

Lecture 3: New Trade Theory

Isabelle Méjean

`isabelle.mejean@polytechnique.edu`

`http://mejean.isabelle.googlepages.com/`

Master Economics and Public Policy, International Macroeconomics

October 30th, 2008

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 → 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 → 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
- ⇒ Each firm has some monopoly power but each producer is constrained in its price choice
- ⇒ 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:

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

$$\Rightarrow P_M C_M = \mu PC = \mu w$$

$$P_A C_A = (1 - \mu) PC = (1 - \mu) w$$

$$P = \frac{P_A^{1-\mu} P_M^\mu}{(1 - \mu)^{1-\mu} \mu^\mu}$$

Closed economy (2)

- Optimal consumption on each variety:

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

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

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

- ⇒ “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:

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

⇒ Mill-pricing:

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

Closed economy (4)

- Free entry:

$$\pi_i = p_i x_i - (\alpha + \beta x_i) = 0$$

$$\Rightarrow x_i = \frac{\alpha}{\beta}(\sigma - 1)$$

- ⇒ 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:

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

$$\Leftrightarrow N = \frac{\mu L}{\alpha \sigma}$$

- ⇒ 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:

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

⇒ 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 ⇒ Law of one price $P_A = P_A^* \Rightarrow$ Equal wages: $w = w^*$
- “Iceberg” trade costs τ in the manufacturing sector

Costly trade (2)

⇒ Mill-pricing and full pass-through:

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

⇒ 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 → explains why firms seek to set up close to their consumers

Costly trade (3)

- Price indices:

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

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

- Individual production:

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

⇒ 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 $s_L = \frac{L}{L+L^*}$

⇒ 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 Maura, 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:

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

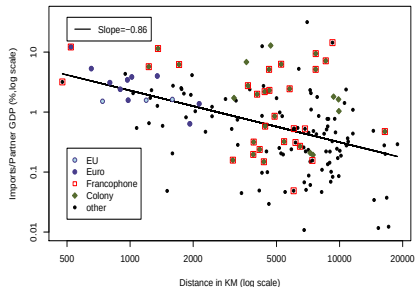
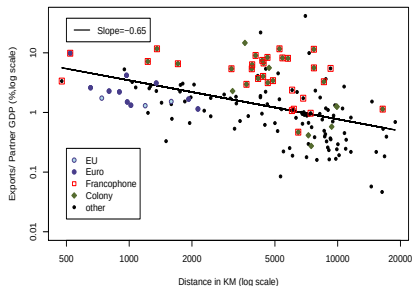
with ε_{rs} a residual term that controls for measurement errors

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 → 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 → 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:

$$\frac{p_i \sum_{j=1}^R \tau_{ij} x_{ij}(z)}{\sigma} \geq w_i a_i F$$

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

⇒ 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 $\bar{y} = (\sigma-1)F$

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

Microfoundations (4)

- Real bilateral trade flows:

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

- 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)

⇒ 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

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

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:

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

- 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:

$$\begin{aligned} \ln Trade_{ij} &= FE_i + (1 - \sigma) \ln \tau_{ij} + FE_j \\ \Rightarrow n_i \hat{p}_i^{1-\sigma} &= \exp(FE_i) \\ E_j \hat{p}_j^{\sigma-1} &= \exp(FE_j) \end{aligned}$$

- 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

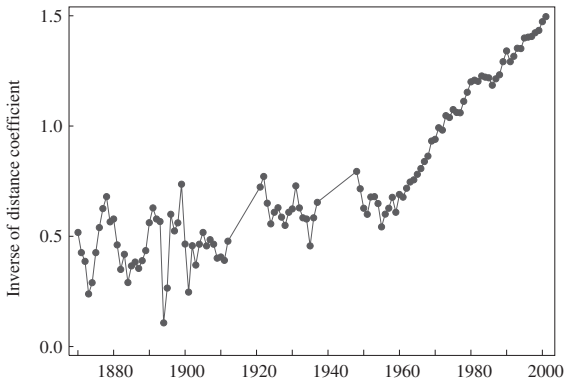
	(1)	(2)	(3)	(4)
ln gdp, origin	0.780 ^a (587.29)		0.783 ^a (588.86)	0.775 ^a (571.04)
ln gdp, dest	0.672 ^a (534.03)		0.673 ^a (534.31)	0.667 ^a (515.73)
ln distance	-1.061 ^a (-304.58)	-1.064 ^a (-304.92)	-0.977 ^a (-260.56)	-0.920 ^a (-234.47)
ln gdp cap, origin		0.764 ^a (413.58)		
ln gdp cap, dest		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 (31.64)	0.526 ^a (30.20)
Common language			0.367 ^a (46.29)	0.343 ^a (43.05)
Colonial relationship			1.661 ^a (91.04)	1.699 ^a (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 (-118.95)	-3.561 ^a (-103.57)	-4.789 ^a (-133.58)	-5.166 ^a (-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

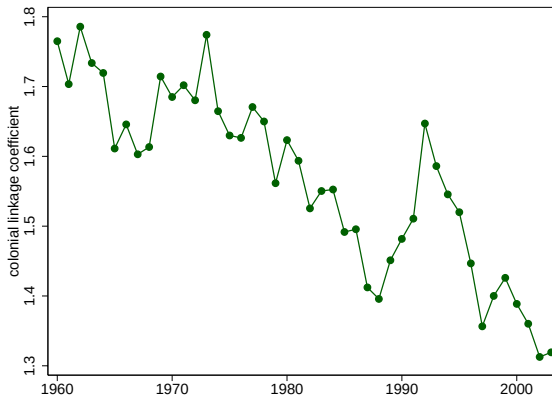
Figure: Impact of distance on trade, 1870-2001 (source: Combes et al., 2007)



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

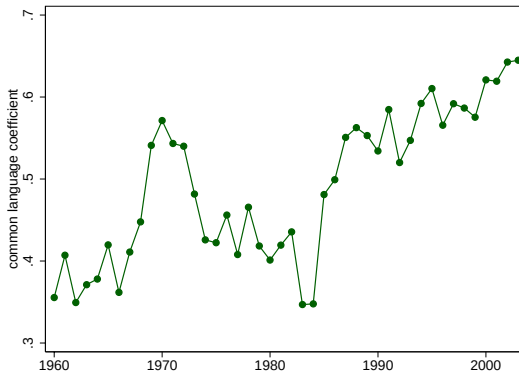
Fixed effects (2)

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