Lecture 7: Imperfect Competition and Intra-Industry Trade

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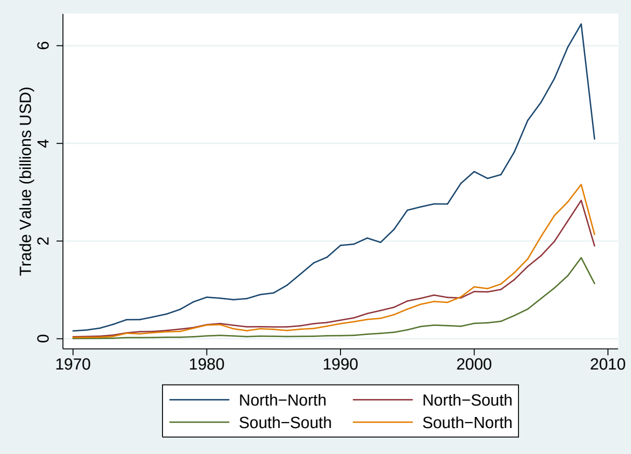
Introduction

- **Neo-classical theories of international trade**
  - Explain trade of different goods across different countries

    in terms of their technology (Ricardo, Eaton & Kortum)

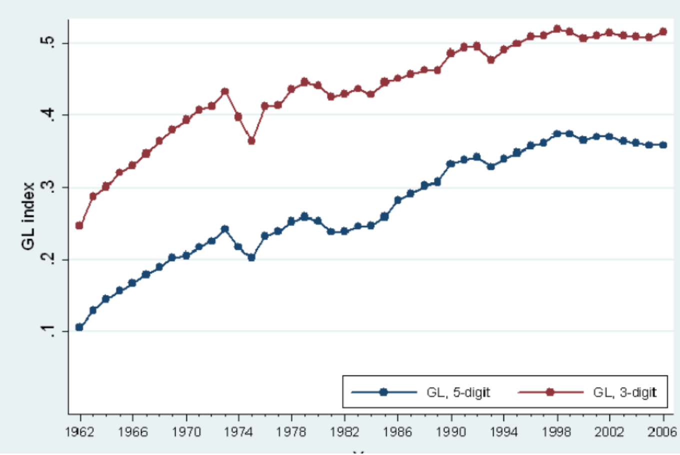
    in terms of factoral endowments (HOS)
  - Gains from trade due to a better allocation of resources when economies specialize in their comparative advantage
- **Limits**
  - Cannot easily explain trade between similar countries
  - Or requires that comparative advantages are random as in eaton & Kortum
- **Trade under imperfect competition**
  - Explain intra-industry trade : Exchange of horizontally differentiated varieties between similar countries
  - Gains from trade due to an improvement in the diversity offered to consumers

Geography of international trade



Source : UN ComTrade

Intra- vs inter-industry trade



Source : Brulhart (2008). Evolution of intra-industry (definition based on 3-digit or 5-digit industries). The share of intra-industry trade is defined on the Grubel-Loyd index, as $IIT_i = 1 - \frac{|X_i - M_i|}{X_i + M_i}$

Intra- vs inter-industry trade

- **Inter-industry trade**
  - Bilateral exchange of different goods
  - Around 60% of world trade
- **Intra-industry trade**
  - Bilateral trade in similar products
  - Around 40% of world trade
  - Heterogeneity across country pairs (eg 87% of bilateral trade between France and Germany)
- **Consequences**
  - Poor empirical performance of HOS might be due to intra-industry trade flows
  - Explaining intra-industry trade requires to introduce the imperfect substitutability between goods

$\Rightarrow$ **New Trade Theories**

The Krugman model

Intraindustry Specialization and the Gains from Trade, The Journal of Political Economy, 1981

Ingredients

- **Economies of scale** (fixed cost of producing)
- **Monopolistic competition** (imperfect substitutability between varieties + free entry)
- **Iso-elastic preferences** (constant price elasticity + preference for diversity)
- **International trade cost** (iceberg cost)

$\Rightarrow$ **International trade** :

- **Welfare improving** : Increases the diversity offered to consumers while preserving a low-enough average cost for producing each variety
- Dampened by international trade costs

Assumptions

- Two countries (Home and Foreign), one differentiated good (a continuum of varieties ω), one factor (labor)
- **Factors** : Perfectly mobile across firms, immobile across countries (w, w^*)
- **Countries** :
  - Similar in terms of their preferences, technology, productivity
  - Different in terms of their size : L and L^*
- **Imperfect competition**

Demand side

- **Preferences** :

$$C = \left(\int_0^n q(\omega)^{\frac{\sigma-1}{\sigma}} d\omega \right)^{\frac{\sigma}{\sigma-1}}$$

$\sigma > 1$ elasticity of substitution between varieties
Limit : $\sigma \to \infty$ = Perfect competition

- **Budget constraint** :

$$\int_0^n p(\omega) q(\omega) d\omega \leq R = wL$$

- **Optimum** demand

$$q(\omega) = \left(\frac{p(\omega)}{P} \right)^{-\sigma} C$$

where P is the ideal price index

$$P = \left(\int_0^n p(\omega)^{1-\sigma} d\omega \right)^{\frac{1}{1-\sigma}} < \int_0^n p(\omega) d\omega$$

Supply side

- No cost when creating a new variety
- **Production function** (Economies of scale)

$$l(q(\omega)) = f + \frac{q(\omega)}{\varphi}$$

  φ labor productivity (assumed identical across firms and countries)

- **Program of the firm**

$$\begin{cases} \max_{p(\omega)} \left[p(\omega)q(\omega) - w\left(f + \frac{q(\omega)}{\varphi}\right)\right] \\ \text{s.t.} \quad q(\omega) = \left(\frac{p(\omega)}{P}\right)^{-\sigma} C \end{cases}$$

- **Optimal price**

$$p(\omega) = \frac{\sigma}{\sigma - 1}\frac{w}{\varphi}$$

Equilibrium in autarky

- **Equilibrium profit** :

$$\pi(\omega) \equiv p(\omega)q(\omega) - w\left(f + \frac{q(\omega)}{\varphi}\right) = w\left(\frac{q(\omega)}{(\sigma-1)\varphi} - f\right)$$

- **Free entry**

$$\pi(\omega) = 0 \quad \Rightarrow \quad q(\omega) = (\sigma-1)\varphi f,\ \forall\omega$$

- **Labor market equilibrium**

$$n\left(f + \frac{q(\omega)}{\varphi}\right) = L \quad \Rightarrow \quad n = \frac{L}{\sigma f}$$

- **Price index**

$$P = p(\omega)n^{\frac{1}{1-\sigma}} = \frac{\sigma}{\sigma-1}\frac{w}{\varphi}\left(\frac{L}{\sigma f}\right)^{\frac{1}{1-\sigma}}$$

Equilibrium in open economy

- **Without any transportation cost**
  - Integration amounts to increasing the size of the country $(L + L^*)$
  - Equilibirum mass of firms increased $(n + n^*)$
  - Welfare gains due to increased diversity
- **With transportation cost**
  - Iceberg trade cost $\tau > 1$
  - Program of the firm :

$$\begin{cases} \max_{p^D(\omega),p^X(\omega)} \left[p^D(\omega)q^D(\omega) + p^X(\omega)q^X(\omega) - w\left(f + \frac{q^D(\omega)+\tau q^X(\omega)}{\varphi}\right)\right] \\ \text{s.t.} \quad q^D(\omega) = \left(\frac{p^D(\omega)}{P}\right)^{-\sigma} C \\ \qquad q^X(\omega) = \left(\frac{p^X(\omega)}{P^*}\right)^{-\sigma} C^* \end{cases}$$

Equilibrium in open economy

- **Segmentation**

$$p^D(\omega) = \frac{\sigma}{\sigma - 1}\frac{w}{\varphi} = p^D \quad \text{and} \quad p^X(\omega) = \frac{\sigma}{\sigma - 1}\frac{\tau w}{\varphi} = \tau p^D$$

- **Equilibirum profit**

$$\pi(\omega) \quad = \quad w\left(\frac{q^D(\omega) + \tau q^X(\omega)}{(\sigma - 1)\varphi} - f\right)$$

- **Free entry**

$$q^D(\omega) + \tau q^X(\omega) = (\sigma - 1)\varphi f$$

- **Labor market equilibrium**

$$n = \frac{L}{\sigma f}$$

Number of firms unchanged. No pro-competitive effect

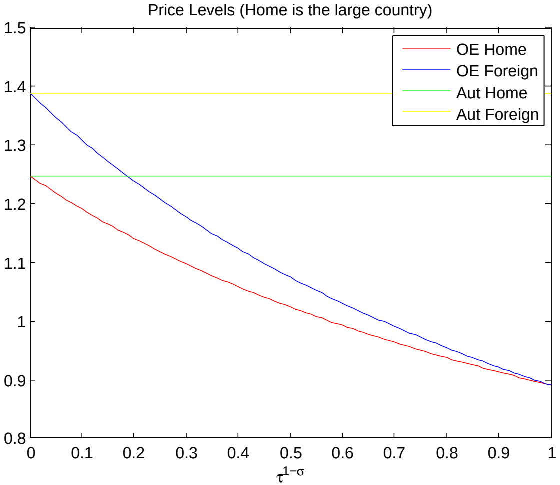
Welfare gains from trade

- **No pro-competitive effects** (constant mark-ups)
- **Consumer utility** : $C = \frac{wL}{P}$
- **Price index**

$$
\begin{aligned}
P &= \left(\int_0^n p^D(\omega)^{1-\sigma} d\omega + \int_0^{n^*} p^{X*}(\omega)^{1-\sigma} d\omega\right)^{\frac{1}{1-\sigma}} \\
&= \left(n\left(p^D\right)^{1-\sigma} + n^*\left(\tau p^{D*}\right)^{1-\sigma}\right)^{\frac{1}{1-\sigma}} \\
&\leq P^a
\end{aligned}
$$

Welfare gains due to an increase in the diversity of products (decreasing in trade costs)

Welfare gains



Equilibrium wages

- **Trade balance**

$$np^X q^X = n^* p^{X*} q^{X*}$$

$\Rightarrow$ Relative wages in equilibrium

$$\frac{w}{w^*} = \left(\frac{P}{P^*}\right)^{\frac{1-\sigma}{\sigma}} = \left(\frac{L w^{1-\sigma} + L^* \left(\tau w^*\right)^{1-\sigma}}{L\left(\tau w\right)^{1-\sigma} + L^* w^{*\,1-\sigma}}\right)^{\frac{1}{\sigma}}$$

- With zero trade costs, $w = w^*$
- For $\tau \to +\infty$, $\frac{w}{w^*} \to \left(\frac{L}{L^*}\right)^{\frac{1}{2\sigma-1}}$ (wage is relatively larger in the large country, which produces more varieties)
- In general, wages relatively larger in large markets. Otherwise, firms would all want to locate in the large market and export from there to the small market

The pro-competitive effect of trade

Assumptions

- Two countries (Home and foreign), one differentiated good (a continuum of varieties ω), one factor of production (labor)
- **Countries** identical except in their size (L et L^*)
- **Preferences**

$$C = q_0 + \alpha \int_0^n q(\omega) d\omega - \frac{\gamma}{2} \int_0^n q(\omega)^2 d\omega - \frac{\eta}{2} \left(\int_0^n q(\omega) d\omega \right)^2$$

q_0 numeraire good (pins down wage so that the pb is basically one of PE). $\alpha > 0$ intensity of preferences for the differentiated good, $\gamma > 0$ means that consumers are biased toward a dispersed consumption of varieties ("love of variety"), $\eta > 0$ a measure of how substitutable varieties (higher η means more substitutatibility)

Optimality conditions

- Inverse demand function :

$$p(\omega) = \alpha - \gamma q(\omega) - \eta \int_0^n q(\omega) d\omega$$

  Price elasticity of demand **increasing in the price**

- Optimal price :

$$p(\omega) = \frac{1}{2} \left[\alpha - \eta \int_0^n q(\omega) d\omega + \frac{w}{\varphi} \right]$$

- Equilibrium Margin :

$$p(\omega) - \frac{w}{\varphi} = \frac{1}{2} \left[\alpha - \eta \int_0^n q(\omega) d\omega - \frac{w}{\varphi} \right]$$

Impact of trade

- Opening to trade increases the diversity offered to consumers
- Because the size of the market has increased, firms can produce at larger scale which reduces their optimal mark-up
- Consumers benefit from the decrease in prices $\rightarrow$ Additional welfare gains due to the **pro-competitive effect**

Specialization in the Helpman-Krugman model

Assumptions

- Two countries (Home and foreign), two sectors (X and Y), one factor of production (labor)
- **Countries** identical except in their size (L et L^*)
- **Preferences**

$$C = C_X^{\mu} C_Y^{1-\mu}$$

  with C_X a CES aggregate

- **Technology in sector X** : Same as before

$$q(\omega) = q^D(\omega) + \tau q^X(\omega) = \left(\frac{p^D(\omega)}{P}\right)^{-\sigma} \frac{\mu w L}{P} + \tau \left(\frac{\tau p^D(\omega)}{P*}\right)^{-\sigma} \frac{\mu w^* L^*}{P*}$$

- **Technology in sector** Y : Linear technology in labor, no transportation cost

$$Y = L_Y \ \Rightarrow \ P_Y = P_Y^* = w = w^* = 1$$

Equilibrium in open economy

- **Free entry**

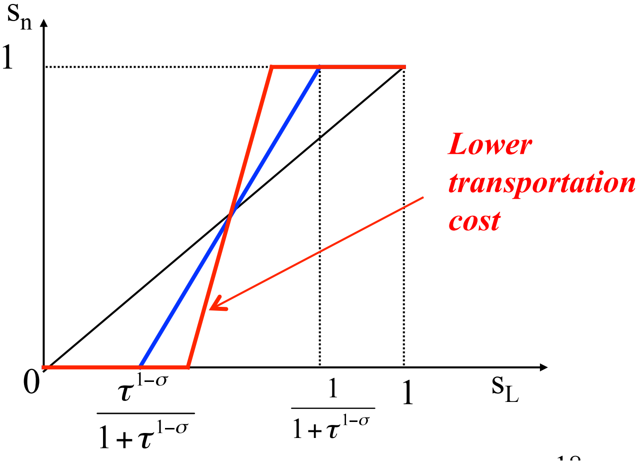
$$\begin{aligned} & q(\omega) = q^*(\omega) = (\sigma - 1)\varphi f \\ \Leftrightarrow \quad & n(L^* - \tau^{1-\sigma} L) = n^*(L - \tau^{1-\sigma} L^*) \end{aligned}$$

- **Firms' location**

$$s_n \equiv \frac{n}{n + n^*} = \begin{cases} 0, & s_L \leq \frac{\phi}{1+\phi} \\ \frac{s_L(1+\phi)-\phi}{1-\phi}, & s_L \in \left[\frac{\phi}{1+\phi}; \frac{1}{1+\phi}\right] \\ 1, & s_L \geq \frac{1}{1+\phi} \end{cases}$$

where $\phi \equiv \tau^{1-\sigma} \in [0, 1]$ and $s_L \equiv \frac{L}{L+L^*}$

Specialization



- "Comparative advantage" due to size ("**Home Market Effect**")

Empirical evidence

Empirical predictions

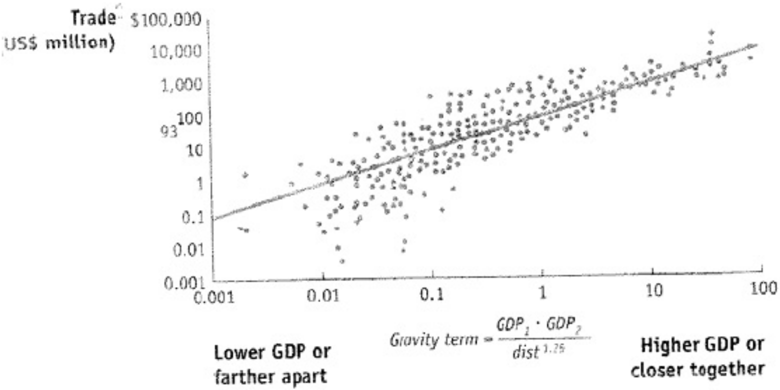
- **Bilateral trade**

$$X_{ij} = n_i p_{ij} q_{ij} = n_i \left(\frac{\sigma}{\sigma - 1} \frac{\tau_{ij} w_i}{\varphi_i P_j} \right)^{1-\sigma} R_j$$

- **Gravity equation**

$$\ln X_{ij} = \underbrace{\ln \left(\frac{\sigma}{\sigma - 1} \right)^{1-\sigma}}_{constante} + \underbrace{\ln n_i + (1-\sigma) \ln \frac{w_i}{\varphi_i}}_{i-specific} + \underbrace{\ln P_j^{\sigma-1} + \ln R_j}_{j-specific} + \underbrace{(1-\sigma) \ln \tau_{ij}}_{cout\ de\ transport}$$

Trade between US states and Canadian regions

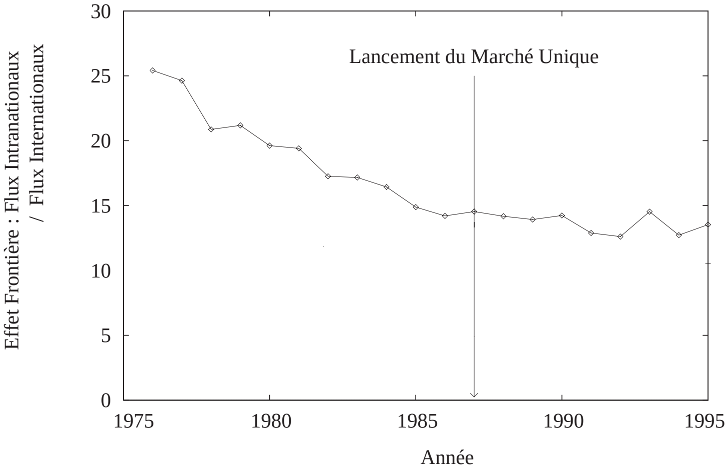


Source : Feenstra & Taylor (2011)

Gravity equation

	Variable dependante : $\ln X_{ij}$					
	(1)	(2)	(3)	(4)	(5)	(6)
ln Population i	0.799^a	0.823^a		1.185^a	1.191^a	
ln GDP per capita i	1.072^a	1.110^a		1.272^a	1.265^a	
ln Population j	0.723^a	0.740^a		0.896^a	0.900^a	
ln GDP per capita j	1.058^a	1.092^a		0.920^a	0.912^a	
ln Distance	-1.008^a	-0.838^a	-1.000^a	-1.511^a	-1.199^a	-1.619^a
Trade agreement		0.917^a	0.643^a		0.758^a	0.493^a
GATT/WTO		-0.011	0.038		0.306^a	0.811^a
Common money		1.470^a	1.460^a		-0.029	0.035
Common border		0.588^a	0.533^a		1.152^a	0.840^a
Common language		0.559^a	0.535^a		1.108^a	0.909^a
Colonial links		1.376^a	1.277^a		0.672^a	0.889^a
Year	1970	1970	1970	2006	2006	2006
Fixed effects	No	No	Yes	No	No	Yes
# observations	9,035	9,035	9,035	16,936	16,936	16,936
R^2	0.583	0.607	0.710	0.631	0.649	0.741

Border-effect, within the EU



Source : Head & Mayer (2000)

Conclusion

- Trade in imperfect substitutes allows explaining the growing share of intra-industry trade, especially between rich countries
- Cannot explain the "zeros"
  - In aggregate data, more than 50% of potential bilateral trade flows display strictly positive trade
  - In disaggregated data, the share of zeros is even stronger
  - Cannot be explained within the Krugman model : All produced varieties are consumed by all countries

Demand functions

- Consumers solves :

$$\begin{cases} \max_{\{q(\omega)\}_{\omega\in[0,n]}} \left[\int_0^n q(\omega)^{\frac{\sigma-1}{\sigma}} d\omega\right]^{\frac{\sigma}{\sigma-1}} \\ s.t. \int_0^n p(\omega)q(\omega)d\omega \leq R \end{cases}$$

- FOC with respect to ω (λ the Lagrange multiplier)

$$p(\omega)q(\omega) = C\lambda^{-\sigma}p(\omega)^{1-\sigma}$$

- Integrate over the continuum :

$$\int_0^n p(\omega)q(\omega)d\omega = C\lambda^{-\sigma}\int_0^n p(\omega)^{1-\sigma}d\omega$$

and

$$C = \left[\int_0^n q(\omega)^{\frac{\sigma-1}{\sigma}} d\omega\right]^{\frac{\sigma}{\sigma-1}} = C\lambda^{-\sigma}\left[\int_0^n p(\omega)^{1-\sigma}d\omega\right]^{\frac{\sigma}{\sigma-1}}$$

Demand functions

- Using $R = PC$ (definition of the ideal price index) :

$$P = \left[\int_0^n p(\omega)^{1-\sigma} d\omega \right]^{\frac{1}{1-\sigma}}$$

and

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

Back to assumptions