Lecture 3: New Trade Theory

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New Trade Models

- Dixit-Stiglitz model of monopolistic competition makes it possible to integrate both increasing returns to scale (IRS) and imperfect competition in a highly tractable general-equilibrium setting
- IRS generates agglomeration of activities in a homogeneous space
- IRS is incompatible with perfect competition $\longrightarrow$ Need for imperfect competition
- General equilibrium accounts for interactions between product and labor markets

Monopolistic competition

- Chamberlian (1933)
- Four assumptions:
  - Firms sell products of the same nature but that are imperfect substitutes $\rightarrow$ Varieties of a differentiated good
  - Every firm produces a single variety under IRS and chooses its price
  - The number of firms is sufficiently large for each of them to be negligible with respect to the whole group
  - Free entry and exit drives profits to zero

$\Rightarrow$ Each firm has some monopoly power but each producer is constrained in its price choice

$\Rightarrow$ The resource constraint imposes a limit on the number of varieties

Scale economies, Product differentiation and the Pattern of Trade (Krugman, 1980)

Motivation

- "Standard" models explain trade as a way to increase aggregate surplus through specialization according to comparative advantage
  - ⇒ Unable to explain intra-industry trade
  - ⇒ No role for demand in driving international trade
- "New Trade Theory" explains international trade on differentiated varieties
- Ingredients: Increasing returns to scale, imperfect competition and international trade costs

Hypotheses

- Two regions of size L and L^*, Same technology (no comparative advantages)
- Two sectors: Agriculture (homogeneous product, perfect competition, no trade costs) and Manufacturing (differentiated good, IRS, monopolistic competition, costly trade)

$$U = C_M^{\mu} C_A^{1-\mu}, \quad 0 < \mu < 1$$

- Dixit-Stiglitz preferences over varieties of the differentiated good $\rightarrow$ Composite good

$$C_M = \left(\sum_{i=1}^{N} c_i^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}, \quad \sigma > 1$$

  Note that the limiting case $\sigma = 1$ boils down to a Cobb-Douglas subutility function, while $\sigma \rightarrow \infty$ implies that varieties are perfect substitutes

- Agricultural technology: $Y_A = L_A$
- Manufacturing technology: $l_i = \alpha + \beta x_i$ (Increasing returns to scale)
- Free entry

Closed economy

- Market-clearing conditions:

$$x_i = Lc_i$$
$$L_A = LC_A$$
$$L = \sum_{i=1}^{N}(\alpha + \beta x_i) + L_A$$

- Sectoral consumptions:

$$\begin{cases} \max_{C_A, C_M} C_M^{\mu} C_A^{1-\mu} \\ s.t. \quad P_A C_A + P_M C_M \leq PC \end{cases}$$

$$\Rightarrow \quad P_M C_M = \mu PC = \mu w$$
$$P_A C_A = (1-\mu)PC = (1-\mu)w$$
$$P = \frac{P_A^{1-\mu} P_M^{\mu}}{(1-\mu)^{1-\mu}\mu^{\mu}}$$

Closed economy (2)

- Optimal consumption on each variety:

$$\begin{cases} \max_{c_i} C_M = \left(\sum_{i=1}^N c_i^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \\ s.t. \quad \sum_{i=1}^N p_i c_i \leq P_M C_M \end{cases}$$

$$\Rightarrow \quad c_i = \left(\frac{p_i}{P_M} \right)^{-\sigma} C_M = \left(\frac{p_i}{P} \right)^{-\sigma} \frac{\mu PC}{P_M} = \left(\frac{p_i}{P} \right)^{-\sigma} \frac{\mu E}{P_M}$$

$$P_M = \left[\sum_{i=1}^N p_i^{1-\sigma} \right]^{\frac{1}{1-\sigma}}$$

⇒ "Large" country in terms of aggregate demand consume more of each variety

⇒ The demand for a variety that is relatively expensive is lower than the demand for cheaper varieties but consumption is still positive (consequence of the preference for diversity)

⇒ A higher number of varieties reduces the demand for each variety (market-crowding effect) → work through the price index

- Remark: The same demand function can be obtained from a population of heterogeneous consumers buying a single variety

Closed economy (3)

- Optimal price in agriculture:

$$P_A = w = 1$$

- Optimal prices in manufacturing:

$$\begin{cases} \pi_i = p_i c_i L - w(\alpha + \beta L c_i) \\ s.t. \quad c_i = \left(\frac{p_i}{P_M}\right)^{-\sigma} \frac{w}{P_M} \end{cases}$$

$\Rightarrow$ Mill-pricing:

$$p_i = \frac{\sigma}{\sigma - 1}\beta$$

Closed economy (4)

- Free entry:

$$\pi_i = p_i x_i - (\alpha + \beta x_i) = 0$$
$$\Rightarrow \quad x_i = \frac{\alpha}{\beta}(\sigma - 1)$$

⇒ There is a unique level of sales that allows the typical firm to just break even, ie to earn a level of operating profit sufficient to cover fixed costs.

⇒ Regardless of the total number of firms, they all have the same size

- Full-employment:

$$L = \sum_{i=1}^{N} (\alpha + \beta x_i) + L_A$$
$$\Leftrightarrow \quad N = \frac{\mu L}{\alpha \sigma}$$

⇒ Larger markets benefit from higher diversity

⇒ As long as the fixed cost is strictly positive, the number of firms and varieties is finite.

Costly trade

- Trade increases the diversity of varieties available for consumption:

$$U = \left(\sum_{i=1}^{N} c_i^{\frac{\sigma-1}{\sigma}} + \sum_{i^*=1}^{N^*} c_{i^*}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\mu\sigma}{\sigma-1}} C_A^{1-\mu}, \quad \sigma > 1$$

$\Rightarrow$ Positive welfare effect

- Note that this assumes that the varieties produced in the domestic and foreign markets enter symmetrically in the composite good (same elasticity of substitution)
- Trade is perfectly free in the homogeneous good sector $\Rightarrow$ Law of one price $P_A = P_A^*$ $\Rightarrow$ Equal wages: $w = w^*$
- "Iceberg" trade costs τ in the manufacturing sector

Costly trade (2)

$\Rightarrow$ Mill-pricing and full pass-through:

$$\begin{cases} \max_{p_i, p_i^*} [p_i L c_i + p_i^* L^* c_i^* - \beta(L c_i + \tau L^* c_i^*) - \alpha] \\ s.t. \quad c_i = \left(\frac{p_i}{P_M}\right)^{-\sigma} \frac{w}{P_M} \\ \qquad c_i^* = \left(\frac{p_i^*}{P_M^*}\right)^{-\sigma} \frac{w^*}{P_M^*} \end{cases}$$

$\Rightarrow$ Optimal prices:

$$\begin{aligned} p_i &= \frac{\sigma}{\sigma - 1}\beta \\ p_i^* &= \frac{\sigma}{\sigma - 1}\beta\tau = \tau p_i \end{aligned}$$

- At the same mill price, the consumption of an imported variety is lower by a factor of $\tau^{-\sigma}$ than the consumption of a domestic variety because the delivered price is higher $\rightarrow$ explains why firms seek to set up close to their consumers

Costly trade (3)

- Price indices:

$$\frac{P_M}{P_M^*} = \left[\frac{N/N^* + \tau^{1-\sigma}}{N/N^* \tau^{1-\sigma} + 1}\right]^{\frac{1}{1-\sigma}}$$

$\Rightarrow$ The relative price of manufacturing goods is a decreasing function of the relative number of firms located in the market.

- Individual production:

$$\begin{aligned} x_i &= c_i L + \tau c_i^* L^* \\ &= \left(\frac{p_i}{P_M}\right)^{-\sigma} \frac{wL}{P_M} + \tau \left(\frac{\tau p_i}{P_M^*}\right)^{-\sigma} \frac{w^* L^*}{P_M^*} \end{aligned}$$

$\Rightarrow$ Production is the sum of local demands, weighted by a spatial discount factor $\phi = \tau^{1-\sigma}$

Costly trade (4)

- Spatial equilibrium equalizing profits:

$$p_i c_i L + \tau p_i c_i^* L^* - w(\alpha + \beta c_i L + \tau \beta c_i^* L^*) = p_{i*}^* c_{i*}^* L^* + \tau p_{i*} c_{i*} L - w^*(\alpha + \beta c_{i*}^* L^* + \tau \beta c_{i*} L)$$

$$\Leftrightarrow s_n = \frac{s_L - \tau^{1-\sigma}(1 - s_L)}{1 - \tau^{1-\sigma}}$$

with $s_n = \frac{N}{N+N^*}$ and $s_L = \frac{L}{L+L^*}$

$\Rightarrow$ Home Market Effect:

$$\frac{ds_n}{ds_L} = \frac{1 + \tau^{1-\sigma}}{1 - \tau^{1-\sigma}} > 1$$

An increase in the relative size of the domestic market more than proportionally increases the relative share of firms located here.

Costly trade (5)

- Note that when wages are endogenous as in Krugman (1980) (no agricultural sector or sector-specific labor), the relative wage is sensitive to the relative size of countries $\Rightarrow$ Home Market Effect on wages: Large countries have relatively higher wages $\Rightarrow$ The size differential is offset by a wage differential which explains that, in general, agglomeration is not total.
- Consequence of the HME: In a world of IRS, countries will tend to export those kinds of products for which they have relatively large domestic demand.
- Benefit of market integration as a way to increase the market potential

The Gravity Equation

Introduction

- Newton's theory of gravitation: Two bodies are attracted to each other in proportion of their mass and in inverse proportion to the square of the distance separating them
- In economics, countries or regions are bodies subject to push and pull forces the intensity of which depends on their sizes and the distances between them

⇒ Economic activity aggregates firms and households in a limited number of human settlements

- Application to migrations (Ravenstein, 1885), international trade (Tinbergen, 1962), capital flows (Portes and Rey, 2005), FDI (Di Maurao, 2000), knowledge flows, etc.

The empirical gravity model

- Describe bilateral trade flows between two countries r and s:

$$X_{rs} = G\frac{Y_r^{\alpha} Y_s^{\beta}}{d_{rs}^{\delta}}$$

with

  - G, α, β and δ parameters to be estimated,
  - Y_s and Y_r the countries' "mass" approximated by their GDP,
  - d_{rs} distance between countries, proxy for trade costs

- Log-linearizing this equation gives a testable equation:

$$\ln X_{rs} = \ln G + \alpha \ln Y_r + \beta \ln Y_s - \delta \ln d_{rs} + \varepsilon_{rs}$$

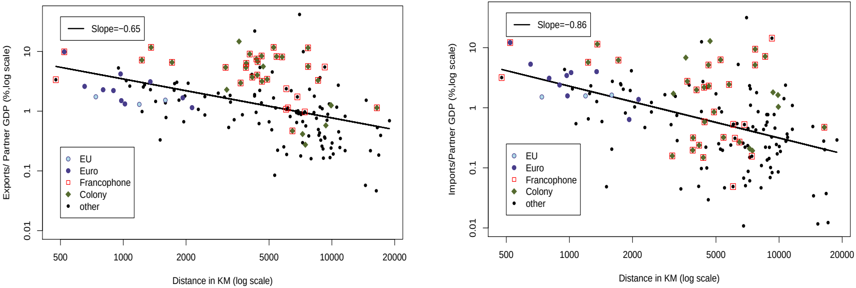
with ε_{rs} a residual term that controls for measurement errors

The empirical gravity model (2)

- Highly popular model because of the quality of its empirical fit
- Disdier and Head (2008) conduct a meta-analysis over 78 articles estimating a gravity equation $\rightarrow$ Results
  - The (negative) impact of distance on bilateral trade flows tended to decrease slightly between 1870 and 1950 but started to increase again after 1950
  - Impact of distance more pronounced in developing countries (inferior quality of their transportation infrastructure?)
  - The mean distance elasticity is 0.89 $\rightarrow$ Doubling distance typically divides trade flows by a factor close to two.
  - Strong heterogeneity across sectors (distance matters more for construction materials than for other goods, surprisingly, distance still matters for services)
- Distance proxies transport costs but also informational costs, time costs (impact of time difference)

The empirical gravity model (3)

Figure: France's exports/imports in 2000



Microfoundations

- New Trade models provide the gravity equation with some theoretical microfoundations. They also underline some limits to the standard gravity estimation.
- Estimated equation derived from a standard multi-country new trade model with:
  - R countries/regions $(i = 1...R)$
  - Manufacturing sector producing under IRS $(CT_i(q) = w_i a_i(q + F))$, differentiated varieties that are imperfect substitutes $(\sigma > 1)$
  - Bilateral iceberg trade costs $\tau_{ij} \geq 1$
  - Preferences:

$$U_j = \left[\sum_{i=1}^{R} \int_{n_i} x_{ij}(z)^{\frac{\sigma-1}{\sigma}} dz\right]^{\frac{\sigma}{\sigma-1}} = \left[\sum_{i=1}^{R} n_i x_{ij}^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}$$

Microfoundations (2)

- Optimal demand for each variety:

$$x_{ij}(z) = \left(\frac{p_{ij}(z)}{P_j}\right)^{-\sigma} \frac{E_j}{P_j}$$

with:

$$P_j = \left[\sum_{i=1}^{R} \int_{n_i} p_{ij}(z)^{1-\sigma} dz\right]^{\frac{1}{1-\sigma}} = \left[\sum_{i=1}^{R} n_i p_{ij}^{1-\sigma}\right]^{\frac{1}{1-\sigma}}$$

- Optimal prices:

$$p_{ij}(z) = \frac{\sigma}{\sigma - 1} w_i a_i \tau_{ij} \equiv p_i \tau_{ij}$$

Mill-pricing

Microfoundations (3)

- Profitability condition:

$$\frac{p_i \sum_{j=1}^{R} \tau_{ij} x_{ij}(z)}{\sigma} \geq w_i a_i F$$
$$\Leftrightarrow \quad \sum_{j=1}^{R} \tau_{ij}^{1-\sigma} P_j^{\sigma-1} E_j \geq \left(\frac{\sigma}{\sigma - 1} w_i a_i \right)^{\sigma} (\sigma - 1) F$$

$\Rightarrow$ maximum value of w_i as a function of the sum of distance weighted "market capacities", called "market access" of country i by Redding & Venables.

- Equilibrium number of firms:

$$Y_i = n_i p_i \bar{y}$$
$$with \quad \bar{y} = (\sigma - 1) F$$
$$\Rightarrow \quad n_i = \frac{Y_i}{p_i (\sigma - 1) F}$$

Microfoundations (4)

- Real bilateral trade flows:

$$n_i x_{ij} = n_i \left(\frac{\tau_{ij} p_i}{P_j} \right)^{-\sigma} \frac{E_j}{P_j} = \frac{Y_i}{(\sigma - 1)F} p_i^{-\sigma-1} \tau_{ij}^{-\sigma} E_j P_j^{\sigma-1}$$

- Real nominal (CIF) trade flows:

$$n_i p_{ij} x_{ij} = n_i p_i^{1-\sigma} \tau_{ij}^{1-\sigma} E_j P_j^{\sigma-1} = \frac{Y_i}{(\sigma - 1)F} p_i^{-\sigma} \tau_{ij}^{1-\sigma} E_j P_j^{\sigma-1}$$

with:

$$P_j = \left[\sum_{i=1}^{R} n_i (p_i \tau_{ij})^{1-\sigma} \right]^{\frac{1}{1-\sigma}}$$

Microfoundations (5)

$\Rightarrow$ Gravity-like prediction with E_j and Y_i proportional to GDPs ($\rightarrow \alpha = \beta = 1$) and τ_{ij} correlated with distance ($\delta = \sigma - 1$)

- Limit:
  - the new trade model yields a gravity equation that involves price terms $\rightarrow$ Instead of GDPs one should introduce the importer's "market capacity" and the exporter's "supply capacity"
  - the term $P_j^{\sigma-1}$ captures general-equilibrium effects associated with third-country interactions: An increase in country j's access to suppliers reduces its price index, which increases real aggregate demand

Empirical implementation

$$\ln Trade_{ij} = \ln\left(n_i p_i^{1-\sigma}\right) + \ln \tau_{ij}^{1-\sigma} + \ln\left(E_j P_j^{\sigma-1}\right)$$

with $Trade_{ij}$ value of the bilateral trade flow, $(n_i p_i^{1-\sigma})$ country i's "supplier capacity", $\tau_{ij}^{1-\sigma}$ trade frictions (called "freeness of trade" by Baldwin et al.), $(E_j P_j^{\sigma-1})$ country j's "market capacity".

- Measuring trade costs:

$$\ln \tau_{ij} = \delta \ln d_{ij} - \beta cont_{ij} - \lambda lang_{ij} - \gamma TradeAg_{ij} + ...$$

  - Natural barriers (distance, mountains, access to the sea, etc.)
  - Institutional barriers (Trade policy measures, environmental/phytosanitary measures, exchange rate costs, etc.)
  - Information costs and cultural differences (language, historical links, etc.)

Empirical implementation

- The first generation of estimates neglects price effects and uses GDPs to proxy market capacity and supplier access:

$$\ln Trade_{ij} = \ln GDP_i + (1-\sigma)\ln \tau_{ij} + \ln GDP_j$$

- Another strategy consists in estimating a fixed-effect model:

$$\begin{aligned} & \ln Trade_{ij} = FE_i + (1-\sigma)\ln \tau_{ij} + FE_j \\ \Rightarrow \quad & \widehat{n_i p_i^{1-\sigma}} = exp(FE_i) \\ & \widehat{E_j P_j^{\sigma-1}} = exp(FE_j) \end{aligned}$$

- When "internal" trade flows are available, one can get rid of market capacities:

$$\ln \frac{Trade_{ij}}{Trade_{jj}} = \ln \frac{Y_i}{Y_j} + (1-\sigma)\ln \frac{\tau_{ij}}{\tau_{jj}} - \sigma \ln \frac{p_i}{p_j}$$

with $\frac{p_i}{p_j}$ obtained from relative wages.

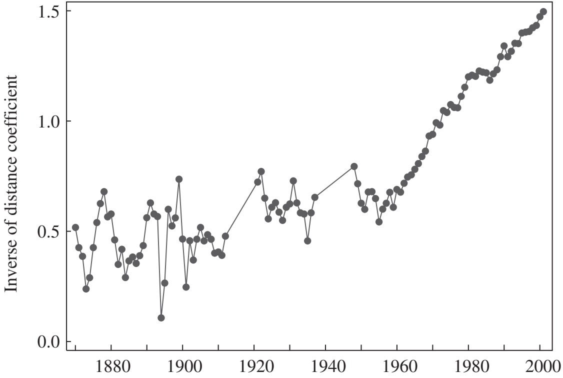
Old fashion

	(1)	(2)	(3)	(4)
ln gdp, origin	0.780[a]		0.783[a]	0.775[a]
	(587.29)		(588.86)	(571.04)
ln gdp, dest	0.672[a]		0.673[a]	0.667[a]
	(534.03)		(534.31)	(515.73)
ln distance	-1.061[a]	-1.064[a]	-0.977[a]	- 0.920[a]
	(-304.58)	(-304.92)	(-260.56)	(-234.47)
ln gdp cap, origin		0.764[a]		
		(413.58)		
ln gdp cap, dest		0.626[a]		
		(340.79)		
ln pop, dest		0.713[a]		
		(441.59)		
ln pop, origin		0.803[a]		
		(469.75)		
Contiguity			0.552[a]	0.526[a]
			(31.64)	(30.20)
Common language			0.367[a]	0.343[a]
			(46.29)	(43.05)
Colonial relationship			1.661[a]	1.699[a]
			(91.04)	(93.24)
Regional trade agreement				0.880[a]
				(46.40)
Currency Unions				0.619[a]
				(16.20)
Gatt/WTO members				-0.015[a]
				(-2.59)
Constant	-3.911[a]	-3.561[a]	-4.789[a]	-5.166[a]
	(-118.95)	(-103.57)	(-133.58)	(-140.82)
Observations	529,387	526,753	529,387	529,387
R^2	0.524	0.526	0.536	0.539

t statistics in parentheses
[c] $p<0.1$, [b] $p<0.05$, [a] $p<0.01$

Fixed effects

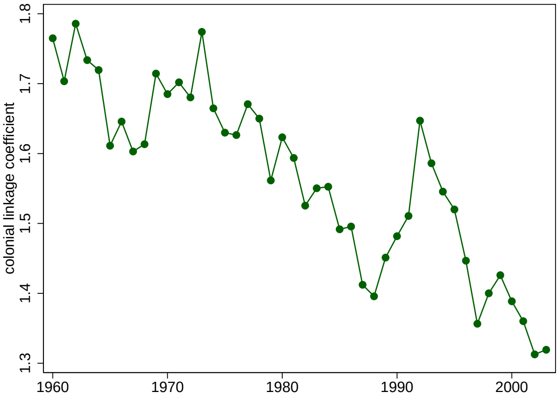
Figure: Impact of distance on trade, 1870-2001 (*source: Combes et al., 2007*)



The importance of geography in the determination of international trade flows has increased over time.

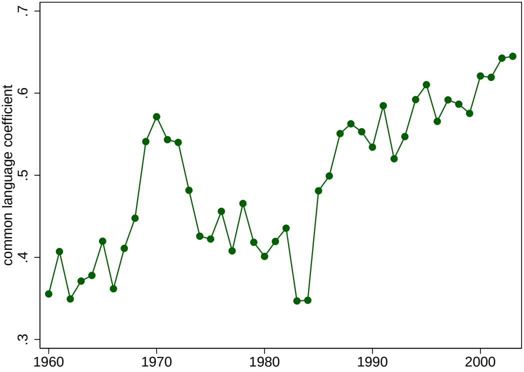
Fixed effects (2)

Figure: Impact of colonial links on trade, 1960-2001 (*source: Head and Mayer, 2007*)



Fixed effects (3)

Figure: Impact of common language on trade, 1960-2001 (*source: Head and Mayer, 2007*)



Increases over time → More complex products?

Limits

- Endogeneity concerns:
  i) an unobservable shock to a country's trade flows must have an impact on its income → the variables related to the sizes of the countries are likely to be correlated with the error term
  ii) relative prices are simultaneously determined with relative trade flows
  iii) endogeneity in trade agreements: countries choose to sign a trade agreement because they expect trade benefits
- Problem of zero trade flows that are not compatible with the New trade model (→ New new trade models) → Tobit or Poisson econometric models