Trade, firm selection, and innovation: the competition channel

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(working paper)
Want to introduce (cost-reducing) innovation and competitive effects of trade.

Use an oligopolistic (as opposed to monopolistic competition) framework.

Model is solved analytically

Abandon use of fixed cost of entering the export market
Impullitti & Licandro aim to create a model that captures the following three stylised facts from the empirical trade literature:

1) Selection Effect
2) Innovation
3) Pro-competitive effects
- **Selection Effect**: Trade liberalisation induces the least productive firms to exit the market and the most productive non-exporters to become exporters.

- **Innovation**: Role of firm heterogeneity in shaping the effects of trade liberalisation on innovation activities: Surviving firms tend to innovate more.
  - **Note**: This is to be differentiated from 'learning-by-exporting'.
Pro-competitive effects: Trade liberalisation has pro-competitive effects that can potentially lead to more selection and innovation.

- eg. Griffith, Harrison & Simpson (2008) have studied the effects of trade integration reforms carried out under the EU Single Market Program and found that these reforms have increased competition (measured as avg. Markups) & stimulated innovation (R&D expenditure).
The Model (Autarky)

- Two goods: Homogenous good, $Y_t$
  Differentiated good, $X_t$

- Consumers have endowments of unit flow of homogenous good $Y$

- Preferences of representative consumer

\[ \int_{0}^{\infty} (\ln X_t + \beta \ln Y_t) e^{-\rho t} \, dt \]
The differentiated good X is produced by the mean of a continuum of varieties of endogenous mass \( M \in [0,1] \), by

Each variety in X is produced by \( n \) identical firms by transforming the homog. good into this particular variety.

\[
X_t = \left( \int_0^{M_t} x_j^\alpha \, dj \right)^{\frac{1}{\alpha}}
\]
Firm production & innovation

- Firms face the same fixed cost $\lambda > 0$, but may have different productivities $z$.

- Firms production tech.: $q_t = (\hat{z}_t + bz_t)(y_t - \lambda)$

  $\hat{z}_t$: avg. productivity of other (n-1) firms producing same variety

  $b$: spillovers (intraindustry)

- Innovation activities: $\dot{z}_t = A \hat{z}_t h$

  $h$: units of $Y$ allocated to innovation

  $A > 0$: innovation efficiency
Much the same as in Melitz (2003)

- Fixed cost of exit
- Fraction $\delta > 0$ of varieties exit every period, regardless of productivity $z$
- We get entry that keeps mass of varieties constant
- We will get a cutoff condition similar to Melitz (2003)
Households solve their utility maximization problem. Among other things this gives a price rule which the firms will then follow.

Firms play a Cournot competition game. We then solve the firms maximization for an open-loop Nash equilibrium.
Firms maximization problem is

\[ V_s = \max_{(q_t, h_t)_{t=0}^{\infty}} \int_{s}^{\infty} \left[ (p_t - (z_t + b^2 t)^{-1}) q_t - h_t - \lambda \right] e^{-(\rho+\delta)(t-s)} \, dt, \quad \text{st.} \]

\begin{align*}
p_t &= \frac{E_t}{X_t^\alpha} x_t^{\alpha-1} \\
x_t &= \hat{x}_t + q_t \\
\dot{z}_t &= A \dot{z}_t h_t \\
z_s &> 0,
\end{align*}
From the firms maximization problem we get that, as is standard in Cournot type equilibria, the markup, $1/\theta$, over marginal costs $(z_t + b\hat{z}_t)^{-1}$ depends on both the demand elasticity and the number of competitors;

$$1/\theta = n/(n-1+\alpha) \quad (=\sigma n/(\sigma n-1))$$

Note: In equilibrium firms producing the same good operate with the same technology $(z_t = \hat{z}_t)$ & face the same initial conditions. So they will also produce the same
We also get that the profitability of R&D depends on production as the benefit of reducing production costs is larger, the higher production.

Since more efficient firms produce more they also have more incentives to do R&D, meaning that firm's R&D activity depends positively on firm's state of technology.
As a result, our equation for productivity growth depends positively on output, which depends on productivity level;

\[ g = \frac{A\theta e}{(1+b)} - \rho - \delta \]

where \( g \) = growth rate of the average productivity \( \overline{z} \) _t_.

The term \( \frac{A\theta e}{(1+b)} \) is the marginal return to R&D investment for firms with the average productivity.
Stationary Equilibrium

- For a stationary distribution of firms we need

\[(1 - M) (1 - F(\tilde{z}^*)) = \delta M\]

\[M(\tilde{z}^*) = \frac{1 - F(\tilde{z}^*)}{1 + \delta - F(\tilde{z}^*)}\]

- The market clearing condition for the homogenous good can be written as

\[n \int_0^M (y_j + h_j) \, dj + Y = n \int_0^M \left( \frac{q_j}{z_j (1 + b)} + h_j + \lambda \right) \, dj + \beta E = 1\]
Equilibrium Equations

- From these equations we get

\[ e = \frac{1}{nM(\bar{z}^*)} + \frac{\delta + \rho}{A} - \lambda \]

(EQ)

- From our market exit cutoff condition we get

\[ e\zeta^* = \frac{\lambda - \frac{\rho + \delta}{A}}{1 - \frac{2 + b}{1 + b} \theta} \]

(EC)
- Make some assumptions about parameters to ensure interior solution
Proposition 2: An increase in $\theta$ raises the productivity cutoff ($d\bar{z}^*/d\theta > 0$), reduces the number of operative varieties ($dM(\bar{z}^*)/d\theta < 0$), has an ambiguous effect on the labor resources allocated to the homogeneous sector ($d(\beta e)/d\theta < 0$) and increases the growth rate ($dg/d\theta > 0$).
They call the change due to shift of MC the direct competition effect.

They call the change due to shift of EC the selection effect.
Open Economy

- Two identical countries
- Iceberg type, $\tau > 0$, trading costs
- No entry cost to export market
Find,

\[
\theta^T = \frac{2n - 1 + \alpha}{n (1 + \tau)^2 (1 - \alpha)} \left[ \tau^2 (1 - n - \alpha) + n (2\tau - 1) + (1 - \alpha) \right]
\]

- This is a decreasing function of \( \tau \)
  - When \( \tau = 1; \) \( \theta^T_{\text{max}} = \frac{(2n - 1 + \alpha)}{2n} \)
  - When \( \tau = \frac{n}{n-1+\alpha}; \) \( \theta = \frac{(n - 1 + \alpha)}{n} \)
- Can also show that \( \theta^T - \theta > 0 \)
Proposition 4:

- The effect of trade liberalisation on selection & growth is decreasing in the number of firms.