The Product Cycle and Its Applicatan to the Spatial Decentralization of the Korean Electronics Industry.

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Ⅰ. Introduction

The inclusion of the product cycle concept in the theory of industrial location is relatively recent. Since Vernon's (1966) first attempt, and subsequent work by Hirsch (1967), the product cycle has apparently shown promise in explaining the locational behavior of manufacturing activities across more and less developed regions or nations. Later, Vernon explicitly applied the product cycle to the analysis of the locational shifts associated mainly with multinational corporations. Likewise, in the field of regional science, researchers such as Thomas (1975), and Krumme and Hayter (1975) first adopted the product cycle as a heuristic for understanding long－term regional economic growth and the locational dynamics of regional industrial change. However, since their studies were primarily theoretical in nature, they require further substantiating empirical work. At any rate, the general lack of broad, dynamic perspectives on the spatial dynamics of manufacturing activities has motivated these researchers to look to other fields for concepts that could adequately explain these phenomena. For this reason, the product cycle started to receive increasing interest, especially in the location analysis of manufacturing activities during the 1970s.

Following Thomas' (1975), and Krumme and Hayter's(1975) works, empirical analysis was subsequently provided by various researchers to verify the validity of the product cycle in explanining the locational shifts of manufacturing activities on various spatial scales. Norton and Rees (1979), Rees (1979), and Hansen (1979), for example, used the product cycle to analyze the interregional shifts of the U. S. manufacturing activities to the U. S. 's Sunbelt. On the other hand, the product cycle was applied by Erickson (1976), and Park and Wheeler (1983) to analyze the filtering down of manufacturing production to U. S. nonmetropolitan areas. Case studies on specific firms and industries have been provided by Krumme and Hayter (1975) on aircraft manufacturing, and by Hekman (1980a, 1980b, 1980c) on the U. S. textiles, computer, and scientific instruments industries. Modelling attempts have also been made by Ersenkal and Dillman (1984), and Sjafrizal (1981). The absence of empirical analyses in developing countries is an obvious obstacle to testing the product cycle's assumption on interregional industry shifts. The one exception has been Hansen (1983), who analyzed the decentralization trends of Brazilian industrial activities in Sao Paulo state. However, his results provide little support for the product cycle's corollary that agglomeration economies are most important in new or innovative industries, and least important in mature or standardized ones [see, e. g., Sjafrizal (1981), p. 131]

This study is undertaken to provide a simple test of the product cycle as applied to the analysis of the locational shifts of Korea's electronics industry – an industry experiencing a process of progressive dispersion towards the periphery of the Seoul metropolitan region(Kyonggi), and towards peripheral areas (the Southeastern provinces) since the late 1970s, as reported elsewhere [Han (1989) and Suarez-Villa & Han (1990)]. In theoretical analysis, an attempt is made to clarify the manner in which the product cycle premises affect the locational shifts of manufacturng activities. A linear regression model is constructured using concrete variables derived from the product cycle assumption of interregional location behaviors, and then tested with a total of 68 domestic electronics plants obtained from a stratified random sample design.

Ⅱ. Hypotheses

The proponents of the product cycle concept assert that, if an industry follows the patterns described in the product life cycle concept, then at the new and growing phases, when the production process is characterized by skill – intensive technology, firms prefer to locate in the more developed region. However, when the industry enters the mature phase, where production is characterized by the labor – intensive technology, the firms are likely to move to the less developed region to take advantage of available cheap labor [see, e. g., Sjafrizal (1981)]. The product cycle concept also indicates that a firm's need for agglomeration economies declines as an industry passes from one phase to another in the cycle. Such behavior appears as a result of an increase in the firm's internal economies which are stimulated by the mass-production process, standardized products, more effective and efficient management, etc. In other words, the need for external economies can be reduced significantly because the firm is able to substitute for them the internal economies which can now be fully exploited.

A simple approach to testing the above product cycle proposition with reference to a specific industry is to examine the relationship between plant location (either categorized as being in metropolitan and less developed areas, or measured as the actual road distance from the metropolitan area) and reliable indicators of the product cycle concept. Some testable hypotheses can be established particularly when the product cycle is applied to the analysis of the locational shifts of Korea's electronics industry:

a) According to the product cycle explanation of interregional location behaviors, electronics plants using a skill-intensive process tend to be concentrated in metropolitan or developed areas due to their greater need for skilled labor reguired, at the new and growing phases, for an rapidly changing and unstable production, but those classified as using classified as using a labor-intensive process are in less developed areas that provide cheap, less skilled labor necessary for their stable and standardized production [see, e. g., Sjafrizal (1981)]. Likewise, the skill-intensity gradient approximated by the ratio of nonproduction to production workers is expected to decline with distance from the Seoul metropolitan area.

b) Intraregional backward linkages can function as a measure of agglomeration economies. In other words, a high concentration of suppliers and subcontractors in a metropolitan area can represent higher agglomeration economies. If the product cycle is accepted as a valid tool for explaining interregional location behaviors in Korean electronics, one could expect that electronics plants in Seoul would have a tendency to rely more on intrametropolitan backward linkages due to that area's number of suppliers and subcontractors. On the other hand, electronics plants in less developed areas would tend to purchase their inputs from areas outside their localities, particularly from Seoul, thus relying more on interregional or nonlocal backward linkages. Thus, we can expect either a nagative relationship between levels of intraregional backward linkages and distance from Seoul, or a positive relationship between the latter and levels of interregional backward linkages.

c) The product cycle assumption of interregional location behaviors states that a greater need for agglomeration economies forces small electronics plants to locate in a metropolitan area, especially when those plants are associated with new, innovative plants. In particular, their small

—volume, their constantly changing interfirm linkages, and their tendency to use large quantities of labor relative to capital in production, create a spatial preference for areas with greater agglomeration economies. On the other hand, large—scale electronics plants normally associated with mass production would tend to move away from the Seoul metropolitan area. This appears to be caused by both their need for large factory space and the advantages derived from economies of scale with respect to large—volume, standardized material linkages and mass transport. Therefore, one would expect to find a positive association between plant employment size and distance from Seoul.

d) The same trend can be expected with respect to the age of plant variable, if the product cycle explanation of location changes is valid in Korean electronics. A greater need of new, innovative plants for skilled labor, and proximity to suppliers and subcontractors and markets, underlies their spatial preference for the Seoul metropolitan area. In contrast, older plants, most likely to be associated with mature consumer electronics or assembly operations of semiconductor production, would tend to locate away from Seoul due to their labor—intensive production.

Ⅲ. The Model

The hypotheses were tested empirically using the following multiple regression model:

$$Y1, 2 = a + b\ X1 + c\ X2 + d\ X3 + e\ X4 + f\ X5 \cdots\cdots\cdots (i)$$

where: Y1 plant location dummy, Y1 = 0 if a plant is located in the Seoul metropolitan area, Y1 = 1 if the plant is located outside Seoul;

Y2 plant location, measured as actual road distance from Seoul;

X1 nonproduction/production workers;

X2 interregional backward linkages dummy, X2 = 0 if a plant's purchase of lesser than 50 percent of total inputs is made from areas outside a twenty—mile radius, X2 = 1 if the plant's purchase of equal to or greater than 50 percent of total inputs is made from areas outside a twenty—mile radius;

X3 domestic backward linkages dummy, X3 = 0 if domestic inputs purchase is less than 50 percent of total inputs, X3 = 1 if domestic inputs purchase is equal to or greater that 50 percent of total inputs;

X4 plant employment size;

X5 age of the plant, measured as (1986—date of establishment).

The model states that plant location in the Korean electronics industry is a function of certain characteristics of that plant. In other words, the spatial decentralization of Korean electronics is closely related to five variables: nonproduction/production workers, interregional backward linkages, domestic backward linkages, plant employment size, and age of plant. These were selected as causal variables for the analysis on the basis of two procedures. We first entered 12 variables closely related to plant's organizational and production characteristics into a discriminant analysis, and then extracted 8 variables that best distinguish metropolitan electronics plants from plants in less developed areas. Among the 8 extracted variables, 5 variables having relatively high correlation coefficients with plant location were chosen for the analysis (see Tables 2 and 3). Four variables relating to the product cycle assumption of interregional location shifts are nonproduction/production workers(X1), interregional backward linkages (X2), plant employment size (X4), and age of the plant (X5). The remaining X3 variable is expected to be also important in explaining the decentralization phenomenon. This is because a higher export propensity found in less developed areas' electronics plants—that propensity which calls for their familiarity with, and greater reliance on, foreign suppliers capable of meeting more exacting input requirements—reduces their need for the agglomeration forces available in Seoul, in particular, its easy access to domestic suppliers and relevant services[see, e. g., Han (1989), p. 281.]

Ⅳ. Empirical Estimation

1. The Data

To empirically test the hypothesized regression equation (i), a sample of 72 domestic electronics plants was obtained using a stratified random sample design. Choice of variables used to stratify the population is restricted to those for which data exists for the actual population of plants: location, age of plant, and plant employment size. A binary locational stratification was employed: the Seoul metropolitan area and less developed areas, the latter being an amalgamation of Seoul, the Kyonggi province, and other regions. The plant age stratification was achieved by aggregating the population into two groups: above and below 13 years. Finally, the population was stratified into two employment size groups: above and below 1000 employees[2]. Within each of the six strata the plants were ranked according to employment size, and systematic sampling within each stratum thereby ensured an adequate spread within the final sample. Of the 72 plants, 68 were chosen for identifying causal variables due to listwise deletion of 4 cases which contain a missing value on any hypothesized variable entered onto the regression equation (i). The overall response rate was modest, 60.5 percent of first sampled plants.

In making inferences about the population, the crucial question is whether the final sample is biased with respect to quantifiable variables such as age, employment size, nonproduction/production workers, or interregional backward linkages. Chi-square values comparing variances for age and employment size to those of the plant population were 42.2 and 41.6 respectively, significant at the confidence level of less than 0.006 percent, although chi-square tests for other variables cannot be performed due to data scarcity for the population. The results in Table 1, therefore, suggest that the final sample respondents are unbiased with respect to the two key variables-age and employment size-providing some evidence that those respondents are representative of the population.

Table 1. Sample survey of domestic electronics plants by location

	Seoul	Less developed areas		Total
		Kyonggi area	other areas	
Actual population	238	201	168	607
Number sampled(A)	49	41	29	119
Number completed (B)	21	32	19	72
Response rate (%) (100B/A)	42.9	78.5	65.5	60.5
Sampling fraction (%) (100B/actual population)	8.8	15.9	11.3	11.9
Final sample	21	30	17	68

	Final sample			Actual population		
	Mean	SD	N	Mean	SD	N
Age of plant	10.94	6.44	68	9.06	8.11	607
	(X^2=42.2 df=67 significance= .994)					
Employment Size	612	2071.45	68	502	2628.8	607
	(X^2=41.6 df=67 significance= .998)					

Notes: Data for actual population were obtained from the Electronics Industry Association of Korea, Directory of Electronic and Electrical Manufacturers 1986.

X^2: chi-square; df: degree of freedom.

2. Testing Results

The five hypothesized independent variables were regressed on the dependent variable, the distance from Seoul, which was measured in two different ways—one, plant location dummy and, the other, the actual road distance from Seoul. The stepwise OLS regression results in Table 2 explain approximately 58 percent of observed variance in plant location dummy, although those variables' explanatory power decreases significantly to .23 in Table 3. The interregional and domestic backward linkages dummies are found to be statistically significant at 99 percent confidence level, and the nonproduction/production workers and plant employment size variables at 95 percent confidence level in Table 2. As shown in Table 3, the nonproduction/production workers variable and the domestic backward linkages dummy become significant at 99 percent confidence level, and the interregional backward linkages dummy at 95 percent confidence level. The age of plant variable becomes statistically insignificant in both results, thus becoming a less important determinant of plant location.

A statistically significant nonproduction/production workers (X1) effect shown in Tables 2 and 3 suggests that this variable undoubtedly becomes an important determinant of plant location. A negative sign of the coefficient for X1 in all the equations shown in Tables 2 and 3 indicates that greater

Table 2. Results of stepwise regression analysis, using plant location dummy as the dependent variable (N=68)

	Mean	SD	N	Label
Y1	.70	.46	68	plant location dummy
X1	.40	.41	68	nonproduction/production workers
X2	.32	.47	68	nonlocal backward linkages dummy
X3	.69	.47	68	domestic backward linkages dummy
X4	612.07	2071.45	68	plant employment size
X5	10.94	6.44	68	age of plant

	Y1	X1	X2	X3	X4	X5
Y1	1.00					
X1	−.31*	1.00				
X2	.52	−.08	1.00			
X3	−.16	.28	.39*	1.00		
X4	.18	−.07	−.18	−.09	1:00	
X5	.30*	−.19	.27	−.03	.18	1.00

* significant at the 5 percent significance level;
SD: standard deviation; N: number of cases.

Equation	R^2	$\triangle R^2$	F	SEE
(1) Y1 = .46 + .54 X2 (3.6)*	.26		13.2	.43
(2) Y1 = .80 + .72 X2 − .52 X3 (−3.5)* (−3.5)*	.44	.18	14.8	.38
(3) Y1 = .74 + .77 X2 − .52 X3 (5.9)* (−3.7)* + 0.00053 X4 (2.5)**	.52	.08	13.2	.35
(4) Y1 = .81 + .76 X2 − .44 X3 (5.9)* (−3.2)* + 0.00050 X4 − .24 X1 (2.4)** (−2.1)**	.58	.06	11.9	.34
(5) Y1 = .82 + .76 X2 − .44 X3 (5.4)* (−3.1)* +0.00051 X4 −.25 X1 − 6.35 X5 (2.4)** (−2.9)** (−0.1)	.58	.00	9.2	.34

* coefficient significant at 99 percent confidence level;
** coefficient significant at 95 percent confidence level;
SEE: standard error of the estimate; N: number of cases;
t−statistic in parenthesis; $\triangle R^2$: change in R^2.

Table 3. Results of stepwise regression analysis, using distance from Seoul as the dependent variable (N=68)

	Mean	SD	N	Label
Y2	118.29	129.37	68	distance from Seoul
X1	.40	.41	68	nonproduction/production workers
X2	.32	.47	68	nonlocal backward linkages dummy
X3	.69	.47	68	domestic backward linkages dummy
X4	612.07	2071.45	68	plant employment size
X5	10.94	6.44	68	age of plant

	Y2	X1	X2	X3	X4	X5
Y2	1.00					
X1	−.30*	1.00				
X2	.16	−.01	1.00			
X3	−.14	.13	.47*	1.00		
X4	.09	−.04	−.16	−.07	1.00	
X5	.08	−.22	.11	−.09	.19	1.00

* Significant at the 5 percent significance level;
SD: standard deviation; N: number of cases.

Equation	R^2	$\triangle R^2$	F	SEE
(1) Y2=155.2−92.7 X1 (−2.5)*	.09		6.3	124.5
(2) Y2=134.4−91.8 X1+63.4 X2 (−2.5)* (2.0)**	.14	.05	5.3	121.7
(3) Y2=172.1−79.4 X1+99.4 X2 (−2.2)* (2.9)** −78.5 X3 (−2.2)*	.20	.06	5.4	118.2
(4) Y2=212.4−89.2 X1 +109.1 X2 (−2.5)* (3.1)** −85.3 X3 −3.2 X5 (−2.4)* (−1.4)	.23	.03	4.6	117.4
(5) Y2=212.4 −89.3 X1 +106.6 X2 (−2.5)* (3.0)** −84.7 X3 −3.0 X5+ 0.003 X4 (−2.4)* (−1.2.) (0.4)	.23	.00	3.6	118.2

* coefficient significant at 99 percent confidence level;
** coefficient significant at 95 percent confidence level;
SEE: standard error of the estimate; N: number of cases;
t−statistic in parenthesis; $\triangle R^2$: change in R^2.

labor−intensiveness characterizes electronics production in less developed areas. Metropolitan electronics plants, on the other hand, make greater use of nonproduction labor. They are found to be, to a large extent, engaged in the production of technology−intensive industrial electronics products or components production in which both skilled labor as well as the acquisition and interchange of technical information assume primary importance[3]. They tend to produce unstandardized and, often, "one−off" products with rapidly changing technology and capricious market demands− products that require less fixed capital outlay for production equipment [see, e. g., Keeble (1976)]. In this case, the metropolitan agglomeration economies, specifically reflected in the abundance of skilled labor and better access to technical know−how and markets, undoubtedly play a major part in attracting technology−intensive, more nonproduction labor−using electronics plants. These plants' preferences for lhigher agglomeration economies were also reported in the U. S. [Estall

(1963); Glasmeier, Hall & Markusen (1983)] and in the U. K. [Keeble (1976); Hoare (1983)].

The coefficient for the interregional backward linkages (X2) variable in Tables 2 and 3 is statistically significant. In particular, this variable, despite its insignificant correlation with distance from Seoul, becomes one of the most significant variables contrasting metropolitan electronics plants with plants in less developed areas. As expected, the positive sign of the coefficient for X2 reflects not only the metropolitan electronics plants' greater use of local suppliers, but also those plants' intent to make greater use of Seoul's agglomeration economies. Expecially when we consider that metropolitan electronics plants are closely related to technology-intensive production, it would appear that their rapidly changing technology and market demands force them to maintain greater flexibility in forming input/output linkage networks. If they are to reduce transaction costs associated with inputs purchasing, they must remain close to a wide range of suppliers capable of meeting changing input requirements and technical specifications. Both easy access to large domestic markets and a large concentration of suppliers and subcontractors in Seoul, therefore, become obvious advantages.

Although electronics plants in less developed areas rely more on suppliers outside their local areas, the expenses they incur from interregional transport of domestic inputs constitute a low proportion of total production costs [see, for example, Han (1989), p. 281]. This suggests that transport expenses do not become an obvious obstacle to the decentralization of electronics plants toward other regions, and that some decentralized electronics plants can certainly offset those transport expenses by fully exploiting other comparative advantages available.

As shown in Table 2 and 3, the domestic backward linkages (X3) dummy becomes a significant determinant, despite its insignificant negative correlation with plant location, measured either as a dummy variable or as road distance from Seoul. This is undoubtedly because this variable takes up the effects of other variables with which it is correlated, particularly of X2. This variable's nagative regression coefficient substantiates its hypothetical relationship with plant location. Likewise, the greater reliance of electronics plants in less developed areas on foreign sources can induce their production facilities to locate in areas outside the Seoul metropolitan area, provided that these areas are equipped with adequate infrastructure. A similar phenomenon was found in a study of manufacturing decentralization in Korea by Lee(1983), who showed that large, export-oriented firms tend to locate near the periphery of Seoul, where the space needed for modern facilities is available. The results also suggest that metropolitan electronics plants tend to utilize the agglomeration advantages of Seoul, particularly reflected in a wider existence of domestic suppliers.

The plant employment size(X4) variable has a statistically significant coefficient coefficient, quite different from zero in Table 2, ldespite its insignificant positive correlation with plant location. As in the case of the domestic backward linkages dummy, the considerable degree of intercorrelations with other variables caused this variable to take up part of their effects, thus helping it become a significant determinant. The positive sign of the coefficient for X4 suggests that, in general, electronics plants in less developed areas are larger than those in Seoul. In this respect, the lower land prices in the former areas becomes an obvious advantage with respect to the ability to retain large－scale plants, particularly when they associated with capital－intensive production requiring large factory space. Also, in a case in which large－scale electronics plants are engaged in labor－intensive mass production, the less developed areas become more attrative locations due to their abundance of cheap and less skilled labor. Large－scale consumer electronics and assembly－oriented electronic components plants in areas outside Seoul exemplify this characteristics. In contrast, the Seoul metropolitan area, experiencing agglomeration diseconomies reflected in higher land prices and wages, becomes a less attrative location for these types of production.

The plant employment (X4) size variable, however,becomes statistically insignificant when it is regressed on road distance from Seoul, as shown in equations (4) and (5) in Table 3. This insignificance indicates that electronics plants show a peculiar spatial pattern with respect to employment size, a pattern derived not from their varying distances from Seoul, but from their greater susceptibility to location factors specific to electronics production. In other words, a considerable number of large－scale, market－oriented plants, particularly those engaged in consumer electronics production, would tend to locate within or near the periphery of Seoul, since they have a greater need to locate near domestic markets. Insofar as the agglomeration advantages available in Seoul can actually offset its agglomeration diseconomies reflected in high wage and land price, those plants continue to locate there, possibly introducing negligible variations in plant employment size. On the other hand, quite a few small, export－oriented electronics plants requiring cheap labor would prefer to locate in areas away from Seoul, if adequate infrastructure is provided. In particular, the Kumi Industrial Estate becomes a favorable site for those plants. It provides localization economies, such as a large supply of low cost labor, and also government incentives. Two specific factors, market orientation and a need for low cost labor, could, therefore, help to nullify the effect of distance from Seoul on variations in plant employment size.

A statistically insignificant age of plant (X5) effect shown in Tables 2 and 3 suggests that this variable is unrelated to plant location. Also, when included in the stepwise regression equation, this variable does not cause a change of R^2, despite its significant positive correlation with plant location (see Table 2). This may be because part of the effect of age of plant is being taken up by other variables with which it is intercorrelated, particularly by X2. Another plausible explanation can be offered for this variable's insignificance: a substantial proportion of new firms creation has actually occurred outside the Seoul area, particularly in its adjacent Kyonggi region and the Kumi area since the late 1970s. The localization economies available in the latter—reflected in a wider existence of labor skills, suppliers, subcontractors, and acquisition and interchange of technical know—how—would become significant in attracting new firms. Both better access to metropolitan agglomeration economies and a possibility of reducing fixed capital costs(e. g., land costs) required for initial operations would allow new firms to locate their production facilities, separable from their headquarters, in the Kyonggi region. This process was also aided in part by Korean government's industrial relocation policies that prohibit new firms creation in the Seoul area.

Overall, the above regression analysis results showed that only four variables, X1, X2, X3 and, to some extent, X4, become significant determinants of the decentralization of Korean electronics. Ample opportunities for innovation, as well as for acquisition and interchange of technological information, combined with skilled labor availability and a wider range of domestic suppliers, undoubtedly play a critical role in attracting skill—intensive electronics plants with a strong tendency to rely on local suppliers. The age of plant variable, however, becomes an exception, showing a sign of the new firms' lesser preference for the agglomeration economies provided by Seoul.

Our empirical objective is to show that, if the product cycle assumption of interregional locational shifts is correct, the regression coefficients of "nonproduction/production workers (X_1)" variable, on one hand, and "interregional backward linkages (X_2)" and "plant employment size (X_4)" and "age of plant (X_5)" variables, on the other, are negative and positive, respectively, when the five hypothesized variables are regressed on the plants' distance from Seoul. This would prove that electronics plants in the Seoul metropolitan area would be newer, smaller, use less production labor, and reveal a high incidence of intramentropolitan backward linkages. In contrast, electronics plants in less developed areas would be larger, older, embody more labor—intensive processes, and depend less on agglomeration economies.

The results in Table 3 show that the negative and positive regression coefficients for X_1 and X_2, respectively meet the above expectations. In addition, X_2 and X_3 variables' respective positive and negative signs indicate that metropolitan electronics plants can be characterized by a greater reliance on domestic suppliers and a lesser reliance on interregional backward linkages. Electronics plants in less developed areas, conversely, depend less on domestic and intraregional backward linkages. This, again, reinforces the claim that intraregional backward linkages are vital to metropolitan plants. The age of plant (X5) and plant employment (X4) variables show negative and positive signs for their coefficients, respectively, in contradiction to the product cycle assumption of industrial location. Also, the coefficients for these variables do not become statistically significant, although that of the plant employment variable becomes significant in Table 2. Thus, they provide a basis with which to reject the established hypothetical relationship.

To provide support for the product cycle's application to Korean electronics, the exact causes of relocation were analyzed, using data based upon the questionnaires delivered to sample movers. Relocation is especially appropriate for this analysis, since it is a characteristic phenomenon that exemplifies, in a concrete manner, the interregional location behaviors; it can be expected from the product cycle that relocation of the plants using a labor—intensive process in less developed areas becomes a major vehicle for achieving manufacturing decentralization, caused by both their greater need for lower cost labor, combined with improvements in productivity.

The responses of those plants relocated to less developed areas outside Seoul are listed in Table 4. About 61 percent of electronics plants moved voluntarily for reasons related to improvement in productivity (Reason 1), and the availability of cheap labor and land (Reason 3 or 4). About 11 percent moved in response to the government's industrial relocation objectives (Reason 5). Those plants affected by government tax incentives schemes (Reason 2) made up 22.2 percent, a considerable portion.

The results, shown in Table 4, reveal the importance of within—firm motivations to relocate, in accord with the product cycle proposition that interregional shifts in location are a result of both a relocating plant's intent to exploit the low labor costs advantages provided by less developed areas, and increases in productivity. These within—firm motivations would become the prime cause of the relocation of labor—intensive, assembly—oriented electronics plants with a greater need for low cost labor. Aside from these plants, large—scale, capital—intensive electronics plants sometimes become candidates for relocation, since they can make greater use of the cheap, spacious land available in those areas. Table 4 shows, again, that government tax subsidies for relocation are more important in spurring the movement to less developed areas than direct relocation policies. In some cases, government subsidies work as additional incentives to potential movers, relieving the burden of relocating costs.

Given this context, we can notice that relocation to less developed areas is affected more by an electronics plant's voluntary motivation—that is, its intent to make greater use of lower labor costs advantages and, in some cases, cheap land, as well as increases in productivity—than by external forces, such as government—ordered relocation, for example. Although limited data fails to provide exhaustive evidence, the product cycle concept can be a useful theoretical tool with which to explain the decentralization of the Korean electronics industry, especially its movement from the Seoul metropolitan area to less developed areas.

Table 4. Reasons for relocation

Reasons	1	2	3	4	5	6	Total
Number of plants	12	12	10	11	6	3	54
Percent (%)	22.2	22.2	18.5	20.4	11.1	5.6	100

Soure: Compiled from the author's questionnaire survery.

Notes: 1 improvement in productivity; 2 tax subsidies for relocation; 3 availability of cheaper labor; 4 land availability and prices; 5 relocation order; 6 proximity to suppliers.

V. Conclusion

Tests of a representative sample of Korean electronics plants showed that, among the four product cycle variables, the nonproduction/production and interregional backward linkages ones are statistically significant, supporting the product cycle assumption. The plant employment size variable, although statistically insignificant, was consonant with its hypothesized positive relationship with distance from Seoul. The results, therefore, provided some evidence to support the product cycle assumption of interregional location shifts particulary in Korea's electronics industry.

Inevitably, there are basic limitations in some hypotheses used to test the validity of the product cycle as applied to the spatial decentralization of Korean electronics. Elements of the product cycle include not only endogeneous technical changes (skill proportion) and external (agglomeration) economies, but also variations in demand structures. In the present study, the first too elements have been analyzed for their validity in explaining locational trends: however, we have said nothing about the third element. For a complete study, demand should be accepted as one of the critical locational factors determining a plant's spatial distribution. It is also necessary to qualify the generalizations obtained from the stepwise regression analyses. First of all, more reliable indicators of the product cycle, particularly of agglomeration economies, would have to be developed and regressed. We shold guestion, further, whether skill-and labor-intensive electronics plants in both regions are exactly equivalent to innovative and mature electronics goods-producing plants, respectively.

NOTES

[1]Hansen(1983), testing the product cycle assumption with Brazilian industry data, used intraregional material linkages as a proxy for agglomeration economies.

[2]The last two criteria were established through an examination of the frequency distribution of a total of 607 domestic electronics plants with respect to each variable. In other words, the value of "mean"for each variable was used as a criterion with which the population could be stratified into two groups.

[3]Of the total 21 electronics plants in the sample, 18 engaged in the production of industrial electronics products or components.

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〈國文抄錄〉

生產品週期理論과 韓國電子產業의 地方分散

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1966年 Vernon이 提案한 生產品週期理論(product cycle)이 工業立地硏究에 積極的으로 活用된 것이 1970年代부터이다. 從來의 工業立地理論들이 輸送費中心的이고 工業技術變動에 의한 立地變動을 考慮하지 못했으나 生產品週期理論은 工業의 發展－衰退에 따른 國際間혹은 地域間 工業立地의 變動을 休系的으로 分析함으로써 工業立地硏究에 動態的이고 長期的인 眼目을 提示하였다. 그러나, 生產品週期理論의 개발도상국가에의 適用은 1983年 Hansen의 브라질工業立地變動分析에 지나질 않아 아직 미흡한 편이다. 本硏究는 1970年중반부터 나타나기 시작한 韓國電子產業의 地方分散현상을 生產品週期理論에 입각하여 單純檢定함으로써 그 理論的 妥當性을 提高데 있다.

韓國電子產業의 地方分散현상을 生產品週期理論에 따라 實證分析키 위해 4개의 分散要因變數, 즉 非生產職勤勞者－生產職勤勞者比率(nonproduction/production workers), 地域內物資및서비스連繫, 工場規模, 그리고 操業期間을 中心으로 假設을 設定하여 層化抽出方法(stratified random sample design)으로 얻은 68개의 國內電子業體를 대상으로 回歸分析하였다. 回歸分析結果에 의하면 生產品週期理論의 주요代理變數인 기술인력의 집약적사용도와 集積利益(agglomeration economies)의 이용도는 電子業體의 서울大都市圈으로부터의 거리에 反比例하고있어 設定된 假設을 立證하는 반면 工場規模나 操業期間은 生產品週期理論에 근거한 電子工業의 立地變動을 설명하는데 說得力이 크게 없는것으로 나타났다. 특히, 서울大都市圈外部地域으로 再配置한 電子業體의 경우는 주로 業體內部的 要因, 즉 製造技術의 變動으로 인한 저렴한 勞動力과 工場부지에 대한 수요증가와 生產性의 增大에 의한 結果로 대부분 나타나고있어 生產品週期理論이 示唆하고 있는 바와 一致하고있다.

요컨데, 生產品週期理論은 韓國電子產業의 地方分散현상을 설명하는 하나의 理論的 틀(framework)로서 어느정도 妥當性이 있다는 것이 本硏究에서 밝혀졌다. 그러나, 개발도상국가의 전반적인 工業立地變動分析을 위해서 이 理論을 적용하는데는 理論的 그리고 實證 分析上의 制約이 많이 있기 때문에 注意를 요한다.