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:

	Neither	only R&D	only Export	Both	Uncond'l
Neither	0.87	0.01	0.11	0.01	0.56
only R&D	0.37	0.34	0.06	0.23	0.04
only Export	0.21	0.01	0.71	0.07	0.26
Both	0.02	0.06	0.15	0.77	0.15

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:

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

- No static optimization
- High ω_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 ω_{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 $g(\cdot)$):

$$\frac{\Delta\omega_{it}}{\Delta e_{it-1}} > 0 \qquad \frac{\Delta\omega_{it}}{\Delta d_{it-1}} > 0 \qquad \frac{\Delta^2\omega_{it}}{\Delta e_{it}\Delta d_{it}} < 0$$

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 ω_{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 ℓ_{it} in estimation?
- Is the absence of persistence in γs crucial?
- Balanced panel: entry and exit decisions?
- e and d are not directly comparable