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**THE INCOME EFFECTS OF DECENTRALIZATION OF
POPULATION IN KOREA: AN ECONOMETRIC
INVESTIGATION**

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Abstract

In Korea, the socio-economic imbalance between the Capital and non-Capital Regions has become a serious issue despite the various decentralization policies instituted since the 1960's. This study aims at analyzing the effect of decentralization of population in the capital region on income, and revealing the difference in productivity between the Capital and non-capital regions. The analysis begins with an estimate of production functions by region. It then analyzes the changes to employment as population decreases in the Capital region, and the economic effects on regional production through the movement of employment in each region. The results show that, decentralization in the capital region would result in decrease national income in Korea.

JEL classification: C50,

Keywords: Decentralization Policy, Total Factor Productivity, Product Function

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1. Introduction

In Korea, the socio-economic imbalance between the Capital and non-Capital Regions has become a serious issue despite the various decentralization policies instituted since the 1960's. By the end of 2001, 46.7% of total population, 47.8% of total national income, 57.0% of all manufacturing companies, and 45.3% of all service-oriented firms were in the Capital Region, which constitutes only 11.8% of the total land mass of South Korea.

The problem of population concentration has been around for a long time, and various measures have been conducted to resolve this issue. For last 40 years, Korean government has been conducting a strong location restriction policy beginning with the "Metropolitan Region Population-Concentrating Prevention Policy" in 1964 and the "Capital Metropolitan Region Planning Act" in 1984. The government has especially been restricting the building or expanding of population-concentrating facilities, such as large corporate plants, two year community colleges or four year universities, public sector's buildings, any large-scaled buildings, and training center in suburb areas, in a noted "Over-Concentration Control Region" currently divided into several sub-areas and imposing over-concentration charge based on the "Capital Metropolitan Region Planning Act."

This types of restriction policy has been beneficial to developing Chungcheong Province (which is just adjacent to the Capital Region) but not to other regions. It has been, however, indicated that this restriction policy may prevent national and foreign direct investment. Based upon this belief, the current government has been approaching the problem via three different measures: National growth through a balanced industrial development strategy and building regional innovation system; decentralization of national government decision making regarding human and financial resources to regional governments; Establishment of a new Capital and dispersion of central government's facilities to various regions. The planning and

implementation of these three national tasks assumes that decentralization policy has a positive effect on Korea's economy and competitiveness. However, empirical analysis does not strongly back this assumption. This is especially true regarding the relocation of the nation's capital to another city. The economic effect cannot be confirmed by the result of empirical analysis [Kim (2003); Cho (2003); Seoul Development Institute (SDI) (2004)]. According to Kim (2003) and Cho (2003), investment in non-Capital regions or a transfer of the public sector to a regional area would increase GDP, whereas research by SDI (2004) shows the economic effect to be quite the opposite. The discrepancy between these studies may result from a difference in the structure of modelling and assumptions.

Researchers who concluded that relocation of the Capital would increase GDP did not clearly recognize the difference between productivity in the Capital and non-Capital regions. But, taking into consideration this differences [Suh (2001 and 2004)], the results would be opposite. This study is predominantly focused on the degree in which population-decentralization affects national income and making clear the difference in productivity between the Capital and non-capital regions. The method of analysis begins with an estimate of production functions by region. It then analyzes the changes to employment as population decreases in the Capital region, and the economic effects on regional production by the movement of employment in each region.

2. Data and Methodology

Korea is divided into five areas, as shown in Fig.1. The division has two meanings: one is the conventional division of the area, and the second is to resolve the degree of freedom in a regression analysis. Table 1 presents the names of the regions and data of population and real Gdp per head.



Table 1.

Region	Name	Population		Gdph	
		1992	2000	1992	2000
1	Capital Region: Seoul + Incheon +Kyonggi-do	18735	21242	10121	13017
2	Chungcheong Region: Taejon + Chungchong-amdo + Chungchong-bukdo	4383	4752	9089	13056
3	Jeolla Region: Kwangju + Cholla-namdo + Cholla-bukdo	5468	5323	7710	10993
4	Youngnam Region: Pusan + Taegu + Ulsan + Kyongsang-namdo + Kyongsang-bukdo	12541	13099	8258	12149
5	Kangweon-Jesu Region: Kangwon-do + Cheju-do	2042	2039	7924	10668
	Total	43170	46636	9066	12393

Note: Population in thousands, Gdp per inhabitant in thousand Won.

In this study, a production function by each region is created to test the effect of decentralization of the capital region over national income. This is first accomplished by dividing the regions. After organizing the data, a sampling period must be established to be

determined the estimate. Annual GRDP data by region and industry are available for the period of 1985 ~ 2000 annually. An explanatory variable that requires an estimate of the production function is employment size. However, statistics on employment size are only available after 1992. Due to a lack of this information, the sampling period needs to be adjusted to 1992 ~ 2000. A production function with the progress of technology is shown below:

$$Y_{it} = A_t F_i(L_{it}, K_{it}) \quad (1)$$

‘i’ and ‘t’ represent region and time, respectively. The letters Y, F, L, and K represent GRDP, production function, labor, and capital, respectively. Y_{it} is GRDP in time ‘t’ for a region “i.” Other variables with subscripts have the same meaning. A_{it} represents Hicks’ neutral technological progress, and $[dA_{it}/dt]/A_{it}$ is TFP or the Total Factor Productivity.

Estimating a production function generally results in the format commonly known as the Cobb-Douglas function. Because data related to the Capital is not generally available, proxy variables are commonly substituted. Variables in this study are reflected by financial market figures such as the sum of loan money ($LOAN_{it}$), amount of bill-clearing ($BILL_{it}$), financial spending by regional government (representing the role of regional government, EXP_{it}), road pavement size (representing a physical sub-structure, $ROAD_{it}$), and so on.

If an explanation variable is adopted, a total of six or seven variables for regression analysis may be included. However, the sample size is only nine for 1992 ~ 2000 period, which will lead to a lack of a degree of freedom. Consolidated time series data and cross-section data were used in regression analysis in order to solve the problem of lack of data. Consolidating this data was done, for instance, by taking a series of GRDP data for Seoul, Incheon, and Gyunggi Province as sub-variables. For region “I,” composed of 3

sub-areas, let's call ij with 'j' being a sub-area in 'i' region ($j = 1,2,3$). In this case, Y_{ijt} represents GRDP of 'j'th sub-area in region 'i' over the time frame. The details are follows: Y_{11t} , Y_{12t} , and Y_{13t} represent GRDP in Seoul ($j=1$), Incheon ($j=2$), and Gyungggi Province ($j=3$) in capital region ($i=1$) for time t.' The sub-variable can be expressed as an row vector: $Y_{11,1992}, \dots, Y_{11,2000}, Y_{12,1992}, \dots, Y_{12,2000}, Y_{13,1992}, \dots, Y_{13,2000}$. Employment and other variables can be used in the same manner in a regression analysis. However, one exception is Ulsan. For Ulsan, only data after 1998 is available.

Therefore, data for 1998 ~ 2000 is used. Variables and proxy variables for the capital that are commonly applied to specific regions are expressed in the following way. For instance, X_{1t} in the capital region for the same year is [$X_{1,1992}, \dots, X_{1,2000}, X_{1,1992}, \dots, X_{1,2000}, X_{1,1992}, \dots, X_{1,2000}$]. In general, for regression analysis with data-integration of time series and cross section, a weighted regression analysis method is used to identify the difference between the data-variance of cross sections by time period. However, cross sectional data for the one period in this study is limited to between two and five so that it is not meaningful to consider the difference in the spread for each time-period. Therefore, a dummy variable is used to explain the variable for regression analysis instead of a weighted regression analysis. It is important to note an issue related to TFP arose when arriving at a result in the regression analysis. It is impossible for a direct trial to estimate A_{it} through regression analysis by integrating data of time series and cross sectional data. Instead of estimating related variables to TFP in regression analysis, it is necessary to find out the ways to clarify the regional difference of TFP in simulations.

Estimated results with production variables for each region are as follows:

(Region 1: Capital Region)

$$\log Y_{1t} = 5.1753 + 1.9658 \log L_{1t} + 0.2655 \log EXP_{1t} + 0.3854 D2$$

(7.03) (11.4) (7.04) (3.21)

adj-R²: 0.9935

(Region 2: Chungcheong Region)

$$\log Y_{2t} = 9.3897 + 0.5112 \log L_{2t} + 0.4588 \log LOAN_{2t} - 0.3854 D2$$

(13.7) (4.61) (10.7) (7.88)

adj-R²: 0.9538

(Region 3: Jeolla Region)

$$\log Y_{3t} = 7.1964 + 0.7575 \log L_{3t} + 0.2978 \log LOAN_{3t}$$

(4.07) (3.43) (13.3)

$$+ 0.1863 \log BILL_{3t} - 0.4862 D1 - 0.3409 D2$$

(3.99) (3.79) (8.64)

adj-R²: 0.9896

(Region 4: Kyeongsang Region)

$$\log Y_{4t} = 15.755 + 0.1779 \log L_{4t} - 0.5229 D2 + 0.3830 D4$$

(31.8) (2.56) (8.93) (6.38)

adj-R²: 0.8473

(Region 5: Kangweon-Jeju Region)

$$\log Y_{5t} = 9.1151 + 0.8171 \log L_{5t} + 0.2169 \log LOAN_{5t}$$

(64.2) (27.3) (8.32)

adj-R²: 0.9930

The above regression analysis yields numbers in parentheses (the t-values), and adj-R²s are the determinant coefficient modified by the degree of freedom. Variables starting with ‘D’ are dummy variables for the regions, and they are shown in Table 2. These dummy variables show the situation of other administrative districts in the same region might be different. As determinant coefficients shown above, estimated results are relatively good. For a simulation, using estimated results for the production function, test results can be falsified by proxy variables, fixed with the same value.

One of the methods that can mollify the problem is to make proxy variables into endogenous variable using function of population size. The population size is the clue of exogenous variation in simulations. Significant consideration should be given to minimizing the possibility of falsification by excessive endogenization of the variables. Regarding this concern, all proxy variables for capital stock adopted

above for the regression analysis are explained by POP_{it} , and only determinant coefficients modified by a degree of freedom above of 0.6 are used for the subjects of endogenization. The only variable that meets this requirement is EXP_{it} in the capital region. The resulting estimates are as follows:

Table 2. Dummy Variables by Region

	D1	D2	D3	D4	D5
Region 1	Seoul	Incheon	Gyeonggi		
Region 2	Daejeon	Chungbuk	Chungnam		
Region 3	Kwangju	Jeonbuk	Jeonnam		
Region 4	Busan	Daegu	Ulsan	Gyeongbuk	GKyeongnam
Region 5	Kangweon	Jeju			

In this paper, a model developed to demonstrate decentralization's influence over the capital's GRDP and other regions and even GDP is developed in this section. To achieve this, the scenario and method for determining the difference of total factor productivity (TFP) need to be determined. A brief procedure for this model is as follows.

As the population decreases in the capital region, employment there is assumed to decrease in direct proportion to the decline in population [employment size / population]. As a result of regression analysis, decreased employment will impact the GRDP of the capital region. Naturally, a decrease of population in capital region will increase population in other regions. This will influence employment in each region accordingly with each ratio, and this change in size of employment will have a direct effect on the GRDP of each region. One scenario, shifting the population from capital region to each

region, would produce an allocation ratio of population summarized in Table 3.

Table 3. Employment/Population Ratio in Model

	Region 1	Region 2	Region 3	Region 4	Region 5
Ratio	0.458	0.450	0.446	0.450	0.455

The differences of TFP by region need to be considered in estimating a production function for models testing a population decrease in capital region and its influence on the GRDP of the capital and other regions. The following example will explain how this problem may be resolved. To being, one must divide the entire country into two regions: Region 1 (capital region) and Region 2 (non-capital regions). The production function is as follows when differences of TFP between regions are considered.

$$Y_{1t} = A_t L_{1t}^a K_{1t}^b \tag{2}$$

$$Y_{2t} = B_t L_{2t}^n K_{2t}^d \tag{3}$$

A_t is different from B_t , which means the TFP in the capital region is different from the one in the non-capital region by some percent change. Difference of TFP in regression analysis is not considered, which means that A_t and B_t are not adopted in the production function, nor adopted with a limit. The above formula (2) and formula below (4) are considered for regression analysis.

$$Y_{2t} = A_t L_{2t}^n K_{2t}^d \tag{4}$$

In formula (4) adopting A_t , unlike a formula (3), v and δ might be changed. In the case that A_t is adopted, instead of B_t , the value of v and δ are not changed and can be the baseline for a maximum decreased case of GDP in a model. In analyzing the effect of

[$\Delta L_{1t} < 0$ and $\Delta L_{2t} = -\Delta L_{1t} > 0$] in the model, changes to a nation's GDP, g , by adopting simply adopting a result of regression analysis can be shown as follows:

$$g = \frac{A_t \mathbf{a} L_{1t}^{a-1} K_{1t}^b \Delta L_{1t} + A_t \mathbf{n} L_{2t}^{n-1} K_{2t}^d \Delta L_{2t}}{A_t L_{1t}^a K_{1t}^b + A_t L_{2t}^n K_{2t}^d} \\ = \frac{\mathbf{a} D_t [\Delta L_{1t} / L_{1t}] + \mathbf{n} E_t [\Delta L_{2t} / L_{2t}]}{D_t + E_t} \quad (5)$$

Where, $D_t \equiv A_t L_{1t}^a K_{1t}^b$, $E_t \equiv A_t L_{2t}^n K_{2t}^d$. In the case that [$\Delta L_{1t} < 0$ and $\Delta L_{2t} = -\Delta L_{1t} > 0$] which considers the difference of TFP as in formula (2) and (3), changes to a nation's GDP, h , are shown as follows:

$$h = \frac{\mathbf{a} A_t D_t [\Delta L_{1t} / L_{1t}] + \mathbf{n} B_t E_t [\Delta L_{2t} / L_{2t}]}{A_t D_t + B_t E_t} \\ = \frac{Z_t \mathbf{a} D_t [\Delta L_{1t} / L_{1t}] + \mathbf{n} E_t [\Delta L_{2t} / L_{2t}]}{Z_t D_t + E_t} \quad (6)$$

Where, $Z_t = A_t/B_t$. The difference between formula (5) and (6) is represented only by the presence of Z_t , and a formula (5) is the case of $Z_t = 1$. By using a formula (6), one can examine how a value of h can be changed according to a change in Z_t for [$\Delta L_{1t} < 0$ and $\Delta L_{2t} = -\Delta L_{1t} > 0$]. In order for this to happen, a differentiated the formula (6) with respect to Z_t is needed as follows:

$$\Delta h = \frac{D_t E_t \{ \mathbf{a} [\Delta L_{1t} / L_{1t}] - \mathbf{n} [\Delta L_{2t} / L_{2t}] \}}{[Z_t D_t + E_t]^2} \Delta Z_t \quad (7)$$

$\Delta h < 0$ is formed because of [$\Delta L_{1t} < 0$ and $\Delta L_{2t} > 0$].

Therefore, as Z_t increases, a decrease in population in the capital region will further reduce GDP. The remaining issue is how Z_t will

be determined, and how this difference will be considered in modelling. Z_t represents the number of “Z” times of production in the non-capital regions equals that of the capital region if coefficients for the production function in capital and non-capital regions are equal, including the quantity of labor and capital inputs for production. This Z_t cannot be found in the data, which negates that indirect method. Therefore, the first data that we consider to take is from a research by Suh (2001). According to Suh (2001), average TFP in the capital region between 1990 ~ 1997 is 0.031, which is much higher than that of the TFP of non-capital regions, which register 0.018. This means that Z_t is much greater than 1. In order to define the value of Z_t , let's compare average labor productivities of capital and non-capital regions in 2000 compared when model data is used. Average labor productivity of the capital region is 1.1 times of that of non-capital regions. Although TFP is different from average labor productivity, the value of 1.1 as a starting point is acceptable. Therefore, there will be three cases where Z_t differs in value (1.05, 1.1, and 1.15). To find out a ratio of GDP change, GRDP for the capital region and change in GRDP need to be multiplied by Z_t . When the ratio of GRDP change for the capital region is to be found, it will be cancelled by applying the same value to both the numerator and denominator. For the capital region, the ratio of GRDP change is to be found by multiplying Z_t to a GRDP change.

4. Findings

In this chapter, a model used to understand the effect of GRDP and employment in the capital and other regions, resulting from a 5% population decrease in capital region, will be conducted. In the capital region, 5% of the population is about 1.1 million people, as of year 2000. Other cases may be also easily computed by using the results of this case. For instance, in order to find out the effect of a 2.5% decrease in the capital's population, simply multiply 0.5 to the result of this case. Two scenarios are prepared for the target region where 5% of the capital's population will be applied. For the first

scenario, the 5% will be evenly distributed across all areas' population ratio. In the second scenario, half of the 5% of the capital's population is distributed in Chungcheong Province, and the other half is evenly distributed across the remaining provinces in Korea. For each case, the change to the ratio of employment is the same. However, changes in GRDP and GDP differ by Z_t . Therefore, there are six cases in total, when calculating by GRDP. The model yields the following results.

For case 1, the even distribution case, change degree of GL_i (change ratio of employment in each region), GY_i (change ratios of GRDP), and GY (change ratios of GDP) are shown in Table 4. The change in GRDP by region has three cases for the value of Z_t . In fact only GY_t and GY_{1t} vary by Z_t , but values in other regions are repeated in the table.

Table 4. Change of GRDP and Employment (Case 1)

GL_1	GL_2	GL_3	GL_4	GL_5
-0.048	0.050	0.054	0.046	0.052
Y ($Z_t = 1.05$)		GY ($Z_t = 1.10$)		GY ($Z_t = 1.15$)
-0.0183		-0.0191		0.0199
$Z_t = 1.05$				
GY_1	GY_2	GY_3	GY_4	GY_5
-0.0558	0.0215	0.0320	0.005	0.0442
$Z_t = 1.10$				
GY_1	GY_2	GY_3	GY_4	GY_5
-0.0585	0.0215	0.0320	0.005	0.0442
$Z_t = 1.15$				
GY_1	GY_2	GY_3	GY_4	GY_5
-0.0611	0.0215	0.0320	0.005	0.0442

The case in which there's a 5% decrease of population decentralization in the capital region results in a decrease of 1.8 ~ 2.0 percentage points in GDP growth. As expected, the greater degree by which GDP decreases results in a greater increase in Z_t . Most notable is a decrease in the degree of GRDP growth rate in the capital region of 5.6 ~ 6.1 percentage points, which is much higher than the GRDP growth rate in other regions.

For case 2, the Chungcheong Province convergence case, a change in the ratio of employment by region and degree of GRDP and GDP changes by region is shown in Table 5. Because this is the Chungcheong Province convergence case, GRDP and employment size in Chungcheong Province increases greatly. However, a decrease in the GDP growth rate of 1.7 ~ 1.9 percentage points is not much different from a case of proportional distribution. This conclusion demonstrates that decentralization of the capital's population to Chungcheong Province does not provide any value added benefits.

Table 5 Change of GRDP and Employment (Case 2)

GL_1	GL_2	GL_3	GL_4	GL_5
-0.048	0.134	0.032	0.028	0.031
$GY (Z_t = 1.05)$		$GY (Z_t = 1.10)$		$GY (Z_t = 1.15)$
-0.0172		-0.0181		-0.0189
$Z_t = 1.05$				
GY_1	GY_2	GY_3	GY_4	GY_5
-0.0558	0.0561	0.0197	0.003	0.0308
$Z_t = 1.10$				
GY_1	GY_2	GY_3	GY_4	GY_5
-0.0585	0.0561	0.0197	0.003	0.0308

$Z_1 = 1.15$				
GY_1	GY_2	GY_3	GY_4	GY_5
-0.0611	0.0561	0.0197	0.003	0.0308

The population decrease in the capital region results in a GDP decrease in all instances. This can be expected from the fact that various productivity indices including a total factor productivity for the capital region, are much higher than those of the other regions. If a population decrease in the capital region is dispersed throughout the other regions pro-rata, GDP decreases between 1.8 ~ 2.0 percentage points. This translates into 10.5 ~ 11.7 trillion won for year 2000. In Chungcheong Province, GDP decreases less in the concentrated distribution case than the equal distribution case. Nonetheless, decentralization of the population in the Capital region still results in a decrease in GDP. A decrease in the GDP growth rate by 1.8 ~ 2.0 percentage points is equal to a decrease of 40 ~ 50% of potential growth rate in Korea. These results point out that decentralization of population and industry in the capital region, without appropriate measures, would result in a sizable decrease in GDP. Therefore, prior measures in both the capital region and other regions must be managed to minimize the social cost. For the capital region, various restrictions can be lightened, however such restrictions are not beyond the scope of this study. The need for deregulation in the framework of the above model is discussed indirectly. A 5% decrease of population in the capital region would result in a change of employment in the capital region that could lead to a decrease in GRDP for the capital region. A decrease in GRDP of the capital region can be readily represented as $\Delta Y_1 \equiv Y_1(\text{before_decentralization}) - Y_1(\text{after_decentralization}), [\Delta Y_1 < 0]$.

If lowering restrictions in the capital region can help to ameliorate the business environment in capital region, this effect can be shown as a decrease in absolute value of Y_1 . In other words, Y_1 by

relaxing restrictions can be represented by $[1-\theta]Y_1$. The more extensive easing of restrictions is necessary as the value of θ ($0 < \theta < 1$) becomes bigger. For a proportional distribution of population and a case of $Z_1 = 1.1$, the value of θ which makes GDP change zero becomes about 0.7. In this case, the growth rate of the capital region is computed as: -1.7 percentage points. The decrease rate of GRDP in the capital region needs to be increased to 4.1 percentage points from the original -5.8 percentage points. Increasing the GRDP growth rate in the capital region by 4.1 percentage points means that that average growth rate of GRDP in the capital region during 1992 ~ 2000 was about 7%. Therefore, increasing the growth rate of GRDP by 4.1 percentage points is nearly equivalent to a 60% increase of past GRDP growth rates. With respect to the issue of lowering restrictions, this means substantial magnitude of restriction release.

5. Conclusion

In this study, the effect of decentralization of the nation's population in the capital region on income for each region and entire nation has been analyzed. In order to do this, production functions for each region are estimated, and the effect over income by region through employment change of each region is analyzed by modelling. If 5% of the capital's population is decentralized, national GDP would decrease significantly. If this population is dispersed with respect to the current population proportion of nation year 2002, the GDP growth rate would decrease by 1.8 ~ 2.0 percentage points. If this population moved to Chungcheong Province by relocating the national government there, the GDP growth rate would be expected to decrease between 1.7 ~ 1.9 percentage points. In the long term, with expectations for Korea's potential growth rate at 3 ~ 4%, such drops in the GDP growth rate are very substantial.

Decentralization in the capital region would result in decrease national income. This is predominantly due to productivity in the capital region being much greater than that of non-capital regions.

Therefore, for a successful decentralization without national income decrease, restrictions in the capital region should be lowered. With consideration of about 7% of average GRDP growth rate in the capital region during 1992 ~ 2000, GRDP growth rate should be raised at least 4.1 percentage points. This is equal to 60% of past totals, making the prevention of declining national income, without easing restrictions, seem very difficult. Equity can have conflict against effectiveness. Decentralization can raise the issue of equity again, but it cannot greatly influence the overall effectiveness. If there is a policy that achieves both equity and effectiveness, it would be a new paradigm for the economy. With this in mind, there seems to be no policy that can meet the requirements needed to satisfy both of these conditions simultaneously. Therefore, the issue of decentralization must be carefully considered with the consent of the people.

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