Competition and Export Destination Dynamics

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Motivation

Question
Does foreign market competitiveness generate different gains that shapes export dynamics?
If so, what are the magnitude of gains of exporting differ by destinations?

Markets and Competitiveness:
1. Domestic market
2. Foreign market
   Competitive: Developed Countries (the North)
   Less Competitive: Developing Countries (the South)
Facts

- Facts regarding exports by destination in both extensive and intensive margin:
  - 1. (Extensive Margin) Exports to the North (South) at $t-1$ that are firms’ priority upon exporting, impose large (small) impact on entry to the South (North) at $t$.
  - 2. (Intensive Margin) Conditional on entry, the export sales to the South increases faster than sales to the North.
Fact 1
Extensive Margin

- 46.8% of exporting firms start with the North while 12.2% firms start with the South. Besides, 41% firms starts at both destinations.
Fact 1

Extensive Margin

\[ Pr(e_{it}^f) = \Phi(X'_{it}\beta + \gamma^N e_{it-1}^N + \gamma^S e_{it-1}^S + \eta_t + \eta_{industry} + \epsilon_{it}) \]

Table: Dynamic Destination Choice

<table>
<thead>
<tr>
<th></th>
<th>( Pr(e_{it}^N = 1) )</th>
<th>( Pr(e_{it}^S = 1) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \gamma^N )</td>
<td>2.54**</td>
<td>1.14**</td>
</tr>
<tr>
<td></td>
<td>(0.013)</td>
<td>(0.015)</td>
</tr>
<tr>
<td>( \gamma^S )</td>
<td>0.67**</td>
<td>1.98**</td>
</tr>
<tr>
<td></td>
<td>(0.016)</td>
<td>(0.018)</td>
</tr>
<tr>
<td>( X_{it} )</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>year/industry effect</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>obs.</td>
<td>881269</td>
<td></td>
</tr>
</tbody>
</table>

Exports to the North at \( t - 1 \) encourage exports to the South at \( t \).
Fact 2
Intensive Margin

Table: Foreign Sales and Export Destinations

<table>
<thead>
<tr>
<th></th>
<th>No Adj.</th>
<th>Adj.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>N</td>
<td>0.22</td>
<td>0.25</td>
</tr>
<tr>
<td>S</td>
<td>0.25</td>
<td>0.30</td>
</tr>
<tr>
<td>D</td>
<td>0.12</td>
<td>0.12</td>
</tr>
<tr>
<td>obs.</td>
<td>34254</td>
<td>18040</td>
</tr>
</tbody>
</table>

Conditional on entry, export sales in the South increases faster than sales in the North.
Summary of Facts

1. Exports to the North (South) at $t - 1$ that are firms’ priority upon exporting, impose large (small) impact on entry to the South (North) at $t$.

2. Conditional on entry, the export sales to the South increases faster than sales to the North.

1 implies exporting to the North increase firm-specific component (productivity). To explain 2, firm-market-specific component (demand) should be explicitly taken into account.

- TFPR productivity: efficiency + quality (firm-specific)
- Demand: custom base (firm-market-specific)
Motivation from Literature

- Static:
  Demand is as important as productivity to determine both entry and foreign sales (EKK, 2011; Roberts, 2012)

- What is their dynamic evolution?

- Dynamic:
  Exports increase productivity (Aw Roberts and Xu, 2011). The effect is significant when a firm exports to developed countries. (DeLoecker, 2007, 2011)

- How does the demand evolution with productivity?
A Digress

- One caveat: R&D, instead of export destination, increases productivity

\[ \omega_{it} = \alpha_0 + \alpha_1 \omega_{it-1} + \alpha_N^N e_{it-1}^N + \alpha_S^S e_{it-1}^S + \alpha^{rd} RD_{it-1} + \epsilon_{it} \]

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \alpha_1 )</td>
<td>0.88**</td>
<td>0.88**</td>
<td>0.88**</td>
</tr>
<tr>
<td>( \alpha_N^N )</td>
<td>0.03**</td>
<td>0.02**</td>
<td>0.02**</td>
</tr>
<tr>
<td>( \alpha_S^S )</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>( \alpha^{rd} )</td>
<td></td>
<td>0.01**</td>
<td>0.006**</td>
</tr>
<tr>
<td>( R^2 )</td>
<td>0.83</td>
<td>0.83</td>
<td>0.83</td>
</tr>
</tbody>
</table>

(2) and (3) controls the discrete and continuous measure of R&D, respectively

- Export destination, rather than R&D, increases productivity!
Literature Review

- **Productivity, demand and Export Destination**
  - Productivity and Export Destination: DeLoecker (2007)
  - Demand(quality) and Destination Selection: Crino (2011), Verhoogen (2012)
  - Demand(customer base): Arkolakis (2011)
  - Productivity, Demand and Destination Selection: EKK(2011), Roberts et al. (2012)

- **Export Dynamics**
  - Aw, Roberts and Xu (2011); Albornoz (2011); Li (2014); Rodrigue (2014); Morales et al. (2014); Araujo et al. (2015)

- **Competition and Firm Performance**
  - Competition and Productivity: Syverson (2004); Backus (2014)
  - Competition and Common Demand: Collard-Wexler (2013)
  - Import Competition: DeLoecker (2015)
Model

- Domestic market $D$ and 2 foreign markets $f$:
  1. developed countries (the North: $N$)
  2. developing countries (the South: $S$)
  3. $f \in \{N, S\}$

- Staying at domestic market is default.

- A dynamic model of firms’ exporting market choice.

- Export decisions in year $t$:
  
  $e_{it} = (e_{it}^N, e_{it}^S) = \{(0, 0), (1, 0), (0, 1), (1, 1)\}$

- Firms involve costly exporting decisions to affect productivity $\omega_{it}$ and demand $\lambda_{it}^f$, $f \in \{N, S\}$
Model: Demand

- Domestic demand:

\[ U_t^D = \int_{it \in \Omega_{it}^D} (h_{it} q_{it})^{\frac{\sigma_D - 1}{\sigma_D}} dt \frac{\sigma_D}{\sigma_D - 1} \]

- \( h_{it} \): quality

- Domestic Demand \( q_{it}^D = h_{it}^{(\sigma_D - 1)}(p_{it}^D)^{-\sigma_D} \Phi_t^D \)

- Foreign Demand \( q_{it}^f = e^{\lambda_{it}^f} h_{it}^{(\sigma_f - 1)}(p_{it}^f)^{-\sigma_f} \Phi_t^f \)

- \( \Phi_t^D \) and \( \Phi_t^f \) absorb the aggregate variables

- \( \lambda_{it}^f(e_{it-1}^f) \) captures the heterogeneity in foreign market sales relative to domestic market sales. It denotes the foreign customer base relative to the domestic market.

- \( \Omega_{it}^N \) contains more high-quality varieties than \( \Omega_{it}^S \)
Model: Cost

- \( k_{it} \) capital stock, \( \varphi_{it} \) efficiency
- \( \ln c_{it} = \ln c(k_{it}, \varphi_{it}) = \beta_0 + \beta_k \ln k_{it} - \varphi_{it} + \delta \ln h_{it} \)
- \( \delta < 1 \)

- CES implies constant markups: \( \frac{\sigma}{\sigma - 1} \)
- \( \sigma^D, \sigma^N \) and \( \sigma^S \): measures the market competitiveness, particularly \( \sigma^N > \sigma^S \)
- The sales in domestic market \( D, r^D_{it} \), and foreign markets \( f, r^f_{it}, f \in \{ N, S \} \):

\[
\ln r^D_{it} = (1 - \sigma^D) \ln \left( \frac{\sigma^D}{1 - \sigma^D} \right) + \ln \Phi^D_t + (1 - \sigma^D)(\ln c_{it} - \ln h_{it}) \\
\ln r^f_{it} = (1 - \sigma^f) \ln \left( \frac{\sigma^f}{1 - \sigma^f} \right) + \ln \Phi^f_t + (1 - \sigma^f)(\ln c_{it} - \ln h_{it}) + \lambda^f_{it}
\]
Model: Profit

\[ \ln r_{it}^D = (1 - \sigma^D) \ln \left( \frac{\sigma^D}{\sigma^D - 1} \right) + \ln \Phi^D_t + (1 - \sigma^D)(\beta_0 + \beta_k \ln k_{it} + (\delta - 1) \ln h_{it} - \varphi_{it}) \]

TFPR productivity:

\[ \omega_{it} = \varphi_{it} + (1 - \delta) \ln h_{it} \]

Improvement in either efficiency or quality increases sales

Profit:

\[ \pi_{it}^D = \frac{1}{\sigma^D} r_{it}(\Phi^D_t, k_{it}, \omega_{it}) \]
\[ \pi_{it}^f = \frac{1}{\sigma^f} r_{it}(\Phi^f_t, k_{it}, \omega_{it}, \lambda^f_{it}), \ f \in \{N, S\} \]
## Terminology Comparison

<table>
<thead>
<tr>
<th></th>
<th>This Paper</th>
<th>Standard Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Productivity</strong></td>
<td>Measure: revenue-based measure</td>
<td>Component: efficiency + quality</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Demand</strong></td>
<td>Measure: revenue teasing out productivity</td>
<td>Component: customer base</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table: Terminology Comparison
Model: Transition of State Variables

- Productivity evolves interdependently: $\epsilon_{it} \sim N(0, \sigma^2_\omega)$

$$\omega_{it} = \alpha_0 + \alpha_1 \omega_{it-1} + (\theta_1 + \theta_2 \sigma^N_\omega) e_{it-1}^N + (\theta_1 + \theta_2 \sigma^S_\omega) e_{it-1}^S + \epsilon_{it}$$

- $\theta_2$ determines the effect of competition on productivity
- $\theta_1$ determines the magnitude of the overall effect. $\theta_2 > 0$

- Do not address the number of markets within $N$ or $S$, exporting to either destination increases the firm’s productivity and that encourages the exports to the other market.
Model: Transition of State Variables

- Demand evolves independently in $N$ and $S$:

$$
\lambda_{it}^N = h(\lambda_{it-1}^N, e_{it-1}) + \epsilon_{it}^N = \phi_0^N + \phi_1^N \lambda_{it-1}^N + \left(\eta_1 + \eta_2 \sigma^N\right) e_{it-1} + \epsilon_{it}^N
$$

$$
\lambda_{it}^S = h(\lambda_{it-1}^S, e_{it-1}) + \epsilon_{it}^S = \phi_0^S + \phi_1^S \lambda_{it-1}^S + \left(\eta_1 + \eta_2 \sigma^N\right) e_{it-1} + \epsilon_{it}^S
$$

$$
\epsilon_{it}^N \sim N(0, \sigma_{\epsilon_N}^2) \quad \epsilon_{it}^S \sim N(0, \sigma_{\epsilon_S}^2)
$$

- $\eta_2$ determines the effect of competition on customer base
- $\eta_1$ determines the magnitude of the overall effect. $\eta_2 < 0$
- Exporting to the North(South) only affects the demand(customer base) in the North(South).
Model: Dynamic Decision

- **Timing**
  1. firms observe their realization of productivity $\omega_{it}$ and demand in foreign market $f$, $\lambda^f_{it}$ at the beginning of period $t$.
  2. firms make the export destination decision before the fixed costs $\kappa^f$ incur.
  3. the associated costs are realized and the state variables evolve to period $t + 1$

- **State variables**: $s_{it} = (\omega_{it}, k_{it}, \lambda^N_{it}, \lambda^S_{it}, \Phi_t)$
Model: Dynamic Decision

\[ V(s_{it}) = \pi^D_{it} + \max_{e_{it}} \left\{ \pi^S_{it} - \kappa^S + \delta \mathbb{E} V(s_{it+1}|e_{it} = (0, 1)), \text{ export to the South} \right\} \]

\[ \pi^N_{it} - \kappa^N + \delta \mathbb{E} V(s_{it+1}|e_{it} = (1, 0)), \text{ export to the North} \]

\[ (\pi^N_{it} + \pi^S_{it}) - \kappa^N - \kappa^S + \delta \mathbb{E} V(s_{it+1}|e_{it} = (1, 1)), \text{ export to both markets} \]

\[ \delta \mathbb{E} V(s_{it+1}|e_{it} = (0, 0))) \}

\[ \text{non-export} \]

\[ \text{The expected future value: } \mathbb{E} V(s_{it+1}|e_{it}) = \int_{\Phi'} \int_{\chi'} \int_{\omega'} V(s') dF(\omega'|\omega_{it}, e_{it}) dF(\chi'|\chi_{it}, e_{it}) dG(\Phi'|\Phi_t) \]
Model: Dynamic Decision

- **Benefit:** exports in year $t$, $e_{it}$, jointly affect the productivity $\omega_{it}$ but separately affect the demand $\lambda_{it}^f$, which in turn affect future export decisions $e_{it+1}$ and value $V(s')$.

- **Cost:** export decision in year $t$ incurs the associated fixed costs.

- **Example:** marginal benefit and cost between $e = (1, 0)$ and $e = (0, 0)$:
  \[
  MB = \pi^N(s) + \delta[\mathbb{E} V(s'|e = (1, 0)) - \mathbb{E} V(s'|e = (0, 0))] \\
  MC = \kappa^N
  \]
Parameters of interests (18 in total):

1. 3 coefficients on markup
   \((\sigma^D, \sigma^N, \sigma^S)\);

2. 6 coefficients in the productivity process
   \((\alpha_0, \alpha_1, \theta_1, \theta_2, \sigma_\omega)\);

3. 8 coefficients in the demand process
   \((\phi^N_0, \phi^S_0, \phi^N_1, \phi^S_1, \eta_1, \eta_2, \sigma_{\lambda N}, \sigma_{\lambda S})\)

4. 2 coefficients in the fixed costs \((\kappa^S, \kappa^N)\)
Data

1. Survey of Chinese Manufacturing Firm Data
   Time: 1999-2007, Annual
   Variables: sales, capital, wage, etc.

2. Chinese Custom Data
   Time: 2000-2006, Monthly
   Variables: product categories, unit price, destination of export and import, etc.

3. Plastic industry: mass market product / ordinary trade / 1675 firms / similar pattern with the total sample
Data

Figure: Products in Plastic Industry
Estimation: Markups

- Demand Elasticity: 
  \[ tvc_{it} = r^D_{it} \left( \frac{\sigma^D - 1}{\sigma^D} \right) + \mathbb{I}(e^N_{it} = 1) r^N_{it} \left( \frac{\sigma^N - 1}{\sigma^N} \right) + \mathbb{I}(e^S_{it} = 1) r^S_{it} \left( \frac{\sigma^S - 1}{\sigma^S} \right) + \epsilon_{it} \]

Table: The Elasticity of Substitution

<table>
<thead>
<tr>
<th></th>
<th>(\sigma^D)</th>
<th>(\sigma^N)</th>
<th>(\sigma^S)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>12.5**</td>
<td>11.1**</td>
<td>5.88**</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.055)</td>
<td>(0.105)</td>
</tr>
<tr>
<td># of obs.</td>
<td>12852</td>
<td>12852</td>
<td>12852</td>
</tr>
</tbody>
</table>

- \(\sigma^D > \sigma^N > \sigma^S\)
- Implied markup: Domestic: 8.7%; North: 10% South: 20%
Estimation: Productivity

- Productivity: \( \ln r_{it}^D = \gamma_0 + \sum_{t=1}^{T} \gamma_t D_t + \chi(k_{it}, m_{it}, e_{it-1}) + u_{it} \)

- \( \hat{\chi}_{it} = \alpha_0 (\sigma^D - 1) + \alpha_1 \beta (\sigma^D - 1) \ln k_{it-1} + \alpha_1 \hat{\chi}_{it-1} - \beta (\sigma^D - 1) \ln k_{it} + (\theta_1 + \theta_2 \sigma^N) (\sigma^D - 1) e_{it-1}^N + (\theta_1 + \theta_2 \sigma^S) (\sigma^D - 1) e_{it-1}^S + \epsilon_{it} \)

<table>
<thead>
<tr>
<th>Table: productivity parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \alpha_0 )</td>
</tr>
<tr>
<td>( \alpha_1 )</td>
</tr>
<tr>
<td>( \beta )</td>
</tr>
<tr>
<td>( \theta_1 )</td>
</tr>
<tr>
<td>( \theta_2 )</td>
</tr>
<tr>
<td>( SE(\epsilon^\omega) )</td>
</tr>
<tr>
<td># of obs.</td>
</tr>
</tbody>
</table>
Estimation: Productivity

- $\theta_2 > 0$ implies the competition indeed increases productivity.
- $\alpha_2^f = \theta_1 + \theta_2 \sigma^f$
- $\alpha_2^N = 0.016$ and $\alpha_2^S = -0.001$
Estimation: Demand and Fixed Cost

\[ \Theta = \left[ \left( \phi^N_0, \phi^N_1, \sigma^2_{\lambda N}, \phi^S_0, \phi^S_1, \sigma^2_{\lambda S}, \eta_1, \eta_2 \right), (\kappa^N, \kappa^S) \right] \]

- Impossible to separately identify
  Demand depends on fixed cost, which in turn determine the magnitude of selection effect.
- Simulated Method of Moments
Estimation: Demand and Fixed Cost

- The 1st set of moments contains cross-sectional discrete type information: export destination choice. (4 moments)
- The 2nd set of moments carries information over time, which consists of 8 moments to characterize the firms’ destination switching behavior at $t$ and $t + 1$. (8 moments)
- In addition to the entry/exit discrete-type information, the 3rd set of moments contains export sales continuous-type information, conditional on exporting. (2 moments)

- 14 moments (10 parameters)
Estimation: Demand and Fixed Cost

- Value Function Iteration. State Variable: 
  \( s_{it} = (\omega_{it}, k_{it}, \lambda_{it}^N, \lambda_{it}^S, \Phi_t) \)

- Time Varying State Variable: 
  \( s_{it} = (\omega_{it}, \lambda_{it}^N, \lambda_{it}^S) \)

- Parallel computing over \( k_i \).

  \[ \Theta = \arg\min \quad (m(\Theta) - M)'\mathbb{W}(m(\Theta) - M) \]

- \( m(\Theta) \): simulated moments; \( M \): data moments
## Estimation: Demand and Fixed Cost

### Table: Dynamic estimation: Demand and Fixed Cost Parameters

<table>
<thead>
<tr>
<th></th>
<th>North</th>
<th>South</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demand</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\phi_0$</td>
<td>-0.612* (0.002)</td>
<td>-0.18** (0.002)</td>
</tr>
<tr>
<td>$\phi_1$</td>
<td>0.872** (0.001)</td>
<td>0.898** (0.027)</td>
</tr>
<tr>
<td>$\eta_1$</td>
<td></td>
<td>1.49** (0.013)</td>
</tr>
<tr>
<td>$\eta_2$</td>
<td></td>
<td>-0.134** (0.007)</td>
</tr>
<tr>
<td>$\sigma_\lambda$</td>
<td>0.21** (0.001)</td>
<td>0.39** (0.004)</td>
</tr>
<tr>
<td><strong>Fixed Cost</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\kappa$</td>
<td>5.41** (0.002)</td>
<td>5.19** (0.002)</td>
</tr>
</tbody>
</table>

$\kappa^N \approx 32000 > \kappa^S \approx 25600$: Exporting to the North is costly each period on average.
Estimation: Productivity

- Unlike competition on productivity, $\eta_2 < 0$ indicates intensifying competition prevents firm expanding customer base quickly!

\[ \eta_1 + \eta_2 \sigma^N = \phi_2^N = 0.003 \]
\[ \eta_1 + \eta_2 \sigma^S = \phi_2^S = 0.702 \]

- Demand in the South increases faster conditional on entry. Recall demand represents the customer base in foreign market relative to the domestic market. Because the domestic market is most competitive, it is reasonable to see the customer base in the South increases the fastest among the 3 market.
Counterfactual 1: The Role of Productivity in the North

Set $\kappa^N$ high enough

Table: Counterfactual 1

<table>
<thead>
<tr>
<th></th>
<th>(N,S)</th>
<th>(S)</th>
<th>difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>extensive margin</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$%(e_{it} = 1)$</td>
<td>8%</td>
<td>1.5%</td>
<td>6.5%</td>
</tr>
<tr>
<td>$%(e_{it}^N = 1)$</td>
<td>7%</td>
<td>0%</td>
<td>7%</td>
</tr>
<tr>
<td>$%(e_{it}^S = 1)$</td>
<td>3%</td>
<td>1.5%</td>
<td>1.5%</td>
</tr>
</tbody>
</table>

Shutting down the option to export to the North kills 1.5 percentage points of exporters to the South
Counterfactual 2: The Role of Demand in the South

Set $\kappa^S$ high enough

<table>
<thead>
<tr>
<th>Table : Counterfactual II</th>
</tr>
</thead>
<tbody>
<tr>
<td>(N,S)</td>
</tr>
<tr>
<td>extensive margin</td>
</tr>
<tr>
<td>$%(e_{it}^N = 1)$</td>
</tr>
<tr>
<td>$%(e_{it}^N = 1)$</td>
</tr>
<tr>
<td>$%(e_{it}^S = 1)$</td>
</tr>
</tbody>
</table>

Shutting down the option to the North kills 0.6 percentage points to the North.
Counterfactual 3: The Role of Foreign Competition

- The South is as competitive as the North: set $\sigma^S = 11.1$

<table>
<thead>
<tr>
<th>Table: Counterfactual 3: Foreign Competition</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sigma^S$</td>
</tr>
<tr>
<td>(1) $\sigma^S = 5.88$</td>
</tr>
<tr>
<td>(2) $\sigma^S = 11.1$</td>
</tr>
<tr>
<td>%($e_{it}^S = 1$)</td>
</tr>
</tbody>
</table>

- When the South becomes competitive as North, number of exporter triples!
Summary

▶ To answer the question at the beginning, market competitiveness indeed generates different gains.

▶ This paper incorporates dynamic demand along with productivity, to investigate firm export dynamics to the North and South.

▶ This paper finds the discrepancy in competition between the North and the South, and highlights the role of competition on both market firm-market specific component (demand) and firm-specific component (productivity).

▶ Compared with exports to the less competitive South, exports to the competitive North help to improve firm-specific productivity. However, the intensive competition also places limits on the firm to expand customer base quickly on that market.