A League of their Own:
High Quality Producers and International Trade

Jacques Potin

ESSEC Business School

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Stylized facts on *firms in international trade* emphasized by Bernard, Redding, and Schott (2007):

- For U.S. firms, exporting is relatively *rare* (15% of firms in tradable goods industries)
- Exporters are *different:* larger, more productive, more skill-intensive + *supply higher quality products* (Baldwin and Harrigan, 2007)
- Trade liberalization leads to a *reallocation of resources* across and within industries
  - Pavcnik (2002): growth of the most productive firms
  - Roberts and Tybout (1991): contraction of large import-competing firms

- Contribution: a GE model with *heterogeneous quality* that *replicates these stylized facts*
- Main assumptions:
  - Build on Melitz (2003):
    - Firms are heterogeneous
    - *Horizontal differentiation*
    - Monopolistic competition along the horizontal dimension
  - Introduce *vertical differentiation:*
    - Firms differ in the quality of the good they can produce (main heterogeneity)
    - The production of high quality goods requires a scarce ability
    - Competition occurs within each quality segment: competition is “local” along the vertical dimension

Outline

Baldwin and Harrigan (2007):

- Fact: export unit values increase with distance
- Interpretation: *self-selection into export markets according to quality*
  - For market m, there is a quality cutoffs q_X^m such that firm i exports only if $q_i \geq q_X^m$
  - q_X^m rises with distance
- A *new model with quality differences:* very close to Melitz (2003), substitute quality differences for productivity differences, *quality = pure demand shifter*
- Similar to Manasse and Turrini (2001), followed by Crozet, Head, and Mayer (2007), Johnson (2008)
- *One more firm enters at a given quality level* $\Rightarrow$ *all firms (at all quality levels) have their sales and profits reduced in the same proportion*

  $\Rightarrow$ Counter-intuitive results on the impact of trade opening

- Hummels and Skiba (2004) (on the “Alchian-Allen conjecture"):
  - Trade costs are rather per unit charges (independent of quality or value) $\Rightarrow$ the relative price of high quality goods decreases with trade costs $\Rightarrow$ the relative demand for high quality goods increases with trade costs
  - But no model of self-selection into export markets
- Bernard, Jensen, and Schott (2007):
  - Combine HO model (2 types of goods, one being more skill-intensive) with Melitz (2003)
  - Skill-intensive good similar to the high quality goods in my paper
  - Explanation for self-selection into export markets within an industry: same as Melitz (2003) (differences in productivity)

Demand:

- A representative consumer has access to goods of various qualities q, distributed over $[\underline{q}, \infty)$, with $\underline{q} > 0$.
- Preferences are Cobb-Douglas over the various qualities

$$U = \int_{\underline{q}}^{\infty} b(q) \ln(X(q)) dq,$$

with $X(q)$ the consumption of goods of quality q, and $\int_{\underline{q}}^{\infty} b(q) dq = 1$

- Taste for variety at each q (subutility function $X(q)$ is CES):

$$X(q) \equiv \left(\int_{i \in \mathcal{A}(q)} x(q,i)^{\rho} di \right)^{1/\rho}$$

- Optimal demand for good (q, i):

$$x(q,i) = \left(\frac{P(q)}{p(q,i)}\right)^{\sigma} \frac{b(q)I}{P(q)}$$

with $\sigma \equiv 1/(1-\rho) > 1$ the CES across varieties, I the total expenditures, and $P(q)$ the dual price index for the goods of quality q

Note: in models where quality = demand shifter, we find instead

$$x(q,i) = \left(\frac{P}{p(q,i)/q}\right)^{\sigma} \frac{I}{P} = q^{\sigma} \left(\frac{P}{p(q,i)}\right)^{\sigma} \frac{I}{P}$$

- My model: a firm enters at quality level $q \Rightarrow P(q)$ goes down $\Rightarrow$ lower sales *only* for firms in segment q: *no longer the symmetric effect (on sales, thus profits) of entry at a particular quality level*

Production

Course of events for a firm:

1. Free entry, with entry cost F_E
2. Draw of a particular q from $g(q)$
3. Voluntary exit?
4. Production with cost function
   $C(x(q,i)) = \left(F(q) + q^{\lambda} x(q,i)\right) w$,
   with $x(q,i)$ the quantity, w the cost of labor (homogeneous)
5. Positive probability of death δ (due to exogenous reasons)
6. and back to point 3

Equilibrium of a closed economy:

- Study the stationary equilibrium
- Let δM be the equilibrium mass of firms entering in each period
- Let $A(q)$ be the mass of active firms at quality level q
  - If all firms remain active at quality level q, $A(q) = Mg(q)$
  - Otherwise $A(q) < Mg(q)$
- Given $A(q)$, the individual profit is

$$\pi(q,i) = x(q,i)[p(q,i) - MC(q)] - F(q) = \frac{1}{\sigma}\frac{b(q)}{A(q)}L - F(q) = \pi(q)$$

- Want to find that the entering firms are less productive than the incumbents $\Rightarrow$
- Assumption 1: $\frac{d}{dq}\left(\frac{b(q)}{F(q)g(q)}\right) > 0$, for every q in $(\underline{q}, \infty)$.
  Other assumption: there is $q_e > \underline{q}$ such that

$$\frac{1}{\sigma}\frac{b(q_e)}{g(q_e)}\frac{L}{M} - F(q_e) = 0$$

  $\Rightarrow$ profits with no voluntary exit are negative for $q < q_e$, and *q_e is the cutoff for voluntary exit*
- Equilibrium mass of firms at q:
  - For $q \geq q_e$, $A(q) = \mu(q)M = g(q)M$
  - For $q < q_e$, some firms exit and $A(q) = \mu(q)M < g(q)M$ such that $\pi(q) = \frac{1}{\sigma}\frac{b(q)L}{\mu(q)M} - F(q) = 0$

Exit by low quality firms:

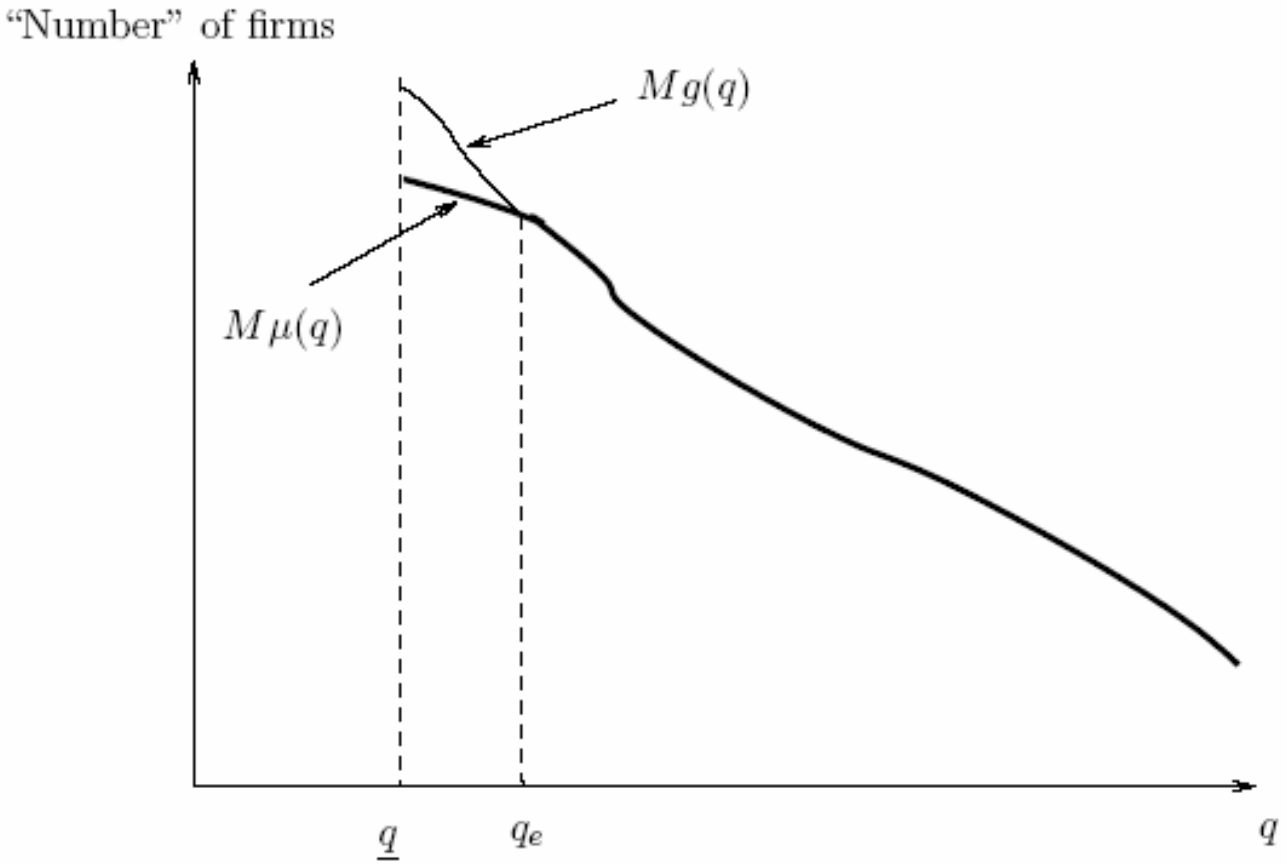

Figure 1: Exit by low quality firms

- Labor productivity goes up with q + exit for $q < q_e \Rightarrow$ the entering firms are on average less productive than the incumbents
- Numerical application with $F(q) = F$:
  - Closed form solution for the equilibrium
  - $g(q)$ *and* $b(q)$ Pareto (with appropriate shape parameters: $k > k_b$) $\Rightarrow$ firm size distribution is Pareto on $[q_e, \infty)$

Equilibrium with *two symmetric* open economies:

- Two identical countries
- Costly trade:
  - Variable transportation cost of the "iceberg" type, τ
  - Fixed cost, F_X, paid in each period if export

  $\Rightarrow$
- Foreign demand to firm (q, i):

$$x_X(q,i) = \left(\frac{P^*(q)}{p_X(q,i)}\right)^{\sigma} \frac{b(q)I^*}{P^*(q)}$$

- Optimal linear pricing: $p_X(q,i) = \frac{\sigma}{\sigma-1}\tau q^{\lambda} = \tau\frac{q^{\lambda}}{\rho}$

- Let $f_X(q)$ be the portion of q-quality firms exporting
- Profits when export, taking $f_X(q)$ as given:

$$\pi_X(q,i) = \frac{1}{\sigma(1+f_X(q)\tau^{1-\sigma})\tau^{\sigma-1}} \frac{b(q)}{\mu(q)} \frac{L}{M_t} - F_X$$

- Let q_x be the quality level such that *some firms export at each* $q \geq q_x$
- F_X sufficiently high $\Rightarrow q_x > q_{et}$, the new cutoff for voluntary exit, and

$$\pi_X(q,i) = \frac{1}{\sigma(1+f_X(q)\tau^{1-\sigma})\tau^{\sigma-1}} \frac{b(q)}{g(q)} \frac{L}{M_t} - F_X$$

- To obtain self-selection into export markets in this model: Assumption 3: *High quality firms are scarce* in the sense that $\frac{d}{dq}\left(\frac{b(q)}{g(q)}\right) > 0$, for every q in $(\underline{q}, \infty)$.
  $\Rightarrow$
- The *equilibrium portion of exporting firms* is given by:

$$f_X(q) = \begin{cases} 0 & \text{if } q < q_x; \\ \frac{1}{\sigma F_X}\frac{b(q)}{g(q)}\frac{L}{M_t} - \tau^{\sigma-1} & \text{if } q \in [q_x, q_X]; \\ 1 & \text{if } q > q_X. \end{cases}$$

Self-selection into export markets:

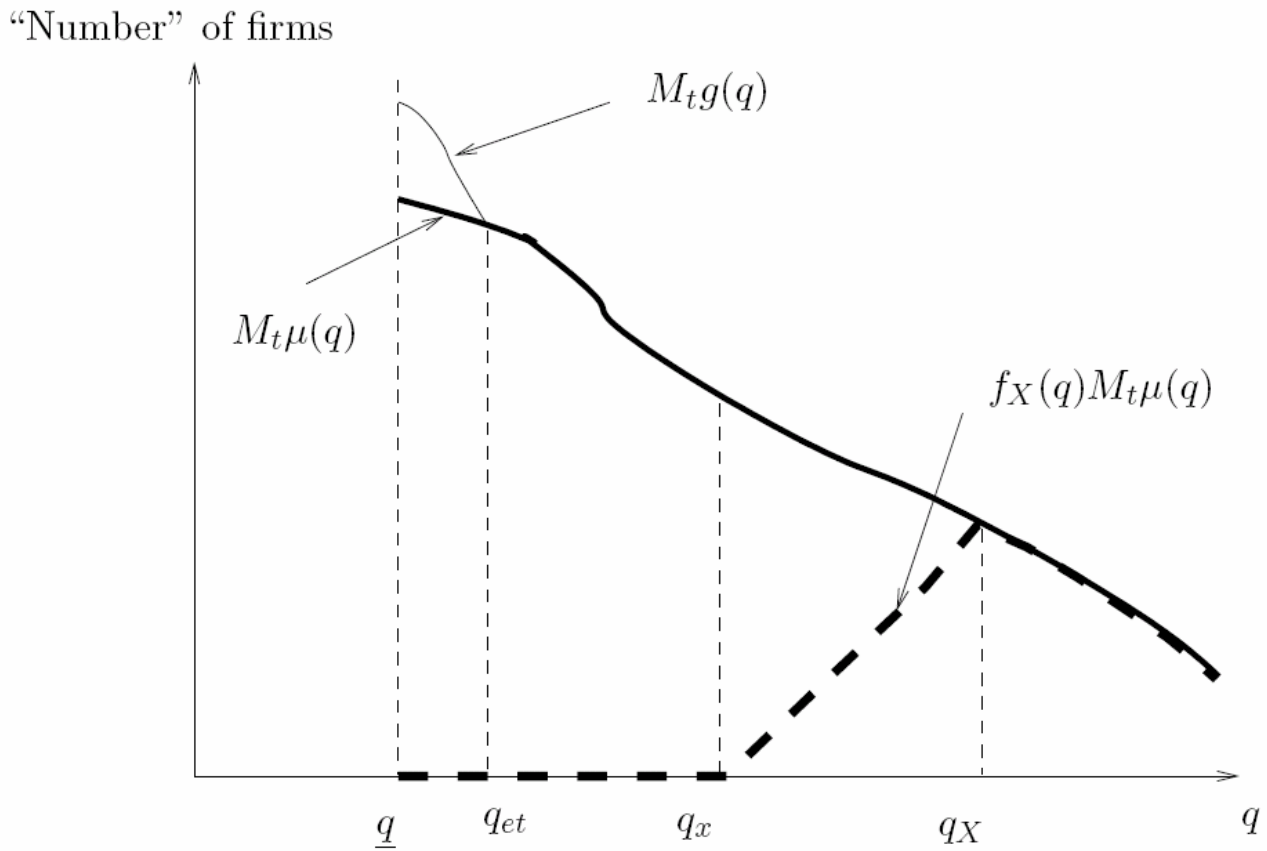

Figure 2: Self-selection into export markets according to quality

Only the high quality firms export. Effect on output?

- *Sales on the foreign market* $\Rightarrow$ output of high quality firms tends to *grow*
- *Sales of foreign firms on domestic market + market segmentation* $\Rightarrow$ output of high quality firms tends to *contract*
- The *net effect* on aggregate sales is *nil!*

Still, the high quality firms grow in terms of employment because each of them has to employ F_X workers to manage exports
$\Rightarrow$ *reallocation of labor towards the high quality, productive, large firms*

Equilibrium with two *asymmetric* open economies:

- Problem in the model with two symmetric countries: no real growth in output for high quality, productive firms. Not consistent with facts.
- Idea: introduce asymmetry between countries so that output of high quality firms grows in one country
  Assumption 4: *High quality firms are scarcer in the foreign country than in the home country*, in the sense that $\frac{d}{dq}\left(\frac{g(q)}{g^*(q)}\right) > 0$, for every q in $(\underline{q}, \infty)$.

Exports by firm (q, i) located in home country:

$$x_X(q,i) = \frac{\rho}{\left(\frac{M_t^* \mu^*(q)}{M_t \mu(q)} + f_X(q)\tau^{1-\sigma}\right)\tau^{\sigma}} \frac{q^{-\lambda} b(q)}{\mu(q)} \frac{L}{M_t}$$

- Compared to the case with 2 symmetric economies, we have $\frac{M_t^* \mu^*(q)}{M_t \mu(q)}$ rather than 1:
  the more numerous the high quality firms located at home are relative to their foreign counterparts, the more they export
- Trade opening $\Rightarrow$ the aggregate output of firms with q sufficiently high *grows* in the home country and *contracts* in the foreign country
- Same result about *self-selection into export markets*: cutoff points $q_{et}^* < q_x < q_X$, and $q_{et} < q_x^* < q_X^*$

Individual profits if export:

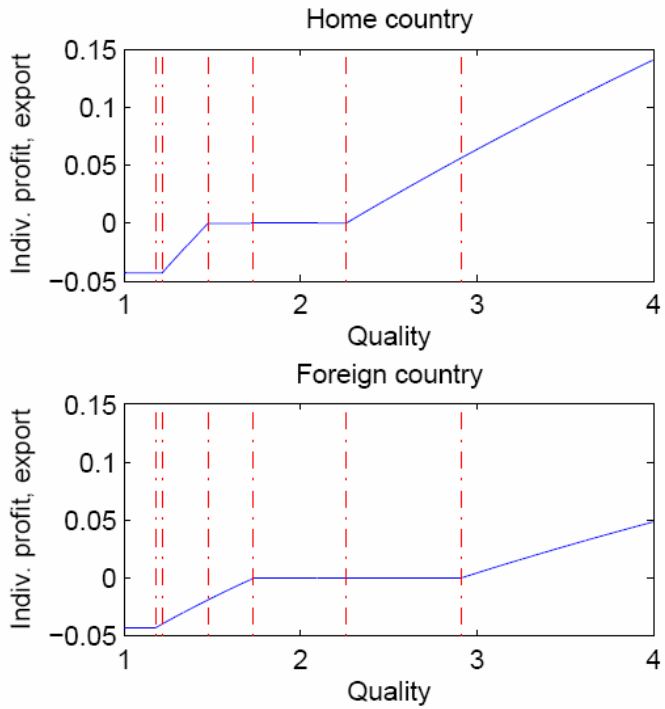

Figure 3: Individual profits if export, home and foreign countries.

Note: This figure shows as a function of q the maximum profits generated by exports, $\pi_X(q,i)$ and $\pi_X^*(q,i)$, assuming that all the other firms behave optimally. The dashed, vertical lines are located at the various quality cutoffs $q_{et} = 1.18$, $q_{et}^* = 1.22$, $q_x = 1.48$, $q_x^* = 1.73$, $q_X = 2.26$, and $q_X^* = 2.91$.

Individual output, autarky and trade:

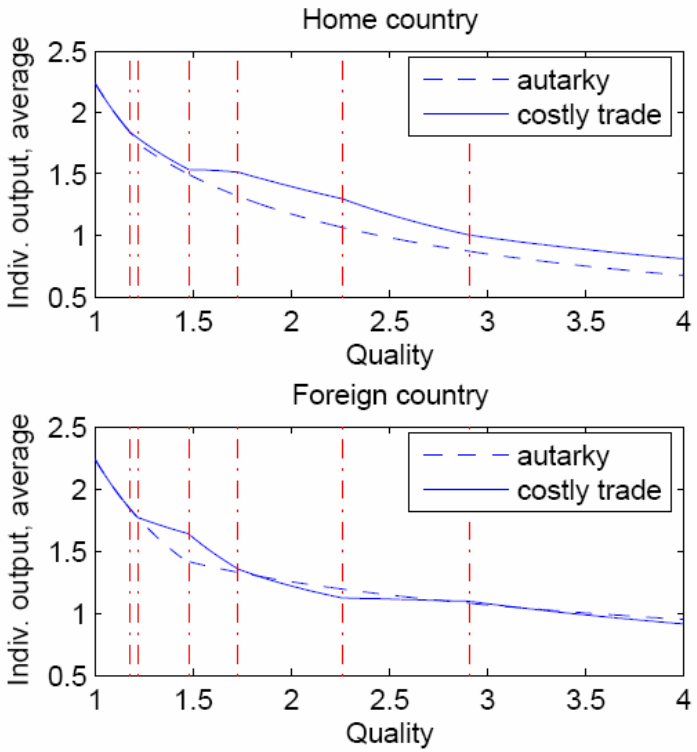

Figure 4: Individual output in autarky and with trade, home and foreign countries.

Note: This figure shows as a function of q the average individual output, $x(q,i) + f_X(q)\tau x_X(q,i)$ and $x^*(q,i) + f_X^*(q)\tau x_X^*(q,i)$. The dashed, vertical lines are located at the various quality cutoffs $q_{et} = 1.18$, $q_{et}^* = 1.22$, $q_x = 1.48$, $q_x^* = 1.73$, $q_X = 2.26$, and $q_X^* = 2.91$.

Contribution

- *Explanation for self-selection into export markets: high quality firms are rare* (given the budget share allocated to high quality goods)
- *Link between two facts:* (1) exporters are rare (2) high quality firms are much more likely to export
- Not the first model to explain self-selection, but more *reasonable assumption of "local" competition* (along the vertical dimension) $\Rightarrow$ should lead to better predictions about the impact of trade opening

Outlook

- Empirical work? Relax some strong assumptions of the model
- Same model with FDI: just as Helpman, Melitz, Yeaple (2004) generalized Melitz (2003)