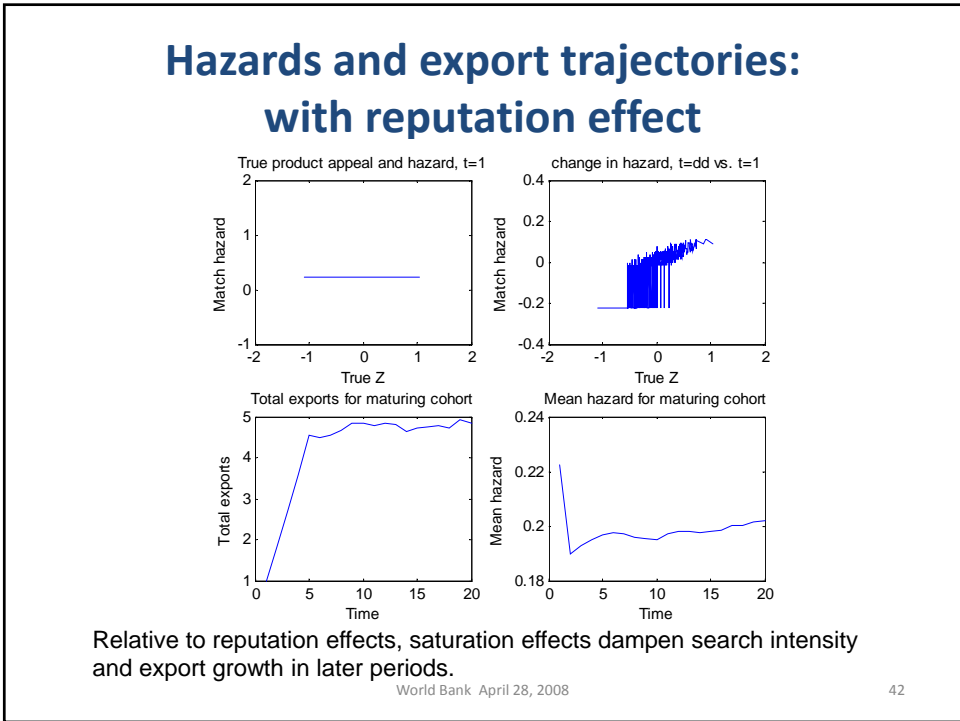
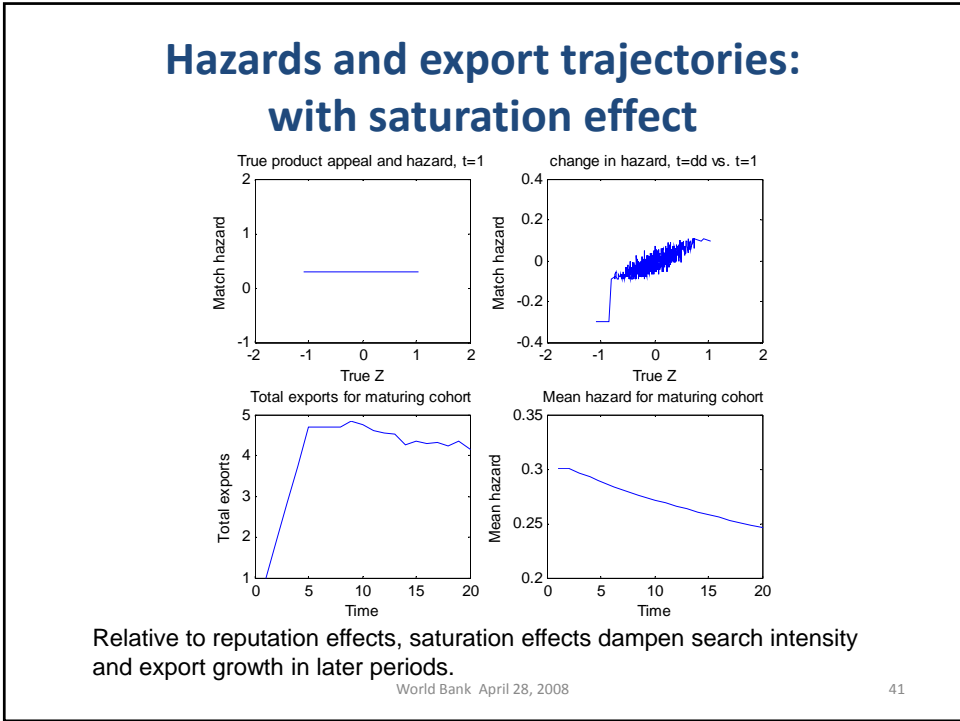
## Hazards and export trajectories: $f=0.04$



Fixed costs dampen exports and slow learning.

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## Next step: econometric estimation

- Match U.S. buyers and Colombian sellers to study relationships
  - Use observed  $\tilde{\pi}$  distributions to infer  $(z, \epsilon)$  distributions.
    - In a given period, sales by  $j$  to  $i$ , divided by demand elasticity, corresponds to

$$\pi(X_t, z_j, \epsilon_{ij}, \varphi_{jt}) = X_t \exp(z_j + \epsilon_{ij}) \varphi_{jt}^{\eta-1}$$

- Regress log sales on log seller productivity, time dummies, and buyer dummies to identify  $\eta$ ,  $\sigma_\epsilon$ ,  $\sigma_z$
  - Directly estimate separation rates
  - Cross-market knowledge spillover effects
- Characterize the types of matches that succeed or fail.
- Using model's structure, identify search parameters using observed match rates, transaction values, productivities, and macro variables.

U. Western Ontario, April 25, 2008

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## Brief comments on policy

- If you believe a sunk cost model characterizes exporter behavior:
  - There is no obvious role for policy intervention.
  - But if you *must* promote exports, export revenue subsidies are far more effective than entry cost subsidies or fixed cost subsidies.

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## Brief comments on policy

### Export Revenue/Cost Ratios for Alternative Subsidy Plans

	<i>Knitting Mills</i>	<i>Leather Products</i>	<i>Basic Chemicals</i>
<b>Revenue Subsidies</b>			
2 Percent	19.23	11.81	11.17
5 Percent	15.67	9.94	9.56
10 Percent	10.09	7.74	7.52
<b>Entry Cost Subsidies</b>			
25 Percent	2.03	-0.54	-0.068
50 Percent	1.02	-0.67	-0.49
100 Percent	0.14	-0.26	-0.23
<b>Fixed Cost Subsidy</b>			
2 Million Pesos	3.96	2.22	2.66
10 Million Pesos	0.99	0.68	0.69

Source: Das, Roberts and Tybout, 2007

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## Brief comments on policy

- If you believe a learning model with knowledge spillovers characterizes exporter behavior:
  - There is, in principle, a role for policy intervention.
  - Export revenue subsidies are more effective than entry cost subsidies or fixed cost subsidies.

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