

Trade with heterogeneous firms

The frontier of trade theory

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Topic 5

Do all firms trade? no!

Starting point of the Melitz (2003) model:

- ▶ the paper provides an extension of Krugman (1980) that incorporates **firm level productivity differences**
- ▶ Consumers like to differentiate their consumption ($\omega > 0$ indicates varieties)
- ▶ Monopolistic competition
- ▶ Productivity is random
- ▶ Only the more productive firms enter the export market (while some less productive firms continue to produce only for the domestic market). Trade will simultaneously force the least productive firms to exit.

Part I

Melitz (2003)

Melitz (2003): closed economy

- ▶ The demand side is CES:
 - ▶ Yields constant elasticity demand functions

$$q(\omega) = \frac{R}{P} \left[\frac{p(\omega)}{P} \right]^{-\sigma} \quad (1)$$

where R is total spending, P is the ideal price index and $\sigma = \frac{1}{1-\rho}$.

- ▶ On the supply side:
 - ▶ Monopolistic competition. Every variety is produced by a single firm and there is free entry into the industry.
 - ▶ Constant marginal costs and a fixed overhead production cost in terms of the single input (labor), which we take as numeraire ($w = 1$).
 - ▶ The fixed cost is identical across all firms; denote it by $f > 0$:
 $l = f + \frac{g}{\varphi}$.

Melitz (2003): the firm's choice (1)

- The marginal labor cost $1/\varphi$ varies across firms,

$$TC(\varphi) = f + \frac{q(\varphi)}{\varphi} \quad (2)$$

Firms with higher φ are more productive. Higher productivity firms charge lower prices, produce more output, and obtain higher revenues $r(\varphi)$ and higher profits $\pi(\varphi)$:

$$p(\varphi) = \frac{1}{\rho\varphi}; \quad q(\varphi) = RP^{\sigma-1}(\rho\varphi)^{\sigma};$$

$$r(\varphi) = p(\varphi)q(\varphi) = R(P\rho\varphi)^{\sigma-1}; \quad (3)$$

$$\pi(\varphi) = \frac{1}{\sigma}r(\varphi) - f. \quad (4)$$

Melitz (2003): the firm's choice (2)

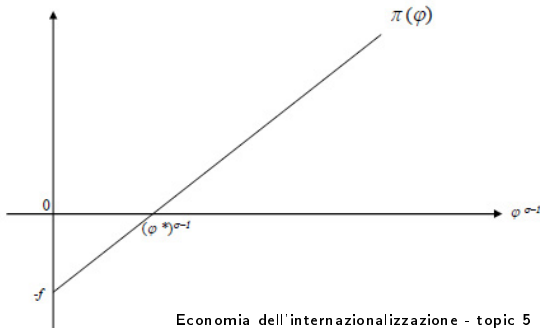
- ▶ Prior to entry, firms face productivity uncertainty:
 - ▶ firm pays a fixed cost of entry f_e in units of labor;
 - ▶ firm then draws its productivity φ from a known distribution $G(\varphi)$ with density $g(\varphi) = G'(\varphi)$;
 - ▶ After observing φ , a producer decides whether to exit or produce.
- ▶ Every firm faces a probability δ of death per unit time.

Melitz (2003): the firm's choice (3)

- ▶ Given stationarity, a firm with productivity φ earns profits $\pi\varphi$ in every period, until it is hit by a shock. The expected value of the firm is:

$$v(\varphi) = \max \left[0, \sum_{t=s}^{\infty} (1 - \delta)^{t-s} \pi\varphi \right] = \max \left[0, \frac{1}{\delta} \pi(\varphi) \right] \quad (5)$$

- ▶ It is clear from (4) and (5) that there is a unique threshold productivity φ^* such that $v(\varphi) > 0$ if and only if $\varphi > \varphi^*$.



- There are two types of trade frictions:
 - ① A standard iceberg cost τ .
 - ② An initial fixed cost of f_{ex} units of labor to start exporting, *which is incurred once the firm has learned φ* (alternatively, the cost f_{ex} could be fixed rather than sunk).
- It is also assumed that the domestic economy can trade with $n \geq 1$ other countries and that all countries are of equal size, which implies that factor price equalization will hold and the wage will equal 1 everywhere (this can be relaxed).

Firm Behavior Revisited

- Firms charge constant markups in both domestic and foreign markets. Domestic and foreign revenues are:

$$r_d(\varphi) = R(P\rho\varphi)^{\sigma-1},$$

$$r_x(\varphi) = \tau^{1-\sigma} R_k(P_k\rho\varphi)^{\sigma-1}.$$

- Factor price equalization implies the same $RP^{\sigma-1}$ in all countries, therefore:

$$r(\varphi) = \begin{cases} r_d(\varphi) & \text{if the firm does not export} \\ (1 + n\tau^{1-\sigma}) r_d(\varphi) & \text{if the firm exports to all countries.} \end{cases}$$

- The corresponding profit levels are

$$\pi_d(\varphi) = \frac{r_d(\varphi)}{\sigma} - f, \quad (7)$$

$$\pi_x(\varphi) = \frac{r_x(\varphi)}{\sigma} - f_x = \frac{\tau^{1-\sigma} r_d(\varphi)}{\sigma} - f_x, \quad (8)$$

where f_x is amortized per-period portion of the initial fixed cost (i.e., δf_{ex}).

Firm Behavior Revisited (continued)

- Defining per period profits as $\pi(\varphi) = \pi_d(\varphi) + \max\{0, n\pi_x(\varphi)\}$, the value of the firm is again

$$v(\varphi) = \max\left\{0, \frac{1}{\delta}\pi(\varphi)\right\}.$$

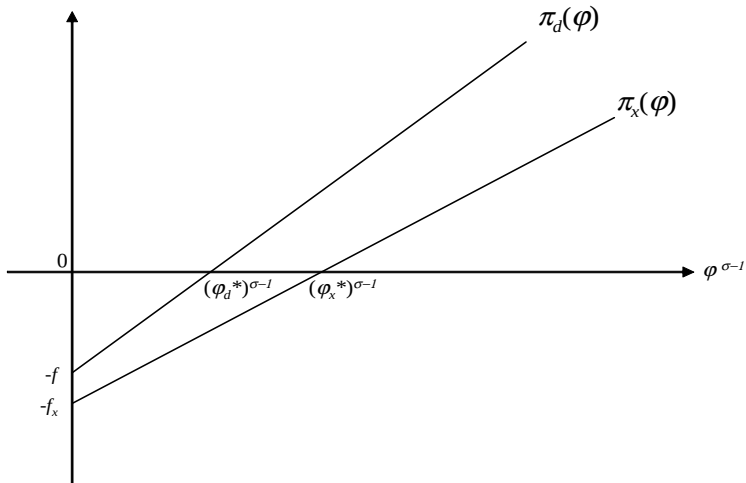
- But we now have two relevant thresholds:

$$\varphi_d^* = \inf\{\varphi : v(\varphi) > 0\}$$

and

$$\varphi_x^* = \inf\{\varphi : \varphi \geq \varphi_d^* \text{ and } \pi_x(\varphi) > 0\}.$$

- Because $RP^{\sigma-1}$ is the same in all countries, φ^* is also the same.
- Firms with $\varphi \geq \varphi_d^*$ remain in the market after learning their productivity, while those with $\varphi \geq \varphi_x^*$ also export.
- So long as $\varphi_x^* > \varphi_d^*$, the model is able to replicate the micro-level findings. This will hold true whenever $\tau^{\sigma-1}f_x > f$, as illustrated in the figure.
- The free entry condition is as before; expected discounted profits equal entry costs.



The Impact of Trade

- Comparing the closed-economy and open-economy equilibria implies $\varphi^* < \varphi_d^*$.
- $\implies$ Productivity is higher in the open economy:
 - Firms with productivity between φ^* and φ_d^* exit.
 - Market shares are reallocated to exporters.
- Intuition:
 - The fall in profits of nonexporters is not explained by a fall in mark-ups driven by increased foreign competition (see, however, Melitz and Ottaviano, 2007).
 - The *main* channel operates through the domestic factor market.
 - Trade raise profitability of the more productive firms $\rightarrow$ more entry $\rightarrow$ increased labor demand $\rightarrow$ higher real wages (w/P) $\rightarrow$ least productive firms can no longer afford to produce.
- Welfare: new source of gains from trade; increased average productivity.
- Similar conclusions for trade liberalization: τ falls.