Lecture 2: New Trade Theory

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Introduction: Krugman’s influence

- New Trade Theory and New Economic Geography
  - Trade models combining increasing returns, imperfect competition and transportation costs
- Strong influence in international trade and in other fields (international macroeconomics, international finance, development economics, etc.)
- Key element of the model: Production patterns result of a concentration/proximity trade-off:
  - Increasing returns to scale $\rightarrow$ Incentive to concentrate production in a single location
  - Transportation costs $\rightarrow$ Incentive to produce near the demand
Introduction: Transportation costs

- Transportation costs = Trade costs (tariffs and non-tariff barriers) + Frictions (Information costs, Time cost; etc.)
  - Transport cost: In 1650, it takes 358 hours to move from Paris to Marseille. In 1854, it takes 38 hours. In 2002, it takes 3 hours.
  - Tariffs on manufacturing goods in developed countries (Source: World Bank and WTO):

<table>
<thead>
<tr>
<th>Year</th>
<th>Average Tariff (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1820</td>
<td>22</td>
</tr>
<tr>
<td>1875</td>
<td>11-14</td>
</tr>
<tr>
<td>1913</td>
<td>17</td>
</tr>
<tr>
<td>1925</td>
<td>19</td>
</tr>
<tr>
<td>1930</td>
<td>32</td>
</tr>
<tr>
<td>1950</td>
<td>16</td>
</tr>
<tr>
<td>1987</td>
<td>7</td>
</tr>
<tr>
<td>1998</td>
<td>4.6</td>
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</tbody>
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⇒ Since 1950, international market integration is mainly driven by the tariff and NTB decrease.
⇒ Price convergence (Findlay and O’Roorke, 2003):
  - Wheat in Liverpool 57.6% higher than in Chicago in 1870, 15.6% in 1913
  - Steel in London 75% higher than in Philadelphia in 1870, 20.6% in 1913
Introduction: Concentration of activities

- Urbanization: Urban population in Europe in 1800 = 12% population, 38% in 1900, 75% in 2000 (Bairoch, 1985) ⇒ Possible because transportation costs have decreased
- Concentration of economic activities: PNB per capita of European countries as a function of distance from UK (source: Combes et al, 2008):

Graphs by year

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Introduction: Concentration of activities (2)
Introduction: Concentration of activities (3)

Figure 1.1. GDP per capita of the NUT2 regions of the European Union in 2004.
Introduction: Modeling agglomeration

- Several explanations can be found for the agglomeration of activities:
  - Comparative advantage (heterogeneity of space) ⇒ Ricardo
  - Agglomeration forces through nonmarket interactions among firms and/or households (informational spillovers) ⇒ Marshall
  - Pecuniary externalities under imperfect competition, associated with demand or supply linkages ⇒ Krugman

- Mechanisms:
  - Under increasing returns to scale, production takes place at only a limited number of sites
  - Under costly trade, producers have an incentive to locate nearby demand to minimize transportation costs (demand from final consumers or demand from other firms in a vertically segmented world)
  - Possibility of “circular causation” if firms concentrate where the demand is, but the market becomes larger where manufactures production is concentrated
Dixit-Stiglitz Preferences
Dixit-Stiglitz Preferences

\[ U = C_M; \quad C_M = \left( \sum_{i=1}^{N} \frac{c_i^{\sigma-1}}{\sigma} \right)^{\frac{\sigma}{\sigma-1}}; \quad \sigma > 1 \]

- \( N \) number of available varieties
- \( c_i \) consumption of variety \( i \)
- \( \sigma \) elasticity of substitution between varieties:

\[ \frac{\partial c_j / c_j'}{\partial p_j' / p_j} \]

Higher when goods become more substitutable

- Remark: In terms of a continuum of varieties:

\[ C_M = \left( \int_{i=0}^{N} c_i^{\sigma-1} di \right)^{\frac{\sigma}{\sigma-1}} \]
Indirect utility function

- Indirect utility function: Maximal utility when faced with a price level $p$ and an amount of income $w$. Represents the consumer's preferences over market conditions. A consumer’s indirect utility $V(p, w)$ can be computed from its utility function $U(c)$ by first computing the most preferred bundle $c(p, w)$ by solving the utility maximization problem; and second, computing the utility $U(c(p, w))$ the consumer derives from that bundle.

$$V = E \frac{E}{P_M}$$

- $P_M$ is the “ideal” price index associated with the Dixit-Stiglitz preferences:

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

\[ \mathcal{L} = \left( \sum_{i=1}^{N} c_i^{-\frac{1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} + \lambda \left[ P_M C_M - \sum_{i=1}^{N} p_i c_i \right] \]

⇒ First-order conditions:

\[ c_j^{-1/\sigma} \left( \sum_{i=1}^{N} c_i^{\frac{\sigma-1}{\sigma}} \right)^{-1} = \lambda p_j, \quad \forall j \in [1, N] \]

\[ \lambda \left[ P_M C_M - \sum_{i=1}^{N} p_i c_i \right] = 0 \]

⇒ Inverse and direct demand curves:

\[ c_i = \left( \frac{p_i}{P_M} \right)^{-\sigma} \frac{E}{P_M}, \quad p_i = \frac{c_i^{-1/\sigma} E}{\sum_{i=1}^{N} c_i^{\frac{\sigma-1}{\sigma}}} \]
The same level of expenditure spread over more varieties increases utility.

If prices are homogeneous across goods:

\[ U = N^{\frac{1}{\sigma - 1}} \frac{E}{p} \]

increases with \( N \)

\( \Rightarrow \) Consumers love variety for variety’s sake
Price setting under Bertrand competition

Maximization program:
\[
\begin{align*}
\max_{p_j} & \quad [p_j c_j - w a_m c_j] \\
\text{s.t.} & \quad c_j = \frac{p_j^{1-\sigma}}{\sum_{i=1}^{N} p_i^{1-\sigma}} E
\end{align*}
\]

⇒ Optimal price:
\[
p_j \left(1 - \frac{1}{\sigma - (\sigma - 1)s_j}\right) = a_m w
\]

where \(s_j = \frac{p_j c_j}{E}\) is the firm's market share

⇒ The perceived elasticity \((\varepsilon = \sigma - (\sigma - 1)s_j)\) falls as \(s_j\) rises

⇒ As long as \(s\) is not zero, the degree of competition does affect pricing behaviour.
Price setting under Cournot competition

- Maximization program:

\[
\begin{align*}
\max_{c_j} & \quad [p_j c_j - w a_m c_j] \\
\text{s.t.} & \quad p_j = \frac{c_j^{-1/\sigma}}{\sum_{i=1}^{N} c_i^{1-1/\sigma}} E
\end{align*}
\]

⇒ Optimal price:

\[
p_j \left[ 1 - \frac{1}{\sigma} - \left( 1 - \frac{1}{\sigma} \right) s_j \right] = a_m w
\]

where \( s_j = \frac{p_j c_j}{E} \) is the firm’s market share

⇒ The perceived elasticity (defined by \( 1/\varepsilon = \frac{1}{\sigma} + \left( 1 - \frac{1}{\sigma} \right) s_j \)) falls as \( s_j \) rises

⇒ As long as \( s \) is not zero, the degree of competition does affect pricing behaviour.
Price setting under monopolistic competition

- Under monopolistic competition, each firm as a negligible share of the market \( s_j \to 0 \)

- The perceived elasticity equals \( \sigma \) and the mark-up is constant: \( \frac{\sigma}{\sigma - 1} \)

- Equilibrium pricing does not depend upon the typical firm’s conjecture about other firms’ reaction (Bertrand and Cournot conjectures produce the same result) \( \Rightarrow \) Rules out pro-competitive effects

- In the discrete version, one must assume that \( N \) is large. With a continuum of varieties, \( s_j \) is automatically zero.

- The invariance of the mark-up implies mill-pricing (ex2): the firm charged the same price “at the mill’ or at the factory gate, whatever the extend of shipping costs
Invariance of Firm Scale

- A fixed mark-up of price over marginal cost implies a fixed operating profit margin:

\[ pq - cq = \frac{cq}{\sigma - 1} \]

⇒ Under fixed production costs, there is a unique level of sales that allows the typical firm to just break down (ie earn a level of operating profit sufficient to cover fixed costs):

\[ q = \frac{F(\sigma - 1)}{c} \]
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 $L^*$
- Two sectors: Agriculture (perfectly competitive, no trade costs) and Manufacturing (IRS, monopolistic competition, costly trade)

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

- Dixit-Stiglitz preferences over differentiates varieties

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

- 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:

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

\[ \Rightarrow \quad P_M C_M = \mu PC = \mu w \]
\[ P_A C_A = (1 - \mu)PC = (1 - \mu)w \]

\[ P = \frac{P_A^{1-\mu} P_M^\mu}{(1 - \mu)^{1-\mu} \mu^\mu} \]
Closed economy (2)

- Optimal consumption on each variety:

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

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

\[
P_M = \left[ \sum_{i=1}^{N} p_i^{1-\sigma} \right]^{\frac{1}{1-\sigma}}
\]
• Optimal price in agriculture:

\[ P_A = w = 1 \]

• Optimal prices in manufacturing:

\[
\begin{align*}
\pi_i &= p_i c_i L - w(\alpha + \beta L c_i) \\
\text{s.t. } c_i &= \left( \frac{p_i}{P_M} \right)^{-\sigma} \frac{w}{P_M}
\end{align*}
\]

\[ \Rightarrow \text{ Mill-pricing:} \]

\[ p_i = \frac{\sigma}{\sigma - 1} \beta \]
Closed economy (4)

- Free entry:

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

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

\[ \Rightarrow \text{There is a unique level of sales that allows the typical firm to just break even, ie to earn a level of operating profit sufficient to cover fixed costs.} \]

- Full-employment:

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

\[ \Leftrightarrow N = \frac{\mu L}{\alpha \sigma} \]
Costly trade

- Trade increases the diversity of varieties available for consumption:

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

⇒ Positive welfare effect

- Trade is perfectly free in the homogeneous good sector ⇒ Law of one price \( P_A = P_A^* \) ⇒ Equal wages: \( w = w^* \)

- “Iceberg” trade costs \( \tau \) in the manufacturing sector
Costly trade (2)

⇒ Mill-pricing and full pass-through:

\[
\max_{p_i, p_i^*} [p_i Lc_i + p_i^* L^* c_i^* - \beta (Lc_i + \tau L^* c_i^*) - \alpha]
\]

s.t.

\[
c_i = \left( \frac{p_i}{P_M} \right)^{-\sigma} \frac{w}{P_M}
\]

\[
c_i^* = \left( \frac{p_i^*}{P_M^*} \right)^{-\sigma} \frac{w^*}{P_M^*}
\]

⇒ Optimal prices:

\[
p_i = \frac{\sigma}{\sigma - 1} \beta
\]

\[
p_i^* = \frac{\sigma}{\sigma - 1} \beta \tau = \tau p_i
\]

⇒ 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.
Costly trade (3)

- 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 (4)

- Note that when wages are endogenous as in Krugman (1980) (no agricultural sector), the relative wage is sensitive to the relative size of countries ⇒ Home Market Effect on wages: Large countries have relatively higher wages ⇒ 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.