New economic geography, part II:
International specialization and industrial clustering

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Fall 2010

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1 Motivation

A key feature of countries is that

- Labor mobility is much greater within than between countries ⇒ Implies much greater potential for differences in real wages and per capita income
- Without labor mobility, there is not agglomeration in the usual sense

However, a process of international specialization and industrial clustering similar to agglomeration can emerge when

- Manufacturing both produces and consumes intermediate inputs
- There are transport costs
- Producers exhibit a love of variety for intermediate inputs
- Production is characterized by increasing returns to scale

In equilibrium, manufacturing or particular industries may become concentrated in a limited number of countries

2 The Krugman and Venables (1995) model

2.1 Key assumptions

- 2 countries: North and South
- Symmetric countries: $L = L^*$
- 2 goods:
  - Agricultural goods: Homogenous, perfect competition and constant returns to scale (CRS)
  - Manufacturing goods: Differentiated goods, monopolistic competition and Increasing returns to scale
- One primary factor of production: Labor – used in both agriculture and manufacturing
• Manufacturing also uses itself as an input: The same aggregate of manufacturing vari-
eties demanded by consumers is also an input into the production of each variety

We describe the Northern economy, noting that the analogous conditions hold in South
(denoted by an asteriks).

2.2 Consumption and production

Consumer preferences

\[
U = C_A^{1-\gamma} C_M^\gamma, \quad 0 < \gamma < 1
\]

\[
C_M = \left[ \sum_i c_i^{\sigma-1} \right]^{\frac{1}{\sigma}}, \quad \sigma > 1
\]

Production

Agricultural production technology

\[
Z = L_A
\]

chosen as numeraire, so that \( P_A = 1 \), which gives equilibrium wage in agriculture

\[
w_A = 1
\]

Manufacturing cost function

\[
TC_i = w_M^{1-\nu} P_M^\nu [\alpha + \beta x_i]
\]

- Both fixed and variable costs use the primary factor of production (labor) and interme-
diate inputs in the same proportions

- Same elasticity of demand among varieties as consumers

2.3 Producer equilibrium

Transport costs

• Agriculture: No transport costs

• Manufacturing: Iceberg costs where between countries, for one unit of a manufacturing
good to arrive, \( \tau > 1 \) units must be shipped
Profit maximization

\[
\max_{p_i} (x_i (p_i)) - w_i^{1-\mu} P_M^\mu [\alpha + \beta x_i (p_i)]
\]  

(5)

- First order conditions for profit maximization

\[
p_i = p = \left( \frac{\sigma}{\sigma - 1} \right) w_i^{1-\mu} P_M^\mu \beta
\]

(6)

- “Cif” and “Fob” prices (cif price of imported goods is \( p \tau \)):

\[\hat{p} = p \tau\]

Free entry implies zero equilibrium profits:

\[
p_i (x_i (p_i)) - w_i^{1-\mu} P_M^\mu [\alpha + \beta x_i (p_i)] = 0
\]

Implies constant equilibrium output of each variety

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

(7)

Equilibrium CES demand

\[
y = p^{-\sigma} P_M^{\sigma-1} E, \quad x = p^{-\sigma} \tau^{1-\sigma} \left( P_M^* \right)^{\sigma-1} E^*
\]

(8)

\[E = \gamma w_M L + \mu px, \quad E^* = \gamma w_M^* L^* + \mu p^* n^* x^*
\]

(9)

\[P_M = [np^{1-\sigma} + n^* (p^* \tau)^{1-\sigma}]^{1/(1-\sigma)}\]

(10)

Equilibrium number of firms

Supply equal demand gives equilibrium number of firms

\[x = p^{-\sigma} P_M^{\sigma-1} E + p^{-\sigma} \tau^{1-\sigma} \left( P_M^* \right)^{\sigma-1} E^*
\]

(11)

The general equilibrium is characterized by (3), (10), (9), (6), and (11) and analogous for the other country, which can be used to find equilibrium values of \( P_M, w_M, p, n, E \) and \( P_M^*, w_M^* \), \( p^*, n^*, E^* \).
2.4 Long run equilibrium

Long run equilibrium manufacturing wages satisfy

<table>
<thead>
<tr>
<th>Wages</th>
<th>Specialization</th>
<th>Home</th>
</tr>
</thead>
<tbody>
<tr>
<td>( w_M = w_A = 1 )</td>
<td>Incomplete specialization</td>
<td>M+A</td>
</tr>
<tr>
<td>( w_M &gt; w_A = 1 )</td>
<td>Home specialized</td>
<td>M</td>
</tr>
<tr>
<td>( w_M &lt; w_A = 1 )</td>
<td>Home specialized</td>
<td>A</td>
</tr>
</tbody>
</table>

2.5 Forces for and against agglomeration

Dispersion forces

1. Product market competition
   - An increase in \( n \) reduces the price index \( P_M \), shifts the demand for each variety down and reduces profitability

2. Diminishing returns in Agriculture

Concentration forces

1. Forward (cost) linkage: increase in \( n \) reduces the price index \( P_M \)
   - reduces the cost of the intermediate input, raises firms profits and therefore manufacturing wages.

2. Backward (demand) linkage: increase in \( n \)
   - increases expenditure on manufactured goods, raises demand and profits of each firm and therefore manufacturing wages.

2.6 Industrial Concentration without National Inequalities

Assumptions

- CRS in agriculture: Equilibrium manufacturing wage will be 1 as long as there is some agricultural employment in an economy
- Share of manufactures in consumption \( \gamma < 1/2 \)
– Level of demand for manufactures is small enough for all manufacturing to potentially fit in one country

– Both countries always produce the agricultural good and their equilibrium wage is always 1

Can solve analytically for the Sustain and Break Points as in Krugman (1991)
Unique Stable Equilibrium for High Trade Costs

These locii of values for \((\lambda_N, \lambda_S)\) are derived from the system of equations for short-run equilibrium earlier.

- The \(W_N = 1\) locus is the set of values for \((\lambda_N, \lambda_S)\) for which \(w_N = 1\).

To the right of the \(W_N = 1\) locus, \(\lambda_N\) is too high for equilibrium given \(\lambda_S\), and must fall for \(W_N = 1\).

- With high trade costs, disagglomeration forces dominate.

Two Stable Corner Equilibria and a Single Unstable Interior Equilibrium with Low Trade Costs

These locii of values for \((\lambda_N, \lambda_S)\) are derived from the system of equations for short-run equilibrium earlier.

- The \(W_S = 1\) locus is the set of values for \((\lambda_N, \lambda_S)\) for which \(w_S = 1\).

To the right of the \(W_S = 1\) locus, \(\lambda_N\) is too high for equilibrium given \(\lambda_S\), and must fall for \(W_S = 1\).

- With low trade costs, agglomeration forces dominate.
2.7 Industrial Concentration and National Inequalities

- The assumptions of CRS in agriculture and $\gamma < 1/2$ ensure that the concentration of manufacturing activity does not bid up wages. In general, the concentration of manufacturing activity will influence international income inequality. Two possibilities:
  
  - Diminishing returns in agriculture
  - A large world manufacturing sector ($\gamma < 1/2$) so that industrial concentration results in one country becoming completely specialized

Begin by considering the second possibility of $\gamma < 1/2$. Suppose that, when the concentration of manufacturing occurs, one country specializes completely in manufacturing and the other remains incompletely specialized.

*Bifurcation Diagram: Industrial structures and specialization*

- Examines how the configuration of equilibria varies with $T$
- Solid lines denote stable equilibria
- Dashed lines denote unstable equilibria

![Bifurcation Diagram](image_url)
2.8 National Inequalities and Trade Costs

At high values of $T$, the symmetric equilibrium is unique and stable:

- Both countries are incompletely specialized, with nominal wages equal to 1 and the same real wage $\omega = w/(P_M)^T$

As transport costs fall below the sustain point $T(S)$, specialization of manufacturing in one country (e.g., North) becomes sustainable

- Multiple stable equilibria

- In the industrial concentration equilibrium
  - The real wage in the North is higher than in the South and than in the symmetric equilibrium
  - The real wage in the South is lower than in the symmetric equilibrium: These real wage changes are driven by both changes in nominal wages (market and supplier access) and changes in the price index

- As transport costs fall below the break point $T(B)$, the symmetric equilibrium becomes unstable

- As transport costs fall to zero ($T = 1$), location becomes irrelevant and both countries enjoy the same (higher) real wages

- History of the World, Part I
  - Imagine a long-run secular fall in transport costs
  - Begin from an initial symmetric equilibrium; the two countries are identical
  - As transport costs fall, an international division of labor spontaneously arises through a process of uneven development
    * North immediately gains from this division of labor
    * South, which suffers deindustrialization, initially loses
  - The world exhibits a core-periphery structure
    * Manufacturing is concentrated in the North
Low wages in the South are not enough to attract manufacturing because of the lack of forward and backward linkages.

- Further reductions in trade costs move the world into a globalization phase.
  - The value of proximity to customer and supplier firms diminishes as transport costs fall.
  - Sustainable wage gap between North & South narrows.
  - During the globalization phase, the North may suffer a real as well as a relative income decline.

### 2.9 Industrial Clustering


- Each manufacturing variety uses all other manufacturing varieties symmetrically as intermediate inputs.
- The question of interest is where will manufacturing industry concentrate (if it does)?
Models of new economic geography can also be used to analyze issues of industrial clustering

- Multiple manufacturing industries

- The question of interest becomes what manufacturing industries will locate where?
  - How is one industry’s location decision influenced by another’s
  - What is the role of transport costs?

3 Final remarks

- Despite labor immobility, vertical linkages between sectors can generate a pattern of industrial concentration across countries that is conceptually very similar to agglomeration within countries.

- The geographic structure of production in the international economy can undergo qualitative and discrete changes for small movements in the values of parameters such as transport costs

- The model provides an explanation of how a single process (a secular decline in transport costs) may lead to
  - An initial period of uneven development, deindustrialization in developing countries, and rising international inequalities
  - A subsequent period of globalization characterized by the dispersion of manufacturing activity and declining international inequalities

4 Extra:

4.1 International equilibria with complete specialization by one country

Main assumption: share of consumer income spent on manufactured goods > 1/2, from which follows that any asymmetric equilibrium must involve specialization by one country in manufactures.
• For high trade costs: a symmetric equilibrium, with intra-industry trade and same industrial structure and wage ($=1$) in both countries.

• For low trade costs: the symmetric equilibrium becomes unstable, one of the countries (North) specializes completely in manufacturing and pay wages above the marginal product of labor in agriculture ($w > w^*$). (If $\gamma < 1/2$, then all manufacturing would agglomerate in North, but $w = w^* = 1$.)

• For intermediate trade costs: multiple equilibria (symmetric and asymmetric)

• **Break point:** Reducing trade, then at some of trade costs, the symmetric equilibrium becomes unstable

$$
\tau^{\sigma-1} = \left(\frac{1 + \mu}{1 - \mu}\right) \left(\frac{\sigma (1 + \mu) - 1}{\sigma (1 - \mu) - 1}\right)
$$

If $\mu = 0$, then any trade cost $\tau > 1$ will imply symmetry between the two economies.

If $\sigma (1 - \mu) < 1$, then a core-periphery pattern will emerge no matter how high trade costs are. Which will be true is economies of scale are very large ($\sigma$ very small), or if the share spent on intermediates ($\mu$) is very high, implying strong forward and backward linkages.

• **Sustain point:** Increasing trade cost, at some point the asymmetric equilibrium becomes unstable
4.2 Summary: Trade and welfare

- High trade costs: symmetric equilibrium and identical wages

- Intermediate trade costs: multiple equilibria

- Low trade costs: asymmetric equilibrium with \( w > w^* \) if \( \gamma > 1/2 \). Real wages fall in the South relative to the North due to falling nominal wages and due to the fact that a high proportion of manufacturing now has to be imported.

- Zero trade cost: Real wages and nominal wages converge as firms relocate to the South and trade costs fall. Real wage in the South rises due to relocation of firms and decline in Northern wages. Real wage in the North may decline or rise. Relocation of firms reduces wages, but the consumer is both affected by relocation as well as by declining trade cost. Hence, the consumer price may fall or rise.

**Comparative static**

\( \gamma \uparrow \) increases the amount of manufacturing activity in the South, and reduces the real wage gap, and no fall in real wages in the North in the "globalization" phase. (see Figure 6)

\( \mu \uparrow \) increases the fores for agglomeration and leads to a bigger real wage gap