# Lecture 7: Imperfect Competition and Intra-Industry Trade

Gregory Corcos
gregory.corcos@polytechnique.edu
Isabelle Méjean
isabelle.mejean@polytechnique.edu

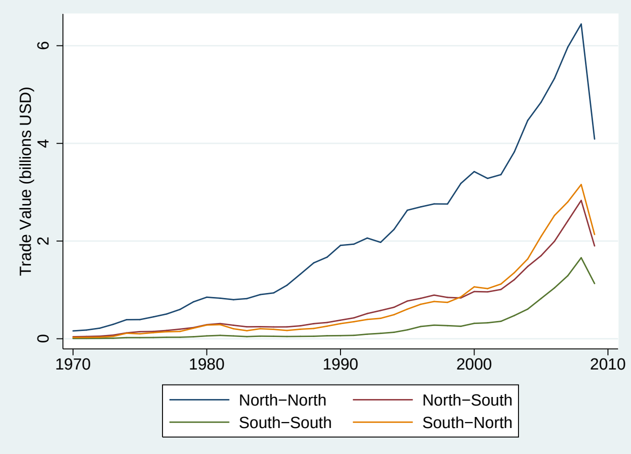
International Trade
Université Paris-Saclay Master in Economics, 2nd year

30 November 2016

# Introduction

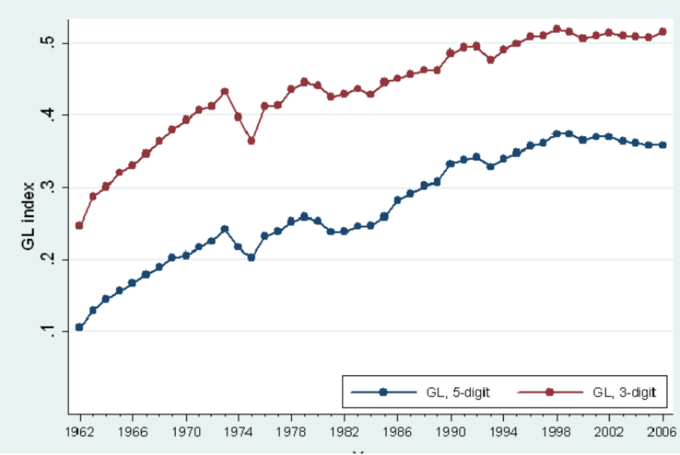
- **Neo-classical theories of international trade**
  - *Free trade is nothing but the extension to the whole world of the regime of free competition* (Léon Walras).
  - Explain trade of *different* goods between *different* countries because of differences in technology (Ricardo, Eaton & Kortum) or factor endowments (HOS/HOV).
  - Gains from trade due to resource reallocation when economies specialize in comparative advantage goods
- **Limits**
  - Cannot easily explain trade between *similar* countries
  - Or require random comparative advantage as Eaton & Kortum
- **Imperfect competition trade theories**
  - Explain intra-industry trade between similar countries : horizontally differentiated varieties, reduced market power
  - Gains from trade due to more variety in consumption and lower markups

# Geography of international trade




Source : UN ComTrade

# Intra- vs inter-industry trade




Source : Brülhart (2008). Share of intra-industry trade, as measured by the Grubel-Lloyd index $IIT_i = 1 - \frac{|X_i - M_i|}{X_i + M_i}$. Industries are defined at the 3-digit (red) or 5-digit (blue) levels.

# 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

Scale Economies, Product Differentiation and the Pattern of Trade, *American Economic Review*, 1980

# 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)
- Welfare gains from trade :
  - Increased by the greater diversity offered to consumers (due to scale economies, countries produce different goods)
  - Dampened by international trade costs

# Assumptions

- Two countries (Home and Foreign), one differentiated good (a continuum of varieties $\omega$), one factor (labor)
- **Factor** : 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

- **Production function** (Economies of scale)

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

$\varphi$ 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**

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

# Open-Economy Equilibrium

- **No transportation cost, free trade**
  - Integration amounts to increasing the size of the country $(L + L^*)$
  - Equilibrium mass of firms increased $(n + n^*)$
  - Welfare gains due to increased diversity
- **With trade costs**
  - 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**

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

- **Equilibrium 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

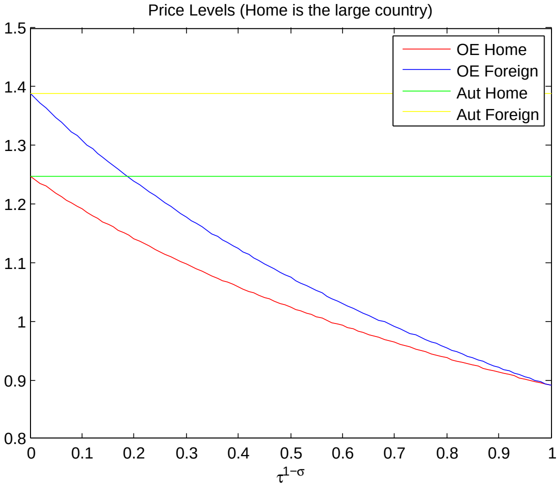
# Welfare gains from trade

- **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

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

- When $\tau = 0$, $w = w^*$
- When $\tau \to +\infty$, $\frac{w}{w^*} \to \left(\frac{L}{L^*}\right)^{\frac{1}{2\sigma-1}} > 1$
- In general, wages are higher in large markets. Those markets have greater labor demand because they minimize trade costs. Higher wages maintain trade balance.

# A Variant with Pro-competitive Effects of Trade

- With CES demand, the price elasticity is constant and firms charge a constant markup over costs. Prices and markups are unchanged by trade.
- Consider a linear demand function e.g.

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

where $\alpha > 0$, $\eta > 0$. $\gamma > 0$ captures love of variety.

- Optimal pricing still verifies :

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

.

- The price elasticity decreases with quantity and increases with price. Firms must charge lower markups (and prices) under free trade.
- Trade is **pro-competitive** and increases welfare by bringing prices closer to marginal costs (lower deadweight loss).

# Specialization in the Helpman-Krugman model

Helpman, E. and P. Krugman (1985), Market Structure and Foreign Trade, Cambridge, MIT Press

# 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** $Y$ : Numeraire, linear technology, no trade cost

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

# Equilibrium in open economy

- **Free entry**

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

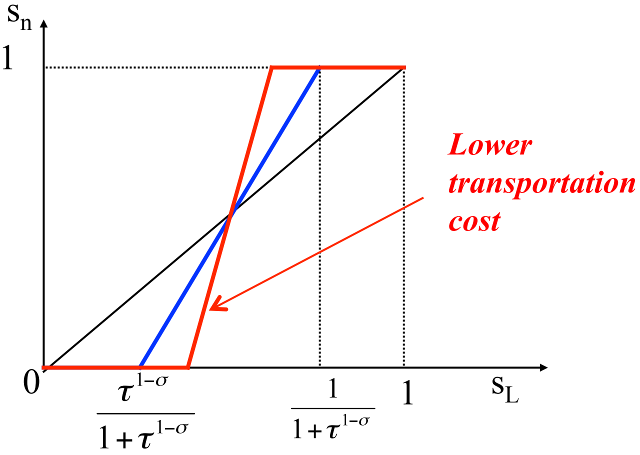
- **Firms' location**

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

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

- If Home is sufficiently large relative to Foreign all production of good X occurs there ("**Home Market Effect**").

# Specialization




- A fall in trade costs makes the Home Market Effect stronger : specialization occurs even with relatively similar countries.

# Empirical evidence

# Empirical predictions

- **Bilateral trade**

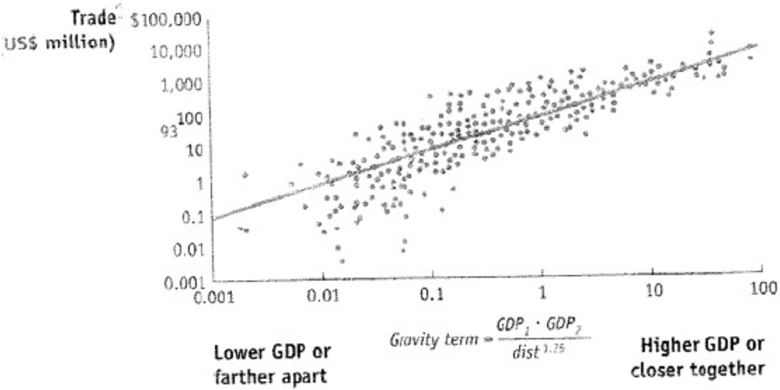
$$X_{ij} = n_i p_{ij} q_{ij} = n_i \left( \frac{\sigma}{\sigma-1} \frac{\tau_{ij} w_i}{\varphi_i P_j} \right)^{1-\sigma} R_j$$

- **Gravity equation**

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

- The trade cost elasticity has a structural interpretation : $1-\sigma$.

# Trade between US states and Canadian regions

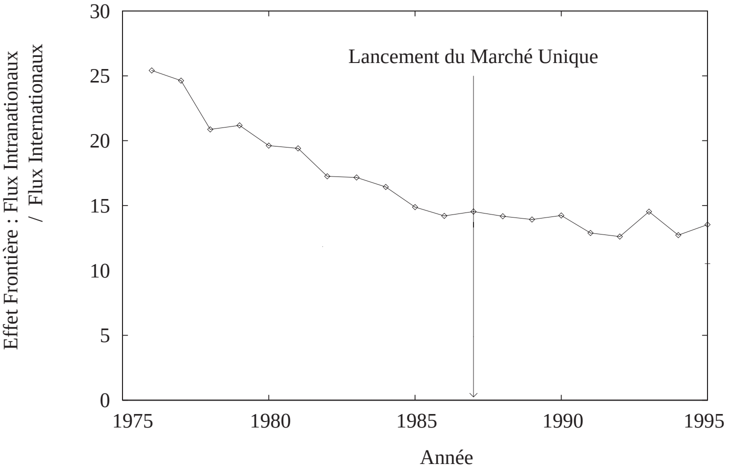



Source : Feenstra & Taylor (2011)

# Gravity equation

| | Dependent Variable : 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

'In this model there are none of the conventional reasons for trade ; but there will nevertheless be trade and gains from trade.' Krugman (1980).

- Countries trade imperfect substitutes because of imperfect competition, economies of scale and love of variety.
- Gains from trade due to increased diversity in consumption.
- Interesting implication : the 'home market effect'. Can be extended to study firm location (economic geography).
- Empirically the Krugman model explains intra-industry trade, especially between rich countries.
- But it fails to explain "zeros" in bilateral trade flows :
  - in the model all produced varieties are consumed by all countries
  - in reality about half of all country pairs display no aggregate trade flows, and an even higher share in disaggregated data

# Appendix : Demand Functions

- Consumers solve :

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

- FOC with respect to $\omega$ ($\lambda$ 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