Lecture 8: International trade and the allocation of resources

Seminario Avanzado de Comercio

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Trade and allocation of resources (I)

- In the last section of the course we will answer the question: How international trade does work under an inefficient allocation of resources?
- For an inefficient allocation we will understand any situation in which the market allocates production factors ("resources") far from the allocation of the social planner (first best).
- In the Melitz (2003) model, the allocation of resources in both autarky and the open economy is efficient.
  - CES demand (which implies equal mark-ups across firms) is key for the result (see Dhingra and Morrow, 2016, forthcoming in JPE)
    - ⋆ Externalities of imperfect competition (the inability of firms to appropriate the full consumer surplus and to account for business stealing from other firms) exactly offset each other.

Trade and allocation of resources (II)

- But in reality, we observe important dispersion in mark-ups:
  - A firm with a higher mark-up will have a larger demand for **all** its inputs with respect to the level of the first best, conditional to firms' productivity.
- Moreover, we could have factor-specific frictions that misallocate inputs:
  - For example, financial constraints misallocate capital across firms; search and matching frictions could misallocate homogenous workers across firms.

Methodological approaches

- Two ways to tackle the problem (Restuccia and Rogerson, 2008):
  - Direct approach (DA): To model explicitly measurable factors that cause factor misallocation
  - Indirect approach (IA): Wedges in the FOC that summarize the complete bundle of underlying factors
- Given the time constraints, we will review very quickly only a couple of papers of the DA:
  - Melitz and Ottaviano (2008): introduces for heterogeneous mark-ups in the Melitz model
  - Manova (2011): introduces for financial constraints in the Melitz model
- For the IA, you can study papers that use sectoral wedges (Tombe (2016), Swiecki (2018)) or firm-specific wedges (Ho (2012), Costa-Scottini (2018), Pulido (2018)).

Melitz and Ottaviano (Restud, 2008)

- Two goals:
  - Introducing heterogeneous mark-ups in the Melitz model
  - Variable mark-ups: restore the pro-competitive effects of trade
- Melitz (2003) + Krugman (1979)

Setup: Demand

- Ottaviano, Tabuchi, Thisse (2002): quasi-linear quadratic preferences

$$U = q_0^c + \alpha \int_i q_i^c \, di - \frac{1}{2}\gamma \int_i (q_i^c)^2 \, di - \frac{1}{2}\eta \left(\int_i q_i^c \, di \right)^2$$

  - parameters α and η measure substitution between numeraire and differentiated goods
  - γ substitution among differentiated varieties (if $\gamma = 0$ then q_i's perfect substitutes)

- Inverse demand for an individual:

$$p_i = \alpha - \gamma q_i^c - \eta Q^c$$

Setup: Aggregate demand

- Total demand:

$$q_i \equiv Lq_i^c = \frac{\alpha L}{\eta N + \gamma} - \frac{L}{\gamma} p_i + \frac{\eta N}{\eta N + \gamma} \frac{L}{\gamma} \overline{p}$$

  - where N is measure of consumed varieties
  - $\overline{p}$ average price

- Always work under assumption that countries produce a positive quantity of both the numeraire good and differentiated varieties

Choke price and elasticity

- "Choke" price: quantity positive if

$$p_i < \frac{\alpha\gamma + \eta N \overline{p}}{\eta N + \gamma} = p_{\max}$$

- Elasticity of demand is not constant

$$\varepsilon_i = \left(\frac{p_{\max}}{p_i} - 1 \right)^{-1}$$

- Elasticity:
  - increases as $N \uparrow$
  - increases as $\overline{p} \uparrow$

Productivity, prices and profits (I)

- Firms differ in marginal cost $c \sim G(c)$ with support $[0, c_M]$
- Entry cost (before drawing c) f_E
- Firm with unit cost c maximizes profits $\Longrightarrow$ profit maximizing price $p(c)$
- Quantity by firm c satisfies

$$q(c) = \frac{L}{\gamma}[p(c) - c]$$

- Define c_D as cost of the firm who is indifferent about remaining in the industry (firm in the cutoff)
- All prices and profits can be written as a function of c_D

$$p(c) = \frac{1}{2}(c_D + c)$$

Productivity, prices and profits (II)

- Mark-up:

$$\mu(c) = \frac{1}{2}(c_D - c)$$

- Profits:

$$\pi(c) = \frac{L}{4\gamma}(c_D - c)^2$$

Closed economy equilibrium

- Zero profit condition:

$$\int_0^{c_D} \frac{L}{4\gamma} (c_D - c)^2 \, dG(c) = f_E$$

- Threshold:

$$c_D = p_{\max} = \frac{\alpha\gamma + \eta N \overline{p}}{\eta N + \gamma}$$

- Take a specific distribution for cost c: Pareto distribution with shape parameter k

$$G(c) = \left(\frac{c}{c_M} \right)^k \quad c \in [0, c_M]$$

Equilibrium under Pareto

- Under parameterization:

$$c_D = \left[\frac{2(k+1)(k+2)\gamma (c_M)^k f_E}{L} \right]^{\frac{1}{k+2}}$$

- In larger markets (trade without any frictions), i.e. $L \uparrow$:
  - more productive firms $c_D \downarrow$ (general)
  - lower prices $\overline{p}$ (general)
  - average mark-ups lower (direct effect: decrease markups as competition$\uparrow$; indirect effect: increase markups through composition)

Open economy

- Assume two countries: $l \in \{H, F\}$
  - different sizes L^l
  - different transport costs τ^l
- Similar derivation to closed economy, but now profits also from exporting:

$$\begin{aligned} \pi_D^l(c) &= \frac{L^l}{4\gamma}\left(c_D^l - c\right)^2 \\ \pi_X^l(c) &= \frac{L^h}{4\gamma}\left(\tau^h\right)^2\left(c_X^l - c\right)^2 \end{aligned}$$

Open economy equilibrium

- Zero profit condition:

$$\int_0^{c_D^l} \pi_D^l(c)\, dG(c) + \int_0^{c_X^l} \pi_X^l(c)\, dG(c) = f_E$$

where

$$\begin{aligned} c_D^l &= p_{\max}^l \\ c_X^l &= \frac{p_{\max}^h}{\tau^h} \end{aligned}$$

- Cutoff under open economy:

$$c_D^l = \left(\frac{\gamma\phi}{L^l} \frac{1-\rho^h}{1-\rho^l\rho^h} \right)^{\frac{1}{k+2}}$$

where $\phi = 2(k+1)(k+2)\gamma(c_M)^k f_E$ and $\rho^l = \left(\frac{1}{\tau^l}\right)^k$

- Distribution of domestic producers cost c^l the same as distribution of exporters from h into l cost $\tau^h c$

Gains from trade

- Reallocation effect as in Melitz (2003)
  - Relative to autarky: lower cutoff c_D
  - Effect independent of wages: wages are constant because of numeraire good with no transport costs
  - As higher number of firms (exporters now competing in domestic market) lower markups
- More variety
- No scale effect (no fixed costs)

Comparing markets

- Symmetric transport costs:
  - larger market has higher welfare: lower cutoff c_D, lower prices, lower mark-ups
  - notice how c_D^l unaffected by partner country size: as $L^h \uparrow$ more opportunity to export, but also tougher competition in export market (they exactly compensate under Pareto)
- Interesting comparative statics: unilateral trade liberalization: one country reduces its τ
  - Welfare in liberalizing country decreases since $c_D \uparrow$
  - The opposite happens in the other (non-liberalizing country)
  - More firm entry in the non-liberalizing country since now firms can serve the other markets from there at lower tariffs

Manova (Restud, 2011)

- Introduction of financial constraints in the Melitz (2003) model
- Identification and quantification of the different channels through credit constrains affect international trade flows under firm heterogeneity.
  - Model-consistent estimation approach replication exercise.

Setup: Firms' costs of production and financing

- Firms in country j pay an entry cost $c_{js} f_{ej}$ to draw a productivity level $1/a$ from the CDF $G(a)$ with support $[a_L, a_H]$, $a_H > a_L > 0$
  - c_{js} is country-sector specific.
- Variable cost is then $c_{js} a$, no fixed costs of production (so all firms that enter produce)
- Fixed costs of exporting $c_{js} f_{ij}$ (from j to i) and iceberg trade costs $\tau_{ij} > 1$.
- Firms finance their domestic production with cash flows from operations but face liquidity constraints in financing their foreign sales.
  - A sector-specific fraction $d_s \in (0, 1)$ of the fixed trade cost must be covered with outside capital, so firms have to borrow $d_s c_{js} f_{ij}$ to service country i.
  - Firms must pledge a collateral, so a fraction $t_s \in (0, 1)$ of the entry cost has to go towards tangible assets that are used as collateral.

Setup: Firms' problem

- Countries differ in their level of financial contractibility, so there is a country-specific probability $\lambda_j \in (0,1)$ of repayment.
- Let $F(a)$ be the repayment in case the contract is enforced, the problem of firms of country j selling to market i is:

$$\underset{p,q,F}{Max}\pi_{ijs} = p_{ijs}(a)q_{ijs}(a) - q_{ijs}(a)\tau_{ij}c_{js}a - (1-d_s)c_{js}f_{ij} - \lambda_j F(a) - (1-\lambda_j)t_s c_{js} f_{ej}$$

s.t.:

1. $q_{ijs}(a) = \frac{p_{ijs}(a)^{-\varepsilon}\theta_s Y_i}{P_{is}^{1-\varepsilon}}$ (demand given by CES utility)
2. $A_{ijs}(a) \equiv p_{ijs}(a)q_{ijs}(a) - q_{ijs}(a)\tau_{ij}c_{js}a - (1-d_s)c_{js}f_{ij} \geq F(a)$ (firm's liquidity constraint)
3. $B_{ijs}(a) \equiv -d_s c_{js} f_{ij} + \lambda_j F(a) + (1-\lambda_j)t_s c_{js} f_{ej} \geq 0$ (investor's participation constraint)

- $A_{ijs}(a)$ and $B_{ijs}(a)$ are the net revenues of firm and investor (outside option of investor is normalized to 0).

Cutoffs

- With competitive credit markets, $F(a)$ is set until the investor's participation constraint binds.
- Since $A_{ijs}(a)$ increase with productivity, the liquidity constraint binds for firms with productivity below a certain cutoff $1/a_{ijs}$, given by the condition:

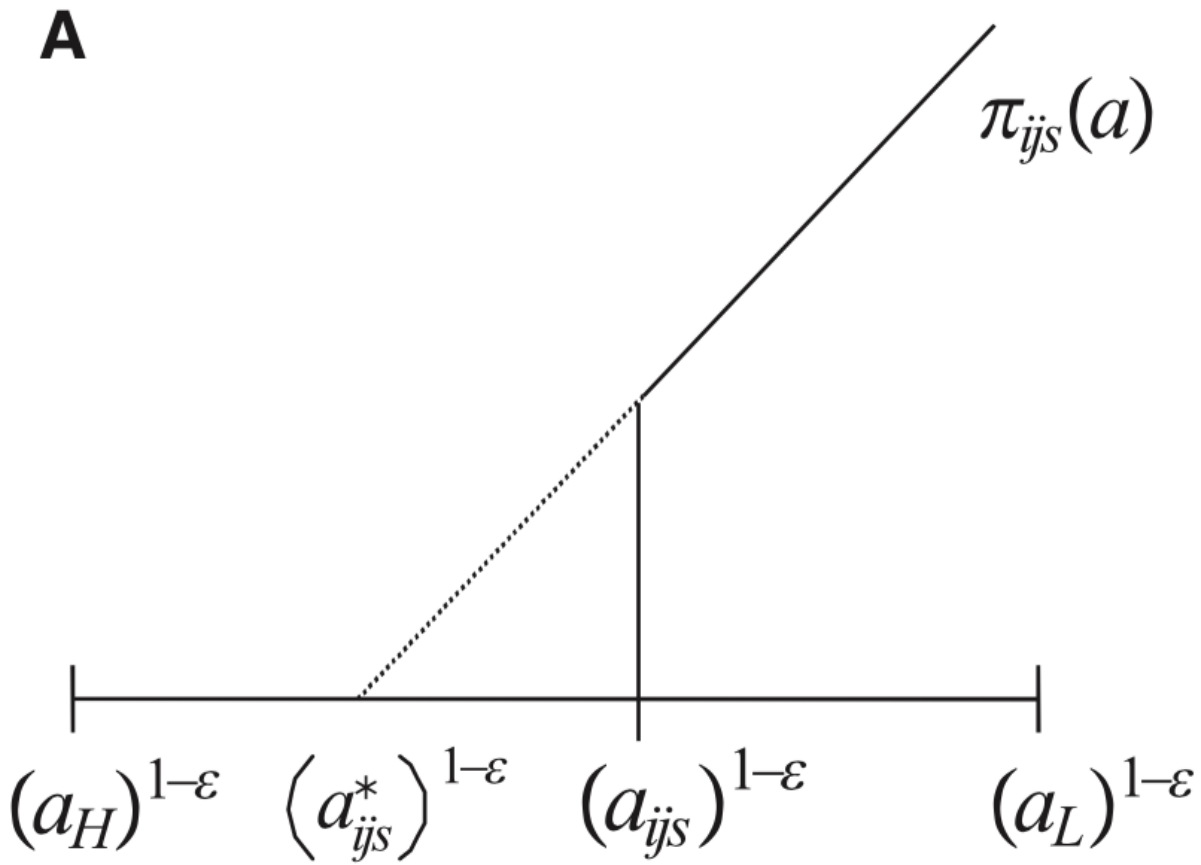
$$(\frac{\tau_{ij} c_{js} a_{ijs}}{\alpha P_{is}})^{1-\varepsilon} \theta_s Y_i = \varepsilon\{(1 - d_s + \frac{d_s}{\lambda_j}) c_{js} f_{ij} - \frac{1-\lambda_j}{\lambda_j} t_s c_{js} f_{ej}\}$$

(obtained plugging $B_{ijs}(a) = 0$ and the optimal price and quantity into the liquidity constraint).

- This cutoff is larger than the exporting cut-off in Melitz model (i.e. without financial frictions).
  - Hence, some firms with positive profits from exporting cannot export since they are not successful to obtain outside finance.
  - Financial constraint leads to an inefficient low trade participation.

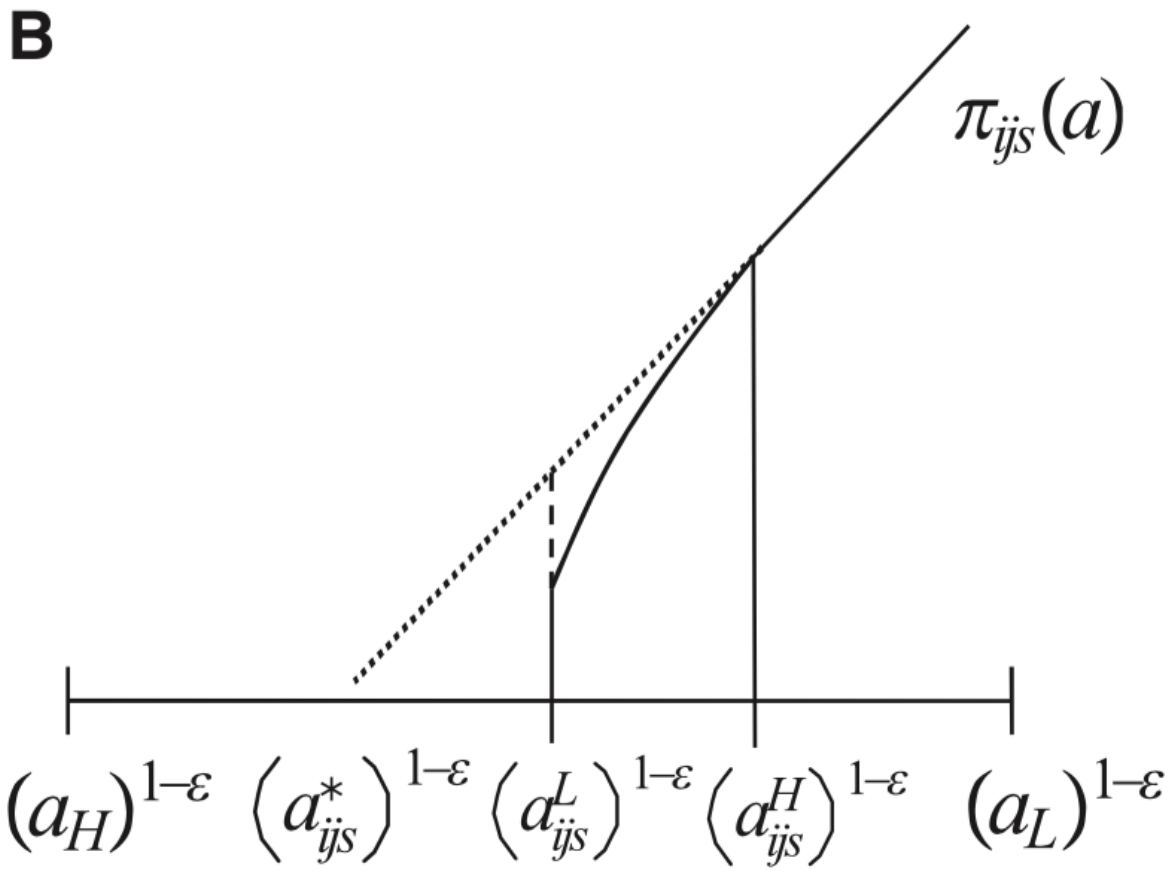
Effect of financial constraints: Basic case

- Basic case: Credit constraints affect the financing of fixed costs only



Effect of financial constraints: More general

- Extending the model: Credit constraints affect the financing of fixed and variable costs



Comparative statics

- All else constant, the cut-off for exporting is higher in financially more vulnerable sectors (high d_s) and lower in financially more developed countries (low t_s or λ_j).
- Financial development in financially more vulnerable sectors:
  - Lowers the cut-off relatively more
  - Increases the probability of exporting and the number of products exported relatively more
  - Increases the number of export destinations relatively more
- Predictions can be tested empirically

Empirical approach (I)

- Total exports from country j to country i in sector s can be expressed as:

$$M_{ijs} = (\frac{\tau_{ij} c_{js}}{\alpha P_{is}})^{1-\varepsilon} \theta_s Y_i N_{js} V_{ijs} E_{ijs} \quad (1)$$

where $V_{ijs} = \begin{cases} \int_{a_L}^{a_{ijs}^L} a^{1-\varepsilon} dG(a) & \text{for } a_{ijs}^L > a_L \\ 0 & \text{otherwise} \end{cases}$ and

$$E_{ijs} = [\frac{\int_{a_L}^{a_{ijs}^H} a^{1-\varepsilon} dG(a) + \int_{a_{ijs}^H}^{a_{ijs}^L} \beta_{ijs} a^{1-\varepsilon} dG(a)}{\int_{a_L}^{a_{ijs}^L} a^{1-\varepsilon} dG(a)}]$$

  - V_{ijs} : direct measure of the selection of firms into exporting
  - E_{ijs}: reflects the effect of credit constraints on average firm sales.

Empirical approach (II)

- Assume a truncated Pareto distribution with support $[a_L, a_H]$, we obtain:
  $V_{ijs} = \frac{k a_L^{k-\varepsilon-1}}{(k-\varepsilon+1)(a_H^k - a_L^k)} W_{ijs}$ with $W_{ijs} = max\{(\frac{a_{ijs}^L}{a_L})^{k-\varepsilon+1} - 1, 0\}$
- Also assume $c_{js} = c_s c_j$ and $\tau_{ij}^{\varepsilon-1} = D_{ij}^{\mu} e^{-u_{ij}}$ where $u_{ij} \sim N(0, \sigma_u^2)$ and D_{ij} is the distance between i and j,
- Eq. (1) can be written in log-linear form as:

$$m_{ijs} = \varsigma_0 + n_{js} + w_{ijs} + e_{ijs} + (\varepsilon - 1)p_{is} - \mu d_{ij} + \varsigma_i + \varsigma_j + \varsigma_s + u_{ij}$$

where $m_{ijs} = lnM_{ijs}$, $n_{ijs} \equiv lnN_{ijs}$, $w_{ijs} \equiv lnW_{ijs}$, $e_{ijs} \equiv lnE_{ijs}$ and $\varsigma_j = -(\varepsilon - 1) lnc_j$, $\zeta_i = y_i$, $\zeta_s = -(\varepsilon - 1) lnc_s + ln\theta_s$ are exporter, importer and sector fixed effects.

Data

- Bilateral exports for 107 countries and 27 sectors in 1985–1995
- Measure of financial development across countries: Private credit as % of GDP (robustness: repudiation of contracts, accounting standards, risk of expropriation).
- Measure of finance dependence of sectors: Share of capital expenditures not financed with cash flows from operations (+) and asset tangibility (share of net property, plant, and equipment in total book-value assets, as a measure of collateralizable assets) (-)

Main results

TABLE 1
Financial constraints and trade vs. production

Financial development measure: Private credit
Dependent variable: m_{ijst}, (log) bilateral exports by sector

				Proxy for p_{is}		
	Total effect of credit constraints	Controlling for selection into domestic production		CPI and interactions with sector FE	Importer's consumption by sector	Importer × sector FE
Fin devt	0.167 (3.14)***	0.251 (4.25)***	0.022 (0.37)	0.225 (3.64)***	0.267 (4.54)***	0.306 (5.26)***
Fin devt × Ext fin dep	1.752 (43.29)***	1.296 (28.31)***	1.489 (30.47)***	1.343 (29.01)***	1.253 (26.36)***	1.372 (33.87)***
Fin devt × Tang	−2.624 (−24.65)***	−2.130 (−16.41)***	−2.077 (−17.75)***	−2.204 (−16.64)***	−2.171 (−16.45)***	−2.434 (−19.46)***
(Log) # Establish		0.318 (40.47)***		0.321 (39.89)***	0.323 (40.66)***	0.321 (42.34)***
(Log) Output			0.316 (18.52)***			
p_{is}				0.008 (6.86)***	0.169 (26.74)***	
LGDPE	0.957 (16.75)***	1.079 (16.17)***	0.667 (9.38)***	1.071 (16.05)***	1.082 (16.29)***	1.119 (16.64)***
LGDPI	0.949 (16.55)***	0.980 (14.41)***	0.946 (14.49)***	1.040 (16.36)***	0.711 (10.28)***	0.998 (14.57)***
LDIST	−1.374 (−79.05)***	−1.408 (−72.20)***	−1.410 (−74.24)***	−1.418 (−70.27)***	−1.414 (−71.74)***	−1.442 (−73.35)***
Controls:						
Exporter, Year FE	Y	Y	Y	Y	Y	Y
Importer, Sector FE	Y	Y	Y	Y	Y	N
Importer × Sector FE	N	N	N	N	N	Y
R^2	0.57	0.57	0.59	0.58	0.58	0.60
# observations	861,380	621,333	703,743	579,485	589,205	621,333
# exporter–importer clusters	9343	7867	8031	7452	7813	7867
# exporters	107	95	94	95	95	95

Other results

- Decomposition of the effect of credit constraints into reductions in trade along the extensive and intensive margins.
  - For extensive margin: Probit for probability of exporting following Helpman et al. (2008)
  - For intensive margin: 2-step procedure (MLE) to correct for selection *a la* Heckman
- Results: Around 40% of the effect of financial development on export volumes results from fewer firms becoming exporters, 60% is due to a drop in the firm-level exports.