Discussion Paper No. 1239

Geography of the World Economy

by

Kiminori Matsuyama
Northwestern University
Economics Department
kmatsu@merle.acns.nwu.edu

April 1998
Revised: January 1999

http://www.kellogg.nwu.edu/research/math

GEOGRAPHY OF THE WORLD ECONOMY

By Kiminori Matsuyama[1]

The First Version: April 1998
This Version: January 1999

Abstract

This paper presents a theoretical framework to study the effects of geographical factors on the distribution of industries in the world economy, which consists of many regions. The geographical feature of each region is summarized by a proximity matrix, whose elements measure the closeness between every pair of regions, and depend on the parameters representing the transport and other costs of using a variety of trade routes. The main objective is to show how a change in these costs of trade affects the distribution of industries, by amplifying the geographical advantages and disadvantages held by different regions. The results are used not only to examine the effects of an improvement in transport infrastructure, but also to discuss some problems from economic history (mostly Japanese and European), regional economic integration, the north-south division, and others.

Keywords: A Multiregion Model of Trade with Increasing Returns and Transport Costs, Regional Economic Integration, Uneven Development, Geography, Locational Advantages and Disadvantages, Proximity Matrix, Trade Routes.
JEL Classification Numbers: F12 (Models of Trade with Imperfect Competition and Scale Economies), F15 (Economic Integration), O11 (Macroeconomic Analysis of Economic Development), R12 (Size and Spatial Distributions of Regional Economic Activity)

[1] Department of Economics, Northwestern University, 2003 Sheridan Road, Evanston, IL 60208, USA.

1. Introduction

Geographical factors play a vital role in shaping the economic landscape of the world. This point, obvious to businesspeople and politicians, has not escaped the attention of economic historians. In their effort to understand the spatial patterns of development, they emphasize not only the resource endowment of various regions, but also their locational advantage, such as the access to navigable rivers, seas, and oceans, as well as the strategic importance of straits and valleys. For example, Braudel (1972), Hicks (1969), McNeill (1974), Pirenne (1939), Pounds (1990), among others, stressed the importance of the Mediterranean sea in explaining the rise of the Greek and Roman civilizations, the economic slump of the Middle Ages, as well as the rise and fall of Italian city-states. Many of them also discussed the vital role played by a variety of trade routes, such as the Rhône valley, the Donau and Rhein rivers, and the Bosporus strait, in the development of European economic history.

Geographical factors also play a significant role in the processes of economic integration. Regional arrangements, such as the European Union and NAFTA, which effectively reduce the internal costs of trade within the blocs, are likely to have different impacts on different regions within participating countries, depending on their geographical proximity to trading partners. They are also crucial for understanding different attitudes among the member countries toward eastward expansion of the European Union. And, of course, for many economists and political scientists who adopt the geopolitical, structuralist view of the world economy, geographical factors are crucial elements for understanding the north-south division, and the emergence of the so-called "New International Economic Order."

In spite of all the significance attributed by economic historians, political scientists and others, the formal theory of international trade pays virtually no attention to geographical factors, with the exception of the resource endowment. This paper presents an attempt to develop a theoretical framework, which allows a systematic study of the effects of geographical factors on the distribution of industries in the world economy. For this purpose, this papers uses the Helpman and Krugman (1985, Ch. 10.4) two-region model of trade with increasing returns and transport cost as a launching pad of the investigation. Due to its two-region assumption, the Helpman and Krugman model cannot accommodate geographical asymmetry across regions. The only asymmetry they examined was the difference in the size of resource endowment. Because of the relatively simple structure, however, their model can be extended to an arbitrary number of regions, a necessary step toward modeling geographical asymmetry across regions. The geographical feature of each region is given by a proximity matrix, whose elements summarize the closeness between every pair of regions, and depend on the parameters representing the transport and other costs of using a variety of trade routes. The main objective of the analysis is to examine how a change in these costs of trade, by amplifying the geographical advantage and disadvantage held by different regions, affects the distribution of industries. Although the proximity matrix depends on geography and transport technologies, the setup is abstract enough to permit a broader interpretation. Hence, the model can also be used to examine the effects of cultural, political proximity across regions.

This paper differs significantly in objective from the "New Economic Geography" literature, initiated by Krugman (1991), in spite of some apparent similarities. This literature attempts to demonstrate how the presence of demand and cost linkages gives an incentive for the industries to cluster together. Agglomeration occurs due to the complementarities in locational decisions. The basic message of this literature is the self-fulfilling nature of industrial location, or "they are there because they are there." For this purpose, most studies in this literature assume the geographical symmetry across the regions and explains the formation of a metropolis in a "featureless plane." If some geographical asymmetries are modeled, its purpose is to show the possibility that a metropolis can be formed in spite of its locational disadvantages, or why most Americans continue to live in the northeastern corner of the country, in spite of inhospitable climate. In the present model, on the other hand, there is no direct demand and cost linkages that would give an incentive for the industries to cluster. On the contrary, the entry of a firm in one region reduces an incentive for other firms to enter in all regions. What generates nontrivial patterns of industrial distribution in the present model is that the entry of a firm in one region reduces an incentive for other firms to enter in different regions in a different degree, due to geographical asymmetry. The goal is to examine how geographical advantages and disadvantages held by different regions play a significant role in the presence of small costs of trade, instead of showing the possibility that self-fulfilling nature of locational decisions can offset geographical disadvantages.

One advantage of the present model is the tractability. The presence of demand and cost linkages makes New Economic Geography models hardly tractable for a large number of regions. For this reason, most studies have to impose two-region or other special assumptions, and even under such restrictive assumptions, they have to rely on numerical simulation. On the other hand, the absence of such linkages helps to keep the present model tractable; The equilibrium can be derived algebraically for many cases with a relative large number of regions. An explicit algebraic expression for the equilibrium not only makes the model useful as an intuition-building device. It has an additional advantage of revealing the inherent nonmonotonicity of the effects of transport costs in industrial distribution.

Another difference between the present study and New Economic Geography is in scope. The latter is mostly interested in the formation of a metropolis and of an urban system, and for this reason, labor mobility plays an important role in generating the linkages.[2] The present study is global in scope, and factor mobility plays no role in the analysis.

The results reported below also have some implications on recent empirical studies of cross-country, cross-regional, productivity studies. On one hand, it offers some justifications for the common practice of including a variety of dummy variables which capture the effects of not only geographical proximity, such as a continent and coastal/inland dummies, but also cultural, linguistic, and political proximity. On the other hand, it offers some cautions when interpreting the evidence of geographical concentration, which may not necessarily suggest the presence of knowledge spillovers and other externalities.

The rest of the paper is organized as follows. Section 2 presents the model and derives the equilibrium condition, which maps a distribution of the resource endowment into a distribution of industries, for a given proximity matrix. Section 3 considers some benchmark cases. Section 4 examines the resource size effects. Section 5 examines the case of three regions. After section 5A looks at the case where the three regions are located on the line, section 5B studies the effect of creating a bypass, connecting the two peripheries. Section 6 looks at the cases where the world consists of superregions, each of which in turn consists of multiple regions. Section 6A examines how a reduction in the cost of trade within superregions affects the distribution of industries across the superregions. Section 6B examines how a reduction in the cost of trade across superregions affects the distribution of industries within the superregions. Section 6C presents the case, where the world consists of superregions, which consist of regions, which in turn consist of subregions. Section 7 presents the case, which portrays the "New International Economic Order," capturing the geopolitical and structuralist view of the world economy. Section 8 offers some conclusions and suggestions for future research.

[2] There are some important exceptions to this characterization of New Economic Geography, which include a series of papers by Venables, of which Krugman and Venables (1995) is most well known, as well as Matsuyama (1996). These studies discuss agglomeration in the context of the global economy.

2. The Model

The model is a multiregion extension of the two region model developed by Helpman and Krugman (1985, Ch. 10.4). The world is populated by a continuum of identical agents, who are distributed over R regions. There is one type of the factor of production, which is nontradeable. It may be interpreted as a composite of many factors, such as labor and land. In contrast to the recent literature on economic geography, the factor mobility does not play any role in the model. Let V_j be the resource endowment of Region j $(j = 1, 2, \ldots, R)$.

All the agents share the identical preferences. They consume a homogenous outside good, and a continuum of differentiated manufacturing goods, which are aggregated by a symmetric CES form. The outside good and the composite of manufactures are combined with Cobb-Douglas preferences with α being the expenditure share of manufactures. More specifically, the agent's preferences are given by

$$U_j = (C_j^o)^{1-\alpha}(C_j^m)^{\alpha}$$

where C_j^o is the outside goods consumed by the agents living in Region j, and C_j^m is the composite of manufacturing goods consumed by them, which is defined by

$$C_j^m = \left[\int_0^{\infty}\left[c_j(z)\right]^{1-\frac{1}{\sigma}}dz\right]^{\frac{\sigma}{\sigma-1}} = \left[\int_{\Omega}\left[c_j(z)\right]^{1-\frac{1}{\sigma}}dz\right]^{\frac{\sigma}{\sigma-1}}$$

where z is an index of a manufacturing good, $\sigma > 1$ is the direct partial elasticity of substitution between every pair of manufactures, and $c_j(z)$ is the manufacturing good z consumed in Region j. The range of manufacturing goods produced in equilibrium is denoted by Ω. Although the space of all potential manufacturing goods is unbounded, the only finite range of them will be produced in equilibrium due to the economies of scale in producing these goods.

The aggregate income in Region j is equal to $w_j V_j$, where w_j is the factor price. Given the price of the outside good, P_j^o, and the price of the manufacturing good, $p_j(z) \in \Omega$, prevailing in Region j, the aggregate outside goods consumption in Region j is given by

$$C_j^o = \frac{(1-\alpha)w_j V_j}{P_j^o}$$

and that of a manufacturing good of variety $z \in \Omega$ is equal to

$$(1) \qquad c_j(z) = \left(\frac{p_j(z)}{P_j^m}\right)^{-\sigma} C_j^m = \left(\frac{p_j(z)}{P_j^m}\right)^{-\sigma} \frac{\alpha w_j V_j}{P_j^m}$$

where

$$(2) \qquad P_j^m = \left[\int_\Omega \left[p_j(z)\right]^{1-\sigma} dz\right]^{\frac{1}{1-\sigma}}$$

is the price index for manufactures in Region j , or for the quantity index, C_j^m.

Turning to the supply side, it is assumed that the outside good can be produced competitively with a constant returns to scale technology, which transforms one unit of factor into one unit of the output. Furthermore, the outside good can be transported across regions with zero transport cost, and hence the law of one price holds in this sector. By choosing the outside good as the numeraire ($P_j^o = 1$), this implies that $w_j \geq 1$ for all j and $w_j = 1$ in any region that produces the outside good.

The manufacturing sector is monopolistically competitive. Each differentiated good is produced by a single monopolist, with an increasing returns to scale technology, which requires $h(x)$ units of factor to produce x units of the output. It is assumed that the ratio of the marginal cost to the average cost, $xh'(x)/h(x)$, is strictly increasing in x, and there is a unique solution, x^*, to $xh'(x)/h(x) = 1-1/\sigma$. Note that there is no reason for two producers to manufacture the same good, because the potential range of manufacturing goods is unbounded, and they all enter symmetrically in the representative agent's utility. This implies in particular that there is no overlap in the range of goods produced in different regions: i.e., $\Omega = \sum_i \Omega_i$, where Ω_i is the set of manufactures made in Region i.

The manufacturing goods are costly to trade, and the transport technologies are constant-return to scale. More specifically, when a manufacture made in Region i is shipped to Region j, it incurs "iceberg" transport costs at a rate equal to $\tau_{ij} \geq 1$; i.e., only a proportion $1/\tau_{ij}$ of the good shipped arrives. Hence, to consume $c_j(z)$ units, $\tau_{ij}c_j(z)$ units must be shipped. Furthermore, if the monopolist producer in Region i charges $p(z)$ per unit, the agent in Region j must pay $p(z)\tau_{ij}$ for per unit of consumption. (One possible interpretation is that competitive traders buy τ_{ij} units of a good for $p(z)$ per unit in Region i and sell one unit of the good at $\tau_{ij}\, p(z)$ in Region j, and make zero profit.) Therefore, from eq. (1), the total demand for a good produced in Region i, when its producer charges $p(z)$, is equal to

(3) $$x(z) = \sum_j \tau_{ij} c_j(z) = \sum_j \frac{\tau_{ij}(p(z)\tau_{ij})^{-\sigma} \alpha w_j V_j}{(P_j^m)^{1-\sigma}} = \alpha \left[\sum_j \frac{\rho_{ij} w_j V_j}{(P_j^m)^{1-\sigma}} \right] (p(z))^{-\sigma}$$

where $0 \leq \rho_{ij} \equiv (\tau_{ij})^{1-\sigma} \leq 1$ is the parameter representing the proximity between Regions i and j. The transport costs depend on geographical factors, and may also be affected by a variety of administrative border restrictions, which slow down the delivery processes. The proximity parameters should thus be interpreted to capture the technological but also cultural, economic, political distances between the regions. For simplicity, it is assumed that $\rho_{jj} = 1$ for all j and $\rho_{ij} = \rho_{ji}$, for all i and j.

Equation (3) shows that producer faces the demand curve whose price elasticity is constant, σ. Hence, the optimal pricing rule is given by $p(z)(1-1/\sigma) = w_i h'(x(z))$. Furthermore, the free entry ensures that $p(z)x(z) = w_i h(x(z))$, if the measure of the firms operating in Region i, N_i, is positive. Combining the pricing rule and the free entry condition thus yields

$$x(z) = x^*, \quad p(z) = \frac{h(x^*)}{x^*} w_i \ ; z \in \Omega_i \text{ if } N_i > 0.$$

On the other hand, $x(z) < x^* \ ; \ z \in \Omega_i$ if $N_i = 0$.

Inserting the above conditions into eq.(3) and rearranging yields

(4) $$\alpha \left[\sum_j \frac{\rho_{ij} w_j V_j}{\sum_k N_k (w_k)^{1-\sigma} \rho_{kj}} \right] (w_i)^{-\sigma} \leq h(x^*) \qquad \text{for } i = 1, 2, \ldots, R.$$

(5) $$N_i \geq 0 \qquad \text{for } i = 1, 2, \ldots, R.$$

where the complementarity slackness applies between (4) and (5). The left-hand side of eq. (4) represents the demand for each firm operating in Region i, measured in the factor unit. Eq. (4) thus states that there will be free entry of firms until the demand is driven down to the break-even level. Note that the demand for each firm located in Region i declines as N_k goes up for all k, including $k = i$. In the present model, there is no positive linkage that would give an incentive for firms to locate together.

Furthermore, we need to have, depending on whether a region produces the outside good,

(6) $w_i \geq 1$ for $i = 1, 2, ..., R$.

(7) $h(x^*)N_i \leq V_i$ for $i = 1, 2, ..., R$.

Again, the complementarity slackness applies between (6) and (7). Equations (4) through (7) determine the equilibrium.

In what follows, the analysis is restricted to the case, where all the regions produce the outside good, and hence, $w_i = 1$ $(i = 1, 2, ..., R)$. (This can be ensured by assuming that α is sufficiently small.) Then, the above equilibrium conditions are simplified to

(8) $$\alpha\left[\sum_j \frac{\rho_{ij}V_j}{\sum_k N_k \rho_{kj}}\right] \leq h(x^*) \quad \text{and} \quad 0 \leq N_i \qquad \text{for } i = 1, 2, ..., R.$$

with the complementarity slackness and

(9) $h(x^*)N_i < V_i$ for $i = 1, 2, ..., R$.

Equations (8) and (9) jointly determine the world distribution of industries, N_k $(k = 1, 2, ..., R)$, given that the world distribution of the resource endowment, V_j $(j = 1, 2, ..., R)$, and the proximity parameters, $\rho_{ij} \equiv (\tau_{ij})^{1-\sigma}$ $(i, j = 1, 2, ..., R)$.

Note that the equilibrium distribution is scale-free in this model. Indeed, by multiplying the above condition by N_i and take the sum over i, one can show that

$$\alpha \sum_j V_j = h(x^*) \sum_k N_k$$

which should be expected, given the Cobb-Douglas preferences and the factor price is equalized across the regions. Using this identity, one can simplify the equilibrium condition further as follows:

(10) $\sum_j \frac{\rho_{ij} v_j}{\sum_k n_k \rho_{kj}} \leq 1$ and $n_i \geq 0$ for $i = 1, 2, ..., R,$

with the complementarity slackness, and

(11) $\alpha n_i < v_i$ for $i = 1, 2, ..., R,$

where

$$v_j \equiv \frac{V_j}{\sum_i V_i} \qquad \text{and} \qquad n_j \equiv \frac{N_j}{\sum_i N_i}$$

are the shares of Region j in the world resource endowment and in the world industrial activities, respectively. Note that eq. (10) is independent of α. Hence, for any solution satisfying (10) can be made to satisfy eq. (11) by letting $\alpha < Min_i \{v_i/n_i\} \leq 1$. Hence, for a sufficiently small α, our task becomes, to solve for a nonnegative vector, $n = [\ n_j\ ]$, $\sum_j n_j = 1$, satisfying eq. (10) for a given positive vector $v = [v_j\ ]$, $\sum_j v_j = 1$, and a given symmetric, nonnegative matrix, $M = [\rho_{ij}\ ]$, $0 \leq \rho_{ij} \leq 1$ for all i and j, $\rho_{jj} = 1$ for all j.

An attempt to solve eq. (10) algebraically for a general case is neither possible nor informative. Instead, the rest of the paper examines a series of special cases, each of which would help to isolate a particular force that affects the equilibrium distribution of the industries.

3. Three Benchmarks

Let us first look at some simple cases, each of which should serve as a benchmark for the analysis that will come later.

Benchmark A: *The Autarky Case.*

If the transport is not possible across the regions, other than to the home market, $\rho_{ij} = 0\ (i \neq j)$, M is the RxR identity matrix. In this case, $n = [\ n_j\ ] = [\ v_j\ ] = v$.

Benchmark B: *The World without Transport Costs.*

If there is no transport cost, $\rho_{ij}= 1$ for all i and j, then any nonnegative vector, $n = [\ n_j\ ]$, $\Sigma_j n_j = 1$, satisfies eq. (10). The equilibrium is hence indeterminate. In this case, the location does not matter, and the equilibrium condition of the model does not impose any restriction on the world distribution of the industries.

Benchmark C: *The World with Symmetric Regions*

Suppose now that the resources are evenly distributed, $v = [\ v_j\ ] = [\ 1/R\ ]$, and all region are symmetrically located in the sense that $\Sigma_i \rho_{ij} > 0$ is independent of j. (In other words, M is a positive scalar multiple of a symmetric, stochastic matrix.) Then, $n = [\ n_j\ ] = [\ 1/R\ ]$.

Benchmarks A and B imply that, for the equilibrium distribution of the industries to display nontrivial patterns, the cost of trade has to be positive but not prohibitive. Benchmark C imply that the regions must be asymmetric in some ways, either in their resource sizes or in their locations. The main goal of the study is to examine how (possibly small) asymmetry in the geographical environment are amplified in the equilibrium distribution of industries. This is in strong contract to the recent literature on economic geography, which has examined how the presence of demand and cost linkages in the locational decision across firms make them cluster together, thereby generating asymmetric multiple equilibria in a perfectly symmetric world. In the present model, there is no linkage that make firms to cluster in the same region to generate an endogenous asymmetry. It is precisely the lack of such a positive feedback mechanism that makes the present model tractable for a wide range of geographical environment.

4. The Resource Size Effects

Before venturing into the study of the effects of geographical asymmetry, let us first understand the effect of unevenly distributed resource bases by consider the following example, where the proximity between every pair of the regions is identical.

Example 1: $\rho_{ij} = \rho_{ji} = \rho < 1\ (i \neq j)$.

This example is a straightforward extension of the model by Helpman and Krugman (1985, Ch. 10.4), who considered the case of $R = 2$. Figure 1 illustrates this example for $R = 5$. The equilibrium in this case is given by

$$[\ n_j\ ] = \left[\left\{\frac{1+\rho(R-1)}{1-\rho}\right\}\left(v_j - \frac{1}{R}\right) + \frac{1}{R}\right] = \left[\frac{\rho R}{1-\rho}\left(v_j - \frac{1}{R}\right) + v_j\right]$$

where, for the ease of exposition, ρ is assumed to be sufficiently small that the nonnegativity constraint is not binding. (It suffices to assume that $\rho \leq Rv^{min}/[1+(R-1)(1-Rv^{min})]$, where $v^{min} \equiv Min_j\{v_j\}$.) Note that the coefficient on v_j is greater than one, hence the share of manufacturing firms in one region increases with its resource base more than proportionately. Uneven distribution of the resources are magnified to create more uneven distribution of the industries. This example demonstrates the tendency of increasing returns to scale sector to locate in the larger market, and to export to other markets. In other words, a large domestic market serves as a base for exports. Such a magnification effect is larger if the transport costs are smaller (a large ρ), and hence a reduction in the transport cost, or more generally in the barriers to trade lead to a greater inequality among regions. Even though transport costs must be positive in order for the location to matter, one should not jump to the conclusion that the location matters more when transport costs are high. Nor should one predict "the end of geography," as a consequence of globalization. Quite the contrary, smaller transport costs make the industry more "footloose," hence a tiny asymmetry across regions make a big impact on the spatial distribution of the industries, which is a prominent feature of all the examples examined below.[3]

Before proceeding, one remark about the welfare is in order. From the above result, one may be tempted to conclude that a region with a smaller endowment benefits from higher barriers to trade. Such a conclusion is false. To see this, note that, due to the factor price equalization, the standard of living in Region j solely depends on, and inversely related to, the price index for manufactures. Indeed, it is straightforward to show that the equilibrium level of utility enjoyed by an agent, who lives in Region j

[3] In other words, this model has the fundamental discontinuity in the properties of equilibrium between the case of zero transport cost, where the equilibrium is indeterminate, and the case of small transport costs, where the equilibrium is determinate. That is to say, the equilibrium correspondence of this model loses the lower-hemi continuity at zero transport cost. (The similar discontinuity exists in New Economic Geography models as well.)

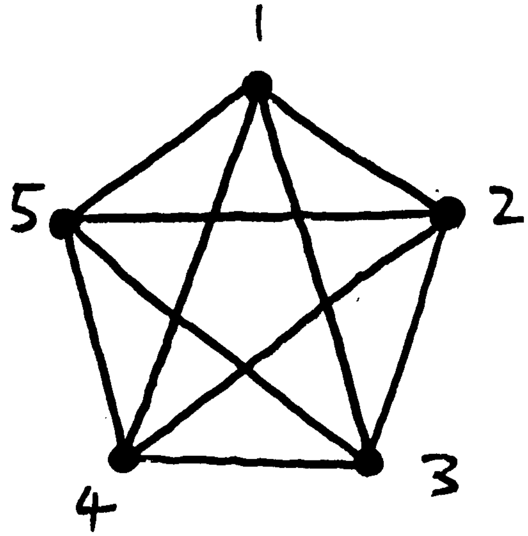


fig. 1

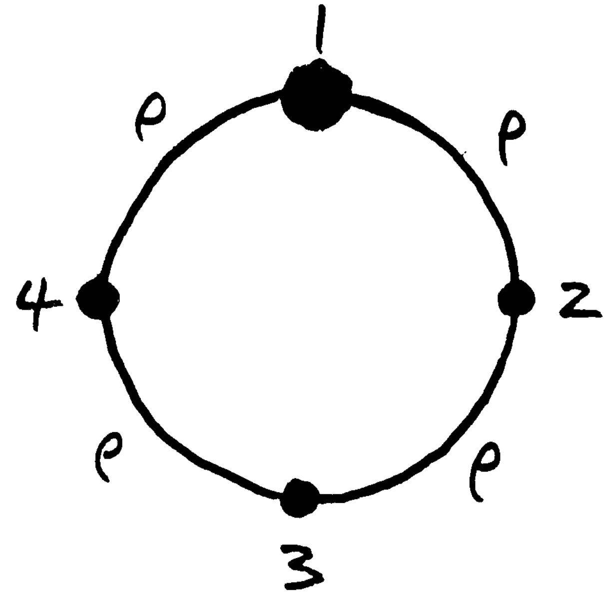


fig. 2

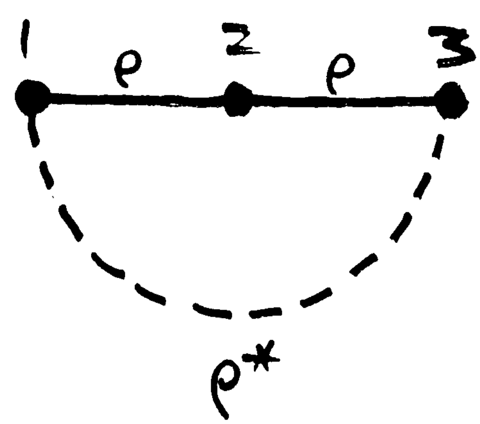


fig. 3

and is endowed with one unit of factor, is an increasing function of $\sum_k n_k \rho_{kj}$. In the above example, this is equal to $n_j + \rho(1-n_j) = \{1 + \rho(R-1)\} v_j$. Hence, lower barriers to trade benefits all the regions, even though a larger region gains more than a smaller region.

From Example 1, one may be tempted to conclude that the proximity to the larger market implies a larger industrial base. The following example shows that such a conclusion is unwarranted.

Example 2: $R = 4$, $v = \frac{1}{4}\begin{bmatrix} 1+3\gamma \\ 1-\gamma \\ 1-\gamma \\ 1-\gamma \end{bmatrix}$ for $0 < \gamma < 1$ and $M = \begin{bmatrix} 1 & \rho & \rho^2 & \rho \\ & 1 & \rho & \rho^2 \\ & & 1 & \rho \\ & & & 1 \end{bmatrix}$.

Figure 2 illustrates this example. There are four regions, located on the circle and each region has two neighbors. (Four is chosen, because it is the smallest number in which a different region can have different neighbors, even though they are all symmetrically located.) The proximity between neighbors is equal to $\rho \equiv \tau^{1-\sigma} < 1$. Shipping goods to a nonneighbor is more costly. For example, shipping goods from Region 1 to Region 3 requires to go through either Region 2 or Region 4, so that only $1/\tau_{13} = 1/\tau^2$ fraction of the good shipped arrives, hence $\rho_{13} \equiv (\tau^2)^{1-\sigma} = \rho^2 < \rho < 1$. This world is asymmetric because Region 1 is bigger than the other three regions, which induces the asymmetry between Regions 2 and 4 and Region 3. Regions 2 and 4 have a big neighbor, and Region 3 does not.

The equilibrium is given by

$$n = v + \frac{\rho\gamma}{(1-\rho)^2}\begin{bmatrix} 2-\rho \\ -1 \\ \rho \\ -1 \end{bmatrix} \qquad \text{if} \qquad 0 \leq \rho \leq \frac{1-\sqrt{\gamma}}{1+\sqrt{\gamma}};$$

$$n = \frac{1}{2}\begin{bmatrix} 1 \\ 0 \\ 1 \\ 0 \end{bmatrix} + \frac{\gamma}{1+\gamma}\frac{1+\rho^2}{1-\rho^2}\begin{bmatrix} 1 \\ 0 \\ -1 \\ 0 \end{bmatrix} \qquad \text{if} \qquad \frac{1-\sqrt{\gamma}}{1+\sqrt{\gamma}} < \rho < \sqrt{\frac{1-\gamma}{1+3\gamma}};$$

$$n = \begin{bmatrix} 1 \\ 0 \\ 0 \\ 0 \end{bmatrix} \qquad \text{if} \qquad \sqrt{\frac{1-\gamma}{1+3\gamma}} \le \rho < 1 .$$

Starting from the autarky case ($\rho = 0$), where each region's share in the industries is equal to its share in the endowment ($n = v$), a reduction in the trade cost (an increase in ρ) increases the industrial shares of Region 1 and Region 3, while those of Region 2 and 4 decline. The presence of a large Region 1 leads to an increase in the industrial base in Region 4. This example thus shows that Region 2 and Region 4 are in the "shadow" of the big neighbor, Region 1, and that Region 3 emerges as a regional center, simply because it does not have a big neighbor. Only after industries disappear from Regions 2 and 4, a further reduction in the trade cost leads to a decline in the industry in Region 3.

This result suggests an intriguing hypothesis. Can Japan's rise as an industrial power, beginning with its success in the textile industry in the late nineteenth century, be partially attributed to the fact that it was far away from the industrial centers of Europe and the United States?[4]

5. The Three-Region World

This section looks at the three-region case, the smallest number in which one can model geographical asymmetries. (For earlier attempts to extend the Helpman & Krugman model into three regions, see Krugman (1993) and Baldwin & Venables (1995).) To focus on the effects of asymmetric locations, let us assume that the resources are evenly distributed across the three regions. Consider the following example.

Example 3: $R = 3$, $v = \frac{1}{3}\begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$, and $M = \begin{bmatrix} 1 & \rho & \rho' \\ & 1 & \rho \\ & & 1 \end{bmatrix}$, where $\rho' \equiv Max\{\rho^2, \rho^*\}$.

[4] Contrary to the belief commonly held at least among non-Japanese economists, the late nineteenth century Japan did not rely on import tariffs to promote infant industries, due to its treaty obligation. Japan's sovereignty over tariffs was restored only after Japan succeeded in renegotiating its treaties with major powers, following the victory in the Russo-Japanese war (1904-1905). One could argue, however, that Japan's infant industries were protected by the natural barriers due to the distance from the world's industrial centers.

Figure 3 illustrates this example. The proximity between Regions 1 and 2 or between Regions 2 and 3 is given by ρ. Between Regions 1 and 3, shipping goods via a direct route costs more (less) than shipping via an indirect route through Region 2, if $\rho^2 > \rho^*$ (if $\rho^2 < \rho^*$). Hence, the proximity parameter between 1 and 3 is equal to $\rho' \equiv Max\{\rho^2, \rho^*\}$.

5A. *The Linear World*

First, suppose $\rho^2 \geq \rho^*$, so that the indirect route is used to ship goods between Regions 1 and 3. Effectively, the three regions are located on the line, without a bypass between Region 1 and Region 3. Region 2 becomes a hub of the three-region world. The equilibrium in this case is given by

$$n = \frac{1}{3}\begin{bmatrix}1\\1\\1\end{bmatrix} + \frac{1}{3}\left(\frac{\rho}{1-\rho}\right)^2\begin{bmatrix}-1\\2\\-1\end{bmatrix} \text{ if } 0 \leq \rho < \frac{1}{2}; \quad n = \begin{bmatrix}0\\1\\0\end{bmatrix} \text{ if } \frac{1}{2} \leq \rho < 1.$$

Although all the regions have the same resource base, Region 2, due to its central location, accounts for a larger share of the industries, while the two peripheries, 1 and 3, account for smaller shares. The distribution becomes more uneven when ρ becomes larger, or barriers to trade between the center and the peripheries become smaller.

This case thus suggests the possibility that building roads connecting the center to the peripheries, as a means of helping the development at the peripheries, may backfire. Or it shows that an improvement in the transport technologies, as well as a structural change in the manufacturing sector that makes the goods less bulky, may be responsible for urbanization and the emergence of a big metropolis in some countries. The recent Japanese experiences might be the case in point. After the two oil crises of the seventies, there was a significant shift toward the service sector, as well as a structural change within the manufacturing sector from heavy industries, such as metal and shipbuilding, to computer, electronics, and other "knowledge-intensive" or "*kei-haku-tan-shoh*," industries.[5] These changes were widely regarded in Japan as a great opportunity to reduce the urban-rural disparities. It was believed that, with lower transport costs, these industries did not need to be located close to big metropolitan areas. That was when the Japanese government launched a blueprint for "technopolis." What happened

[5] This term was coined by listing the common features of successful products. That is, in order to succeed in a market, new products must be light (*kei*), thin (*haku*), short (*tan*), and small (*shoh*), as best exemplified by Walkman.

afterward was exactly the opposite of the widely held expectations. Not only "*kei-haku-tan-shoh*" industries failed to make up for the shipyards, aluminum refineries, and steel mills shut down in remote regions. Many ended up locating even closer to the major metropolitan areas, leading to even a bigger concentration.

This example also suggests that the US gains more than Canada and Mexico from NAFTA.

5B. *The Effects of a Bypass*

Next, let us suppose $\rho^2 < \rho^*$, which creates a bypass (a highway, a bridge, a canal, a tunnel, etc.) between 1 and 3. The equilibrium is then given by

$$n = \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix} \qquad \text{if } \rho^2 < \rho^* \le \rho - (1-\rho)^2;$$

$$n = \frac{1}{3}\begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} + \frac{1}{3}\frac{\rho(\rho^* - \rho)}{(1-\rho)(1+\rho^* - 2\rho)}\begin{bmatrix} 1 \\ -2 \\ 1 \end{bmatrix} \text{ if } Max\{\rho^2, \rho-(1-\rho)^2\} < \rho^* < Min\{1, \rho + \frac{(1-\rho)^2}{|3\rho - 1|}\};$$

$$n = \frac{1}{2}\begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix} \qquad \text{if } \rho + \frac{(1-\rho)^2}{|3\rho-1|} \le \rho^* < 1.$$

Let us focus on the case, where all the regions have active industries. As long as $\rho^* < \rho$, Region 2 still has the advantage of being at the central location, and has a larger share of the industries. If $\rho^* = \rho$, the three regions are symmetric and each accounts for a third of the industries. If $\rho^* > \rho$, then the locational advantage now shifts from Region 2 to Regions 1 and 3, due to their superior access to the bypass. The effect of an increase in ρ^* is thus straightforward; the share of Region 2 declines monotonically in ρ^*. This result is a reproduction of the production shifting effect, derived by Baldwin & Venables (1995, Section 2.2.1.), who discussed it in the context of regional economic integration.

There are many examples in which a bypass has lead to a decline in a region. Let us mention one: the rise of Portugal and the decline of Venice, after Vasco da Gama's discovery of the direct route around the Cape of Good Hope to India replaced the trans-Arabian caravan route.

It is also meant to be sarcastic, because these adjectives acquire pejorative meanings, when they are used in combination; i.e., to be successful, one must be shallow or idiotic (*kei-haku*) and minuscule or diminutive (*tan-shoh*).

Let us now examine the effect of an increase in ρ. When $\rho^* < \rho$, the effect is the same as in the case without a bypass. Region 2 is the center of the world, that it has a disproportionately large share of industries, and that a further increase in ρ leads to a further rise in its already large share in the industry. (This captures what Krugman (1993) called the hub effect.) When $\rho^* > \rho$, however, the effect is nonmonotone. In this case, a better interpretation might be that Region 2 is a remote area, isolated from the industrial belt of Regions 1 and 3. Starting with a sufficiently small ρ, improving access to Region 2 makes its industry shrink, thereby making the distribution more uneven. To be more precise, when

$$\rho^* > \rho + (1-\rho)\left[\frac{\sqrt{1+4\rho}-1}{2}\right],$$

an increase in ρ reduces n_2, and increases $n_1 = n_3$. A continuing rise in ρ, however, eventually lead to an increase in n_2, and a decline in $n_1 = n_3$.

This above result thus suggests the possibility that the bilateral agreement between Eastern European countries and the European Union (as an intermediate step toward the full membership) may discourage the industrial development in the former communist blocs.

To understand the nonmonotonicity, note that two things happen when an access to a region improves. First, it makes the region attractive as a home base from which to export products, which tends to increase the size of the region's industry. Second, it also makes it less important to locate in the region in order to serve customers living in that region, which works in the opposite direction. Given that there are two offsetting forces at work, it is not surprising to have the nonmonotonicity. As it turns out, this is one of common features of the model, as demonstrated in other examples below.

6. Internal versus External Costs of Trade

Let us now examine the cases, where the world consists of superregions, which in turn consist of multiple regions, and see how the costs of trade internal and external to superregions affect the distribution within and across superregions.

6A. *Internal Costs of Trade and Distributions across Superregions*

The following example demonstrates how a reduction in the internal cost of trade within a superregion shifts the industrial center toward the superregion.

Example 4: $R = 4$, $v = \frac{1}{4}\begin{bmatrix}1\\1\\1\\1\end{bmatrix}$, and $M = \begin{bmatrix}1 & \rho_1 & \rho'\rho^* & \rho^* \\ & 1 & \rho^* & \rho'\rho^* \\ & & 1 & \rho_2 \\ & & & 1\end{bmatrix}$, where $\rho' \equiv Max\{\rho_1, \rho_2\}$ and $(\rho^*)^2 < Min\ \{\rho_2/\rho_1,\ \rho_1/\rho_2\}$.

Figure 4 illustrates this example. Regions 1 and 2 form Superregion I, whose internal cost of trade is captured by ρ_1. Regions 3 and 4 form Superregion II, whose internal cost is captured by ρ_2. The two superregions are linked via two routes, one connecting Regions 1 and 4, the other Regions 2 and 3. The proximity between the two superregions is given by ρ^{**}. In this example, different internal costs of trade break the symmetry. Note that, when goods are shipped between Regions 1 and 3, or between Regions 2 and 4, the route connecting Regions 1 and 2 are used when $\rho_1 > \rho_2$, while the route connecting Regions 3 and 4 are used when $\rho_1 < \rho_2$. The condition, $(\rho^*)^2 < Min\ \{\rho_2/\rho_1,\ \rho_1/\rho_2\}$, by making the cost across the superregions high, ensures that the trade within a superregion always takes place directly. One may indeed argue that this restriction determines the grouping of four regions into two superregions. (The case where $(\rho^*)^2 > Min\ \{\rho_2/\rho_1,\ \rho_1/\rho_2\}$, can actually be viewed as a special case of the next example examined.)

The equilibrium is given by

$$n = \frac{1}{4}\begin{bmatrix}1\\1\\1\\1\end{bmatrix} + \frac{1}{4}\frac{\rho^*(\rho_1 - \rho_2)}{(1-\rho^*)(1+\rho_2-\rho^*(1+\rho_1))}\begin{bmatrix}1\\1\\-1\\-1\end{bmatrix} \qquad \text{if } \rho_1 > \rho_2 > \rho_1(\rho^*)^2,$$

and

$$n = \frac{1}{4}\begin{bmatrix}1\\1\\1\\1\end{bmatrix} + \frac{1}{4}\frac{\rho^*(\rho_1 - \rho_2)}{(1-\rho^*)(1+\rho_1-\rho^*(1+\rho_2))}\begin{bmatrix}1\\1\\-1\\-1\end{bmatrix} \qquad \text{if } \rho_2 > \rho_1 > \rho_2(\rho^*)^2$$

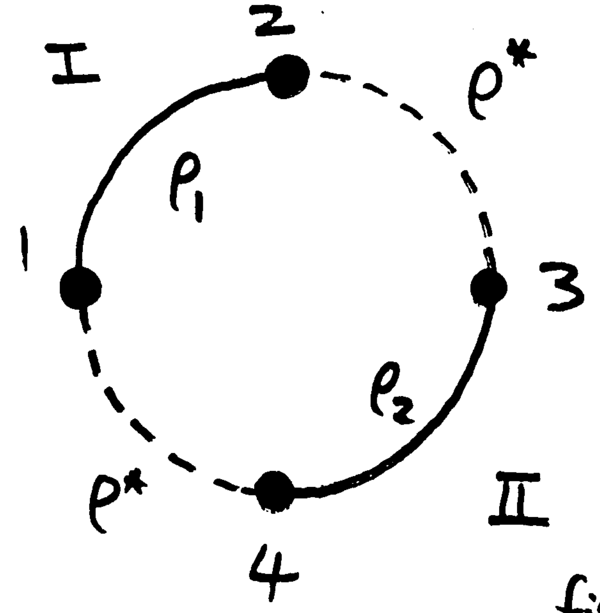


fig. 4

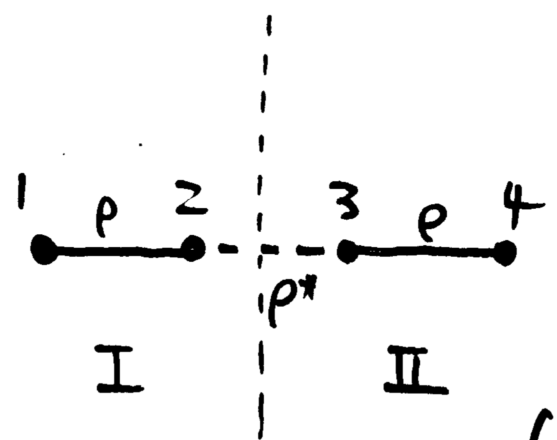


fig. 5

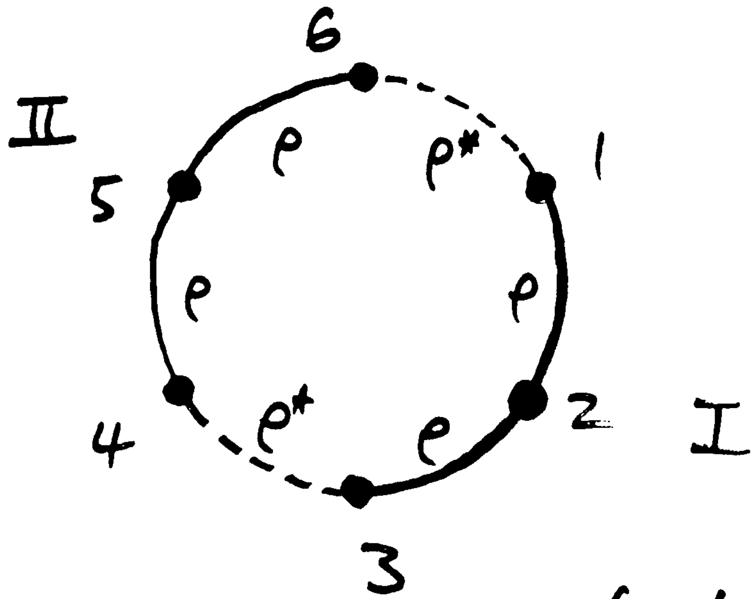


fig. 6

when the nonnegative constraints are not binding. Thus, the share of Superregion I, consisting of Regions 1 and 2 is increasing in ρ_1, and decreasing in ρ_2. And Superregion I accounts for a larger share if $\rho_1 > \rho_2$. A reduction in the cost of trade across superregions, an increase in ρ^*, on the other hand, amplifies the existing bias in distribution.

This example can be used to illustrate one reason why the center of Europe shifted from south to north after the 16th century, which McNeill (1974) called "the most important watershed in European history (p.46)." Imagine that Superregion I is northern Europe or the Atlantic zone, Superregion II southern Europe or the Mediterranean zone. The external routes are transalpine passes, while the two internal routes are the Atlantic and the Mediterranean. The southern dominance, which lasted 4000 years, is partly attributed to what McNeill called the "nautical advantage" enjoyed by the Mediterranean zone. Only after "improvements in ship design and navigation began to make travel on the stormy and tide-troubled Atlantic waters almost as safe as seafaring within the Mediterranean (p.47)," southern Europe lost the technological basis of its supremacy and the center of Europe shifted toward north.

From the industrial policy perspective, this example suggests that an improvement in transport infrastructure, or more generally a dismantling of a variety of trade restrictions, within a superregion bring the benefits more than the direct effects of lower costs of trade. The benefits also include additional effect of business shifting at the expense of other superregions. If a superregion is interpreted as a nation, this suggests the possibility of competitive advantages of nations, argued by Porter (1990). If superregion is interpreted as continents, such as Europe and North America, this result captures the popular concerns that the European gains from its regional integration partially at the expense of other regions, and suggests the possibility of the strategic roles of regional integration, argued by Thurow (1993).

6B. *External Costs of Trade and Distributions within Superregions*

In Example 4, the internal structure of each superregion is symmetric. Hence, the costs of trade affect the distribution of the industries across superregions, but not within a superregion. In the next two examples, on the other hand, the superregions are symmetric, so that the share of each superregion is independent of internal and external costs of trade. However, these costs affect the distribution within a superregion, because of the asymmetry of the internal structure of superregions.

Example 5: $R = 4$, $v = \frac{1}{4}\begin{bmatrix} 1+\gamma \\ 1-\gamma \\ 1-\gamma \\ 1+\gamma \end{bmatrix}$ for $0 < \gamma < 1$, and $M = \begin{bmatrix} 1 & \rho & \rho\rho^* & \rho^2\rho^* \\ & 1 & \rho^* & \rho\rho^* \\ & & 1 & \rho \\ & & & 1 \end{bmatrix}$.

Figure 5 illustrates this example. The four regions are located on the line, and Regions 1 and 2 form a superregion, so do Regions 3 and 4. The transport cost internal to the superregions is captured by ρ, while the transport cost across the superregions is by ρ^*. Regions 1 and 4 are in the interior of the superregions, while Regions 2 and 3 are on the border. In this example, the border region attracts industries due to the direct access to the rest of the world, $\rho^* > 0$, while the internal region's larger size, $\gamma > 0$, makes it a favorable location for industries. The tension between these two factors plays a critical role in this example.

The equilibrium is given by

$$n = v + \frac{\rho\{(2-\rho\rho^*+\rho^*)\gamma - (1+\rho)\rho^*\}}{4(1-\rho)(1-\rho\rho^*)}\begin{bmatrix} 1 \\ -1 \\ -1 \\ 1 \end{bmatrix} = \frac{1}{4}\begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \end{bmatrix} + \frac{(1+\rho)(\gamma-\rho\rho^*)}{4(1-\rho)(1-\rho\rho^*)}\begin{bmatrix} 1 \\ -1 \\ -1 \\ 1 \end{bmatrix}.$$

when the nonnegativity constraints are not binding.

The effect of a change in ρ^* is monotone, and straightforward. For example, if the trade between the two superregions are prohibitive ($\rho^* = 0$), the world consists of two identical, superregions in autarky, each of which is a replica of the two-region economy analyzed by Helpman and Krugman; $n_j = v_j + \{2\rho/(1-\rho)\}(v_j - 1/4)$. The internal regions thus have a disproportionately larger share of the industries because of $\gamma > 0$. With a smaller cost of external trade (an increase in ρ^*), the share of the border regions in the industries rises, monotonically, and it becomes larger than its share of the resources if

$$\rho^* > \frac{2\gamma}{1+\rho-(1-\rho)\gamma},$$

and can become even larger than the industry in the internal regions, if

$$\rho^* > \frac{\gamma}{\rho},$$

which is possible if the size advantage of the internal regions is small (i.e., $\gamma < \rho$).

Note that, because of the assumed symmetry across superregions, lower barriers to trade across superregions will not affect the distribution across superregions, and yet it affect their internal structures, by shifting the center from an internal region toward a border region.

The above result suggests another possible cause for the end of the Mediterranean dominance and the shift of the European center from south to north: the rise of Ottoman Empire, which causes the fall of Italian city states due to the losses of the Black Sea route to Asia, after the Turkish expansion to the Balkan peninsula in the fifteenth century, including the fall of Constantinople, as well as that of the trans-Mediterranean trade after the Turkish expansion to North Africa, from Egypt to Algiers in the sixteenth century. Or it suggests that the loss of the colonies in Asia, and the communist victory in China, as well as a reduction in trans-Pacific transport costs, shifted the industrial center of Japan from west (i.e., *kitakyushu* and *hanshin* areas) to east (*chukyo* and *keihin* areas) after World War II. The above result also captures one of the reasons why Germany and Spain have different attitudes toward eastward expansion of the European Union.

The effect of γ is also straightforward. If $\gamma = 0$, the border regions have the larger share of the industries, due to their locational advantage. Indeed, with the even distribution of the resource bases, the case of $\gamma = 0$ can be viewed as an extension of Example 3, the Linear World without a bypass to four regions case. (It is also isomorphic to Example 4, when the restriction, $(\rho^*)^2 < Min\ \{\rho_2/\rho_1,\ \rho_1/\rho_2\}$ does not apply, if regions and superregions are appropriately relabelled.). As γ increases, the share of the internal regions increases monotonically, and if $\gamma > \rho\rho^*$, it becomes greater than the border regions, if $\gamma > (1+\rho)\rho^*/(2-\rho\rho^*+\rho^*)$, it becomes greater than their share in the resource endowment.

Unlike the effects of ρ^* or γ, the effect of ρ is more subtle. When the size advantage of the internal region is sufficiently large ($\gamma > \rho^*$), a reduction in the internal cost of trade increases the share of internal regions in the industry monotonically. If the size advantage is sufficiently small ($\gamma < \rho^*/(2+\rho^*)$), it declines monotonically. In an intermediate case ($\rho^*/(2+\rho^*) < \gamma < \rho^*$), it is not monotone; a rise in ρ initially lead to an increase in the size of the industry in the internal regions, and then a decline.

Example 6: $R = 6$, $v = \frac{1}{6}\begin{bmatrix}1\\1\\1\\1\\1\\1\end{bmatrix}$, and $M = \begin{bmatrix}1 & \rho & \rho^2 & \rho^2\rho* & \rho\rho* & \rho* \\ & 1 & \rho & \rho\rho* & \rho^2\rho* & \rho\rho* \\ & & 1 & \rho* & \rho\rho* & \rho^2\rho* \\ & & & 1 & \rho & \rho^2 \\ & & & & 1 & \rho \\ & & & & & 1\end{bmatrix}$.

Figure 6 illustrates this example. The six regions of the same size are on the circle, and Regions 1, 2, and 3 form a superregion, so do Regions 4, 5, and 6. The transport cost between the neighbors within a superregion is captured by ρ. Regions 2 and 5 are in the interior. Regions 1 and 6 are the border regions facing each other, whose proximity is given by $\rho*$. The same is true with Regions 3 and 4.

The equilibrium is given by

$$n = \frac{1}{6}\begin{bmatrix}1\\1\\1\\1\\1\\1\end{bmatrix} + \frac{\rho(\rho*-\rho)}{6(1-\rho)^2(1-\rho\rho*)}\begin{bmatrix}1\\-2\\1\\1\\-2\\1\end{bmatrix}.$$

where, again for the sake of brevity, appropriate restrictions on the parameters have been imposed to ensure the nonnegativity constraints.

Because of the greater symmetry assumed, this example is easier to analyze than Example 5. If the trade between the two superregions are prohibitive ($\rho*= 0$), the world consists of two identical, three-region economies, isolated to each other. Within each superregion, three regions are located on the line segment, so that the case is isomorphic to the case of the linear world without a bypass, analyzed in Example 3. The interior regions, 2 and 5, hence account for a larger share than the border regions, 1, 3, 4, and 6. A reduction in the external cost of trade (an increase in $\rho*$) shifts the industries away from the interior regions and toward the border regions. At $\rho* = \rho$, all the regions become symmetric and hence each region accounts for one-sixth of the industries. If the external cost of trade becomes lower than the internal cost ($\rho* > \rho$), a border region has a larger industrial base than an internal region.

The effect of an increase in ρ is not monotone, similar to the case of Example 3. Starting with a very small ρ, where the border regions have a larger share of the industries, improving access to internal regions shifts the industry away from internal regions to border regions, hence magnifies the existing patterns of distribution. Then, a further improvement leads to a rise in the industry in the interior, and once the interior overtakes the role of the industrial center ($\rho > \rho^*$), a rise in ρ further amplifies the locational advantage of the internal regions.

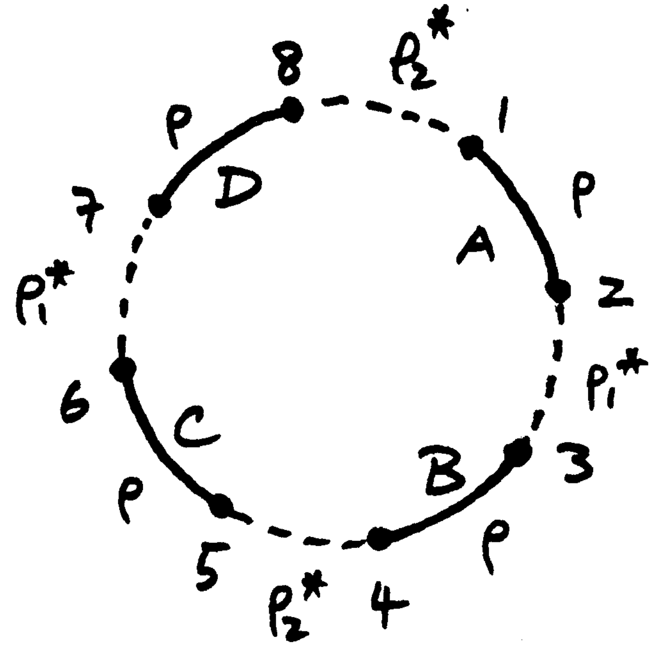
When interpreting the results of Examples 5 and 6, greater care must be taken regarding what is meant by a "region" and a "superregion." In the context of the European Union, for instance, one may interpret a superregion as a member country, which consists of a border region and an internal region. Then, European integration should be viewed as a reduction in the external cost in these examples. Then, the result on the effect of a change in ρ^* suggest that a greater integration leads to a shift toward a border region within a member country, such as *Baden-Württemberg* of Germany, *Rhône-Alpes* of France, *Lombardia* of Italy, and *Cataluña* of Spain. Alternatively, one may interpret a superregion as a continent, such as North America and Europe. Then, an increase in ρ, or a reduction in the internal cost of trade, may be interpreted a move toward regional economic integration. Then, the above result suggests a caution when predicting whether such a regionalism benefits the internal regions of these blocs, such as Midwest, or *Mitteleuropa,* as it might depend on the detail of the structure of the economies.

6C. *Subregions, Regions, and Superregions*

The following example allows the possibility that the world consists of superregions, which consist of regions, each of which in turn contains more than one subregion. Furthermore, a composition of superregions may depend endogenously on the proximity matrix.

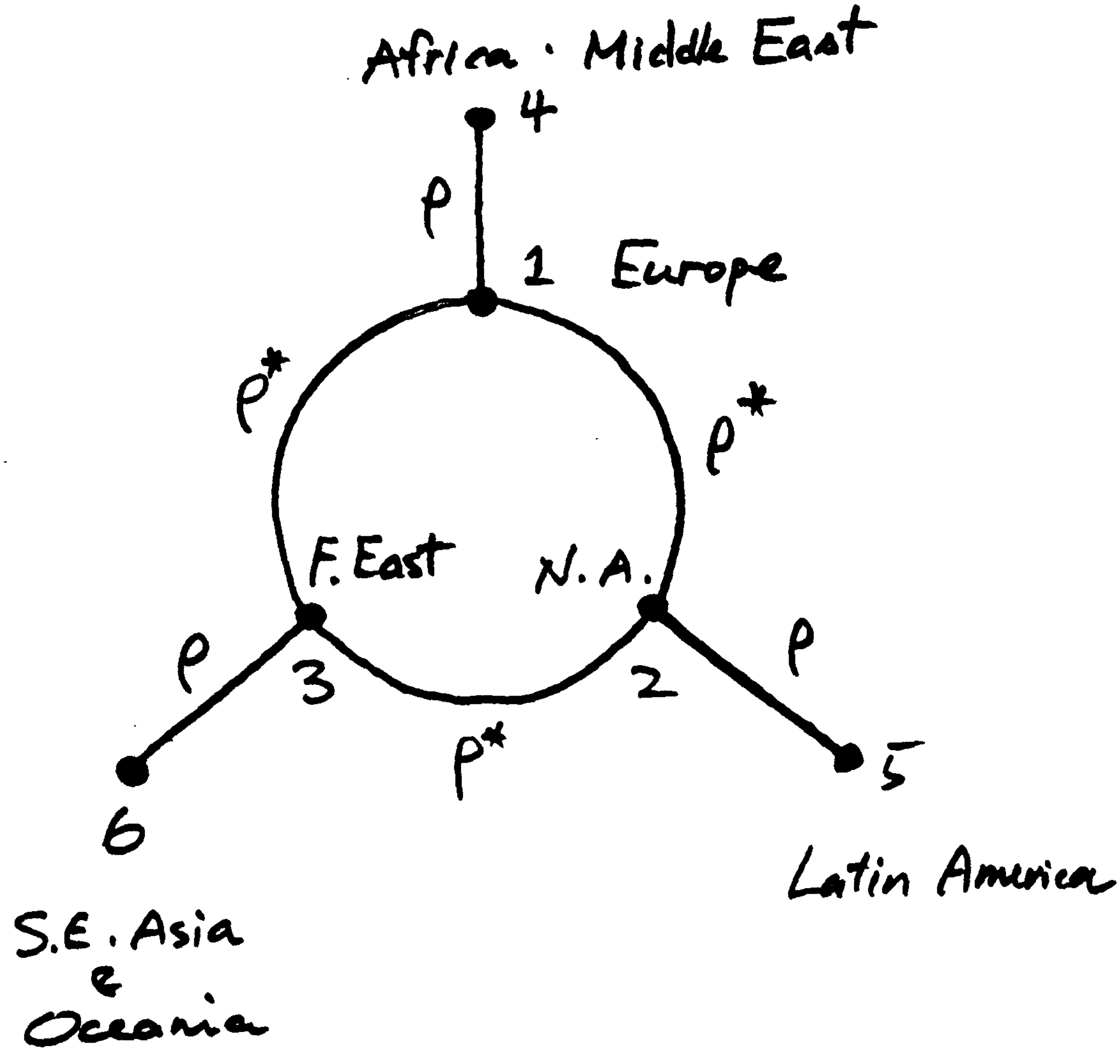
Example 7: $R = 8$,

fig. 7



8
ρ_2^*
1
ρ
A
2
ρ_1^*
3
B
ρ
4
ρ_2^*
5
ρ
C
6
ρ_1^*
7
D
ρ

fig. 8.



Africa · Middle East
4
ρ
1
Europe
ρ^*
ρ^*
F. East
N. A.
ρ
ρ
3
2
ρ^*
6
5
Latin America
S.E. Asia
&
Oceania

$$v = \frac{1}{8}\begin{bmatrix}1\\1\\1\\1\\1\\1\\1\\1\end{bmatrix}, \text{ and } M = \begin{bmatrix} 1 & \rho & \rho\rho_1^* & \rho^2\rho_1^* & \rho^2\rho_1^*\rho_2^* & \rho\rho_1^*\rho_2^* & \rho\rho_2^* & \rho_2^* \\ & 1 & \rho_1^* & \rho\rho_1^* & \rho\rho_1^*\rho_2^* & \rho^2\rho_1^*\rho_2^* & \rho^2\rho_2^* & \rho\rho_2^* \\ & & 1 & \rho & \rho\rho_2^* & \rho^2\rho_2^* & \rho^2\rho*\rho_2^* & \rho\rho_1^*\rho_2^* \\ & & & 1 & \rho_2^* & \rho\rho_2^* & \rho\rho_1^*\rho_2^* & \rho^2\rho_1^*\rho_2^* \\ & & & & 1 & \rho & \rho\rho_1^* & \rho^2\rho_1^* \\ & & & & & 1 & \rho_1^* & \rho\rho_1^* \\ & & & & & & 1 & \rho \\ & & & & & & & 1 \end{bmatrix}.$$

Figure 7 illustrates this example. The world consists of four Regions, A, B, C, and D, each of which has two Subregions. Four Regions can form two superregions in two different ways. If $\rho_1* > \rho_2*$, A and B form Superregion AB, and C and D form another, CD. Then, Subregions 2 and 3 become the center of Superregion, AB, and Subregions 6 and 7 that of Superregion, CD. Subregions 1, 4, 5, 8 then become the peripheries of the two superregions. Alternatively, if $\rho_1* < \rho_2*$, B and C form Superregion BC, and D and A form another, DA. And the positions of subregions, whether they are the centers and the peripheries, are reversed. The cost of trade within a Region is captured by ρ.

The equilibrium is given by

$$n = \frac{1}{8}\begin{bmatrix}1\\1\\1\\1\\1\\1\\1\\1\end{bmatrix} + \frac{1}{8}\frac{\rho(\rho_2^* - \rho_1^*)}{(1-\rho\rho_1^*)(1-\rho\rho_2^*)}\begin{bmatrix}1\\-1\\-1\\1\\1\\-1\\-1\\1\end{bmatrix}$$

Again, appropriate restrictions have been imposed for the nonnegativity. Subregions 2, 3, 6, and 7 have a larger share of the industries from the formation of AB-CD Superregions, leaving subregions 1, 4, 5, and 8 at the peripheries, which rather prefer to see the formation of BC-DA Superregions. This example thus captures the conflicts of interest in the formation of superregions and the malleability of superregions within Europe, emphasized by Delamaide (1994). Note that a reduction in internal cost of trade in this case is simple. It merely amplifies the uneven patterns generated by a particular formation of superregions.

7. Geopolitics of the New International Economic Order

Finally, let us consider the following example, which combines some elements discussed in the previous examples.

$$\text{Example 8: } R = 6,\ v = \frac{1}{6}\begin{bmatrix}1\\1\\1\\1\\1\\1\end{bmatrix},\ \text{and } M = \begin{bmatrix}1 & \rho^* & \rho^* & \rho & \rho\rho^* & \rho\rho^* \\ & 1 & \rho^* & \rho\rho^* & \rho & \rho\rho^* \\ & & 1 & \rho\rho^* & \rho\rho^* & \rho \\ & & & 1 & \rho^2\rho^* & \rho^2\rho^* \\ & & & & 1 & \rho^2\rho^* \\ & & & & & 1\end{bmatrix}.$$

Figure 8 illustrates the view of the world that motivates this example. It represents the geopolitical, structuralist view of the world economy. It is also shared by some business strategists, such as Ohmae (1985). The three northern regions, Europe, North America, and Far East, form a core. The proximity between any two regions in the core is given by ρ^*. The other three, Africa and Middle East, Latin America, and South East Asia and Oceania are more isolated, connected only to one of the core regions. The proximity between a core-periphery pair is given by ρ.

The equilibrium is

$$n = \frac{1}{6}\begin{bmatrix}1\\1\\1\\1\\1\\1\end{bmatrix} + \frac{\rho\rho^*(1+\rho)}{3(1-\rho)(1-2\rho\rho^*)}\begin{bmatrix}1\\1\\1\\-1\\-1\\-1\end{bmatrix} \quad \text{or } n = \frac{1}{3}\begin{bmatrix}1\\1\\1\\0\\0\\0\end{bmatrix}$$

depending on whether the nonnegativity constraint is binding.

This shows that the geopolitical advantages held by the core regions lead to a formation of the industrial triangle in the Northern Hemisphere, and leaving the southern regions to the peripheries. This result also offers some justification for the common practice of including continental dummies in regressions in the cross-country productivity studies. Note also that because of the inherent asymmetry between north and south, both an increase in ρ and in ρ^* makes the size of the industries in the Northern Hemisphere grow. A globalization thus only magnifies the uneven patterns of development.

Another interpretation of Example 8 might be worth mentioning, which captures the Wallerstein's (1991) view of the world. The three former colonial powers of Europe form the core, while three peripheries are African countries, each linked only to its former colonial master through historical connections.

8. Concluding Remarks

No region exists in isolation; every region depends on interregional trade. The geography of a region, particularly its location relative to others, is one of the critical determinants of the region's prosperity. All countries that achieved the economic primacy at the beginning of modern economic history, surveyed by Kindleberger (1996), from Italian city-states to Portugal and Spain and to the Low Countries, had benefited from their geographical advantages. The economic success of many countries, from Britain to Japan, and more recently, to Hong Kong, and to Singapore, cannot entirely be explained without taking into account their maritime characters. Many of the poorest countries in the world, from Afghanistan, Bolivia, Chad, to Zambia and Zimbabwe, are landlocked, far away from the economic center of the world. Geography is also the key to understand the debate concerning the regional economic integration. In spite of the obvious importance, the geography of regions, except the resource endowment, plays little, if any, role in the theory of international trade.

This may partially reflect the belief that geographical features, particularly the location of a region with relative to others, are not conducive to formal modeling. What has been shown in this paper is that a simple, tractable model can be built to capture the effects of geographical factors on regional distribution of the industries. The equilibrium condition derived, Equation (10), is flexible enough to allow one to study a wide range of geographical environment, and serves as an intuition-building device. Many examples discussed in this paper were designed to illustrate a few of critical mechanisms through which the distance, the transport and other costs of trade affect the distribution of industries. The reader is invited to use the model to examine the effect of whatever geographical environment that comes to his/her mind.

Obviously, there are many ways in which the analysis could be extended. The following four seems particularly important.

First, the model may be extended to endogenize the proximity between regions. The transport infrastructure is an important part of public investment, which includes the construction of bridges, tunnels, railroads, airports and harbors. The costs of trade can also be reduced significantly by deregulation of transportation industries, one of the most heavily regulated. The proximity between regions that belong to different countries also depends on a variety of border restrictions, hence can be reduced by regional trade agreements between the countries. As the analysis in this paper has suggested, such regional trade agreements would have different impacts on different regions within participating countries. They would also affect non-participating countries. The framework presented in this paper thus seems a natural starting point to analyze a variety of strategic issues associated with industrial and public policies designed to reduce the economic distances between regions.

Second, the model, as it stands, has no factor mobility. Yet much of policy debate over globalization centers on the potential impacts of capital movement, as well as migration. Thus, it is natural to extend the model to allow for multiple factors, some of which are mobile across regions. It is conjectured that introducing factor mobility has effects similar to reducing transport costs of goods; it would magnify geographical advantages and disadvantages held by different regions. Indeed, the model, when extended to include capital mobility, should be able to offer an answer to the famous question posed by Lucas (1990).

Third, even though the model's tractability comes from the absence of demand and cost linkages, introducing some complementarities in industrial location, in the spirit of New Economic Geography, is desirable in view of realism. In addition to all the linkages discussed in this literature, the effect of increasing returns in transportation technologies seems particularly relevant in many of the issues discussed in this paper, which is another interesting way of endogenizing the proximity between regions.

Fourth, the model is highly aggregated. For example, there is only one type of industrial goods. An interesting extension would be to introdcue more than one type of industries, which differ in the cost of trades. The relevant question is then: do different regions with different locational advantages specialize in different types of products?

It is hoped that the theoretical framework presented in this paper will become as a useful important first step for these extensions, and more generally, help to stimulate further research in geography of the world economy.

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