# New Exporter Dynamics
# (2017, IER)

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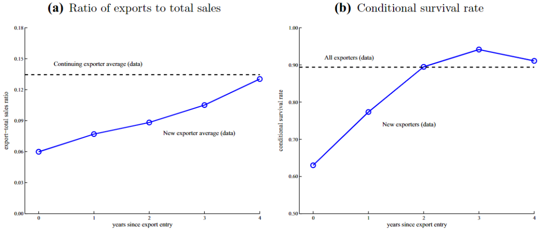
October 26, 2022

# Motivation

- The static trade model and standard sunk-cost model
  - Replicates the key features of the exporters
  - e.g., low participation rate, exporter size premium, low entry & exit rates, aggregate impact of policy
- How about the dynamics of "new" exporters?
  - Can sunk-cost models reproduce the key dynamics of new exporters?
- In the data, new exporters..
  1. begin small gradually expand their export volumes (Figure 1a)
  2. are more likely to exit the export market (Figure 1b)

Figure 1: New Exporter Dynamics



# Model: Standard Sunk-Cost Model

- Environment
  - CES prefernce: $U(c) = C = \left(\sum_{j=1}^{J} c_j^{\frac{\theta-1}{\theta}}\right)^{\frac{\theta}{\theta-1}}$
  - Production: $f(\tilde{\epsilon}_j, n_j, k_j) = \tilde{\epsilon}_j n_j^{\alpha N} k_j^{\alpha K}, \qquad \tilde{\epsilon}_j \sim \text{AR}(1)$
  - Entry and maintaining costs to export ($f_0$ and $f_1$)
  - Profit: $\Pi_j = \frac{p_j}{P} y_j + I(\underbrace{X'_j}_{\text{current export status}} = 1) \times \underbrace{Q}_{\text{real exchange rate}} \times \frac{p_j^*}{P^*} y_j^* - wn_j - rk_j, \qquad Q \sim \text{AR}(1)$
- Static and dynamic decision problem of plants
  - **(Static problem)** Given $X'_j$, the optimal amount $(y_j,\ y_j^*) = \left(\frac{Q^{-\theta}\frac{C}{C^*}}{1+Q^{-\theta}\frac{C}{C^*}}\tilde{\epsilon}_j n_j^{\alpha N} k_j^{\alpha K},\ \frac{1}{1+Q^{-\theta}\frac{C}{C^*}}\tilde{\epsilon}_j n_j^{\alpha N} k_j^{\alpha K}\right)$
  - **(Dynamic problem)**

$$V(X_j, \epsilon_j, Q) = \max_{X'_j}\left[\Pi(X'_j, \epsilon_j, Q) - f_X(X_j, X'_j) + R\mathbb{E}_{\epsilon'_j, Q'} V(X'_j, \epsilon'_j, Q')\right]$$

$$\Rightarrow\ X'_j(0, \epsilon_j, Q) = \begin{cases} 1 & \text{if} \quad \Pi(1, \epsilon_j, Q) + R\mathbb{E}_{\epsilon'_j, Q'}\left[V(1, \epsilon'_j, Q') - V(0, \epsilon'_j, Q')\right] - f_0 \geq 0 \\ 0 & \text{otherwise} \end{cases}$$

# Model: Extended Model with Two Modifications

1. Gradual foreign demand
    - Plant $j$ that has been an exporter for $a$ periods faces the following demand:

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

$$\gamma(a) = \begin{cases} \gamma_0 + \gamma_1 a \quad \text{if} \quad a = 0, \cdots, 21 \\ 1 \quad \text{if} \quad a > 21 \end{cases}$$

2. Stochastic entry cost
    - With probability $1 - \zeta_L$, $f_0 = f_H$, and with probability $\zeta_L$, $f_0 = f_L = 0$

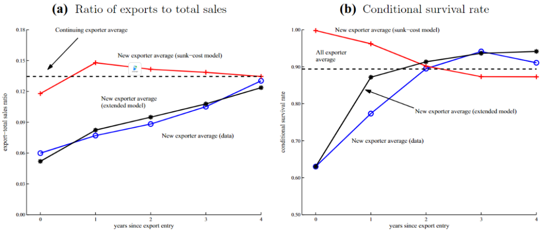
# Estimation & Results

- Fit $\phi = (f_0, f_1, C^*, \rho_\epsilon, \sigma_\epsilon)$ using 5 moments from the data:
  - Starter rate, stopper rate, average export-sales ratio, the coefficient of variation of plant size, and AR(1) coefficient of domestic sales

Table 1: Estimated Parameter Values

| | $f_0$ | $f_1$ | $C^*$ | $\sigma_\epsilon$ | $\rho_\epsilon$ | $\gamma_0$ | $\gamma_1$ | $\xi_L$ |
|---|---|---|---|---|---|---|---|---|
| Standard Sunk-Cost | **0.961** | 0.047 | 0.146 | 0.116 | 0.873 | | | |
| Gradual Demand | **0.286** | 0.064 | 0.198 | 0.116 | 0.873 | 0.258 | 0.024 | |
| Gradual Demand & Stochastic Entry | **0.590** | 0.057 | 0.185 | 0.116 | 0.873 | 0.278 | 0.026 | 0.009 |

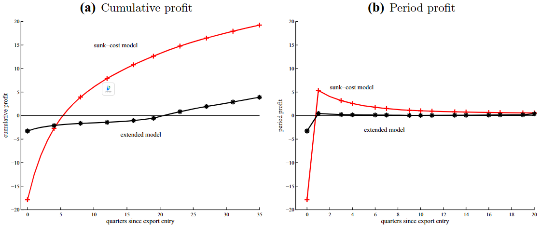
Figure 2: The Sunk-Cost Model and the Extended Model



# Mechanism & Aggregate Implication

- Mechanism
  - In the extended model, the cumulative profit grows slowly (22 quarters till break even)
  - It takes only 7 quarters in the standard sunk-cost model
  - The standard model front-loads the profits from exporting

Figure 3: Average Export Profit of Export Entrants




- Aggregate Implications: larger response in the extended model
  - Temporary shock: one-standard deviation increase in the real exchange rate
  - Permanent shock: 4% rise in foreign demand

# Discussion

- Summary
  - New exporter dynamics: slow growth & greater exit rate
  - The standard sunk-cost model fails to account for the dynamics in the data
    - The estimated entry cost is exaggerated
  - With two modifications, the entrant's behavior of the model matches the data
- Discussion
  - Partial equilibrium
    - Simple (is best)
    - Wage, interest rate, price level is fixed $\Rightarrow$ limit the welfare and aggregate implications
  - The extensions are not justified
    - Overall acceptable, but temporary exit initialize the foreign demand function, $\gamma(a)$?
  - Exporter size premium may become smaller: why not targeted?
- Possible applications
  - S-shaped gamma function, stochastic process of entry cost
  - Application to the mortgage lenders

Thank You!

# Appendix: The Model Description Details

# Overview

- The decisions that plants make in response to changes in relative prices and productivity
- Abstract from general equilibrium effects by assuming a constant wage, interest rate, and domestic price level.

# Demand

- A representative agent in the domestic economy
  - Supplies labor inelastically.
  - Preferences over an aggregate consumption good, $C$.

$$U = C = \left( \sum_{j=1}^{J} c_j^{\frac{\theta-1}{\theta}} \right)^{\frac{\theta}{\theta-1}}. \quad (1)$$

where $\theta$ is the elasticity of substitution b/w varieties and $J$ is the number of varieties.

  - Budget constraint:

$$\sum_{j=1}^{J} c_j p_j = I. \quad (2)$$

where $I$ is the consumer's income.

# Demand
(ctd.)

- Then, the representative agent's demand for variety $j$ is:

$$c_j = (p_j / P)^{-\theta} C, \tag{3}$$

where $P$ is the price of a unit of aggregate consumption,

$$P = \left( \sum_{j=1}^{J} p_j^{1-\theta} \right)^{\frac{1}{1-\theta}}. \tag{4}$$

- The rest of the world: a representative consumer with an analogous utility function and budget constraint.
  - Foreign demand for variety $j$:

$$c_j^* = (p_j^* / P^*)^{-\theta} C^*, \tag{5}$$

# The Plant's Static Problem

- Monopolistic competition environment.
  - Plant $j$ chooses productions for the domestic market, $y_j$, and the export market, $y_j^*$.
  - Production function:

$$f(\tilde{\epsilon}_j, n_j, k_j) = \tilde{\epsilon}_j n_j^{\alpha_N} k_j^{\alpha_K}. \tag{6}$$

  - The plant chooses prices, production, input demand, and export status.

$$\Pi_j = \frac{p_j}{P} y_j + I(\underbrace{X_j'}_{\text{export status}} = 1) Q \frac{p_j^*}{P^*} y_j^* - w n_j - r k_j. \tag{7}$$

  - The plant's static maximization problem:

$$\Pi_j(X_j', \epsilon_j, Q) = \max_{y_j, y_j^*} \left[ C^{\frac{1}{\theta}} y_j^{\frac{\theta-1}{\theta}} + I(X_j' = 1) Q C^{*\frac{1}{\theta}} y_j^{*\frac{\theta-1}{\theta}} - w n_j - r k_j \right] \tag{8}$$
$$\text{s.t.} \quad y_j + y_j^* = \tilde{\epsilon}_j n_j^{\alpha_N} k_j^{\alpha_K}, \ (\alpha_N + \alpha_K \leq 1).$$

# The Plant's Static Problem
(ctd.)

- The optimal quantities shipped domestically and abroad:

$$y_j = \frac{Q^{-\theta}\frac{C}{C^*}}{1 + Q^{-\theta}\frac{C}{C^*}} \tilde{\epsilon}_j n_j^{\alpha_N} k_j^{\alpha_K}, \tag{9}$$

$$y_j^* = \frac{1}{1 + Q^{-\theta}\frac{C}{C^*}} \tilde{\epsilon}_j n_j^{\alpha_N} k_j^{\alpha_K}.$$

- The maximized profit given $X_j'$, $\epsilon_j$, and $Q$ ($\epsilon_j = \tilde{\epsilon}^{\frac{\theta-1}{\theta}}$):

$$\Pi(X_j', \epsilon_j, Q) \equiv \max_{n_j, k_j} \left[1 + I(X_j' = 1) Q^{\theta} \frac{C^*}{C}\right]^{\frac{1}{\theta}} C^{\frac{1}{\theta}} \epsilon_j n_j^{\alpha_N \frac{\theta-1}{\theta}} k_j^{\alpha_K \frac{\theta-1}{\theta}} - w n_j - r k_j. \tag{10}$$

# The Plant's Dynamic Problem

- There are entering ($f_0$) and maintaining costs $f_1$ to export ($f_0 - f_1$: sunk entry cost).

$$f_X(X_j, X_j') = f_0 I(X_j' = 1 | X_j = 0) + f_1 I(X_j' = 1 | X_j = 1). \tag{11}$$

- The $Q$ and $\epsilon_j$ are assumed to follow AR(1) processes

$$\ln \epsilon_t = \rho_\epsilon \ln \epsilon_{t-1} + \omega_{\epsilon,t}, \quad \omega_{\epsilon,t} \sim (N, \sigma_\epsilon^2) \tag{12}$$

$$\ln Q_t = \rho_Q \ln Q_{t-1} + \omega_{Q,t}, \quad \omega_{Q,t} \sim (N, \sigma_Q^2). \tag{13}$$

- A plant's dynamic decision problem is given by:

$$V(X_j, \epsilon_j, Q) = \max_{X_j'} \left[ \Pi(X_j', \epsilon_j, Q) - f_X(X_j, X_j') + R\mathbb{E}_{\epsilon_j', Q'} V(X_j', \epsilon_j', Q') \right]. \tag{14}$$

# The Plant's Dynamic Problem
(ctd.)

- Policy function for export entry decision:

$$X_j'(0, \epsilon_j, Q) = \begin{cases} 1 & \text{if} \quad \Pi(1, \epsilon_j, Q) + R\mathbb{E}_{\epsilon_j', Q'}\Big[V(1, \epsilon_j', Q') - V(0, \epsilon_j', Q')\Big] - f_0 \\ 0 & \text{otherwise.} \end{cases} \tag{15}$$

# Gradual Demand: Setting

- Plant $j$ that has been an exporter for $a$ periods faces the demand curve:

$$c_j^*(a) = \gamma(a)(\frac{p_j^*(a)}{P^*})^{-\theta} C^* \tag{16}$$

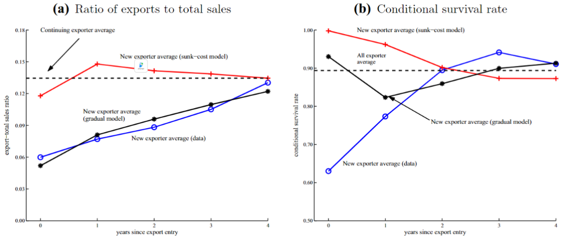
$$\gamma(a) = \begin{cases} \gamma_0 + \gamma_1 a & \text{if} \quad a = 0, \cdots, 21 \\ 1 \quad \text{if} \quad a > 21 \end{cases} \tag{17}$$

- Demand function leads a new exporter to slowly increase its exports.
- In the estimation, $\gamma_0$ and $\gamma_1$ are estimated by adding moments.
  - i.e., the coefficients of the regression of $\frac{ex_a}{sales_a}$ on $a$.

# Gradual Demand: Results

- As in the data, a plant's export profits are pushed out into the future.
  - It lowers the present value of export entry.
  - $f_0$ now falls to 29% of the median plant's sales.
- The gradual demand model still cannot account for the pattern of new exporter survival.

Figure 2. The Sunk-Cost Model and the Gradual Demand Model

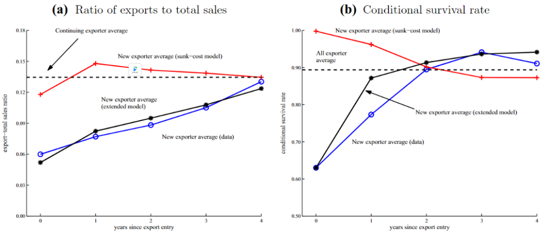


# Gradual Demand and Stochastic Entry Costs (Extended Model)

- To generate a low survival rate for new exporters, the model needs to allow for some "bad" plants to enter the export market:
  - With probability $1 - \zeta_L$, $f_0 = f_H$, and with probability $\zeta_L$, $f_0 = 0$.
- $\zeta_L$ is estimated by further including the initial survival rate in the moment vector.

The extended model captures the conditional survivor rate dynamics.

Figure 3. The Sunk-Cost Model and the Extended Model



# Gradual Demand and Stochastic Entry Costs (Extended Model) (ctd.)

- In the extended model, the plant's cumulative profit grows slowly and it takes 22 quarters to break even.
  - It takes only 7 quarters in the sunk-cost model.
  - The standard model front-loads the profits from exporting.

Figure 4. Average Export Profit of Export Entrants