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An Analysis of Agglomeration Economies in the Manufacturing Sector of Korea

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Ⅰ. Introduction

Economic activities tend to be concentrated in certain locations rather than spread evenly over the entire area of any given country. This is especially more true of many manufacturing industries than primary or service industries. This phenomenon of industrial agglomeration not only is universal but also has been observed throughout the history of the modern industrial society.

Korea provides a good example of this general tendency. As a matter of fact, Korea is one of the few countries that have resorted to a policy of promoting industrial agglomeration in the pursuit of government-led economic development.

In the case of Korea, this policy, combined with its remarkably high rates of economic growth sustained through the 1960s-80s, has resulted in a pattern of regional economic growth that is heavily skewed towards the south-easterly axis running from the nation's capital, Seoul, to the Gyeongnam Province. So much so, in fact, that balanced national development is one of the major — one may even say the most important — national policy agenda of the present government. It has legislated the Special Law for Balanced National Development, and is currently implementing the first Five-Year Balanced National Development Plan (2004~2008) that puts emphasis on, among other things, industrial clustering in the country's regions.

Given these recent policy developments, this paper attempts to provide answers to some of the pressing policy questions concerning industrial clustering. The most important issue here is that of the industrial concentration in the Capital Region which includes Seoul, Incheon and the Gyeonggi Province, which has defied the continued efforts of the successive administrations to reverse the trend. We approach this issue by estimating both the static and the dynamic effects on the productivity of firms or industries of agglomeration in the Capital Region and comparing them with those in the Non-Capital Region. We also address the related question of what are the factors that give rise to agglomeration economies, by region and by industry.

In Section Ⅱ the concept of agglomeration economies is explained and their sources are discussed, while in Section Ⅲ we look at the state of industrial agglomeration in Korea. Our model for the estimation of agglomeration externalities is presented and the estimation results are discussed in Section Ⅳ. The paper concludes by deriving implications for industrial clustering policies in the final section.

Ⅱ. The Concept and Sources of Agglomeration Economies

Agglomeration economies can be defined as the external economies (or diseconomies) that arise from the concentration of firms or industries in a particular location. Agglomeration economies are usually measured by cost reductions or productivity increases of the firms or industries in an agglomerated region; sometimes (when data for production cost or output are unavailable), these measures are replaced by changes in the level of employment or in the rates of employment growth.

The original idea of agglomeration economies can be traced to Alfred Marshall (1980), although he did not use the term as such. He argued that businesses gather around a locality because there are advantages to operating amongst businesses following the same skilled trade: advantages associated with the diffusion of trade secrets, inventions and improvements in machinery, in processes and the general organizations of the businesses, exchange of new ideas, and the proximity of firms supplying materials and equipments.

There are two categories of agglomeration economies. One is localization economies; these arise from interactions of firms operating in the same kind of local industry. Localization economies are external to the individual firms but internal to the local industry in question. This is sometimes called Marshall-Arrow-

Romer's (MAR) externalities due to the respective authors.[1] The other is urbanization economies deriving from the variety and diversity, rather than specialization, of geographically proximate industries.[2] These economies are external to the individual firms and industries but internal to the local economy as a whole.

Agglomeration economies can be further differentiated between static and dynamic economies. The static economies refer to the changes in the level of cost, productivity or employment of a firm or industry at a point in time, whereas the dynamic economies are associated with the rate of change of cost, productivity or employment over a given period of time.

There is more or less a consensus in the literature on the sources of agglomeration economies. These are:

(ⅰ) the economies of scale in the local supply of intermediate inputs;
(ⅱ) higher efficiency of the local labour market;
(ⅲ) spillovers of information and knowledge; and
(ⅳ) improvement in the quality of public utilities such as communication infrastructure, electricity, and water supply.

Finally, but above all else, there is the role of increased local competition, but opinions (and empirical evidence as well) are divided on this. One school, represented by Marshall-Arrow-Romer, maintain à *la* Schumpeter that less competition is

1) Arrow(1962) provided an early formalization of knowledge spillovers between firms in a local industry, while, much later, Romer(1986) emphasized the importance of knowledge spillovers in the context of economic growth.
2) Jacobs(1969) is an early exponent of this idea.

beneficial to the growth of local industry because it enables better internalization of the benefits of knowledge spillovers which in turn is conducive to greater innovation. The other school, including Jacobs(1969) and Porter(1990), follow the orthodox argument that greater competition promotes innovation and growth.

So far, we have discussed agglomeration *economies* only. This, of course, does not mean that agglomeration economies are always positive. As industrial concentration in a given place increases beyond a certain level, negative agglomeration economies, i.e., agglomeration *dis*economies, set in and lead to a rise in production cost. Typical examples include a rise in the price of lands and buildings, the associated hike in wages, traffic congestion and pollution.

Ⅲ. The State of Industrial Agglomeration in Korea

Before we set out to investigate empirically the extent of agglomeration economies in manufacturing industries in Korea, it will be useful first to have a look at a broad-brush picture of industrial agglomeration in the country. For this, we first differentiate between agglomerated and non-agglomerated regions

Table 1. Geographical Distribution of Agglomerated Regions, 2001

Province/ Metropolitan City	No. of Agglo. Regions	% Share of national total		
		Value added[1)]	Employees[1)]	Population
Seoul[2)]	1	1.15	1.43	0.56
Incheon[2)]	2	3.25	4.71	1.62
Gyeonggi	8	19.41	16.80	8.29
(Sub-total: Capital Region)	(11)	(23.81)	(22.94)	(10.47)
Gwangju[2)]	1	1.11	1.17	0.56
Daejeon[2)]	1	1.36	0.90	0.49
Ulsan[2)]	1	11.30	5.10	2.24
Chungbuk	1	1.42	1.09	1.26
Chungnam	2	3.84	3.02	1.32
Jeonnam	2	3.19	1.03	0.97
Gyeongbuk	2	7.64	3.84	1.83
Gyeongnam	4	6.98	7.55	2.48
Total	25	60.66	46.64	21.62

1) Manufacturing industries only.
2) Metropolitan city.

Table 2. Geographical Distribution of Agglomerated Regions, 1988

Province/ Metropolitan City	No. of Agglo. Regions	% Share of national total		
		Value Added[1]	Employees[1]	Population
Seoul[2]	3	6.92	9.12	4.27
Incheon[2]	2	4.79	5.42	1.51
Gyeonggi	8	14.47	13.05	3.93
(Sub-total: Capital Region)	(13)	(26.18)	(27.59)	(9.71)
Busan[2]	2	3.97	7.02	1.35
Daegu[2]	1	1.61	2.43	0.68
Daejeon[2]	1	1.06	0.84	0.29
Chungbuk	1	1.41	1.35	0.88
Jeonnam	1	1.50	0.24	0.11
Gyeongbuk	2	6.80	3.49	0.83
Gyeongnam	4	12.47	9.75	3.83
Total	25	55.00	52.71	17.68

1) Manufacturing industries only.
2) Metropolitan city.

and define the former as the region whose manufacturing value-added share of the national total is not less than one per cent.[3] Geographically, we define a region at the lowest autonomous administrative levels of city, *kun*,[4] and *ku*.[5] There are 243 and 267 such administrative units in Korea as of 2001 and 1988, respectively.

3) This criterion of one per cent is of course arbitrary, but so would any other number. In the present case, we justify our choice by the fact that the resulting identification of agglomerated regions on our definition nicely fits with the actual localities with heavy industrial concentration.
4) Roughly corresponding to a county.
5) Roughly corresponding to a district.

Tables 1 and 2 show the share of agglomerated regions in the country's total manufacturing value added, manufacturing employment, and population in 2001 and 1988, respectively. In 2001, agglomerated regions altogether account for 60.7% of total manufacturing value added. The number of agglomerated regions on our definition is only 25, or 10.3%, out of total 243 administrative units. The corresponding share of manufacturing employment, by contrast, is 46.6%, implying that agglomerated regions are specialized in relatively capital- or technology-intensive industries compared with non-agglomerated regions. On the other hand, population "density" in the industrially concentrated regions is much lower than in non-agglomerated regions.

Of Korea's 16 provinces and metropolitan cities in total,[6),7)] the Gyeonggi province has by far the largest number of agglomerated regions, accounting for 19.4% of the nation's total manufacturing value added, followed by the Gyeongnam province with four agglomerated regions. In terms of value added share, however, Ulsan is the second most heavily aggregated region after Gyeonggi, with 11.3% of total value added. The Capital Region, consisting of Seoul, Incheon and Gyeonggi, altogether has 11 agglomerated regions out of total 25, and explains about a quarter of total manufacturing output and employment.

Table 2 for 1988 paints a roughly similar picture of regional

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6) Some of the 16 provinces and metropolitan cities are not included in Tables 1 and 2 as they have no agglomerated regions on our definition.

7) Metropolitan cities will henceforth be also referred to as provinces for simplicity of expression.

manufacturing agglomeration to Table 1 for 2001. The number of agglomerated regions, at 25, happens to be the same as for 2001, but it represents 9.3% of total 267 administrative units in 1988 compared with 10.3% in 2001. The agglomerated regions' combined share of total manufacturing production is also lower than in 2001 (55% against 60.7%). This can be interpreted as an indicator of increased industrial concentration over the 13-year period. In terms of manufacturing employment, the higher share (52.7%) in 1988 compared with 46.7% in 2001 signifies that the capital- and technology-intensity of manufacturing production in the agglomerated regions has risen over the period.

The Gyeonggi province was again the most heavily concentrated of the country's provinces in 1988. However, its value added share at 14.5% was much lower than the corresponding share (19.4%) in 2001. The second most heavily agglomerated province in 1988 was Gyeongnam, with 12.5% of total value added. On the other hand, the Capital Region's combined share in 1988 was lower than in 2001 in both value added and employment terms. Thus, industrial concentration in the Capital Region decreased somewhat between 1988 and 2001, although the country's overall agglomeration measured by value added share increased slightly during the same period.

Ⅳ. Estimation of Agglomeration Economies

1. Why Another Estimation?

In this section we estimate agglomeration economies in Korea's manufacturing sector. Agglomeration economies are measured in terms of their effect on value added productivity per employee at the firm or industry level. The purpose of this empirical examination is (ⅰ) to compare and contrast the agglomeration externalities in the Capital Region with those in the Non-Capital Region; (ⅱ) to differentiate agglomeration economies by region and by industry; (ⅲ) to find out the changes in the extent of agglomeration economies over time; and (ⅳ) to identify the factors that contribute to the economies of agglomeration. We estimate both static and dynamic agglomeration economies. Static agglomeration externalities are estimated for 1988 and 2001, respectively, and dynamic agglomeration economies for the period of 1988~2001.

There exist quite a number of studies in the literature that have estimated agglomeration economies. However, there are only a handful of such investigation for the Korean case. Here we add our analysis to the existing empirical research on Korea for there remain several questions that have not received sufficient treatment.

First of all, we differentiate agglomerated regions from

non-agglomerated ones in our estimation. This is what the existing empirical studies have *not* done: their regional classification is solely in terms of administrative divisions such as provinces and cities, regardless of their differences in the degree of industrial agglomeration. However, we start from the hypothesis that the size and characteristics of agglomeration economies are different as between agglomerated and non-agglomerated regions. Working with this hypothesis has the additional advantage of sharpening the policy implications deriving from the empirical analysis.

Secondly, we investigate changes in agglomeration economies by estimating for two different years, 1988 and 2001. The only empirical study that has looked at temporal changes in agglomeration externalities is Lee and Yoon (1998) who, however, used data at manufacturing sub-sectoral level compared with our firm-level data. In addition, our analysis updates estimation to 2001 whereas Lee and Yoon's latest estimate was for 1993.

Thirdly, we explicitly compare and contrast estimates for the Capital Region with those for the Non-Capital Region, which no previous study has done. We believe that policy implications derived therefrom will be of greater relevance.

2. The Model

(1) The static model

We follow the literature in taking the flexible production function as our starting point:

$$Y = A(\cdot) \cdot F(K, L) \quad \cdots\cdots (1)$$

where Y is value added, K the capital stock, L the labour, and $A(\cdot)$ a shift function representing external economies.

Eq.(1) can be rewritten as an intensive production function on the constant-returns-to-scale assumption of $F(\cdot)$:

$$Y/L = A(\cdot) \cdot f(K/L) \quad \cdots\cdots (2)$$

where Y/L is value added per employee.[8] As theoretical discussion of the arguments to be included in $A(\cdot)$ is abundantly done in the literature, we will straight away posit our log-linear estimation equation for static agglomeration economies as follows:

$$\begin{aligned}\log(V/L) = {} & b_1 \log(K/L) + b_2 \log(SPEC) + b_3 \log(COMP) \\ & + b_4 \log(DIV) + b_5 \log(L_j / E_j) \\ & + b_6 \log(LT/ET) + b_7 \log(L_j / Area) \\ & + b_8 \log(POP) + b_9 \log(Road/Area) \\ & + b_{10} \log(HS) + b_{11} \log(COL) + DR + DI + e \quad \cdots\cdots (3)\end{aligned}$$

In this equation all the variables must carry subscripts i (for firm), j (for industry) and r (for region), but in most cases they have been suppressed to avoid notational clutter. Thus, for example, V/L stands for $V_{i,j,r} / L_{i,j,r}$ and $SPEC$ for $SPEC_{j,r}$.

- *The variables*

$SPEC$ (specialization) denotes the degree of specialization of

8) To be precise, employees here include non-paid family members working for the firm.

the regional industry (henceforth, "region-industry") in which the firm is operating, and is defined as follows:

$$SPEC_j = (V_j / \sum_j V_j) / (V_{jT} / V_T)$$

V_j = industry j's regional total value added;
$\sum_j V_j$ = region's total manufacturing value added;
V_{jT} = national total of V_j ;
V_T = national total manufacturing value added.

COMP (competition) signifies the degree of competition in the region-industry and defined in such a way as to show an inverse relationship between the value of the variable and the intensity of competition:

$$COMP_j = \sum s^2$$

s = the share of a firm's value added in V_j.

DIV (diversity) measures the industrial diversity of the region and is likewise defined so as to exhibit an inverse relationship:

$$DIV_j = \sum s_k^2$$

s_k = the value added share of each of the largest five industries ($k \neq j$) in the region.

E_j denotes the number of firms in a regional industry j, hence L_j/E_j shows the average size of industry j in terms of the number of employees. Similarly, letting LT and ET respectively measure the total number of employment and firms in the

region's manufacturing sector as a whole, LT/ET shows the average size of the region's firms. The estimated value of b_5 on L_j/E_j captures the economies of scale in the region-industry j and reflects part of localization economies, whereas b_6 on LT/ET will reflect the size of scale economies in the region's manufacturing sector as a whole, hence part of urbanization economies.

$L_j/Area$ represents the employment density of industry j of a region and is used to capture the possible effect of the intensity of interaction among workers employed in industry j. This variable draws on Ciccone and Hall (1996). While other studies, for example Henderson (1986) and Lee (2000), include L_j or $1/L_j$ to capture localization economies, we disregard either of this variable in our model as their inclusion would cause multicollinearity and/or endogeneity problem.

POP denotes the size of regional population, and $Road/Area$ dividing the total length of roads in a region by its size measures regional road facility. Two education variables are also included. COL (college) is the proportion of workers employed in a region's manufacturing sector with at least college education, and HS (high school) without it. These two variables are defined not for individual firms but for the region as a whole. Therefore, they are only intended to capture indirectly the effect of schooling on firm-level productivity through its influence on the quantity and quality of information and knowledge spillover among workers in the region.

Finally, two kinds of dummies are included in the equation to allow for fixed effects due to characteristics specific to individual regions and industries. DR is defined for each province (16 in 2001 and 14 in 1988), and DI for each industry

(22 in 2001 and 28 in 1988).

The data we use for value added, employment, and capital stock in 2001 are at the establishment[9] level in the two-digit Korean Standard Industrial Classification (KSIC) manufacturing industries, while the data for 1988 are at the two- or three-digit industry level.[10] These data were obtained from the Korea National Statistical Office (KNSO). Geographically, the data cover the entire country at the lowest administrative levels of city, *kun,* and *ku*. The rest of the data, on population, area, road, and education, are at the regional or two-digit industry level and were obtained from the Korea Statistical Information System (KOSIS) or other statistical publications from the KNSO. The maximum size of our cross-sectional sample is 103,738 establishments for 2001, of which 33,391 are in agglomerated regions and the rest in non-agglomerated ones. The corresponding sample sizes for 1988 are 52,420, 20,946, and 31,474 establishments, respectively.

The generalised linear squares (GLS) method has been used for all our regressions, while the White's method has been applied to treat the heteroscedasticity problems frequently encountered in cross-sectional analysis such as ours.

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9) So far we have used the term "firm" instead of "establishment". The actual data we use for estimation below are those for establishment. In Korea's statistics a firm may have two or more establishments in different locations.

10) The industry classification to be used for 1988 estimation will be described in more detail below.

(2) The dynamic model

We also estimate dynamic agglomeration economies over the period of 1988~2001. Dynamic agglomeration economies are estimated by the rate of change of productivity (or employment or production cost) over a period of time that derives from an agglomeration of industrial activities in a given place.

Some modifications to the static model described above are required to transform it into a dynamic one. In the static model represented by Eq. (1) the level of technology is given at a point in time and thus ignored. For dynamic analysis, however, changes in technology need to be taken into consideration. Following the literature and drawing in particular on Glaeser et al. (1992) on this point, we assume that the technology (A) of the economy as a whole consists of two elements:

$$A = A_N \cdot A_r \quad \cdots\cdots (4)$$

where A_N denotes the national component common to all regions and A_r is the regional component. The growth of technology then is the sum of the growth of national technology and that of regional technology:

$$\log(A_{t+1}/A_t) = \log(A_{N,t+1}/A_{N,t}) + \log(A_{r,t+1}/A_{r,t}) \quad \cdots\cdots (5)$$

The regional element is assumed to grow at a rate exogenous to the firm in a region but to depend on various technological externalities affecting the region-industry:

$$\log(A_{r,t+1}/A_{r,t}) = g(\textit{specialization}, \textit{competition}, \textit{diversity}, \textit{initial conditions}) + e_{t+1} \quad \cdots\cdots (6)$$

All the variables in $g(\cdot)$ are evaluated at the base time t (=1988), but the time subscript has been dropped for simplicity. Initial conditions include the average firm size and employment density of the region-industry, and the population and the road ratio of the region.

Next, in order to capture technological changes at the national level, we include three categories of control variables each representing the growth of all other region-industries. (The detailed definitions of these will follow shortly.) This is because technological changes in other region-industries will lead to changes in their demand and production, which in turn will impinge on the production per labour of the particular region-industry in question. Apart from reflecting the influence of technological changes, growth of other region-industries will also reflect spatial interdependence between different region-industries. For example, an increase in production in region r_1 owing to a non-technological shock may cause an increase or decrease in production in the neighbouring region r_2.

Taking all these considerations into account, we postulate our dynamic estimation equation as follows:

$$\begin{aligned}\log(GVL) = {} & b_1\log(SPEC) + b_2\log(COMP) + b_3\log(DIV) \\ & + b_4\log(L_j/E_j) + b_5\log(LT/ET) \\ & + b_6\log(V_j/L_j) + b_7\log(GV1) + b_8\log(GV2) \\ & + b_9\log(GV3) + b_{10}\log(L_j/Area) \\ & + b_{11}\log(Road/Area) + b_{12}\log(POPT2) \\ & + DR + DI + e \qquad \cdots\cdots (7)\end{aligned}$$

As in the static equation (3) above, subscripts j and r have

been (selectively) suppressed for convenience. Because of data limitation, the basic data in the dynamic estimation are at the region-industry level instead of at the region-establishment level of the preceding static estimation. Thus subscript i for establishment is not required here.

Five new variables are included in Eq.(7) compared with Eq.(3). The dependent variable now is *GVL* instead of *V/L* previously. *GVL* is defined as $V_{j,t+1}/V_{j,t}$, the (multiple) rate of growth of value added per employee in industry j in region r. On the right-hand side, *GV1* measures the similarly defined growth rate of all other industries (i.e., except j) in the same region, *GV2* represents the growth rate of the same industry j in all other regions (except r), and *GV3* stands for the growth rate of all other industries in all other regions. *POPT2* denotes the initial population size at the provincial level. Definitions of the remaining explanatory variables are the same as for Eq.(3), except that V_j/L_j is now value added per employee in industry j in the initial period (t=1988).

As for data, value added and employment are now at the *industry* level, whereas they were at the establishment level in the static analysis. This is because industry j in 2001 is not the same as industry j in 1988 in terms of its constituent members (i.e., individual establishments) owing to exits and entries. Hence, the resulting estimates of dynamic agglomeration economies are those for industries not for establishments.

We have to modify also industrial classification. Because of changes in the KSIC during the sample period (1988~2001), it is not possible to use the same KSIC for our dynamic analysis;

so we rearranged individual industries into ten new subsectoral groups as shown in the Appendix Table A.1. In this process a few industries that had existed in 1988 but no longer did in 2001 had to be eliminated. The final total sample size is 1,258 region-industries, of which only 253 (20.1%) is in the agglomerated regions; this compares with 40.0% for 1988 and 32.2% for 2001 in the static analysis.

Finally, nominal value added data for the two sample years have been deflated into comparable real values using the Bank of Korea's national accounts deflators for 2000.

3. Estimation Results

(1) Static agglomeration economies

We first run Eq.(3) for all samples of 1988 and 2001, respectively, regardless of regions and industries and show the results in Table 3.[11] In all four columns, most of the explanatory variables have turned out to be highly statistically significant and carry the "correct" signs, that is to say, the signs predicted by theory. Conspicuously statistically insignificant is *DIV* in column (3). This is the variable representing the diversity of local industries and characteristically capturing urbanization

11) In all the tables presenting our estimation results, those for dummies representing each region (at the province level) and industry (at the two-digit level) are not shown for reasons of space. The dummies are in most cases found to be statistically significant at 1 or 5 per cent level.

Table 3 Static estimation results for all samples

Variables	1988		2001	
	(1) Agglomerated regions	(2) Non-agglomerated regions	(3) Agglomerated regions	(4) Non-agglomerated regions
$SPEC$	0.116*** (11.4)	0.039*** (7.6)	0.1097*** (8.8)	0.0321*** (8.0)
$COMP$	-0.071*** (-9.4)	0.008 (1.4)	-0.0545*** (-9.2)	-0.0225*** (-6.2)
DIV	-0.055*** (-4.9)	0.068*** (9.9)	0.0033 (0.3)	0.0139** (2.5)
L_j/E_j	0.124*** (8.9)	0.040*** (3.6)	0.1029*** (6.1)	0.1024*** (10.7)
LT/ET	0.120*** (6.8)	0.016 (1.3)	0.1271*** (6.1)	0.1089*** (9.1)
$L_j/Area$	-0.173*** (-13.7)	-0.015*** (-3.2)	-0.1087*** (-7.8)	-0.0064* (-1.9)
POP	0.071*** (3.8)	-0.057*** (-7.7)	0.1609*** (9.8)	-0.0123* (-1.9)
HS	0.014 (0.4)	0.420*** (19.6)	-0.1811 (-1.2)	0.4536*** (12.8)
COL	-0.061* (-1.9)	0.043*** (3.0)	-0.0052 (-0.2)	0.0824*** (8.0)
$Road/Area$	0.190*** (11.1)	0.021*** (2.9)	0.0635*** (4.6)	-0.0057 (-1.1)
K/L	0.224*** (50.8)	0.188*** (56.1)	0.2073*** (68.8)	0.1910*** (81.4)
$Adj.R^2$	0.2202	0.1899	0.2471	0.2204
Observations	20,946	31,474	33,391	70,349

Notes: t ratios are in parentheses.
*** 1%, ** 5%, * 10% significance level.

economies. In column (1) for 1988, however, DIV is revealed to be statistically significant and of the correct sign.

The results in columns (2) and (4) indicate the existence of

agglomeration economies in non-agglomerated regions as well. However, comparing the estimated coefficients between the two different sets of regions indicates that agglomerated regions exhibit consistently greater degree of agglomeration economies across the explanatory variables than non-agglomerated regions. This lends support to our working hypothesis adopted at the outset that the two sets of regions are qualitatively different from the point of view of agglomeration economies.

As the results shown in Table 3 pertain to country-wide samples ignoring regional divisions and industry types, their discussion need not detain us any longer, and we turn immediately to the more interesting question of how estimated agglomeration economies in the Capital Region compare with those in the Non-Capital Region.

• Capital Region vs. Non-Capital Region

Division of Korea's 25 agglomerated regions into the Capital and the Non-Capital regions yields more meaningful estimation results than does the estimation on all agglomerated regions treated as a single group. In Table 4 all variables except *DIV* are highly statistically significant and of the expected sign for both 1988 and 2001.[12] This shows clearly that firms enjoy agglomeration economiesin both the Capital and the Non-Capital Regions. Also to be noted is the negative sign on the competition

12) The two education variables, HS and COL, have been dropped in this and all subsequent regressions. This is because in most regressions they turn out to be statistically insignificant or they cause the singularity problem in estimation due to insufficient data variation within the sample.

Table 4. Static estimation results for Capital Region and Non-Capital Region

Variables	1988		2001	
	(1) Capital Region	(2) Non-Capital Region	(3) Capital Region	(4) Non-Capital Region
$SPEC$	0.101*** (6.9)	0.085*** (4.2)	0.124*** (4.3)	0.152*** (9.1)
$COMP$	-0.065*** (-6.9)	-0.079*** (-4.5)	-0.048*** (-5.6)	-0.112*** (-9.9)
DIV	-0.065*** (-3.4)	-0.012 (-0.5)	-0.008 (-0.7)	-0.010 (-0.4)
L_j/E_j	0.140*** (6.6)	0.087*** (3.4)	0.078*** (3.2)	0.151*** (5.6)
LT/ET	0.048** (2.0)	0.125*** (4.7)	0.097*** (3.6)	0.242*** (5.6)
$L_j/Area$	-0.157*** (-10.0)	-0.111*** (-4.6)	-0.137*** (-4.2)	-0.173*** (-8.5)
POP	0.047** (2.4)	-0.026 (-0.7)	0.187*** (8.6)	0.118*** (3.7)
$Road/Area$	0.147*** (7.7)	0.107*** (3.5)	0.072*** (2.8)	0.222*** (4.9)
K/L	0.224*** (39.6)	0.214*** (29.3)	0.199*** (51.6)	0.222*** (44.6)
$Adj.R^2$	0.2161	0.2431	0.2176	0.2946
Observations	13,379	7,564	21,992	11,399

Notes: Capital Region comprises Seoul, Incheon, and Gyeonggi Province.
t ratios are in parentheses.
*** 1%, ** 5%, * 10% significance level.

variable in both years, which indicates that the more intense the competition between firms in the same local industry, the greater its positive effect on productivity. This lends support to Michael Porter's thesis (rather than Marshall-Arrow-Romer's) that emphasizes the beneficial role of within-industry com-

petition for efficiency and innovation.

However, comparing columns (1) with (2), and (3) with (4) reveals interesting contrasts between the two regions. Especially noteworthy from the results for 2001 is the fact that the estimated coefficients on all the variables other than *DIV* and *POP* are much higher (in absolute value terms) for the Non-Capital Region than for the Capital Region. In other words, those variables reflect consistently stronger effect of agglomeration economies on the productivity of firms in the Non-Capital Region than in the Capital Region. In particular, competition has more than two times as much influence in the Non-Capital Region than in the Capital Region. Also in the case of the two variables reflecting scale economies, *Lj/Ej* and *LT/ET*, the two regions show similarly striking difference in the relative strength of their influence on productivity. However, the coefficients on *LT/ET* are greater than those on *Lj/Ej* in both regions, implying that the scale economies associated with inter-industrial interactions between different industries in the agglomerated regions are greater than the scale economies due to the average firm size in the same local industry.

It is only in the role of the population variable that the Capital Region shows relative locational preferability to the Non-Capital Region, confirming that urbanization economies are greater in the Capital Region than in the Non-Capital Region. All in all, these results indicate that agglomeration economies in 2001 measured in terms of firm-level productivity were considerably higher in the Non-Capital Region than in the Capital Region.

The results for 1988 throw up yet more noteworthy facts.

Contrary to the results for 2001, the coefficients on the variables representing within-industry specialization (*SPEC*), scale economies (*Lj/Ej*), employment density (*Lj/Area*), and road facility (*Road/Area*) are greater (in absolute value terms) in the Capital Region than in the Non-Capital Region. In other words, in 1988 localization economies captured by these variables were greater in the Capital Region than in the Non-Capital Region. These results combined with those for 2001 described above imply that the relative locational superiority of the Non-Capital Region to the Capital Region from the point of view of agglomeration economies increased during 1988~2001. The dynamic estimation results to be described later confirm this temporal change in agglomeration externalities in the two regions.

• Extended Regions

Estimation of agglomeration economies can be sharpened by dividing the Non-Capital Region sample further into four Extended Regions each comprising two latitudinally adjacent provinces and metropolitan cities, if any.[13] In this way, firms in an Extended Region are geographically closer to each other than they are in the much larger Non-Capital Region as a whole and, consequently, estimation results can be given more realistic meaning. The results for each of these Extended Regions are presented in Table 5.[14]

Overall, most of the variables are highly statistically significant and carry the expected signs. It is especially remarkable

13) Metropolitan cities outside the Capital Region are Busan, Daegu, Gwangju, Daejeon, and Ulsan.

14) For reasons of space, results for 2001 only are shown and described.

that the two characteristic variables to capture localization economies, *SPEC* and *COMP*, are strongly statistically significant for all of the five regions: both specialization and within-industry competition have positive effects on firm's productivity. However, *DIV*, the variable supposed in the theoretical literature to be the most important source of urbanization economies, is statistically insignificant in four of the five regions as well as having the "wrong" sign in two of the regions. The statistical insignificance and the wrong sign of the diversity variable is very often the case in many empirical tests. Another source of urbanization economies, *POP*, has significant coefficients in three regions, but one of them shows the wrong (negative) sign.

Employment density, *Lj/Area*, is another variable that performs consistently for all five regions. It is not only remarkably significant but also consistent in having negative coefficients in all the regions. According to Ciccone and Hall (1996) who introduced this variable in empirical testing of agglomeration economies, a positive coefficient on this variable indicates that beneficial effects of agglomeration on productivity outweigh negative, congestion effects of agglomeration. Viewed this way, our results might be interpreted as implying that congestion effects overwhelm in our sample. However, in our model, an alternative interpretation suggests itself. Given that in our sample data, variations in *Lj* are by far greater than the corresponding variations in *Area*, the effect of employment density on the dependent variable derives mostly from the size of employment itself, rather than from the density as such. Therefore, the density variable has more to do with the degree

Table 5 Static estimation results for Extended Regions, 2001

Variables	Capital Region	Southeast	Gyeongbuk	Southwest	Chung-cheong
$SPEC$	0.124*** (4.3)	0.099*** (4.5)	0.329** (2.4)	0.373*** (4.2)	0.202*** (3.8)
$COMP$	-0.048*** (-5.6)	-0.094*** (-6.1)	-0.413*** (-3.2)	-0.235*** (-3.7)	-0.158*** (-4.6)
DIV	-0.008 (-0.7)	0.051 (1.5)	0.186 (0.6)	-0.481 (-1.6)	-0.643** (-2.2)
L_j/E_j	0.078*** (3.2)	0.129*** (3.3)	0.381** (2.3)	0.366*** (3.0)	0.234*** (3.9)
LT/ET	0.097*** (3.6)	0.120** (2.1)	n.a.	n.a.	1.269** (2.1)
$L_j/Area$	-0.137*** (-4.2)	-0.104*** (-4.0)	-0.502*** (-2.6)	-0.618*** (-4.9)	-0.319*** (-4.3)
POP	0.187*** (8.6)	0.159*** (3.8)	-1.204** (-2.1)	0.128 (1.0)	n.a.
$Road/Area$	0.072*** (2.8)	0.104** (2.1)	n.a.	n.a.	n.a.
K/L	0.199*** (51.6)	0.206*** (36.1)	0.270*** (14.2)	0.203*** (11.5)	0.245*** (18.3)
$Adj.R^2$	0.2176	0.3024	0.3568	0.3427	0.2477
Observations	21,992	6,279	1,202	1,310	2,607

Notes: t ratios are in parentheses.
*** 1%, ** 5%, * 10% significance level.
n.a.: The variable has been excluded from the regression because of either data unavailability or the "singularity" problem in the regression owing to collinearity or insufficient variations in the sample data.
The "Southeast" comprises Ulsan and the Gyeongnam Province.
The "Southwest" comprises Gwangju and the Jeonnam Province.
The "Chungcheong" region comprises Daejeon and the Chungbuk and Chungnam Provinces.

of within-industry competition than with the physical intensity of knowledge spillovers among local workers and, thus, the

density variable may reflect additional effect of local competition which operates in a separate way from the *COMP* variable.

Of the five Extended Regions, the Daegu-Gyeoungbuk Region and the Southwest are distinguished from the other three Extended Regions by the fact that most of their estimated coefficients are considerably greater (in absolute value) than their counterparts in the other three regions. *SPEC* and *COMP* show relatively very strong effect on productivity of local firms, as do *Lj/Ej* and *Lj/Area*.

The Chungcheong region is the only region that shows statistically significant *DIV* with the correct sign as well as a high coefficient on *LT/ET*, indicating that industries in the region enjoy the strongest urbanization economies of the five Extended Regions. It is to be noted that in this five-region division, too, the Capital Region turns out to be one of the regions with the weakest agglomeration economies.

• By Industry Type

So far we have discussed the results based on regional groupings. We turn next to the question of how the estimates of agglomeration economies may differ between types of industries. For this purpose we classify our industry sample into four types of industries on the basis of their locational characteristics. Table 5 shows one such classification of 23 two-digit manufacturing industries for 2001.

The regression results presented in Table 7 are qualitatively rather similar to those based on regional groupings described above. Except for the diversity and the two education variables, most variables are on the whole strongly statistically significant.

Table 6. Classification of industries by type of location

Type of location	KSIC code
Assembly	28~35
Basic materials	23, 24, 27, 37
Raw materials	15, 16, 20, 21, 26
Consumer oriented	17~19, 22, 25, 36

Notes: Assembly type: Relatively free from locational restrictions; ubiquitous, foot-loose.
Basic materials type: Close to sea for transportation of heavy or bulky materials or products.
Raw materials type: Close to sources of raw materials or to places of easy access to such sources.
Consumer oriented: Close to consumers; cities.

Specialization and competition, again as expected, turn out most clearly. They are consistent across all four types in their statistical high significance and sign. However, basic materials industries are found to derive the strongest agglomeration economies from local specialization and within-industry competition. (Although not shown for space reasons, the same holds for 1988.) They are contrasted with the assembly industries, which show the weakest positive role of specialization and competition in the productivity externalities of locational concentration.

Employment density also turns out to be another important source of localization economies but in the present case its sign is negative across all industry types. This seems to confirm our earlier alternative interpretation of this variable as reflecting the effect of local competition rather than knowledge spillovers among local workers.

Unlike in the case of the Extended Region-based estimation discussed earlier, urbanization economies are clearly captured by

population size in this industry-based regression. *POP* is highly significant and has the correct positive sign with its coefficients being far from negligible in all four types. By contrast, diversity of local industries does not seem to lead to higher productivity across industries.

(2) Dynamic agglomeration economies

In this subsection we discuss the estimation results of dyna-

Table 7. Static estimation results by industry type, 2001

Variables	Assembly	Basic materials	Raw materials	Consumer oriented
SPEC	0.090*** (5.4)	0.147*** (2.9)	0.111*** (2.9)	0.106*** (4.1)
COMP	-0.032*** (-4.2)	-0.094*** (-3.7)	-0.083** (-2.2)	-0.044*** (-3.1)
DIV	-0.009 (-0.7)	0.014 (0.3)	0.018 (0.4)	-0.002 (-0.1)
L_j/E_j	-0.028 (-1.1)	0.180*** (2.7)	0.238*** (4.1)	0.101*** (2.9)
LT/ET	0.194*** (6.3)	0.104 (1.3)	-0.060 (-0.9)	0.163*** (3.7)
$L_j/Area$	-0.076*** (-4.3)	-0.148** (-2.2)	-0.147** (-2.5)	-0.106*** (-3.5)
POP	0.125*** (6.1)	0.184** (2.3)	0.184*** (2.7)	0.167*** (4.4)
$Road/Area$	0.033* (1.9)	0.113 (1.4)	0.078 (1.4)	0.060* (2.0)
K/L	0.185*** (51.4)	0.279*** (22.5)	0.266*** (24.6)	0.199*** (29.3)
$Adj.R^2$	0.1742	0.3095	0.2308	0.2291
Observations	19,342	2,855	3,836	7,358

Notes: t ratios are in parentheses.
*** 1%, ** 5%, * 10% significance level.

mic agglomeration economies for 1988~2001. As mentioned already, dynamic agglomeration economies refer to the externality effects on region-industry's growth rate of productivity of concentration of industrial activities in a given location. Owing to unavailability of establishment-level data as used in the preceding static analysis, our data in this dynamic regressions are based on two-digit industry level data. The consequent drastic reduction in the sample size has inevitably led to regression results that are far less satisfactory than the static counterparts in terms of statistical significance of the estimated coefficients. Still some interesting results have been emerged.

• All samples

Table 8 shows the results for all samples divided into two groups: all agglomerated regions and all non-agglomerated regions. First to be noticed is the sharp rise in the goodness of fit of the regressions compared with the corresponding fit obtained for the static estimation. This change is not unexpected because the sample data are now at the aggregated industry level not establishment level. However, this improvement in the fit is not without cost. Above all, the number of variables that have turned out to be statistically significant is now smaller than for the static case: only four out of total 12 explanatory variables. This, however, is not as bad a result as it might seem, for five of the explanatory variables are control variables not directly associated with agglomeration economies *per se*.

In the agglomerated regions group, competition is again confirmed to be a significant positive source of dynamic agglomeration economies, favouring the Jacobs-Michael Porter thesis

Table 8. Dynamic estimation results for all samples, 1988~2001

Variables	Agglomerated regions	Non-agglomerated regions
SPEC	-0.035 (-0.8)	0.006 (0.3)
COMP	-0.082** (-2.0)	-0.019 (-0.8)
DIV	-0.068 (-0.9)	-0.013 (-0.4)
L_j/E_j	0.252*** (3.6)	0.171*** (3.9)
LT/ET	-0.057 (-0.6)	0.063 (1.2)
Vj/Lj	-0.452*** (-5.5)	-0.716*** (-14.4)
*GV*1	0.073 (1.6)	0.070*** (3.5)
*GV*2	-3.498*** (-2.7)	-9.666*** (-3.0)
*GV*3	-0.992 (-0.2)	4.130 (0.9)
$L_j/Area$	-0.046 (-1.6)	-0.019 (-1.3)
$Road/Area$	0.022 (0.3)	-7.165 (-1.0)
*POPT*2	-0.020 (-0.2)	0.948 (0.9)
$Adj.R^2$	0.4823	0.4631
Observations	253	1,005

Notes: t ratios are in parentheses.
*** 1%, ** 5%, * 10% significance level.

about the role of competition in innovation and growth. Disappointingly, however, we fail to identify specialization as a significant factor in explaining dynamic agglomeration economies

whereas it has consistently been found to play an important role in static agglomeration externalities.[15] The coefficient on *Lj/Ej*, an additional variable reflecting localization economies, is also significant and has positive sign, indicating that there are within-industry scale economies of agglomeration differentiating the growth rates of productivity between different region-industries.

Of the four variables included to control for initial conditions, V_j/L_j and *GV2* are revealed to exert statistically significant negative influence on growth of productivity. The negative coefficient on V_j/L_j means that the greater the production per employee of a region-industry in 1988, the lower its growth rate during 1988~2001, the partial elasticity being −0.035 per annum. *GV2* is the only significant of the three GV_i (i=1, 2, 3) controling for growth rate of productivity in all other regions/industries. It seems natural that of the three, only *GV2* is picked up to be significantly responsible with the expected negative coefficient: the higher the growth of productivity in the same industry in all other regions, the lower the productivity growth of the industry in the region in question.

The results for all non-agglomerated regions suggest that dynamic externalities of agglomeration are, not surprisingly, comparatively less clear. Not even the competition variable, which is highly significant in the agglomerated regions, fails to be significant. Another variable, *Lj/Ej*, is significant but its effect on industry productivity growth is much weaker than its

15) Lee and Hong (2001), although they use a very different model from ours, similarly obtained competition as the only statistically significant variable explaining dynamic agglomeration externalities.

counterpart in the agglomerated regions sample. Thus, broadly speaking, the qualitative contrast between agglomerated and non-agglomerated regions found for the case of static agglomeration economies may be said to replicate in dynamic agglomeration economies.

• Capital Region vs. Non-Capital Region

The regression results summarized in Table 9 show that none of the three characteristic variables contributing to dynamic agglomeration economies, *SPEC, COMP* and *DIV*, are statistically significant in the Capital Region and, in the Non-Capital Region, only *COMP* is significant. However, the within-industry scale economies variable, *Lj/Ej*, shows statistical significance in both regions but its positive influence on productivity is stronger in the Non-Capital Region than in the Capital Region.

These dynamic results are not as good as the static results discussed earlier, but they confirm our earlier finding that the locational advantage, from the point of view of agglomeration economies, of the Capital Region relative to the Non-Capital Region deteriorated over the 1988~2001 period. It is to be noted again that the urbanization economies variable *DIV* turns out statistically insignificant in this dynamic case, too. The only control variable with statistical significance in both regions is the initial industry-wide productivity, V_j / L_j. Its coefficient is greater (in absolute value) in the Capital Region than in the Non-Capital Region, and this combined with the fact that *GV3* is significant only in the Capital Region implies that the proportion of industries whose value added growth rates over the

period in question were relatively low was higher in the Capital Region than in the Non-Capital Region.[16)]

Regressions have also been run, as in the static regression, for samples classified by type of industry and also for the case of division into five Extended Regions. The results are provided in Appendix Tables A.2 and A.3, respectively, but they do not merit separate discussion here as they are not as satisfactory, in terms of the number of statistically significant variables, as in the static estimation. The main reason for this is that division of the sample into smaller sub-samples further reduces the sample size which is already relatively small, while at the same time regional and/or industry dummies are retained to allow for fixed effects, leading to still further restriction of degrees of freedom in regression.

16) This implication is corroborated by the fact that value added production per employee in 1988 was 68.3% higher in the Capital Region than in the Non-Capital Region but its growth rate in the Capital Region over the period in question was 26.6% lower than in the Non-Capital Region.

Table 9. Dynamic estimation results for Capital and Non-Capital Regions, 1988~2001

Variables	Capital Region	Non-Capital Region
$SPEC$	0.031 (0.5)	-0.059 (-0.9)
$COMP$	-0.064 (-1.1)	-0.195** (-2.5)
DIV	0.074 (0.5)	-0.183 (-1.3)
L_j/E_j	0.264** (2.4)	0.355*** (3.4)
LT/ET	0.054 (0.4)	0.063 (0.5)
V_j/L_j	-0.650*** (-4.1)	-0.418*** (-3.9)
$GV1$	0.051 (1.3)	0.123 (1.4)
$GV2$	0.143 (1.0)	0.800 (1.4)
$GV3$	-1.078** (-2.0)	-1.475 (-0.2)
$L_j/Area$	-0.044 (-1.1)	-0.061 (-1.2)
$Road/Area$	n.a.	0.192 (0.2)
$POPT2$	n.a.	-0.079 (-0.1)
$Adj.R^2$	0.2748	0.4770
Observations	131	122

Notes: t ratios are in parentheses.
*** 1%, ** 5%, * 10% significance level.

Ⅴ. Implications for Regional Industrial Clustering Policy

Our empirical examination of productivity externalities of industrial agglomeration in Korea has yielded results that mostly are consistent with the predictions of the theory on agglomeration economies. Particularly important results and their implications for regional industrial clustering policy can be presented as follows.

(ⅰ) Our regression results have confirmed that the productivity effects of industrial agglomeration are distinctly greater in the agglomerated than in the non-agglomerated regions. This may sound self-evident or even tautological. However, this has never been established empirically in previous studies of industrial concentration in Korea. This result suggests that a policy of promoting industrial agglomeration in selected localities of the country will ensure more efficient allocation of resources than would otherwise be the case. This also lends support to the effectiveness of industrial development policy of successive Korean administrations over the past four decades that, with financial, fiscal, and administrative incentives, promoted concentration of strategic manufacturing industries in selected regions of the country.

(ⅱ) In most cases of regional and industrial groupings of our sample, localization economies deriving from an agglomeration

of a particular industry are clearly found to lead to higher productivity than urbanization economies associated with the diversity of industries in a region.[17] In particular, the degree of specialization turns out to be the strongest factor contributing to higher productivity. This suggests that in designing regional industrial clustering programmes, emphasis had better be placed on specialization rather than diversification.

(iii) Agglomeration economies are estimated to be not uniform across industries. Our results by locational type of industry indicate that productivity externalities are greatest in basic materials industries, followed by the raw materials type. By contrast, ubiquitous or footloose industries, as expected, do not show clear agglomerative effects. These results may be utilized as criteria in selecting industries for cluster promotion in particular regions.

(iv) Of the various factors that are seen to exert influence on agglomeration economies, within-industry competition, on the one hand, is generally found to be the second most highly significant factor in productivity difference between firms or industries. On the other, firm size also turns out to play an important role in raising productivity per employee. These facts

17) Contrary to the predictions of the theory of urbanization economies, many other empirical investigations share our finding that diversity of local industries is more often than not statistically insignificant as a source of agglomeration economies. It is possible to imagine that this is due to the exclusion of service industries from the model. However, our experiment with models that incorporate the service sector along with the manufacturing sector shows that it does not in any significant way alter the results that we have reported in this paper.

point to two policy implications: the government must ensure that an appropriate degree of competition is maintained among the firms operating in any given local industry in agglomerated regions, and at the same time induce each firm to be of a sufficient size to exploit scale economies. It is to be admitted, however, that these two requirements are not always easily reconciled. Even with a sufficient number of firms each of a sufficient size for scale economies on its own, there may not be enough competition if some of them are large enough to be able to exert dominant market power at the expense of the others.

(v) Our analysis also throws some interesting lights on the question of how agglomeration economies in terms of value added per employee compare between the Capital Region and the Non-Capital Region. The static estimation results show that in 1988, agglomeration externalities were greater in the Capital Region than in the Non-Capital Region, but that this relative position was reversed in 2001. The dynamic results, however, indicate that during 1988~2001, the Capital Region experienced smaller dynamic agglomeration economies than did the Non-Capital Region. These results suggest that if industrial concentration in the Capital Region continues, the efficiency in terms of agglomeration economies of national resource allocation will be lower than would otherwise be the case. It follows that government policy designed to discourage further industrial concentration in the Capital Region would be justified *on this account*.

There is a caveat here, however: the above implication is only based on the results derived from our model. The model, as with practically all empirical models in the literature on

agglomeration economies, abstracts from many other considerations that in the real world may possibly influence firm's locational decisions, hence its productivity. This is testified by the goodness of fit of our estimations that remain in the lowly range of 0.22~0.30, although it is not a particularly bad fit in view of most other cross-sectional estimates in this field. It must be further noticed that, in 2001, the R-squared of 0.2176 for the Capital Region is considerably lower than 0.2946 for the Non-Capital Region, implying that there are factors, ignored by our model, that exert influence on the productivity of firms in the Capital Region to a greater extent than those in the Non-Capital Region. Put differently, the question "Why do firms prefer the Capital Region for their location to the Non-Capital Region?" is a much broader question than the question that we have asked of ourselves in this paper, namely, "How high is the productivity of firms operating in the Capital Region compared with that of those in the Non-Captial Region?" Our analysis in this paper has only attempted to throw a light on the second question rather than the first.

Finally, some suggestions are in order for further research that would improve on the limitations of our analysis in this paper. We have examined, for the first time for the case of Korea, both static and dynamic agglomeration economies for 1988, 2001, and 1988~2001. The evidence drawn from this exercise may be enriched or modified by studies that incorporate the years that fall between the two benchmark years. Another issue that merits further research is that of spatial interdependence. This has received some attention in recent years, but its incorporation in the study of agglomeration econ-

omies is yet to be implemented.[18] Spatial interdependence in the present context means that knowledge spillovers may take place across regions as well as within a region, hence may act as further influence on the productivity of firms in a given place. This, albeit a difficult task, will undoubtedly enhance our understanding of how and with what productivity effects agglomeration economies work in the real world.

18) Fingleton and McCombie (1998) and Fingleton (2000) are examples of such effort.

Appendix

Table A.1 Industrial grouping for dynamic estimation

KSIC 1988	Our grouping	KSIC 2001
311~314	1	15~16
321~324	2	17~19
331, 341~342	3	20~22
351~354	4	23~24
355~356, 361~362, 369	5	25~26
371~372	6	27
381~382	7	28~30
383, 385	8	31~33
384	9	34~35
332, 390	10	36~37

Table A.2 Dynamic estimation results by type of industry

Variables	Assembly	Basic materials	Raw materials & Consumer oriented
$SPEC$	-0.008 (-0.1)	-0.074 (-0.6)	-0.015 (-0.3)
$COMP$	-0.162 (-1.6)	-0.181 (-1.6)	-0.007 (-0.1)
DIV	-0.028 (-0.1)	0.173 (1.1)	-0.107 (-1.0)
L_j/E_j	0.244 (1.1)	0.371** (2.1)	0.219*** (3.0)
LT/ET	0.080 (0.3)	-0.158 (-0.7)	0.075 (0.9)
V_j/L_j	-0.462* (-1.7)	-0.691*** (-3.9)	-0.442*** (-3.8)
$GV1$	0.131 (1.0)	-0.061 (-0.5)	0.114** (2.0)
$GV2$	-2.823 (-1.4)	-1.559 (-1.3)	-6.354*** (-3.8)
$GV3$	13.0 (1.1)	-15.681* (-1.9)	-3.302 (-0.8)
$L_j/Area$	-0.136** (-2.2)	0.007 (0.1)	0.000 (0.0)
$Adj.R^2$	0.3985	0.4285	0.4371
Observations	75	48	130

Notes: t ratios are in parentheses.
*** 1%, ** 5%, * 10% significance level.

Table A.3 Dynamic estimation results for Extended Regions

Variables	Capital Region	Southeast	Gyeongbuk	Southwest	Chung-cheong
$SPEC$	0.031 (0.5)	-0.166 (-1.6)	0.874 (0.6)	0.085 (0.3)	-0.204 (-1.4)
$COMP$	-0.064 (-1.1)	-0.049 (-0.5)	0.378 (0.7)	-0.174 (-1.0)	-0.529*** (-2.9)
DIV	0.074 (0.5)	-0.129 (-0.7)	1.174 (1.0)	-0.517* (-2.0)	0.038 (0.1)
L_j/E_j	0.264** (2.4)	0.285 (1.6)	0.729 (2.0)	0.198* (2.0)	0.525*** (2.8)
LT/ET	0.054 (0.4)	-0.318 (-1.4)	4.135* (2.2)	0.411 (0.6)	0.028 (0.1)
V_j/L_j	-0.650*** (-4.1)	-0.350** (-2.1)	-1.904 (-1.2)	-0.439 (-1.8)	0.048 (0.2)
$GV1$	0.051 (1.3)	0.101 (1.3)	-1.456 (-1.9)	0.003 (0.0)	0.231 (0.9)
$GV2$	0.143 (1.0)	-2.733* (-2.0)	-1.797 (-1.9)	0.118 (0.4)	0.351 (1.1)
$GV3$	-1.078** (-2.0)	-10.041 (-0.8)	-14.113* (-2.6)	-1.999 (-1.1)	-1.688 (-0.6)
$L_j/Area$	-0.044 (-1.1)	0.072 (0.7)	-0.864 (-0.7)	-0.171 (-0.6)	-0.152** (-2.2)
$Adj.R^2$	0.2748	0.5046	0.2166	0.5399	0.4263
Observations	131	54	14	20	34

Notes: t ratios are in parentheses.
*** 1%, ** 5%, * 10% significance level.

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