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Geographic Concentration and Industry Characteristics: An Empirical Investigation of East Asia

Soon-Chan Park, Hongshik Lee, and Mikyung Yun

KOREA INSTITUTE FOR
INTERNATIONAL ECONOMIC POLICY

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KIEP

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Executive Summary

In this paper, we assess the geographic concentration of 26 manufacturing industries over the 1986-1997 period, based on annual employment data for 8 East Asian countries. The average level of geographic concentration, in the relative term, has decreased continuously during the period in this region. We show that intra-industry linkage and inter-industry linkage have a positive and significant influence on relative concentration. Furthermore, the industries with large demand bias, high scale intensity and low capital intensity are geographically concentrated. Finally, we find the evidence that regional integration in East Asia will lead to agglomeration of industries.

JEL classification: F12, F13
Key words: economic integration, location of industries, economic geography, industry characteristics.

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Geographic Concentration and Industry Characteristics:
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I. Introduction

The localization patterns of industries are different from industry to industry. Some industries are concentrated geographically, while others are dispersed. What are the underlying characteristics that drive location of industries? Traditional trade theory suggests that the location of production is determined by factor endowments and technology, whereas new economic geography identifies the interaction of economies of scale as well as input-output linkages with trade costs as important driving forces for geographic concentration of industries.

The objective of this paper is to assess the evolution of geographic concentration patterns in East Asia by investigating the characteristics driving agglomeration of industries. Specifically, we study the changes in geographic concentration of 26 manufacturing industries

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over the 1986-1997 period, based on annual employment data for 8 East Asian countries.

Most empirical studies on economic geography (Amiti 1999, Brühlhart and Torstensson 1997, Haaland et al. 1999, Midelfart-Knarvik et al. 2000a, b) have focused on European industries since the EU has been undergoing rapid and sustained integration in recent years. However, there is little empirical evidence on how the economic geography in East Asia has changed over time, even though in the process of globalization and development, this region has experienced dramatic changes in economic structure and rapid increase in intra-regional trade.

Furthermore, existing studies do not show consistent results regarding driving forces behind the location of industries. Some studies support traditional trade theory, but others do not. For example, using employment data, Brülhart and Torstensson (1996) report that 14 of 18 industries have become more spatially concentrated in Europe and that these industries are characterized by large economies of scale. Amiti (1999) finds, on the other hand, that geographically concentrated industries are characterized by high intermediate intensity providing some support for new trade theory and new economic geography theory but not traditional trade theory.

Related studies in the same tradition are Brülhart and Traeger (2003) and Haaland et al. (1999). Using entropy indices[1)], they find that European manufacturing has gradually become more spatially concentrated. In particular, Midelfart-Knarvik et al. (2000a, b) find

1) In particular, Haaland et al. (1999) confirms that economic geography as well as comparative advantage matter for geographic concentration in Europe.

that important determinants of industrial location are high skill labor, scientific labor, and forward and backward linkages to industry. That is, the combination of comparative advantage and geographical forces is an important determinant of industry location.

In this paper, we build on previous empirical studies to gain some insights to help explain the patterns of geographic concentration through assessing geographic concentration patterns in East Asia. The paper also fills the gap in the literature and provides a perspective on economic geography of East Asia. In particular, we focus on industry characteristics as major determinants of industrial location. In addition, this paper addresses one of the most pressing questions for this region—what is the potential impact of regional integration in East Asia on industrial location? New economic geography literature predicts that industries become agglomerated as economies integrate. The advance of economic integration in East Asia, mainly due to globalization, allows us to examine the relationship between trade costs and geographic concentration.

The remainder of this paper is organized as follows. Section II reviews the related works on industry location. Section III explains how we measure the industry characteristics and geographic concentration index. This section also provides the data sources and a general description of the data. In Section IV, we discuss the empirical model and results. Section V concludes.

II. An Overview of the Literature on Industry Location: Traditional Trade Theory versus New Economic Geography

What determines a country's structure of production and level of income? Crafts and Venables (2002) indicate two points. One is the country's internal capacity, which depends on its factor endowments such as capital, labor, human capital and so on. The other is its external relationship with other countries: its geography, meaning the access that it has to external suppliers of goods and factors. We believe that these two factors are not separable, rather they affect each other. We will see below how location patterns are driven by interactions between internal capacity and geography.

For that purpose, we outline theoretical approaches to explaining the location patterns of economic activities. One approach is traditional trade theory in which the structure of production is determined by factor endowments and technology. We contrast this with the new economic geography approach in which the interaction of increasing returns to scale with transport costs creates a tendency towards agglomeration of economic activities.

1. Traditional Trade Theory

The geographical differences of economic structure are presented traditionally in terms of differences in factor endowments (Heckscher-Ohlin) or technologies (Ricardo). How does traditional trade theory

predict the impact of economic integration? It predicts that countries will become increasingly specialized in the production of goods intensive in their abundant factors since regional integration allows countries to exploit their comparative advantages more fully. Even though endowments and technologies certainly play an important role in determining the spatial pattern of production, such explanations fail to provide a reasonable answer for why a priori similar countries can develop different economic structures. They also fail to explain the changes in countries' comparative advantages.

2. Static Economic Geography Models

The issues of industry location occupie a great part of regional economics, which was started by von Thünen (1826), and further developed by Christaller (1933) and Lsch (1940). Even though these early works are still valid, the new economic geography literature provides a somewhat different approach. Instead of asking why a particular industry is agglomerated in a particular region, it asks why manufacturing in general might end up concentrated in one or a few regions of a country, leaving others relatively undeveloped.

Based on new trade theory with increasing returns to scale and imperfect competition, Krugman (1991) incorporates the concept of cumulative causation, which was emphasized by development economist in the 1950's, such as 'circular and cumulative causation' of Myrdal (1957), and 'forward and backward linkages' of Hirshman (1958). Krugman (1991) develops a simple model, in which the interaction of labor migration across regions with scale economies and transport costs creates a tendency for firms and labor to cluster

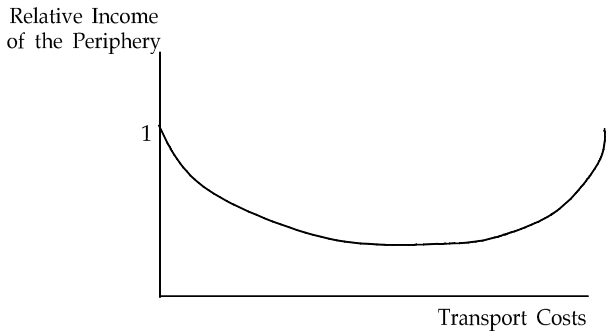
together. The most profitable locations of production will be those near areas with relatively large demand for manufactures, since production in a large market minimizes transport costs. Where will demand be large? Some of the demand for manufactures will come from other sectors such as agriculture. But they will also come from the manufacturing sector itself, because there will be a large number of workers where the production of manufactures is concentrated. This creates circular causation: manufactures production will tend to concentrate where there is a large market, but the market will be large where manufactures production is concentrated.

Krugman and Venables (1995) expand the economic geography model of Krugman (1991) to the international level, assuming that firms are interrelated through input-output structure. The final sector produces consumption goods and the intermediate sector produces intermediate goods used as inputs in the production of final goods. This linkage between industries creates pecuniary externalities that produce a tendency for agglomeration of industries. Suppose that one country has a larger final sector than another. It would be more profitable for intermediates firms to locate in this country, since the demand for intermediates is larger. This effect corresponds to the concept of 'backward linkage.' In contrast, if one country produces a greater variety of intermediate goods than another, prices in this country, because of transport costs, will be lower, meaning lower costs of production of final goods. This effect is called 'forward linkage.' Once these forward and backward linkages started, the agglomeration process will feed on itself. Then, the world economy will organize itself into an industrialized core and a deindustrialized periphery.

The important point here is that concentration patterns of industries depend upon the levels of transport costs. At high transport costs industries are dispersed across countries. Although linkages between upstream and downstream firms exist, these are dominated by the need for firms to meet local demands. In this case, each country will be essentially self-sufficient. But when transport costs fall below a critical value, agglomeration forces become relatively more important than the incentives for self-sufficiency. So agglomeration is sustainable and a core-periphery forms. At still lower transport costs, it becomes cheaper to ship intermediate goods. The input-output linkages between firms matter less and the effects of factor price differences become dominant so that the economic structure of countries converges.

The spatial distribution of economic activities will be associated with changes in real national income. The concentration of industries will drive up demand for labor in the industrialized core, while the decline of industry in the periphery will lead to a decrease in labor demand. Thus, real wages and income will rise in the core and

<Figure> Economic Integration and National Income



decline in the periphery. Static economic geography models predict a U-shaped pattern of the real income between the core and periphery, depending on the share of industry in each country.

3. Dynamic Economic Geography Models

The contributions to the new economic geography literature, discussed so far, are static. In such models, the income levels of countries depend exclusively on the share of industry, and the location of industry has no impact on growth. There are a few contributions that attempt to explore the relationship between industry location and growth. Martin and Ottaviano (1999), combining the static economic geography model of Krugman (1991) and endogenous growth theory (Romer 1990; Grossman and Helpman 1991), show that with local spillovers in R&D, industries concentrate in the core, resulting in an increase in the growth rate of innovation. Walz (1996) constructs a model, in which migration and aggregate increasing returns to scale at the local level can trigger agglomeration and faster growth. However, he focuses on aggregate rather than firm-level increasing returns to scale, which new economic geography addresses. Incorporating the static geography model with endogenous growth theory, Baldwin, Martin and Ottaviano (1999) show that economic integration may produce a catastrophic agglomeration in the sense that deindustrialization in one country is a necessary condition for industrialization in the other.

These dynamic economic geography models above predict commonly that geographical agglomeration will divide countries into winner and loser. Unlike these models, Park (2002) and Fujita and

Thisse (2002) draw a quite different implication. Park (2002), starting from the presumption that economic activities are interdependent, shows that geographical agglomeration causes interdependent specialization between countries. Furthermore, the core and periphery grow at the same rate in the specialization steady states while this growth rate exceeds that in the symmetric steady states. Hence, geographical agglomeration has an international growth effect rather than a national one. The periphery might, in the long run, be better off than under dispersion. Moreover, economic integration may reduce the income inequality between countries that arises from the agglomeration process. Economic integration also has growth effects. Adding an R&D sector into the framework of Krugman (1991), Fujita and Thisse (2002) study the effect of interregional integration on growth and location within a country. The mechanism creating the externalities is the linkages between firms and workers. Fujita and Thisse (2002), similar to Park (2002), show that those who stay in the periphery are better off than under dispersion, provided that the growth effect triggered by the agglomeration is strong enough.

New economic geography models, despite differences in details, arrive at a common conclusion. Economic integration changes the location of economic activities, depending on transport costs. As a consequence, economic integration leads to differences in the absolute level of national income among countries. Furthermore, the geographical agglomeration of economic activities has growth effects. But dynamic economic geography models are not in accord on the point of whether spatial agglomeration has growth effects only for one country, or both countries. Fujita and Thisse (2002) and Park (2002) indicate that growth effects may be interregional or international,

while Baldwin et al. (1999) and Martin and Ottaviano (1999) show a divergence in growth among countries.

III. Industry Characteristics and Concentration

1. Geographic concentration

Geographic concentration measures the distribution of an industry across East Asian countries. An industry i is geographically concentrated if a few countries supply a large part of the product i sold in a given market. There are two approaches assessing geographic concentration: absolute and relative concentration. Absolute concentration shows the simple distribution of an industry in East Asia, while relative concentration presents the distribution of an industry relative to the country size. That is, an industry is relatively concentrated, if a country's share of that industry in East Asia exceeds its share of total manufacturing in East Asia. As Amiti (1999) indicates, absolute concentration may not be useful in depicting an accurate picture of economic geography, since a measure of absolute concentration is sensitive to small changes in a big country if all countries are treated equally. Hence, we employ the following index for relative concentration. This is known as the standard deviation of the Balassa-index (Haaland et al. 1999).

$$C_i(t) = \sqrt{\frac{1}{m}\sum_j \left(c_{ij} - \bar{c}_{ij} \right)^2}$$

$$c_{ij}(t) \equiv x_{ij}(t) / \sum_j x_{ij}(t), \qquad \bar{c}_{ij}(t) \equiv \sum_i x_{ij}(t) / \sum_i \sum_j x_{ij}(t)$$

where m indicates the number of countries, $c_{ij}(t)$ is the share of country j in the employment of industry j in East Asia, $\bar{c}_{ij}(t)$ depicts country j's share of total employment in East Asia. An increase in C_i indicates that industry i has become more geographically concentrated, implying that the share of industry i in some countries has increased more than their share of total industries relative to the rest of East Asia.

The concentration index is calculated based on employment data from the UNIDO database for East Asian countries at the industry level over the 1986-1997 period. It provides national industrial data on number of employees for 28 industries classified according to the International Standard Industrial Classification (ISIC Rev.2) at the 3-digit level. However, employment data for petroleum refineries (353) and miscellaneous petroleum and coal products (354) are almost nil, so we exclude these two industries. We also do not include Thailand due to insufficient data coverage. Thus, we analyze 26 industries for eight East Asia countries: China, Indonesia, Japan, Korea, Malaysia, Philippines, Singapore and Taiwan.[2)]

The indices for geographic concentration are calculated as three years average for the two periods 1986-1988 and 1996-1997 respectively, to minimize any variations arising from annual fluctuations. Table 1 shows that the level of relative concentration at the industrial level for two the periods measured by the standard deviation of the Balassa-index. The industries with the highest level of concentration in 1986/88 were tobacco (314), plastic product (356) and furniture except metal (332), while pottery, china, and earthenware (361) showed the lowest level of relative concentration.

2) See appendix for 26 industries.

<Table 1> Relative concentration

Industry	1986/88	1989/91	1992/94	1995/97	1995/97−1986/88
311	0.0450	0.0565	0.0875	0.0667	0.022
313	0.0720	0.0772	0.0497	0.0664	-0.006
314	0.1817	0.2035	0.2214	0.2048	0.023
321	0.0433	0.0438	0.0299	0.0367	-0.007
322	0.0757	0.0461	0.0795	0.0492	-0.026
323	0.0343	0.0663	0.0532	0.0810	0.047
324	0.0634	0.0553	0.0661	0.0287	-0.035
331	0.1215	0.0699	0.0755	0.0558	-0.066
332	0.1784	0.0792	0.0846	0.0716	-0.107
341	0.0177	0.0083	0.0183	0.0089	-0.009
342	0.1083	0.0831	0.1008	0.0831	-0.025
351	0.0990	0.0911	0.0578	0.0688	-0.030
352	0.0380	0.0297	0.0466	0.0252	-0.013
355	0.0791	0.0439	0.0369	0.0210	-0.058
356	0.1803	0.0904	0.0919	0.0590	-0.121
361	0.0179	0.0221	0.0522	0.0715	0.054
362	0.0444	0.0378	0.0280	0.0445	0.000
369	0.0520	0.0500	0.0598	0.0747	0.023
371	0.0487	0.0468	0.0241	0.0398	-0.009
372	0.0554	0.0340	0.0204	0.0308	-0.025
381	0.1455	0.0805	0.0868	0.0640	-0.082
382	0.0698	0.0602	0.0211	0.0287	-0.041
383	0.1085	0.0840	0.0872	0.0710	-0.037
384	0.0707	0.1582	0.0592	0.0298	-0.041
385	0.0525	0.0341	0.0296	0.0316	-0.021
390	0.0684	0.0615	0.0425	0.0468	-0.022
Average	0.0797	0.0659	0.0620	0.0562	-0.024

The patterns of relative geographic concentration have changed over time. Five[3] of 26 industries have experienced increase in geographic concentration between the two periods, 1986/88 and 1995/97. Glass and products (362) showed hardly any change. The rest of the industries show a decline in concentration. There indeed seems to be quite a lot of variation by industry.

2. Industry characteristics

Trade theory and economic geography literature argue that distinct industry characteristics can lead to geographic concentration. Given the differences in relative factor endowments across countries, Heckscher-Ohlin model suggests that an industry intensive in the use of a certain factor would be agglomerated in a country with abundant endowment of this factor. To capture these effects we include here capital and human capital intensity as important industry characteristic that may affect industrial location.

On the other hand, new trade theory predicts that industries will agglomerate to take advantage of scale economies, even if there is no difference in factor intensities. Krugman (1980) and Helpman and Krugman (1985) show that market size matters, if trade of the differentiated goods is costly. They emphasize home market effects: e.g., increasing returns industries tend to concentrate production near larger markets and export to smaller markets. At the same time, since increasing returns to scale is associated closely with demand bias, one can also expect industries with a strong final demand bias to be

3) These five industries are food products, tobacco, leather products, pottery china/earthenware, and other non-metallic products.

agglomerated around large markets.[4)]

Krugman and Venables (1995) also consider the input-output linkages among industries as another important driving force behind the rise of geographic concentration. The forward and backward linkages between industries create pecuniary externalities leading to agglomeration of industries. In the presence of trade costs, it would be more profitable for intermediates firms to locate near a large final sector. In turn, trade cost in the final sector can be reduced if it is concentrated in the country with a large intermediates sector. To capture these effects on geographic concentration, we include intra-industry linkages and inter-industry linkages as explanatory variables.

Further, the new economic geography literature indicates that agglomeration patterns of industries depend upon levels of transport costs. At high trade costs industries are dispersed across countries to meet local demands. But when trade costs fall below a critical value, agglomeration forces become relatively more important than the centrifugal forces. If this prediction is correct, we should expect that regional integration due to decreasing trade costs in East Asia would lead to increased concentration of industries.

In sum, we test the following five hypotheses about industry characteristics:

4) Davis and Weinstein (1996) indicate that if the estimated coefficient of demand bias is high, it supports new trade theory but not Heckscher-Ohlin model, and vice versa. Similar argument is made by Lundbck and Torstensson (1997). In this study, we simply focus on the presence of a causal relationship, as the actual size of the estimated coefficient may not be so meaningful due to data shortcomings.

H1) Industries with certain factor intensity (e.g., capital and human capital) are geographically concentrated in countries where that factor is abundant;
H2) Industries with scale economies agglomerate around large markets;
H3) Industries with strong final demand bias agglomerate around large markets;
H4) Industries with high input-output linkages (both inter-firm and intra-firm linkages) are positively correlated with geographic concentration
H5) Increased regional integration (lower tariffs) in East Asia leads to increased agglomeration of industries in this region.

Datasets with both cross-country and cross-industry are hard to obtain because there are no comprehensive data on industry characteristics. Thus, most of the empirical studies construct indices to capture the characteristics of the geographically concentrated industries. However, such basic data necessary to construct industry characteristic indices are not available for East Asian countries. A simple way to get around this problem is to rely on previous studies on industry characteristics for other regions as proxies. In this paper, we assume that industry characteristics are not so different from region to region. There may be variations in intensities of industries between different regions in absolute terms, but the relative rankings of intensities among industries should not be so great across regions.

Fortunately, Midelfart-Knarvik et al. (2000a), based on the classification of OECD (1994), provide information on the relative position of industries with respect to the intensity measures. They classify in-

dustries into high, medium and low groups according to their rank in each characteristic. We take the information on capital intensity, intra-industry linkage, inter-industry linkage and final demand bias from this source. For human capital intensity and R&D intensity, we use the data provided by Midelfart-Knarvik (200b).

For scale economies of industries, we draw on Haaland et al. (1999). They use a scale economies index developed by Cawley and Davenport (1988), which is a transformation of the engineering estimates of minimum efficient scale calculated by Pratten (1988). This index represents percentage reduction in average costs for a one percent increase in output. The data on tariff rates for 26 industries in 8 countries are obtained from UNCTAD Trains database. The definition of industry characteristics is described in more detail in the Appendix.

IV. The Relationship between Geographic Concentration and Industry Characteristics

1. The Estimation Techniques

We estimate two points in time 1986/88 and 1995/97 respectively. The data from the two periods are not pooled. As Haaland et al. (1999) indicates separate estimation has an advantage of allowing us to examine the changes in forces driving agglomeration of industries over time. The following equation is employed in estimating the patterns of relative concentration at a given point in time.

$$\ln(c_{ij} - \bar{c}_{ij}) = \beta_o + \sum_k \beta_{ik} z_{ik} + \eta_i + d_j \varepsilon_{ij} \quad (1)$$

where subscript i denotes industry and subscript j denotes country; z_{ik} represents k characteristic of i industry. d_j is an individual country fixed effect, η_i is an industry effect and ε_{ij} is a country and industry specific effect.

Most of the previous work discussed above, and in fact much of the geographic concentration literature until recently has been based on estimations of an equation similar to (1) using cross sectional data, although the drawbacks are well known. Since we work with cross sectional data, we need to control for some econometric problems. First, heteroscedasticity is likely to be a problem. To control for this problem, we obtain robust variance estimates using linear regression. Second, cross sectional regressions clearly suffer from endogeneity

problems as well. Endogeneity implies contemporaneous correlation between the error term and the explanatory variables. 2SLS offer a potential solution to the endogeneity problem through the use of instrumental variables (IV). One common approach is to use lagged variables as instruments for the endogenous variables. As Haaland (1999) pointed out, however, endogeneity in this context might be a less severe problem. Therefore, we do not discuss the results from 2SLS regressions any further. Third, the issue of unobserved country and industry specific effects also needs to be addressed. We control for this by adding country dummy variables and apply standard fixed and random effect estimation methods to capture differences across industries.

2. Estimation Results

We estimate equation (1) on a sample spanning 26 industries at the 3-digit level; 8 East Asian countries; and two periods, 1986/1988 and 1995/1997. Since we do not have data on tariff for the period 1986/88 at the industry level for East Asian countries, tariff is not included in the estimation of geographic concentration for 1986/88.

Tables 2 and 3 report the estimation results. The first three columns of each table show the estimates using fixed effect model and the second three columns show results from the random effects model. We see that relative geographic concentration is strongest in sectors with low capital intensity in both periods, implying that capital-intensive industries tend to be more dispersed than other industries. This suggests that capital is no longer a scarce factor of production, which exists only in certain countries.

<Table 2> Regression results of relative concentration (1986/89)

	Fixed (1)	Fixed (2)	Fixed (3)	Random (4)	Random (5)	Random (6)
constant	-12.64*** (3.11)	-3.07*** (3.16)	-8.57*** (4.86)	-7.68*** (1.05)	-7.76*** (1.09)	-7.68*** (1.17)
capital intensity	-.72*** (.17)	.76*** (.18)	-.66*** (.19)	-.79*** (.21)	-.82*** (.23)	-.83*** (.24)
final demand bias	.72*** (.17)	.74*** (.17)	.70*** (.17)	.63*** (.21)	.65*** (.21)	.66*** (.23)
interindusty linkage	1.05*** (.25)	1.05*** (.25)	1.14*** (.37)	.87*** (.28)	.86*** (.29)	.87*** (.30)
intraindustry linkage	.94*** (.34)	.94** (.34)	1.14*** (.37)	.66* (.38)	.65* (.39)	.66* (.40)
scale economies	1.59*** (.49)	1.57*** (.49)	1.65*** (.49)	1.92*** (.56)	1.93*** (.58)	1.87*** (.64)
R&D intensity	-13.36*** (4.58)	-14.89*** (4.98)	-12.64** (5.20)	-12.97** (5.84)	-14.03** (6.48)	-14.45** (6.89)
human capital intensity		.69 (.88)	-.16 (1.04)		.49 (1.13)	.62 (1.32)
Agricultural input intensity			.41 (.28)			-.06 (.25)
R−squred	.62	.62	.62	.61	.61	.61
No. of observation	208	208	208	208	208	208

Note: Numbers in parenthesis show standard errors. Robust standard errors for fixed effects. Confidence level at *** 1%, ** 5%, and * 10%.

In contrast, the human capital intensity variable has no effect on geographic concentration in East Asian countries. Although the coefficients carry a negative sign, they are never significant in any of the estimations. This result differs from previous studies (Haaland et al. 1999, Midelfart-Knarvik et al. 2000a) that report a significant positive influence of human capital on relative concentration. However, we cannot exclude the possibility that this result may be

<Table 3> Regression results of relative concentration (1995/97)

	Fixed (1)	Fixed (2)	Fixed (3)	Random (4)	Random (5)	Random (6)
constant	-8.06*** (2.61)	-7.90*** (2.66)	-2.35 (4.08)	-7.20*** (.87)	-7.16*** (.90)	-6.86*** (.96)
capital intensity	-.46*** (.14)	-.45*** (.15)	-.54*** (.16)	-.46*** (.17)	-.45** (.19)	-.47** (.19)
final demand bias	.34** (.14)	.33** (.15)	.37** (.15)	.33* (.17)	.32* (.18)	.39** (.19)
interindusty linkage	.66*** (.21)	.66*** (.21)	.55** (.22)	.64*** (.23)	.64*** (.24)	.68*** (.24)
intraindustry linkage	.58** (.29)	.58** (.29)	.39 (.31)	.54* (.31)	.54* (.32)	.59* (.33)
scale economies	.77* (.41)	.77* (.41)	.69* (.41)	.81* (.47)	.81* (.48)	.58 (.53)
R&D intensity	-7.42* (3.85)	-6.86 (4.19)	-9.15** (4.36)	-7.32 (4.82)	-6.73 (5.33)	-8.42 (5.62)
Tariff	-.44* (.22)	-.44* (.22)	-.48* (.22)	-.52* (.22)	-.53* (.22)	-.54* (.22)
human capital intensity		-.25 (.22)	.61 (.88)		-.27 (.93)	.31 (1.08)
Agricultural input intensity			-.48* (.22)			-.23 (.20)
R−squred	.64	.64	.64	.64	.64	.64
No. of Observation	208	208	208	208	208	208

Note: Numbers in parenthesis show standard errors. Robust standard errors for fixed effects. Confidence level at *** 1%, ** 5%, and * 10%.

due to data limitations. Note that the human capital intensity of each industry used here is measured for European industries. While quality of capital may not differ across regions, it is possible that quality of human capital may differ significantly between regions.

We also find that the scale economies variable has a significant, positive influence on relative geographic concentration in 1986/88 as well as in 1995/97. This finding is consistent with the results of Brülhart and Torstensson (1996) and Amiti (1999) who studied the patterns of geographic concentration in Europe. Final demand bias also positively affects relative geographic concentration, implying that industries tend to locate near markets with relatively large demand to save trade costs. The positive and significant impact of scale economies and demand bias may be interpreted as giving support for the conclusions of the new economic geography literature.

As hypothesized, inter-industry linkages have a significant impact on relative geographic concentration. This means that industries whose products are widely used across industries show a tendency to agglomerate. The intra-industry linkages also have a strong influence on relative geographic concentration. This implies that industries that are closely related, other things equal, tend to agglomerate than other industries. These results—positive impacts of the intra- and inter-industry linkages on relative concentration—indicate that the agglomeration of industries is self-reinforced, generating their own demand through the input-output linkages as Krugman and Venables (1995) argued. On the other hand, the R&D intensity variable is negatively correlated with relative geographic concentration. However, this variable becomes significant only in 1986/88.

Finally, we find that tariffs have a negative and significant impact on relative concentration in 1995/97, the years for which data is available. This result implies that highly protected industries tend to be dispersed geographically. Hence, one may conclude that further regional integration in East Asia will reinforce agglomeration of

industries in this region. To the best of our knowledge, this is the first empirical evidence supporting the prediction of new economic geography literature that regional integration will strengthen the trend of geographic concentration of industries. Previous studies, for example, Haaland et al. (1999) which explored industry data for Europe, report that non-tariff barriers do not have any significant impact on geographic concentration, and Brülhart (2000) shows that trade barriers are associated positively with geographic concentration.

V. Concluding Remarks

In this paper, we test the relationship between industry characteristics and geographic concentration. We find that most of the industry characteristics studied here, significantly affect tendency of industries to agglomerate. First, the inter-industry linkages and intra-industry linkages seem to be the most important determinants of the economic geography of East Asia. Regardless of the model specification and time, they always have a positive and significant impact on industrial concentration. This robust result supports Krugman and Venables (1995) who argued that vertical linkages among industries create pecuniary externalities, which in turn drives industrial agglomeration.

Second, the capital intensity also always shows a negative and significant influence on relative concentration, implying that capital is no longer a scare factor across East Asian countries. Third, we find scale economies and final demand bias to positively affect geographic concentration, as the new economic geography literature predicts. Fourth, we provide the first empirical evidence which show that trade barrier, in terms of tariff, has a negative and significant impact on industrial location, at least in East Asia. From this one may conclude that further regional integration in East Asia would reinforce geographic concentration of industries.

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Appendix 1: Variable Description

Industry characteristics	Description
Capital intensity	High, medium, low measured by capital stock per employee. Source: OECD(1994), Midelfart-Knarvik et al. (2000a).
Final demand bias	High, medium, low measured by percentage sales to consumers and exports. Source: Midelfart-Knarvik et al. (2000a).
Inter-industry linkage	High, medium, low measured by use of intermediates from other sectors as share of value of production. Source: Midelfart-Knarvik et al. (2000a).
Intra industry linkage	High, medium, low measured by use of intermediates from own sectors as share of value of production. Source: Midelfart-Knarvik et al. (2000a).
Scale economies	Index of scale economies based on Pratten (1988). Source: Haaland et al. (1999).
R&D intensity	R&D expenditures as share of value added. Source: Midelfart-Knarvik et al. (2000b).
Human capital intensity	Share of non manual workers in workforce. Source: Midelfart-Knarvik et al. (2000b).
Tariff	MFN average tariff. Source: UNCTAD
Agricultural input intensity	High, medium, low measured by use of primary inputs as share of value of production

Appendix 2: Industry list
(The ISIC Classification)

ISIC 3 digit	description
311	Food products
313	Beverages
314	Tobacco
321	Textiles
322	Wearing apparel except footwear
323	Leather products
324	Footwear except rubber or plastic
331	Wood products except furniture
332	Furniture except metal
341	Paper and products
342	Printing and publishing
351	Industrial chemicals
352	Other chemicals
353	Petroleum refineries
354	Miscellaneous petroleum and coal products
355	Rubber products
356	Plastic products
361	Pottery china earthenware
362	Glass and products
369	Other non-metallic products
371	Iron and steel
372	Non-ferrous metals

381	Fabricated metal products
382	Machinery except electrical
383	Machinery electric
384	Transport equipment
385	Professional and scientific equipment
390	Other manufactured products

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