Discussion of
“R&D Investment, Exporting, and Productivity Dynamics”
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I. Place in the Literature

1. Empirics on exporting and productivity:
   — Bernard and Jensen (1999)
   — Bustos (2007)

2. Theoretical models with export and R&D investment:
   — Atkeson and Burstein (2008)
   — Constantini and Melitz (2008)

3. Structural estimation of industry equilibrium:
   — Olley and Pakes (1996): productivity dynamics
   — Das, Roberts and Tybout (2007): exporting with sunk and fixed costs
II. Data

- Taiwanese Electronics Industry
- Balanced panel of 1,237 plants for 2000-2004
- Data on domestic and export revenues, as well as R&D expenditure

Export and R&D transition dynamics:

<table>
<thead>
<tr>
<th></th>
<th>Neither</th>
<th>only R&amp;D</th>
<th>only Export</th>
<th>Both</th>
<th>Uncond’l</th>
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</thead>
<tbody>
<tr>
<td>Neither</td>
<td>0.87</td>
<td>0.01</td>
<td>0.11</td>
<td>0.01</td>
<td>0.56</td>
</tr>
<tr>
<td>only R&amp;D</td>
<td>0.37</td>
<td>0.34</td>
<td>0.06</td>
<td>0.23</td>
<td>0.04</td>
</tr>
<tr>
<td>only Export</td>
<td>0.21</td>
<td>0.01</td>
<td>0.71</td>
<td>0.07</td>
<td>0.26</td>
</tr>
<tr>
<td>Both</td>
<td>0.02</td>
<td>0.06</td>
<td>0.15</td>
<td>0.77</td>
<td>0.15</td>
</tr>
</tbody>
</table>
III. Model

- Firm’s problem:

$$\max_{\{e_t, d_t \in \{0, 1\}\}} \left\{ \mathbb{E}_0 \sum_{t=0}^{\infty} \delta^t \left\{ \pi^D(\omega_t) + e_t \left[ \pi^X(\omega_t, z_t) - \gamma^X(e_{t-1}) \right] - d_t \gamma^R(d_{t-1}) \right\} \right\}$$

subject to productivity evolution:

$$\omega_t = g(\omega_{t-1}, e_{t-1}, d_{t-1})$$

- No static optimization
- High $\omega_t$ affects incentives for both $e_t$ and $d_t$
- Interactions between $e_t$ and $d_t$ through both objective function and productivity dynamics
- Persistence through sunk versus fixed costs (both iid): option value of waiting
IV. Estimation

1. Static equations:
   - \( \{ tvc_{it}, r_{it}^D, r_{it}^X \} \) to estimate elasticity of demand
   - \( \{ r_{it}^D, k_{it}, m_{it}, n_{it} \} \) to estimate productivity \( \omega_{it} \)
   - \( \{ r_{it}^X, \omega_{it} \} \) to estimate export demand shock \( z_{it} \)

2. Productivity dynamics:
   \[ \omega_{it} = g(\omega_{it-1}, e_{it-1}, d_{it-1}) \]
   Estimated by OLS using a parametric assumption about \( g(\cdot) \)

3. Dynamic exporting and investment decisions:
   - \( \{ e_{it}, d_{it} | z_{it} \} \) to estimate parameters of the model (sunk and fixed costs) using ML
V. Results

1. Productivity dynamics (estimation of $g(\cdot)$):

\[
\frac{\Delta \omega_{it}}{\Delta e_{it-1}} > 0 \quad \frac{\Delta \omega_{it}}{\Delta d_{it-1}} > 0 \quad \frac{\Delta^2 \omega_{it}}{\Delta e_{it} \Delta d_{it}} < 0
\]

2. Sunk and Fixed costs of Exporting and R&D:
   - R&D costs roughly twice as big as Export costs
   - Sunk costs are roughly twice as big as Fixed costs
   - Around 10% of revenues

3. Interdependence between exporting and investment:
   - Selection based on $\omega_{it}$ for both $e_{it}$ and $d_{it}$
   - A lot of persistence due to large sunk costs relative to fixed costs
   - Probability of exporting decreasing in R&D and probability of investment decreases in export status due to the interaction in the productivity dynamics
VI. Comments

1. What is the takeaway: virtually no interaction between exporting and investment decisions?

2. What are the guidelines for calibration (fixed and sunk costs)?

3. $g(\cdot)$ is a black box: what is the source of interaction between $e$ and $d$?

4. Benchmark when $g$ is separable in $e$ and $d$: interaction only through the objective function.

5. Endogeneity in $\omega_t = g(\omega_{t-1}, e_{t-1}, d_{t-1})$

6. Data on R&D expenditure is not used
VI. Comments
(continued)

• The role of $k_{it}$ in the marginal cost? Absence of $\ell_{it}$ in estimation?

• Is the absence of persistence in $\gamma$s crucial?

• Balanced panel: entry and exit decisions?

• $e$ and $d$ are not directly comparable