Regional Productivities, Employment and Technological Progress of Korea from 1970 to 2014

By

Dongkyun, RYU

Dissertation

Submitted to

KDI School of Public Policy and Management

In Partial Fulfillment of the Requirements

For the Degree of

DOCTOR OF PHILOSOPHY

IN DEVELOPMENT POLICY

2020

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Abstract

The objective of this thesis is to investigate the effects of regional industrial structure on local labor market outcomes in terms of both productivity and employment level by utilizing a panel dataset compiled for five regions in Korea between 1970 and 2014. To that end, three specific indices of regional industrial agglomeration are formulated by each region and time period to be used as explanatory factors: the extent of industrial specialization (henceforth, SPE), the degree of industrial diversity (DIV), and the level of competition (COM). The main dependent variables used include total factor productivity (TFP) and employment (EMP), which are also measured at the regional level over time.

While the initial hypothesized effects of the three agglomeration factors are positive for both TFP and EMP because all three factors can generate positive externalities to local economic outcomes, the actual empirical results based on our sample are very much mixed, dependent upon combinations of time and location. From the pooled-sample estimation, while COM shows positive but not statistically significant effects on employment, both SPE and DIV have negative and significant coefficients; from the regional-level estimation, the coefficients of SPE and COM are split roughly half and half between positive and negative signs roughly, while DIV shows a negative significant effect on employment in the Capital, Yeongnam, and Gangwon regions. These mixed empirical outcomes are in fact consistent with those of prior studies. That is, de Groot, Poot, and Smit (2008) surveyed 322 empirical papers on the issue of impacts of the above three factors on local employment, and reported that the estimated coefficients for SPE were positive for about half of the studies and negative for the other half, with the outcomes for COM and DIV being similarly mixed.

However, when performing a separate sample estimation before and after 1998, the results are quite different. Before 1998, all three factors (SPE, COM, and DIV) fairly consistently show positive and significant effects on both EMP and TFP, indicating a positive nexus between regional agglomeration factors and local labor market outcomes. On the other hand, such a mechanism is not

shown to exist for the period after 1998: that is, in the case of the Capital region, SPE shows a negative impact on TFP but little impact on employment, COM has a positive impact on employment while DIV shows a negative effect on the same variable, and neither COM nor DIV shows a statistically significant effect on TFP. Upon further investigation, the two alternative scenarios of technological progress – neutral versus biased (labor-augmenting or capital-augmenting) – are applied to interpret the disparate empirical outcomes before and after 1998.

Our analysis indicates that, while a capital-augmenting technological progress (A_K) seemingly occurred in Korea before 1998, a labor-augmenting technological progress (A_L) appeared to be dominant after 1998. As supporting evidence, the ratio of average wage to average cost of capital (w/r) as well as the labor shares, the criteria for judging a capital-augmenting technological progress, rose before 1998 and then declined afterward. TFP, which is a standard measure for technical change, contains both A_K and A_L elements and is determined by the stronger one of the two. The analysis in this regard demonstrates that TFP, w/r and the labor share all advance in the same directions before 1998, indicating that TFP is primarily influenced by A_K for that time period, which has changed to the opposite after 1998 as stated above. Applying this biased technological progress clarifies the changing directions of the three agglomeration factors' effects on local economic outcomes in Korea, which should be viewed as the main contribution of this study. Given the likelihood of a superior outcome involved with the capital-augmenting technological progress (A_K), related policy implications for regional development policy in Korea are discussed.

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CHAPTER I: INTRODUCTION

In the literature, the agglomeration (concentration) effects of regional industrial structures on local economic outcomes has been examined primarily based on three empirical indices – SPE, COM and DIV. The main issue with this strand of the literature is the fact that the empirical findings are very much mixed as the directions of the effects by those factors, which is generally interpreted under the assumption of neutral technological progress. According to de Groot, Poot, and Smit (2008), who analyzed 322 quantitative studies on the correlation between industrial structure indices and employment, 179 (45.5%) negative correlations were found in a total of 393 cases. This is contradictory because indices are widely assumed to have a positive correlation with productivity. It is difficult to explain these negative correlations in a neutral technological progress where the direction of technological progress and production factors must match. To interpret this, this study introduces a biased technological progress in which progress asymmetrically affects factor demand.

This study builds a panel data set compiled for five regions in Korea between 1970 and 2014 in order to clarify these ambiguous relationships between industrial structure, TFP and employment. As well as analyzing the whole period, a regression analysis was applied with pre - and post -1998 period samples separately to see clearly the impact of biased technological progress on TFP and employment. To get further information about biased technological progress, this study constructed w/r, proxy for A_K/A_L, and TFP by the dual method as well as the primal method. One more purpose of this study is to show that regional employment and productivity can be sufficiently explained only by looking at the manufacturing industry. So, for the construction of industrial structure indices, Mining and Manufacturing Survey (MMS) data were used. In each region, 20 manufacturing industries were incorporated to construct the indices. Data sources used for construction of TFP and indices are listed in Table 1 of Appendix F.

Hicks (1932) reported under the assumption of stability of capital intensity K/L before and after technological progress that if the relative factor price w/r and accordingly labor share increases

(decreases), it is classified as a labor (capital) -biased technological progress. Recently, the notion of factor augmenting technological progress, which expresses the qualitative improvement of technological progress as an increase in the physical input of the factor, has been widely used. Acemoglu (2001b) explains that if technological progress causes an equivalent effect of increase in physical capital (labor), it is a capital (labor) -augmenting technological progress. The relationship between factor-biased technological progress and factor-augmenting technological progress is that when the substitution elasticity of labor and capital (σ) is less than 1, A_K becomes labor-biased technological progress, and A_L becomes capital-biased technological progress. The substitution elasticity is generally less than 1. By the classification of Hicks (1932), while A_K occurred in Korea before 1998, A_L appeared to happen after 1998. According to Acemoglu (2001b), cost minimizing companies choose between A_K and A_L which expand their relatively more abundant factors.

In a biased technological progress, there are two elements that affect EMP. First, technological progress leads to a relatively higher use for any one of production factors. If σ is less than 1, labor and capital become complementary, and if the use for one factor of production increases after technological progress, the demand for the other factors must also increase. Second, a tradeoff between A_K and A_L affects EMP. The tradeoff means if companies choose one type of technology for example A_L, they must reduce the other type A_K. By definition of biased technological progress, there is a difference of growth between A_K and A_L. If growth of A_K is larger than that of A_L, when A_L advances, it sacrifices the larger A_K and decreases productivity and accordingly EMP. So, it is necessary to find out which is the faster type between A_K and A_L. By comparison of TFP and w/r trends, the size of tradeoff can be guessed. The growth of primal TFP is an unexplained residual, which accounts for an increase in GRDP not caused by the labor input and capital. In this case, TFP, which is a standard measure for technical progress, contains both A_K and A_L. TFP is influenced by the faster progress type. In this study, TFP moves in the same direction as w/r, which is a proxy variable of invisible A_K/A_L. This means A_K is larger than A_L.

If growth of A_K is larger than the conflicting A_L, the puzzle of de Groot, Poot, and Smit (2008) can be explained as follows. This study assumes that a rise in indices causes A_K, and a fall causes A_L. As discussed, when A_L appears, it decreases TFP and accordingly EMP. So, without complementarity, indices have positive correlations with EMP. But complementarity can reverse correlations. So, when A_L appears, negative correlations can also occur between indices and EMP. The key findings are summarized as follows. Before 1998, SPE, COM and DIV all showed positive correlations with both TFP and EMP in most regions except for the Gangwon region owing to strong productivity effects by A_K. On the other hand, when A_L appears, positive, negative and insignificant correlations between indices and EMP all appear according to the magnitude between the negative EMP effect of A_L and the positive EMP effect of complementarity.

The economic reforms after the 1998 financial crisis were mainly to oppress aggressive investment and reckless business expansion by large companies, which was regarded as the main cause of 98 financial crisis (Shin & Chang, 2003). Korea's strong suppression of the regional concentration of capital by large companies might lead companies to choose A_L because large companies are the major determinant of regional capital abundance. At the same time before 1998, relative capital abundance made companies choose more favorable A_K (Acemoglu, 2001b). This study shows most regions enjoy faster TFP and EMP growth by growth of A_K before 1998. In terms of income equality, A_K also has advantage over A_L because A_K increases wage and labor shares. Chapter 3 will cover productivity analysis and changes of key variables such as w/r, TFP and EMP etc. In Chapter 4, correlations of indices with regional TFP and EMP will be analyzed. And these results will be interpreted in terms of biased technological progress. In Chapter 5 and 6, policy implications, conclusions and limitations will be discussed.

CHAPTER II: LITERATURE REVIEW

2-1. Industrial Structure and Regional Employment

The geographical concentrations of industry are widely recognized to have positive technological externalities. Glaeser, Kallal, Scheinkman, and Shleifer (1992) classified the modes of industrial concentration into three industrial structure indices: SPE, COM and DIV. The positive externality SPE cause is called the MAR effect because Marshall (1890), Arrow (1962), and Romer (1986) thought market-dominant companies diffuse knowledge to related companies in the same industry. Porter (1985, 1990) focused on the competitive advantage (COM) of innovative small firms in industry clusters in the US. This theory assumes that competitive pressures among small companies in the same industry make companies more cost-efficient and agile to accept new technology. Meanwhile, Jacobs (1969) argued that cities with diverse industries tend to grow faster (DIV) because the borrowing and transformation of knowledge among small companies across diverse industries is the basis of regional growth.

Regarding the size of the company on industrial structure, the consensus among researchers in this field is that SPE is mainly influenced by large companies. On the other hand, DIV and COM are mainly influenced by SMEs. This study added to the argument that DIV can also be influenced by business diversification of large companies as well as by SMEs, based on the research of Chandler (1990), who in his book, “The Scale and Scope” showed how large companies in the US, UK, France, Germany, and Japan from the 1890s to the 1990s caused technological innovations by economies of scale and scope. Chandler also argued that the diversification of business into new industries or new regions by large companies typically invigorates economies in the above countries, and he argued that this vitalizing effect is the source of economies of scope. In the geographical concentration literature, DIV is related to economies of scope (Glaeser, Kallal, Scheinkman, & Shleifer, 1992).

Conventionally, urban economists (Glaeser, Kallal, Scheinkman, & Shleifer, 1992; Henderson, Kunkoro, &Turner, 1995), under the assumption of neutral technological progress, have regarded

regional employment increases as proportionate to the technological externalities caused by industrial concentration. As a result, they only focused on the correlation between employment and the three indices that measure industrial concentrations. While it is widely recognized that industrial concentration generates positive externalities to the local economy, enhances the productivity of firms, and creates new employment opportunities, the existing empirical studies provide no clear evidence on the concentration-employment nexus.

The results of preceding domestic and foreign studies are as follows. Glaeser, Kallal, Scheinkman, and Shleifer (1992) found positive correlations in DIV and COM with 6–10 US cities' panel data in 5–10 industries in 1956 and 1987. Glaeser, Kallal, Scheinkman, and Shleifer (1992) frankly expressed surprise at not discovering positive correlation in SPE, explaining that positive correlations in SPE could be found in the data of young and fast-growing cities instead of mature cities used in their study. Henderson, Kunkoro, and Turner (1995) found positive correlations in SPE in mature manufacturing industries and positive correlations in SPE and DIV in hi-tech industries with US cities' panel data from 1970 to 1987.

Table 1: Vote Counts of Three Indices

Statistical Significance	Specialization (SPE)		Competition (COM)		Diversity (DIV)	
	count	percent	count	percent	count	percent
Negative Significant	60	37%	16	20%	17	11%
Negative Insignificant	33	20%	13	16%	40	26%
Positive Insignificant	16	10%	19	24%	37	24%
Positive Significant	53	33%	31	39%	58	38%
Total	162	100%	79	100%	152	100%

Source: de Groot, Poot, and Smit (2008), p. 28.

Since the seminal papers of Glaeser, Kallal, Scheinkman, and Shleifer (1992) and Henderson, Kunkoro, and Turner (1995), a lot of studies of geographical concentration have been carried out according to their theoretical frameworks. de Groot, Poot, and Smit (2008) analyzed 322 quantitative papers with more than one index among SPE, COM and DIV, as seen in Table 1. In the case of SPE, there were 60 negative correlation results out of 113 results. On competition, positive correlation results are twice those of negative correlation cases. In the case of DIV, the number of positive

significant cases was over 3 times that of negative significant cases. Across the three indices, negative outcomes account for 179 cases (45.5%) of the total of 393. These results are confusing because favorable externality by industrial concentration so often decreases local employment.

In the case of Korea, positive correlations prevail in SPE and DIV. But with recent data such as that provided by Lee (2014), negative results occur relatively more often. In the case of COM, correlation results are mixed. Lee and Chang (2001) analyzed the data for eight manufacturing industries from 1981 to 1996 and found positive correlation in DIV. Min and Kim (2003) reported negative correlation in COM. Lee, Kim, and Jung (2008) found positive correlation in SPE. Lee and Park (2010) found positive correlation in SPE and DIV in panel data from 1994 to 2006 in manufacturing industries. Lee (2014) reported positive correlation in COM. Lee and Kang (2012) reported all positive correlations in SPE, COM, and DIV. Lee (2014) built micro-manufacturing data and found positive correlations in SPE and DIV, but negative correlations in COM with labor productivity dependent variables. To the contrary, with employment dependent variables, he found negative correlations in SPE and DIV and positive correlations in COM.

Another interesting point about the results is that according to the dependent variable in the regression analysis, the results are not consistent. Dekle (2002) found non-correlations in SPE when TFP was used as the dependent variable with finance, manufacturing, and service industry data in Japan from 1975 to 1995. However, when employment was used as the dependent variable, he found positive correlations in SPE. Cingano and Schivardi (2010) found positive correlations in SPE when TFP was used as the dependent variable, but when employment was used as the dependent variable, positive correlations in COM and DIV were found, but not in SPE, with Italian whole-industry data. Henderson (2000) found positive SPE in hi-tech industry data when TFP was used as the dependent variable, but when employment was used as the dependent variable, such correlations disappeared.

2-2. Biased Technological Progress

Historically, the classification of technological progress was judged by change of factor income by technological progress. Hicks (1932) argued that when the labor income share rises, there is a labor-biased (= labor using = capital saving) technological progress. This is the case when w/r rises after technological progress because Hicks (1932) assumed K/L is constant in the economy. If the labor income share has not fluctuated, it is classified as neutral technological progress. This is the case when w/r remains constant after technological progress. To the contrary, if the labor income share falls, it is classified as capital-biased (= capital using= labor saving) technological progress. This is the case when the relative factor price w/r decreases after technological progress. Recently, the notion of factor-augmenting technological progress has often been used as an expression of technological progress. This theory assumes that the qualitative efficiency increase of the production factor is equivalent to the effect of physical factor increase. Acemoglu (2001b) explains that if technological progress causes an equivalent effect of increase in physical capital input, it is a capital-augmenting technological progress (A_K). Conversely, if there is the same effect of labor input increase after technological progress, it is judged as a labor-augmenting technological progress (A_L). The increase in the efficiency of capital as a result of A_K means that it can be expressed equally by the increase in capital input. For example, if A_K=2, even if capital K is fixed at K_0, the result of technological progress is actually the same as the result of increase of input $2K_0$. In addition, Acemoglu (2001b) defined labor-biased technological progress when the marginal productivity of labor increases more than the marginal productivity of capital after technological progress ($\frac{d\frac{MP_L}{MP_K}}{dA} = \frac{d\frac{w}{r}}{dA} > 0$). The capital-biased technological progress is defined in the same way. Here, A is the technology index.

A simple model can be used to explain the effect of factor-augmenting technological progress on productivity and labor demand. First, let's assume the CES production function that allows the

variation of the relative factor price and factor income shares.

$$Y = F(K, L) = \left((A_L L)^{\frac{1-\sigma}{\sigma}} + (A_K K)^{\frac{1-\sigma}{\sigma}} \right)^{\frac{\sigma}{1-\sigma}} \quad (1)$$

Here, σ is substitution elasticity between capital and labor. First-order conditions (3) and (4) are derived in the cost-minimizing production Y under the budget constraint of a representative company (2):

$$C = wL + rK \quad (2)$$

$$r = \lambda F_K = \lambda A_K{}^{\sigma-1} K^{-\frac{1}{\sigma}} Y^{\frac{1}{\sigma}} \quad (3)$$

$$w = \lambda F_K = \lambda A_L{}^{\sigma-1} L^{-\frac{1}{\sigma}} Y^{\frac{1}{\sigma}} \quad (4)$$

Here λ means marginal cost as the increase in cost for one unit increase in output Y. Dividing (3) by (4), relations among relative technological progress (A_K/A_L), capital intensity (K/L) and r/w is derived as (5)

$$\frac{r}{w} = \frac{MP_L}{MP_K} = \left(\frac{A_K}{A_L}\right)^{\frac{\sigma-1}{\sigma}} \left(\frac{K}{L}\right)^{\frac{-1}{\sigma}} \quad (5)$$

If σ<1, (σ-1)/σ at the top $\left(\frac{A_K}{A_L}\right)^{\frac{\sigma-1}{\sigma}}$ become negative, and the movement between $\left(\frac{A_K}{A_L}\right)$ and $\frac{r}{w}$ is opposite. In other words, if A_K appears, $\frac{w}{r}$ rises. To the contrary, if A_L appears, $\frac{w}{r}$ falls. Equation (5) is very important in the judgment of the type of technological progress. If A_K=A_L, then $\frac{r}{w}$ does not change because in this case, technological progress becomes Hicks neutral (1932). This means that there are necessarily size and growth rate differences in A_K and A_L in biased technological progress. By modifying the equation (5), the effect of biased technological progress on factor intensity K/L can be seen in equation (6).

$$\frac{K}{L} = \left(\frac{A_K}{A_L}\right)^{\sigma-1} \left(\frac{w}{r}\right)^{\sigma} \quad (6)$$

If $\sigma<1$, when A_K appears, $\frac{K}{L}$ decreases with $\frac{w}{r}$ constant. To the contrary, when $A_L$appears, $\frac{K}{L}$ increases with $\frac{w}{r}$ constant. The first case, the K/L decrease effect by A_K, is called labor bias. The second case, the K/L increase effect by A_L, is called capital bias. However, it should be remembered that this is established under the condition of ceteris paribus. Biased technological progress also can change factor prices, w/r in (6), which has the opposite effect on factor demand. For example, after appearance of A_K, K/L can increase if a rise of capital demand by a rise of w/r is larger than the labor bias. To the contrary, K/L can decrease if a rise of labor demand by a fall of w/r is larger than the capital bias. So, after biased technological progress, it is not known in advance whether the relative factor demand K/L will rise or fall. But one thing is clear in terms of labor demand, namely employment. Even if capital bias is strong, employment usually increase because this increased capital by capital bias requires a complementary factor, labor. If both sides of equation (6) are multiplied by w/r, equation (7) is derived showing the change in factor income according to type of technological progress.

$$\frac{rK}{wL} = \left(\frac{A_K}{A_L}\right)^{\sigma-1} \left(\frac{w}{r}\right)^{\sigma-1} \quad (7)$$

It can be known that when $\sigma<1$, A_K increases the labor income share, whereas A_L increases the capital income share. There is one more important consideration when it comes to employment. A_K and A_L cannot be increased at the same time according to the "innovation possibility frontier", which shows a trade-off between A_K and A_L. The innovation possibility frontier is derived in the problem of maximizing the output growth rate R under given K and L (Acemoglu, 2001a).

$$R = \alpha \frac{dA_L}{A_L} + (1-\alpha)\frac{dA_K}{A_K} \quad (8)$$

This is rewritten as follows:

$$\frac{dA_L}{A_L} = F\left(\frac{dA_K}{A_K}\right) (9)$$

Here α is labor income share. The innovation possibility frontier in equation (9) is a concave and negatively sloped curve, which means, when companies choose A_K (A_L), they have to sacrifice A_L (A_K). The tradeoff between A_K and A_L has important implications on employment. If A_L is assumed to be the slower type, when A_L appears, overall productivity and accordingly employment can decrease because A_L has to sacrifice the lager A_K. On the contrary, capital bias by A_L can increase employment by the complementarity. In biased technological progress, employment depends on the relative size of this trade-off and the complementarity.

2-3. Derivation of Hypothesis

It is widely recognized that industrial concentration would generate positive externalities to the local economy, enhance the productivity of firms, and create new employment. The three indices of SPE, COM, and DIV, which measure the concentration externality, have positive correlation with productivity because the three indices have apparent theoretical backgrounds. The following functional relationship is established.

$$\mathrm{TFP} = \mathrm{TFP}\,(\mathrm{SPE}, \mathrm{COM}, \mathrm{DIV})\ (10)$$

While there is consensus on the positive nexus between industrial concentration and productivity, existing empirical studies provide no clear-cut evidence of positive correlations between the three indices and employment. In de Groot, Poot, and Smit (2008), who analyzed a total of 393 cases, positive and negative correlations appear roughly half and half. This phenomenon can be interpreted to mean that even when productivity decreases, employment can still increase. Then, the assumption of neutral technological progress is hard to explain because productivity increases all factors L and K proportionately. To explain this problem, this study introduces the notion of biased (factor-augmenting) technological progress in which technological progress asymmetrically affects factor demand. The relationship between factor-augmenting technological progress and factor-biased technological progress is that when the substitution elasticity of labor and capital (σ hereafter) is less than 1, A_K becomes labor-biased technological progress, and A_L becomes capital-biased technological progress. The σ is generally less than one at home and abroad. Therefore, in this paper, the terms *factor-augmenting* and *factor-biased technological progress* will be used interchangeably. According to equation (6) and (8), unobservable factor-augmented technological progress can be identified by available w/r and labor income share, a proxy variable for A_K and A_L. In Korea, the long-term trends of w/r and labor shares show both that A_K might appear before 1998 and A_L seemingly appeared. This assumption can be justified in terms of the market size effect of Acemoglu (2001b), in which a cost-minimizing company chooses technological progress that augments the

relatively more abundant (or inexpensive) factor. This study assumes that through policies mainly pertaining to large companies and location regulations, capital became relatively abundant before 1998, while labor became relatively abundant after 1998. That is to say, Korea's strong suppression of regional concentration of capital by large companies has led to A_L because in most economies, large companies are the main suppliers of capital stock.

As previously discussed, biased technological progress necessarily assumes a different growth rate of A_K and A_L. According to equation (10), the negative sloped innovation possibility frontier shows that the A_K and A_L are in a trade-off. Namely, one type of technological progress appears by necessarily sacrificing the other type of technology. In this case, if companies choose a slower technological type, overall productivity can decrease through sacrificing faster technological progress. The faster of the two options can be judged by comparison of TFP and w/r. The movement of A_K/A_L can be judged by the movement of its observable proxy variable w/r in equation (6). If w/r rises, it can be judged that A_K increases (A_L decreases) and if w/r falls, A_K decreases (A_L increases). The TFP by primal method (TFP_P) includes everything except physical factor increase. If there are no scale economies or extra profit, TFP_P should include A_K and A_L. In this case, the trend of TFP_P is affected by the stronger of the two. In Korea from 1970 to 2014, w/r shows strong positive correlations with TFP_P by regression analysis. TFP_P increases as A_K appears and decreases when A_K falls. This means the growth rate of A_K is higher than A_L. If A_L were faster, w/r would show negative correlations with TFP_P. Moreover, in this study, there are high correlations between GTFPs (growth rate of TFP) by primal and dual method ($GTFP_P$ and $GTFP_D$). Shapiro (1987) also showed high correlations between the two with long-term US data. The $GTFP_D$ is defined as the weighted sum of the growth rate of w and r. The problem, then, is explaining why after 1998 the visual trends of w/r do not show clear correlations with TFP_P, even though there are very strong correlations by regression analysis. After 1998, TFP clearly decreased, but w/r seemed to slightly increase regionally. The answer to this question is closely related to explanations of mixed correlations (de

Groot, Poot, & Smit, 2008).

The faster growth rate of A_K has two important consequences in terms of employment and w/r. First, it is clear that the faster growth of A_K strongly increases productivity, and accordingly employment. However, if a company chooses A_L, owing to the trade-off, overall productivity can decrease because A_L has to sacrifice faster A_K. This leads to a decrease in employment. Second, the faster growth rate of A_K leads a company to have consistent preference for the use of capital. In terms of embodied technological progress, in which technology is part of physical capital, A_K is a production factor that brings higher expected future returns than labor. This preference can happen when the incompleteness of the capital asset market caused by minor participants and limited use due to asset specificity causes uncertain future profit to be insufficiently reflected in capital price r (Williamson, 1975, 1985). The assumption of capital preference can answer why the w/r trend slightly increases, even though A_L might appear. In equation (6), K/L increase by capital preference causes w/r to rise. If this offsetting effect is larger, w/r can increase even under A_L, which inherently lowers w/r. And in this case, indices show negative correlations with w/r.

Capital preference also has an important implication for employment. When σ is smaller than 1, labor and capital become complementary. This increased capital use by capital preference necessarily increases the demand for the complementary factor of labor. The strong complementarity by capital preference can offset employment decrease by A_L. Therefore, increase or decrease of employment depends on the relative magnitude of the two conflicting forces of complementarity and A_L. In this case, employment, TFP and w/r are not only the function of three indices. The complementarity by capital preference C_P also needs to be considered. This study assumes that a rise in indices causes A_K, and a fall in indices causes A_L. So, regional employment equation EMP can be written as follows:

$$\mathrm{EMP} = \mathrm{EMP}\left[\mathrm{TFP}\left(\frac{\mathrm{A_K}}{\mathrm{A_L}}(\mathrm{SPE}, \mathrm{COM}, \mathrm{DIV})\right), \mathrm{C_P}\right] (11)$$

If the complementarity does not exist, when indices rise, A_K rises, and w/r and TFP also rise accordingly. When indices fall, A_L rises, while w/r and TFP fall. So, overall, there is a positive nexus between indices, w/r, and TFP. Namely:

Indices (SPE, COM, DIV) ↑ → A_K ↑ → A_K/ A_L (w/r) ↑ → TFP ↑ → EMP (employment) ↑

Indices (SPE, COM, DIV) ↓→ A_L ↑ → A_K/ A_L (w/r) ↓→ TFP ↓ → EMP (employment) ↓

However, the complementarity raises employment and w/r consistently. The complementarity thus fortifies the correlation of indices with w/r, TFP and EMP when A_K appears. But when A_L appears, complementarity weakens or reverses the correlations. So, hypothesis can be established as follows.

H l: If A_K appears, the three indices have positive correlations with w/r, TFP and EMP.

H 2: If A_L appears, the three indices will not show consistent correlations with w/r, TFP and EMP. If the complementarity is strong enough, three indices can show even negative correlations with w/r, TFP and EMP.

CHAPTER III: PRODUCTIVITY ANALYSIS

3-1. Construction of Data for Productivity Analysis

The basic approach to regional data compilation in this study, including the constructions of indices, is to dissect national data into five regions using appropriate ratios. These regional ratios have been obtained from surveys, but considerable estimations have been made because of the scarcity of regional data before 1990. There are two real GDP series based on two different methods: the fixed weight and chain-weighted methods. This study used chain-weighted GDP, which is regarded as a more advanced method for national accounts. However, the sums of real GRDPs are not equal to the total real GDP in the chain-weighted method. Therefore, this study applied nominal expenditure GRDP ratios to the regional partition of chain-weighted GDP since 1986. The regional ratios of the GRDP from 1970 to 1985 were obtained in the ARGRP (Annual Report of Gross Regional Product). In the Economic Activity Census (EAC) on KOSIS, regional employment data, wageworker and non-wage worker are only available from 1990. Regional employment data from 1970 to 1978 is available in the ARGRP. And from 1979 to 1980 a linear interpolation method was applied. From 1981 to 1989, regional employment ratios referred to the Establishment Census (EC) of 1981, 1986, and 1991 and ALCAE (Actual Labor Conditions at Establishment). In terms of the regional wage rate, the Survey Report on Occupational Wages (SROW) and the Report on Monthly Labor Survey (MLS) include regional average wage rates from 1970 to 1992. From 1993 to 2007, regional wage rate data is available from the Survey Report on the Wages and Working Hours at Establishment. Since 2008, the Report on the Occupational Labor Force Survey at Establishments was used. Employee income data was compiled by the sum of the wageworker and non-wage worker employee incomes. Regional employee incomes of wageworkers (non-wage worker) are compiled by multiplying regional average wage rates by the number of regional wage workers (non-wage worker). In case of non-wage worker employee incomes, the imputed wage rates need to be estimated. Cho (2016) regards the imputed wage of the non-wage worker as 50% that of the wage

worker. This paper follows this 50% rule regionally as Cho (2016) showed it is consistent with employee income statistics in the national accounts.

In the construction of capital stock, the compilation method differs by periods and assets. The Perpetual Inventory Method (PIM) was applied to the fixed capital formations in ARGRP for 1970 to 1976. From 1998 to 2014, KOSIS released regional capital formations and regional capital stock was easily constructed by the PIM. Meanwhile, from 1977 to 1997, construction assets and facilities assets were compiled separately. First, the construction assets were compiled by construction works completed (CWC) using PIM. CWC is the amount of already completed construction work, as surveyed by the Construction Association of Korea from 1976. CWC data is the most important source used by BOK for the compilation of construction investment. Facility assets from 1977 to 1997 were compiled separately by government and industry sector; facility assets in government sectors from 1977 to 1997 were connected by PIM by using data in the government sector in the 1977, 1987, and 1997 NWS (National Wealth Surveys). Facility assets in industry sectors were compiled as follows: Because of difference of industrial classifications by period and survey, the facility assets were compiled for seven industries using NWS, MMS, and another available annual survey, as shown in Table 2 of Appendix F. The compilation of mining and manufacturing industry data were the most important because the facility assets of the mining and manufacturing industry composes about 60% (1977: 58.7%, 1987: 57. 7% and 1997: 51.8%) of total facility assets. The MMS contains the facility asset data. ICs (Industrial Censuses) are the extended version of the MMS, conducted every 5 years from 1968 to 1997. IC also includes the regional facilities asset data for the electricity, gas, and water supply industries. This data was used for facility asset compilation of these industries. If there is no available survey with facility asset information in the industry, each region's NWS data by industry was connected with PIM to the following NWS. NWSs, which was carried out by NSO (National Statistical Office) in 1968, 1977, 1987, and 1997 are important sources of facility assets because regional capital stock data are difficult to find, both at home and abroad.

3-2. Productivity Analysis

3-2-1. Theories on Productivity Analysis

Productivities are typically estimated by GTFP, which stands for invisible technological progress. Thus, GTFP growth is indirectly gauged by subtracting visible factor growth from output growth. This is an unexplained residual that accounts for the growth in GRDP (Y) that is not caused by a regions' labor input (L) and capital stock (K). Conventionally, GTFP is compiled by the primal method shown above. This study additionally compiles GTFP by the dual method. In business cycles, both primal GTFP and w/r moves pro-cyclically. Keynesian economists argue that fluctuations in w/r, GTFP, and Y arise from demand shocks. However, RBCT argues that productivity change by technological progress is itself the cause of the business cycle. As shown below, dual GTFP is a function of growth of factor prices. If primal GTFP does not include true productivity shocks, it should not show a high correlation with dual GTFP (Shapiro, 1987). Thus, for identification of the correlations of both, the dual method is compiled as well. Under CD production function and neutral technological progress, the primal and dual GTFP results are theoretically equal. Yet, under more generalized conditions, both need not necessarily be the same. If the production function is a CES type that allows K/L and w/r to change with technological progress, primal and dual GTFP can differ.

Primal GTFP is compiled using the growth accounting method. This assumes the Cobb-Douglas (CD) production function with constant returns to scale technology.

$$Y = AF(L, K) = A\, L^{\alpha} K^{(1-\alpha)} \quad (12)$$

Where A: TFP, α: labor income share, and (1- α): capital income share. After taking the log and differentiation of both sides, the typical $GTFP_P$ (growth of TPF_P) equation is derived.

$$GTFP_P = \frac{dA}{A} = \frac{dY}{Y} - \alpha \frac{dL}{L} - (1-\alpha)\frac{dK}{K} \quad (13)$$

In the primal method, GTFP is defined as the residual besides the weighted sum of the growth of L and K. The dual method compiles GTFP by growth of factor prices w and r, and is called the factor price method. For national income identity, all national income is distributed between the production factors L and K. Namely:

$$Y = rK + wL \quad (14)$$

Where r: cost of capital (or price of capital), and w: real wage rate. By differentiating both sides of the above equation and inserting the $GTFP_P$ equation, a $GTFP_D$ equation is derived.

$$\frac{dY}{Y} = (1-\alpha)\frac{dr}{r} + (1-\alpha)\frac{dK}{K} + \alpha\frac{dw}{w} + \alpha\frac{dL}{L} \quad (15)$$

$$GTFP_D = \frac{dA}{A} = \frac{dY}{Y} - \alpha\frac{dL}{L} - (1-\alpha)\frac{dK}{K} = \alpha\frac{dw}{w} + (1-\alpha)\frac{dr}{r} \quad (16)$$

In the factor price method, $GTFP_D$ can be defined as the weighted sum of growth of w and r.

In the primal method, the regional capital stock is usually compiled by PIM (perpetual inventory method). K_n is attained by adding investment I_n to the previous capital stock K_{n-1} adjusted by depreciation rate δ:

$$K_n = K_{n-1}(1-\delta) + I_n \quad (17)$$

GDP deflators are applied to transform nominal capital stock into real capital stock. And in the aggregation of capital stock, the Tornqvist quantity measure was adopted, which gave the weight by the average of capital shares over two successive years. The dual method has the advantage that it can be estimated without assuming a specific type of production function or CRS. However, the dual method requires a separate estimation of r (cost of capital). To obtain estimates of r_0, it is necessary to measure the asset price and volume of capital used in production. In market clearing conditions, the unit capital cost r_0 for a new asset is approximately equal to the rate of capital return i_0 adjusted for real anticipated changes in asset price p_0 (i.e., the nominal rate of capital return corrected for

general inflation π_0, and depreciation of a new asset δ_0).

$$r_0 = P_0(r_0 - \pi_0 + \delta_0) \quad (18)$$

The rate of capital return is the opportunity cost of holding durable goods rather than financial claims (Jorgenson, 2009). There are two kinds of rate of capital returns: ex-post and ex-ante. In a market with no uncertainty, the ex-post and ex-ante rates of capital return are the same because the expected (ex-ante) amount of capital will be the same as ex-post due to immediate price adjustment. However, in growth accounting, expected capital used in production does not equal the actually realized capital stock (Pyo, Jung, & Cho, 2007). The ex-post approach is recommended in the OECD manual (Schreyer, 2001). It is called the ex-post and endogenous rate of capital return because it is drawn in equality between the capital income and the value of capital service actually used in production. This naturally guarantees the conformity of income and production accounts. In this study, rate of regional capital return (i) was compiled by dividing regional capital income by regional capital stock K. A regional capital income is a remainder of GRDP minus labor income wL. The regional wage rate w is the regional average wage rate compiled by survey data. Namely:

$$i = \frac{(Y - wL)}{K} \quad (19)$$

3-2-2. Comparison of TFP Compilation Results

Table 2: Comparison of Labor, Capital, and TFP Growth by Researchers

Year	Author				Cho (2016)				Kim (2012)			
	Growth	Capital	Labor	TFP	Growth	Capital	Labor	TFP	Growth	Capital	Labor	TFP
1971-'14	7.2	3.4	1.5	2.3	6.9	3.6	1.7	1.7	6.9	1.1	2.2	3.3

Sources: Cho (2016) and Kim (2012)

First, the regional TFP growth compilation is very rare, so the national TFP growth results of this study are mainly compared to the domestic analyses of Cho (2016), Kim (2012), and the foreign study by Jorgenson, Mun, and Stiroh (2005) with similar time coverage, as seen in Tables 2 and 3. Sixteen regional TFP growth results in Park (2010) will also be compared. In Table 2, the growth of TFP (GTFP hereafter) compiled by the author, Cho (2016) and Kim (2012) show at 2.3, 1.7, and 3.3. The estimated capital growth of Cho (2016) and the author are similar at 3.6 and 3.4, but Kim's shows only 1.1. The labor growths of the three studies are relatively similar. The differences in Cho (2016) and Kim (2012) are caused by growth of capital and GTFP. Overall, the author's GTFP, labor and capital growth lie between those of Cho (2016) and Kim (2012). However, questions remain as to why two representative studies show such severe differences in capital growth. Next, a comparison of GTFPs before and after 1998 will be carried out. The studies by Cho (2016) and Kim (2012) compiled a decrease in GTFP since around 2000, as did the results of this study. Shin (2014) compiled similar GTFP after 1998. Pyo and Lee (2018) found that GTFP increased after 1998, especially in the service industry, because of successful 1998 restructuring reforms.

Table 3: Source of Output Growth in Developing Asia (16 Economies): 1995-2003

Economy	Period 1989-1995						Period1995-2003					
	GDP growth	Sources of Growth (%point per annum)					GDP growth	Sources of Growth (%point per annum)				
		Capital		Labor		TFP growth		Capital		Labor		TFP growth
		ICT	Non-ICT	Hours	Quality			ICT	Non-ICT	Hours	Quality	
Korea	7.48	0.29	2.31	1.45	0.31	3.13	4.09	0.46	1.67	0.88	0.26	0.85
All Groups	7.35	0.15	1.73	1.19	0.42	3.86	5.62	0.43	2.27	0.81	0.38	1.72

Source: Jorgenson, Mun, and Stiroh (2005). In their study, quality of labor was considered and GTFP was compiled separately from ICT and Non-ICT industries.

Table 3 is an excerpt from the source of growth in developing Asia by Jorgenson, Mun, and Stiroh (2005). This includes the GTFP of Korea that shows a dramatic decrease from 3.13 in the 1989 to 1995 period to 0.85 in 1995 to 2003. Namely, the contributions of GTFP to GDP growth decreased from 41.8% (3.13/7.48) to 20.8% (0.85/4.09). The GTFP results of Jorgenson, Mun, and Stiroh (2005) are very similar to the author's at 3.3% before 1998 and 0.5% after 1998. Other foreign results mostly show that GTFPs in Korea have consistently decreased since 1990s. In the case of the OECD productivity compilation, GTFP was 4.2% (1981–2010) and 1.1% (1991–2010) respectively (Cho, 2016).

Table 4: Regional TFPs Estimates by Park (2010) by Primal Method

	Nation	Seoul	Busan	Daegu	Incheon	Gwangju	Daejeon	Ulsan	Gyeonggi	Chungbuk	Chungnam	Jeonbuk	Jeonnam	Geongbuk	Geongnam
88-97	5.7	6.4	4.5	3.4	6.8	6.1	5.9	1.4	5.2	6.7	3.0	6.4	7.0	5.0	8.2
98-06	2.5	2.8	2.1	0.9	2.8	2.6	3.2	2.3	2.4	2.5	3.2	2.3	3.0	2.3	1.1

Source: Park (2010)' 16 *si, do* GTFP results from his Appendix Table.

As seen in Table 4, Park (2010) compiled the GTFPs of 16 regions between 1988 and 2006. The national GTFP level is 4.49. Most regional GTFPs were halved after the 1998 financial crisis. Only Ulsan and Chungnam showed an increase in GTFP during this period. Park (2010) compiled quite similar dual GTFPs, estimating them to be nationally higher than Cho (2016) and Kim (2012), and regionally higher than the author. Kim (2012), Cho (2016), and this study estimate around 2–3%, but Park (2010) found close to 6% before 1998 in Table 4. The difference mainly arises from capital stock compilations because information for capital is limited for both home and abroad. Considering the very rare regional GTFP compilations, even though Park (2010) compiled considerably higher GTFP results, they are meaningful in that the study also confirms that regional GTFPs as well as national GTFP have been decreasing since 1998 (Park, 2010). In general, the GTFP and factor contributions of this study are in the middle of major studies. Some domestic studies have shown that GTFP increased from the late 1990s, but recent studies, including overseas studies, argue that GTFP has been decreasing since the late 1990s.

3-2-3. Productivity Analysis and its Limits

Table 5: Correlation between GRDP Growth and GTFP Growth during 1971–2014

Regions	Nation	Capital	Chungcheong	Yeongnam	Honam	Gangwon
Correlations	0.708	0.569	0.808	0.717	0.818	0.866

Note: Correlation: Correlation between GRDP growth and GTFP (Growth of TFP)

Table 6: GTFP and Contributions during 1971-2014

Region	Growth Rate				Contributions (%)			
	GRDP	Capital	Labor	TFP	GRDP	Capital	Labor	TFP
Capital	7.9	3.5	2.6	1.9	100.0	43.9	32.6	23.5
Chungcheong	7.3	3.7	1.0	2.6	100.0	51.0	13.1	35.9
Yeongnam	6.8	3.7	1.0	2.1	100.0	54.1	15.3	30.5
Honam	5.8	2.5	0.2	3.1	100.0	42.6	4.1	53.2
Gangwon	5.6	2.3	0.5	2.9	100.0	40.4	9.0	50.6

Note: Growth Rate: actual growth of GRDP, capital, labor and TFP (Left), Contributions: portions of capital, labor and TFP growth in GRDP growth (Right)

This section examines the contributions of factors and TFP to GRDP growth in five regions over a 10-year period. The limits of the analysis will be discussed afterwards. Before productivity analysis, simple correlations of GRDP growth and GTFP can easily show how much GRDP growth can be explained by GTFP. In Table 5, from 1971 to 2014, the correlation in the Capital region is relatively low at 0.569. However, all other regions show over 0.7. In Gangwon region, it approaches 0.866. These results support the common hypothesis that regional GTFPs decisively affect GRDP growth. Next, a productivity analysis of the whole period will be conducted to determine the contributions of labor, capital, and TFP to GRDP growth, as seen in Table 6. The Table 6 on the left side shows the actual growths of factor and TFP, and those on the right shows their contributions of the GRDP growth. In five regions, the GRDP growth is fastest in the Capital region at 7.9, mainly owing to the capital growth at 3.5 and labor growth at 2.6, despite having the lowest GTFP at 1.9. The Chungcheong and Yeongnam regions show fast GRDP growth at 7.3 and 6.8, respectively, mainly owing to the fast capital growth, both at 3.7. The Gangwon region shows lowest GRDP growth at 5.6. The contributions of capital, labor, and TFP are 40.4%, 9.0%, and 50.6%, respectively. In the cases of Honam and Gangwon, the contributions of TFP are highest among 5 regions, at 53.2% and

50.6%. Yet, their labor contributions are less than 10%. The low GRDP growths of these two regions are mainly caused by these minimal contributions of labor, despite high TFP contributions.

Table 7: Growth and Contributions of Capital, Labor, and TFP before and after 1998

Year		Nation				Capital				Chungcheong				Yeongnam				Honam				Gangwon			
		GDP	K	L	TFP	GRDP	K	L	TFP	GRDP	K	L	TFP	GRDP	K	L	TFP	GRDP	K	L	TFP	GRDP	K	L	TFP
'71-'97	Growth	9.0	4.7	1.9	2.4	10.0	4.9	3.4	1.7	8.4	5.0	1.0	2.4	8.8	5.2	1.5	2.1	7.4	3.2	0.3	3.8	7.2	2.9	0.6	3.7
	Contribution	100.0	52.1	21.1	26.7	100.0	48.9	34.2	16.8	100.0	59.1	12.2	28.7	100.0	59.7	16.7	23.7	100.0	44.0	4.2	51.8	100.0	39.7	9.0	51.3
'98-'14	Growth	4.3	1.7	0.7	1.9	4.5	1.4	1.1	2.0	5.5	2.4	0.8	2.4	3.7	1.7	0.3	1.8	3.4	1.8	0.1	1.5	3.1	1.9	0.2	1.0
	Contribution	100.0	38.8	16.4	44.8	100.0	31.9	24.3	43.8	100.0	42.8	13.8	43.4	100.0	44.8	8.3	46.9	100.0	52.6	2.7	44.7	100.0	59.6	7.8	32.5

Note: Growth: actual growth of GRDP, capital (K), labor (L) and TFP (Left), Contributions: portions of capital, labor and TFP growth in GRDP growth (Right)

Next, the contributions of TFPs and factors are decomposed for the periods before and after 1998 in Table 7. Before 1998, the order of the regions in terms of GRDP growth was Capital (10.0), Yeongnam (8.8), Chungcheong (8.4), Honam (7.4), and Gangwon (7.2). After 1998, the order was Chungcheong (5.5), Capital (4.5), Yeongnam (3.7), Honam (3.4), and Gangwon (3.2). These orders were similar before and after 1998, although Chungcheong ranked ahead of Yeongnam after 1998. However, in GTFP orders, reversions appear before and after 1998. The GTFPs before 1998 were rather high in Honam and Gangwon. However, after 1998, on the contrary, the Capital region was the highest, and Gangwon and Honam were both low. More concretely, as compared to the pre-1998 period, TFP contribution considerably increased in the nation (26.7%→44.8), Capital (16.8→43.8), Chungcheong (28.7→43.4), and Yeongnam (23.7→46.9). On the contrary, TFP contribution considerably decreased in Honam (51.8→44.7) and Gangwon (51.3→32.5). A nearly opposite phenomenon could be observed on the factors' side. The capital contribution decreases in nation (52.1%→38.8), Capital (48.9→31.9), Chungcheong (59.1→42.8), and Yeongnam (59.7→44.8). Yet, capital contributions increase in Honam (44.0→52.6) and Gangwon (39.7→59.6). On the contrary, minimal labor contributions became more severe after 1998 in Honam and Gangwon. The labor contribution fell short of 10% in Gangwon and fell below 5% in Honam, and labor contributions decrease in every region except Chungcheong (12.2→13.8). As will be seen in next chapter, this minuscule labor contribution might be caused by appearance of A_L in Honam and Gangwon regions.

In the correlation analysis, regional GRDP is explained by a GTFP over 70% on average. However, in the productivity analysis, the TFP contribution has a much lower value, on average of 40% by region. This means that technological elements included in GTFP also explains factor growth in GRDP growth. This implies actual technological progress is biased progress, in which technological progress directly affects factor demand. Before 1998, at the national level, TFP contribution was only 26.7%. And in leading regions such as the Capital and Yeongnam, rapid GRDP growth was caused by factor contributions over 80%. This is why Krugman (1994) argued that the fast growth of East Asia, including Korea, was mostly achieved by factor contributions, not by TFP contribution. But this argument cannot explain why after 1998 TFP contribution doubled (26.7→ 44.8), but GDP growth decreased by more than half (9.0 →4.3) at the national level. And also in Capital, Chungcheong, and Yeongnam after 1998, TFP contributions nearly doubled, but GRDP growth decreased by more than half. On the contrary, capital contributions decreased considerably in these regions. It can be easily seen that the role of factor contributions, especially capital, was very large in these regions with fast GRDP growths. These results imply that the conventional productivity analysis result should be reinterpreted in terms of embodied technological progress, one kind of biased technological progress. In capital embodied technological progress, technology is inseparable from capital. Of course, technology is not wholly embodied in capital, but is mainly embodied in new and delicate facility assets. In Korea before 1998, where new facility asset investments were very active, it can be reasonably assumed that considerable technology was embodied in capital. The studies of Cho (2016) and Kim (2012) showed remarkable differences in the growth contribution of capital contributions. In the case of delicate facility assets and intangible assets, accurate compilations of capital stock are very difficult to achieve. Over- or underestimation of capital stock skews the contributions of capital, labor, and TFP. Yet, in terms of capital embodied technological progress, this skewing does not cause serious problems because the contributions of TFP and capital should be considered as a whole.

3-3. Trends of Key Variables in Regional Economic Development

Table 8: Change of Key Variables in Korea and Five Regions from 1970 to 2014

Regions	Variable	Period			
		1970-1980	1981-1990	1991-2000	2001-2014
Nation	Growth of GDP	0.089	0.098	0.070	0.041
	Growth of Fixed Assets (Capital Stock)	0.164	0.110	0.095	0.042
	Facility/Fixed Assets	0.314	0.322	0.236	0.158
	Growth of Employment	0.036	0.028	0.016	0.015
	Labor Share α	0.624	0.661	0.707	0.613
	K/L (Capital Intensity)	15.4	40.3	90.4	147.8
	w (Average Wage Rate)(unit: million won)	5.4	10.4	19.5	26.0
	r (Cost of Capital)	0.25	0.14	0.10	0.12
Capital	Growth of GRDP	0.104	0.110	0.074	0.042
	Growth of Fixed Assets (Capital Stock)	0.163	0.112	0.097	0.041
	Facility/Fixed Assets	0.317	0.339	0.257	0.180
	Growth of Employment	0.089	0.047	0.025	0.020
	Labor Share α	0.575	0.673	0.719	0.661
	K/L (Capital Intensity)	22	45	89	133
	w (Average Wage Rate)(unit: million won)	6.8	11.9	21.1	28.2
	r (Cost of Capital)	0.25	0.14	0.10	0.11
Chungcheong	Growth of GRDP	0.060	0.101	0.084	0.055
	Growth of Fixed Assets (Capital Stock)	0.165	0.124	0.113	0.048
	Facility/Fixed Assets	0.277	0.259	0.203	0.133
	Growth of Employment	0.019	0.009	0.015	0.019
	Labor Share α	0.690	0.650	0.630	0.523
	K/L (Capital Intensity)	9.5	34.5	101.8	179.9
	w (Average Wage Rate)(unit: million won)	4.4	8.6	17.3	24.5
	r (Cost of Capital)	0.26	0.15	0.11	0.13
Yeongnam	Growth of GRDP	0.096	0.089	0.065	0.036
	Growth of Fixed Assets (Capital Stock)	0.178	0.101	0.087	0.039
	Facility/Fixed Assets	0.338	0.342	0.237	0.153
	Growth of Employment	0.022	0.031	0.012	0.008
	Labor Share α	0.584	0.598	0.698	0.568
	K/L (Capital Intensity)	15.8	41.3	87.8	148.0
	w (Average Wage Rate)(unit: million won)	5.0	9.5	18.6	24.1
	r (Cost of Capital)	0.27	0.17	0.10	0.13
Honam	Growth of GRDP	0.063	0.077	0.065	0.036
	Growth of Fixed Assets (Capital Stock)	0.162	0.120	0.093	0.042
	Facility/Fixed Assets	0.308	0.291	0.216	0.124
	Growth of Employment	0.006	-0.002	0.001	0.005
	Labor Share α	0.758	0.771	0.737	0.592
	K/L (Capital Intensity)	8.2	30.7	90.7	169.3
	w (Average Wage Rate)(unit: million won)	4.5	9.1	17.6	22.7
	r (Cost of Capital)	0.22	0.10	0.08	0.10
Gangwon	Growth of GRDP	0.068	0.089	0.042	0.035
	Growth of Fixed Assets (Capital Stock)	0.105	0.102	0.098	0.046
	Facility/Fixed Assets	0.207	0.224	0.160	0.115
	Growth of Employment	0.020	0.002	0.004	0.005
	Labor Share α	0.836	0.692	0.712	0.610
	K/L (Capital Intensity)	15.4	38.1	105.7	209.7
	w (Average Wage Rate)(unit: million won)	5.9	10.4	18.3	22.7
	r (Cost of Capital)	0.08	0.14	0.08	0.07

This section sets out to show the fluctuations of key variables in the regional economy such as GRDP, employment, capital stock, w/r and K/L, as seen in Table 8. The change in other variables in

each region is elaborated in Tables 1- 6 of Appendix C. Regional substitution elasticity σ also will be shown in Table 9. Conventionally, the economy is described as CD production function and neutral technological progress. In this case, technological progress does not change w/r and relative factor demand K/L. Accordingly, labor share α does not change. However, as seen in the above Table 8, labor share α actively changes and reverses in the period from 1991 to 2000. The relative factor price w/r also fluctuates. More concretely, the regional wage rate w increased at about double the rate in most regions from 1970–1980 to 1981–1990: Nation (5.4→10.4), Capital (6.8→11.9), Chungcheong (4.4→8.6), Yeongnam (5.0→9.5), Honam (4.5→9.1), and Gangwon (5.9→10.4). From the period 1991–2000 to 2001–2014, w still increased, but the increase rate considerably decreased in all regions: Capital (21.1→28.2), Chungcheong (17.3→24.5), Yeongnam (18.6→24.1), Honam (17.6→22.7), and Gangwon (18.3→22.7). On the contrary, r shows nearly the opposite movement to w. In nation, the cost of capital r started as 0.25 in 1970–1980, rapidly decreased to 0.10 in 1991–2000, and slightly rebounded to 0.12 in 2001–2014. In most regions, just like in the nation, r shows the similar trends and values. More concretely, r decreases by half in most regions from the 1970–1980 to 1981–1990 periods: Capital (0.25→0.14), Chungcheong (0.26→0.15), Yeongnam (0.27→0.17), and Honam (0.22→0.10). On the contrary, from 1991–2000 to 2001–2014, the cost of capital r slightly increases in all regions: Capital (0.10→0.11), Chungcheong (0.11→0.13), Yeongnam (0.10→0.13), and Honam (0.08→0.10). Interestingly, in Gangwon, the cost of capital r increases from 0.08 to 0.14 from 1970–1980 and from 1981–1990 and then slightly decreases from 0.08 to 0.07 between 1991–2000 and 2001–2014. This implies that a different type of technological progress might appear in Gangwon. The labor share α increased in most regions from 1970–1980 to 1981–1990: Capital (0.575→0.673), Yeongnam (0.584→0.598), Honam (0.758→0.771), and Chungcheong (0.69→0.65). In Gangwon, the labor share decreased from 0.836 to 0.692 in these periods. As seen in the next chapter, in Gangwon, A_L might appear and α naturally decreased. Although for the periods 1990–2000 and 2001–2014, regional wage rate w showed stagnant trends,

labor share α apparently decreased in Capital (0.719→0.661), Chungcheong (0.630→0.523), Yeongnam (0.698→0.568), Honam (0.737→0.592), and Gangwon (0.712→0.610). Before the 1981–1990 period, regional wage rate w increased quickly and cost of capital r decreased quickly. On the contrary, after 2000–2014, both w and r slightly increased. This made w/r increase very quickly until the 1981–1990 period, while w/r was stagnant after 2001–2014. Given the stagnancy of w/r, apparent decreases in labor share α after 1991–2000 must have been caused by the increase of K/L, even though the growth of K/L itself fell considerably after 2001–2014. More concretely, K/L increased by two to four times regionally from 1970–1980 to 1981–1990: Capital (22→45), Chungcheong (9.5→34.5), Yeongnam (15.8→41.3), and Honam (8.2→30.7). From 1991–2000 to 2001–2014, K/L increased by less than twice in all regions: Capital (89→133), Chungcheong (101.8→179.9), Yeongnam (87.8→148.0), Honam (90.7→169.3) and Gangwon (105.7→209.7).

In Table 8, in the 1970–1980 period both nationwide and regionally, the growth of capital stock (fixed asset) was 16–17% but gradually decreased to around 4% in the 2001–2014 period. In 1981–1990 and 1991–2000 periods, there was a very slight decrease in capital growth, but this abruptly reduced to less than half in the 2001–2014 period nationwide and in all regions. The employment growth showed different patterns. The employment growth in the Capital region was 8.9% in 1970–1980 and 2% in 2001–2014. In other regions during these periods, reduction of employment growth was less severe than those of capital. From 1991–2000 to 2001–2014, the Korean economy showed stagnancy of employment growth similar to jobless growth, in which GRDPs grew but level of employment did not decrease: Nation (1.6% →1.5%), Yeongnam (1.2% →0.8%), Honam (0.1% →0.5%), and Gangwon (0.4% →0.5%). In 2001–2014, the employment growth was highest in the Capital at 2%. As seen in the next chapter, industrial structure indices also showed that manufacturing companies relocated to the Capital after 1998. Overall, the fast decrease of capital growth and stagnant employment growth in the 2001–2014 period confirms that the cause of low GRDP growth is related to a drastic decrease in capital growth. This phenomenon casts dim prospects

for economic growth, because global historical GDP growth cases since the late 1980s show that sustained GDP growth is in most cases accompanied by robust investment (Shin and Chang, 2003). The close nexus of capital and GRDP growth is again identified in the examination of facility asset ratio trends regionally. The facility asset ratios (= Facility Asset/Capital Stock), representing quality of capital stock, reached their peak level of 32.2% in 1981–1990 in nation and decreased by about half to 15.8% in 2001–2014. In Capital and Yeongnam, the regions with the largest capital stocks, facility asset ratios had their peaks of 33.9% and 34.2% in these periods. In the nation and all regions, the facility asset ratios decreased from over 30% in 1970–1980 to well below 20% in the 2000–2014 periods. In the case of Capital and Yeongnam, the facility asset ratios were over 15%, and in Chungcheong, Honam, and Gangwon they were 11%–13%. As will be seen in the trends of TFP in Figure 6, facility asset ratios show the same trends as TFP. This may confirm embodied technological progress theory in which technology is embodied in capital stock, especially in facility assets. If A_K is interpreted as technology embodied in facility assets, which have a factor-augmenting effect, this can explain the movement of w/r and labor shares. When facility investment was very active before 1998, w/r and labor share α increase by equations (6), (8) and vice versa. As seen later, in Capital and Yeongnam, regions with high facility asset ratios, SPE and COM showed strong positive correlations with TFP and employment.

Figure 1: Capital Intensity (K/L) of Korea in 1971–2014

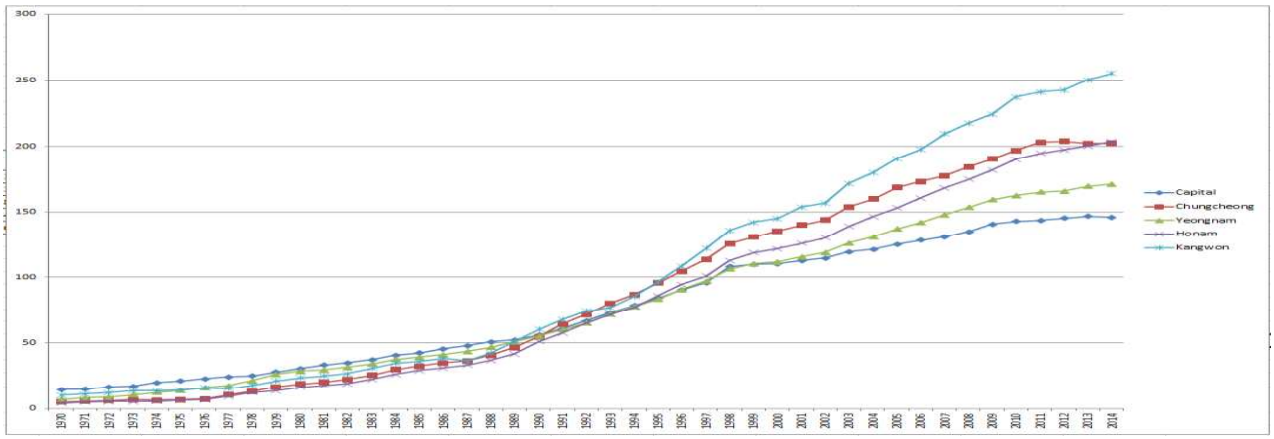


Figure 1 shows the annual movement of K/L. Before 1998, convex curves show increasing regional growth rates, but after 1998 the curves become concave. The two curves are mathematically discontinuous, which implies that structural change began in the Korean economy in the late 1980s or early 1990s, and through transition periods a sweeping shift in economic structure began in the late 1990s or early 2000s. This study assumes that the full-scale turning point happened around 1998, when policy reform following the 1998 financial crisis was carried out in earnest. This discontinuity in capital intensity may be interpreted as the result of regulation on the concentration of large companies and scattering policies. An example of this policy is the "Capital Region Readjustment Act", enacted in 1982 and strictly enforced in the late 1990s. In Article 3 of the enforcement decree, "population concentration facilities" that induce population concentration include the facilities of large companies. This policy necessarily influenced cost-minimizing decisions and made companies choose different types of technological progress. According to Acemoglu (2001b), technological progress happens in relative abundant factor, and the above policies made the capital factor less abundant by directly obstructing regional capital concentration after 1998. Figure 1 also shows the reversal of K/Ls due to Korea's long-standing scattering policy. Before 1998, the regional order of K/L was the Capital, Yeongnam, Gangwon, Chungcheong, and Honam regions. These were the same as the GTFP rankings before 1998. On the other hand, after 1998, the order was reversed to Gangwon, Chungcheong, Honam, Yeongnam, and Capital. In other words, Gangwon and Honam become the most capital-intensive regions, and the Capital and Yeongnam become relatively labor-intensive regions. Before 1998, the Capital region, like most countries, was a concentrated region of facilities as well as population. The Capital region was regarded as the leading region in terms of GRDP growth, highly capital-intensive and inducing mutual growth because the eruption of productivity actively sent capital and technology to the periphery, as seen in Table 1 and 2 of Appendix A. On the other hand, after 1998, as the Capital region became labor-intensive, its leading

position was weakened and growth disappeared, as seen in the lower GRDP growth in the Honam and Gangwon regions.

As Kaldor's study of economic growth (1957) described, K/Ls continued to rise in most countries. The trend of K/L in Figure 1 shows that this also applies in Korea. Yet, this continuous increase cannot be taken for granted. Hicks (1932) thought K/L was constant in the economy under the assumption of neutral technological progress. In equations (6) and (7), A_K can reduce K/L by labor bias but raise K/L by w/r increase. A_L can raise K/L by capital bias but can reduce K/L by w/r decrease. Theoretically, the consistent increase in K/L cannot be easily explained. It can be argued that continuous increase in K/L is natural because the labor is biologically limited. But as seen in the Industrial Revolution in the UK in the eighteenth century, productivity increases by manufacturing companies resulted in explosive global increases in population and employment. Even though there is no theoretical background, K/L ordinarily increases in most economies. This implies there might be a very strong element that works favorably for a company's capital use rather than labor use.

Figure 2: Growth Rate of GRDP

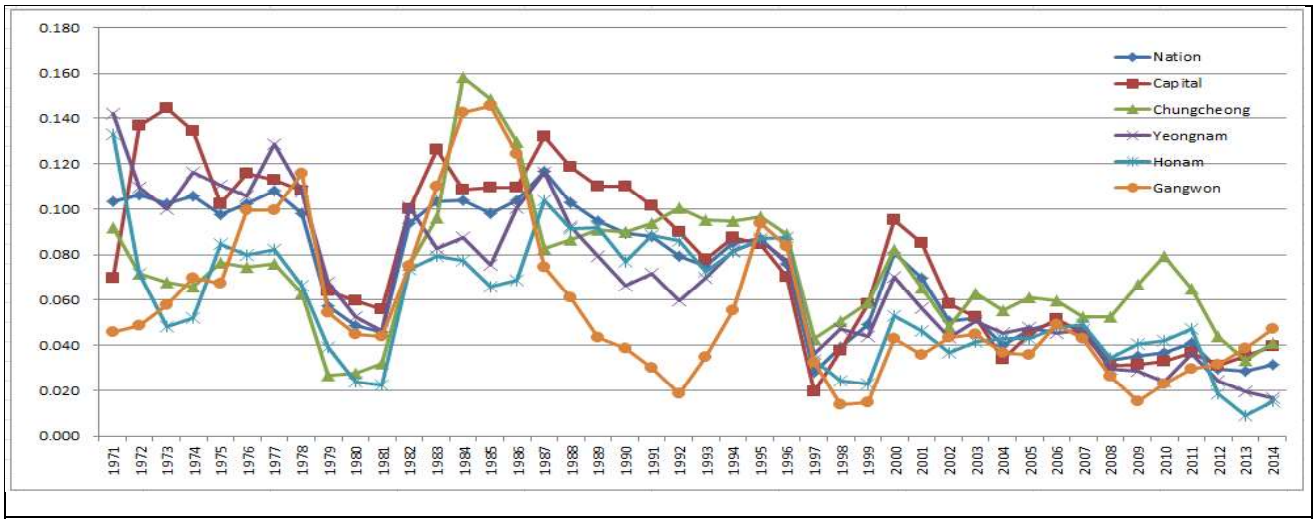
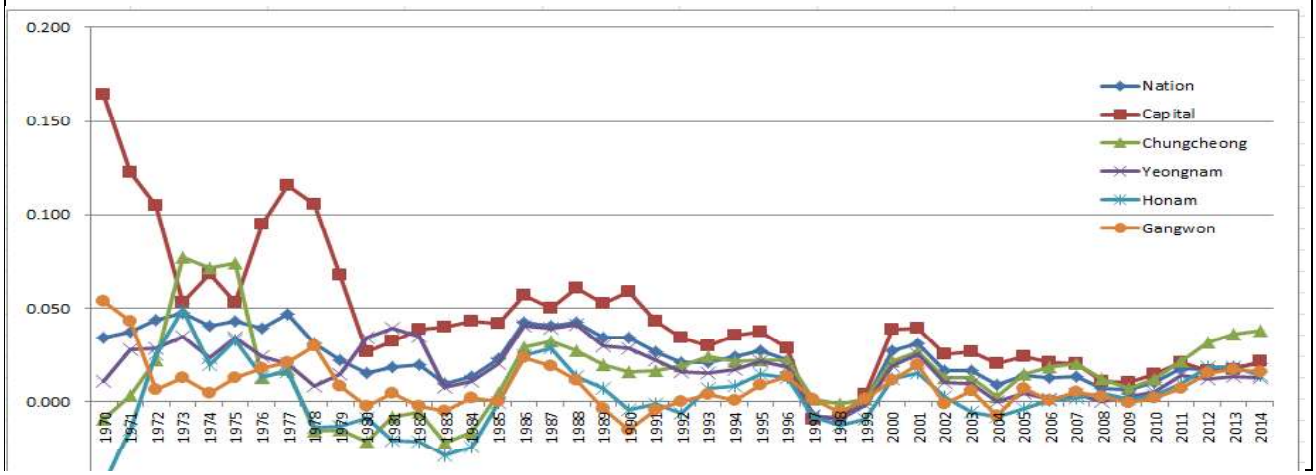


Figure 3: Growth Rate of Regional Employment



In the Figure 3 of Appendix G, the GRDP orders of the Capital, Yeongnam, Honam, and Gangwon regions are maintained until 1970–2014. However, as seen in Figure 2 above, the GRDP growth shows regional dynamic fluctuations. Looking at Figures 3 and 4, employment growth in each region mostly followed GRDP growth. However, it can be easily seen that fluctuation of GRDP growth is larger than that of employment growth. In the case of GRDP growth, rank change between regions are relatively frequent, but less so in employment growth. For example, in the late 1970s, Chungcheong ranked fifth in GRDP order, but in early 1980 it ranked last. The Capital region ranks highest overall in GRDP and employment growth before 1998. In Chungcheong, GRDP growth after 1980 skyrocketed and then decreased gradually, but it has ranked high since then. Especially after the mid-2000s, the fast growth of GRDP and employment has been very impressive in Chungcheong. This may arise from industry concentration around the Daedeok Science Complex developing since 1980 and administrative capital relocation around 2000. Honam and Gangwon ranked low in employment growth throughout whole period, but Honam showed relatively robust GRDP growth from 1988 to 1998, which was faster than that of Yeongnam in this period. Gangwon showed dynamic fluctuations in GRDP growth, which skyrocketed from 1981 to 1985 and plummeted until 1992. This may reflect that Gangwon could not develop an alternative to replace its mining industry. Despite the strong enforcement of scattering policy, employment growth was highest in the Capital

region after 1998. To the contrary, Yeongnam ranked second overall before 1998, but after 1998 employment growth was similar or lower to that of Honam and Gangwon. This reflects the economic decline in the Yeongnam region and the relocation of employment to the Capital region.

It is widely known that employment is relatively insensitive to demand or supply shocks (Malley, Muscatelli, & Woitek, 1999). After 1998, the dynamics of GRDP and employment growth markedly decreased. After 1998, GRDP growth showed apparent downward trends, but employment has shown consistent increases since 2009. From 1988, when overall GRDP growth showed a downturn, employment tended to converge and stagnate regionally. Even when a serious decrease of GRDP growth appears, the level of employment does not decrease very often except in a large-scale depression such as the 1998 financial crisis. Negative employment growth only appeared from 1980 to 1985 in Chungcheong and Honam, from 1989 to 1991 in Gangwon, and from 2002 to 2006 in Gangwon and Honam. This implies there might be a strong force that makes employment less sensitive to economic shocks that cause GRDP to fluctuate. This also implies that even under a slight decrease in productivity, employment can be stagnant.

Table 9: Results of Substitution Elasticity σ with Y Control Variable

	Before 1998						After 1998					
	K/Lpooled	K/L_{CA}	K/L_{CC}	K/L_{YN}	K/L_{HN}	K/L_{GA}	K/Lpooled	K/L_{CA}	K/L_{CC}	K/L_{YN}	K/L_{HN}	K/L_{GA}
w/r	0.68***	0.14***	0.35***	-0.12	0.199***	0.29***	-0.06	-0.005	0.16**	0.13	0.1	0.21*
Std. Err.	0.04	0.04	0.13	0.13	0.08	0.05	0.13	0.09	0.6	0.21	0.08	0.11
Y	0.29***	0.57***	1.04***	1.3***	1.45***	1.07***	-0.12***	0.51***	0.6***	0.87***	1.03***	1.25***
Std. Err.	0.02	0.05	0.18	0.18	0.16	0.04	0.03	0.03	0.03	0.03	0.03	0.04
_cons	-0.25	-3.09***	-7.45***	-10.8***	-11.8***	-6.63***	6.6***	-1.9***	-2.25***	-6.1***	-6.9***	-7.9***
Std. Err.	0.28	0.53	0.97	1.98	1.5	0.37	0.53	0.38	0.52	0.71	0.44	0.53
No. of obs	140	28	28	28	28	28	80	16	16	16	16	16
Adj R^2	83.5	99.3	97.6	98.2	97.3	97.7	0.25	95.2	96.9	98.5	99.0	98.4

Notes: ***p<0.01, **p<0.05 and *p<0.1, w/r: relative factor price, K/L: capital Intensity, coefficient of independent Variable w/r is substitution elasticity σ, Y: GRDP.

Next, the main premise of this study as to whether σ<1 or not regionally will be examined. A substitutional elasticity is estimated through the following equation (20) by transforming equation (6).

$$\mathrm{Ln}\left(\frac{\mathrm{K}}{\mathrm{L}}\right) = \beta_0 + \tilde{\sigma}\,\mathrm{Ln}\left(\frac{\mathrm{w}}{\mathrm{r}}\right) + (1-\sigma)\mathrm{Ln}\left(\frac{\mathrm{A_K}}{\mathrm{A_L}}\right) + \mathrm{e_{it}} \quad (20)$$

To obtain the unbiased estimator of σ, the confounding factors such as biased technological progress should be controlled. The problem is that $\frac{\mathrm{A_K}}{\mathrm{A_L}}$ and other hidden factors included cannot be observed.

In this case, the easy solution is to introduce Y (GRDP) as a controlling variable because Y is a reflection of all confounding factors as well as biased technologies. Table 9 shows the estimation results of σ by using the following equation:

$$\ln\left(\frac{\mathrm{K}}{\mathrm{L}}\right) = \beta_0 + \hat{\sigma}\ln\left(\frac{\mathrm{w}}{\mathrm{r}}\right) + \mathrm{Y} + \varepsilon_{\mathrm{it}} \quad (21)$$

As seen in Table 9, the regional substitutional elasticities (σ) were estimated to be much less than 0.5 at 0.1–0.3, which are clearly lower than 1 excluding pooled regression results. Hence, labor and capital are confirmed to be complementary factors, which mean that an increase in one factor use increases demand for the other. These low values of σ should not be interpreted to mean that the factor price hardly changes K/L. To the contrary, this means that when the use of one factor increases by the w/r changes, a complementarity increases the demand for the other factor also by almost 70% to 90% of its own factor use. Jeong (2015) also reached similar σ estimation results, which is much less than 0.5. In this study, as seen in Table 1 of Appendix B, when Y is not controlled after 1998, σ is estimated at 0.42 with pooled data, but in the Chungcheong and Gangwon regions, negative substitutional elasticities (σ) were estimated. In the results of Jeong (2015), when wage rate w was used as the controlling variables, two negative results among six were also estimated after 2000 in Table 10.

Table 10: Results of Substitution Elasticity σ

	Fixed-Effect Panel Model						Pooled Regression					
	Before 2000			After 2000			Before 2000			After 2000		
σ	0.158***	0.066***	0.157***	-0.352***	0.068***	0.137***	0.486***	0.049***	0.119***	-0.674***	0.106***	0.143***
Dep. Var.	w	r	w/r	w	r	w/r	w	r	w/r	w	r	w/r
No. of Obs	600	600	600	390	390	390	30	30	30	30	30	30
Adj R^2	8	79.1	78.9	17.5	86.7	91.6	-1.4	81.2	78.7	21.6	82.2	91.7

Notes: ***p<0.01, **p<0.05 and *p<0.1, Dep Var.: dependent variable, No. of Obs.: number of observations, Source: Jeong (2015)

In general, if r increases after 1998 (w/r decreases) and K is replaced with cheaper labor, K/L

should decrease, and a positive σ value should appear. A negative σ value is interpreted as a company can still increase a use of K (K/L increase) even when capital price becomes relatively higher (w/r decrease). In this study, after 1998 all regional data for factor price, L, and K are available in KOSIS. This robustness of data naturally led to very high AR^2 after 1998, as in Table 9. This can mean that when biased technological progress and other hidden confounding variables were not controlled, negative results could be derived locally. This may also be a typical example of asymmetry when correlations between the key variables change according to booms and depressions. In Table 9, the coefficients of Y are overwhelmingly larger than the coefficients of w/r in all outcomes. This means that the hidden element affecting Y is very large as compared to the substitution effect by w/r. It can be assumed that according to region and period, this force can potentially be larger than the substitution effect. So, even if the price of capital r rises, capital use can still increase because of strong preference for capital. As seen in the next chapter, these phenomena are two sides of the same coin of mixed correlations (de Groot, Poot, & Smit, 2008) because this increased use of capital K above in turn increases employment by complementarity, even under negative productivity shocks.

3-4. Productivity Analysis and Biased Technological Progress

In the previous chapter, the limitations of productivity analysis were discussed when explaining short- and mid-term economic fluctuations as seen in change of w/r and labor share in five Korean regions from 1970 to 2014. However, assuming factor-biased technological progress under the CES production function, productivity analysis becomes very complex, practically close to impossible. Besides the advantage of productivity analysis that easily decomposes the contributions of factors and TFP to GRDP growth, it can make it possible to judge whether fluctuations were caused by the aggregate demand side shock or the supply side shocks by comparison of primal GTFP and dual GTFP. Furthermore, there necessarily are size differences between A_K and A_L in biased technological progress. The primal TFP contains A_K and A_L. Thus, it is possible to guess the size difference between them by comparison of primal TFP and w/r, which is proxy variable of A_K/A_L.

First, productivity analysis can show whether economic fluctuations and long-term GRDP growth are caused by the demand side or supply side shocks through a simple comparison of primal and dual GTFPs. In actual business cycle, primal GTFP and w/r show pro-cyclical behavior. If factor prices w and r, the key variables in economic fluctuations have close correlation with primal GTFP, and then the short-term fluctuations and long-term growth are decided by the technological progress of companies. The primal GTFP is derived under the assumption of CD production function. The dual GTFP does not assume certain production functions, so both GTFP results need not show high correlations. Namely, if primal GTFP does not include real technological progress elements, it does not need to covary with dual GTFP, including growth of factor price w and r. Regarding the cause of the business cycle, there are still disputes between Keynesian and RBCT economists. In “The Procyclical Behavior of Total Factor Productivity in the United States, 1890–2004”, Field (2010) explains this procyclical behavior of primal GTFP and relative factor price by demand shock as a Keynesian economist. Under the assumptions of relative stability of r, w/r increases during an economic boom because aggregate demand rises by fiscal expansion raises labor demand and

accordingly w, and vice versa. On the contrary, Shapiro (1987), an RBCT economist, argued that the business cycle can be explained mostly by technological shock by showing that primal and dual GTFPs showed very high correlations in long-term US data. This study also explains mixed correlations phenomena (de Groot, Poot, & Smit, 2008) by technological shock caused by industrial concentration. As in RBCT, this study argues that GTFP by technological progress itself directly increases Y, and increased Y accordingly increases the demand for labor, which causes w to rise (w/r rises). In this study, primal GTFP and dual GTFP were compiled to be the very similar. Figure 1 and 2 of Appendix G show the results of the GTFPs by both methods of the five regions to have very similar patterns. Since 1998, GTFPs in all regions become lower in comparison to pre-1998 periods. The primal and dual GTFP is compiled at 2.3 and 2.1% at the national level during whole period. The yearly data on GTFP by both methods are listed in Table 18 and 19 of Appendix D. The ranks and values of two yearly GTFPs in the five regions are also very close in both methods. To see the statistical correlations between GTFP by both methods, regression analysis was conducted separately with pre-1998 and post-1998 data.

$$\ln(\mathrm{GTFP_D}) = \beta_0 + \beta_1 \ln(\mathrm{GTFP_P}) + \mathrm{e_{it}} \quad (22)$$

Here, $\mathrm{GTFP_P}$ is primal GTFP and $\mathrm{GTFP_D}$ is dual GTFP. As in Shapiro's study (1987), in the case of Korea, the GTFP results by the two methods have very high correlations. Especially after 1998, they show over 90% AR^2. Detailed regression results are listed in Table 2 of Appendix B. This result means that as RBCT predicts, short-term fluctuations as well as 45 years of growth in Korea can be better explained by the supply side or technological progress of the company.

In addition to the comparison of primal and dual GTFPs, the comparison of primal TFP level and w/r level can give additional information. Assuming that biased technological progress is more general in the real economy, there must be size and growth rate differences between A_K and A_L because if they are the same, technological progress becomes neutral. The labor share α and w/r, which are the proxy variables for A_K/A_L show the consistent trends. This can imply that the growth

rate difference between A_K and A_L is systematic by region and period. The primal TFP includes the A_K and A_L that cannot be observed. If primal TFP trends are compared with those of w/r, which type is faster can be guessed.

Figure 4: Labor Income Share in Nation and Five Regions in 1970–2014

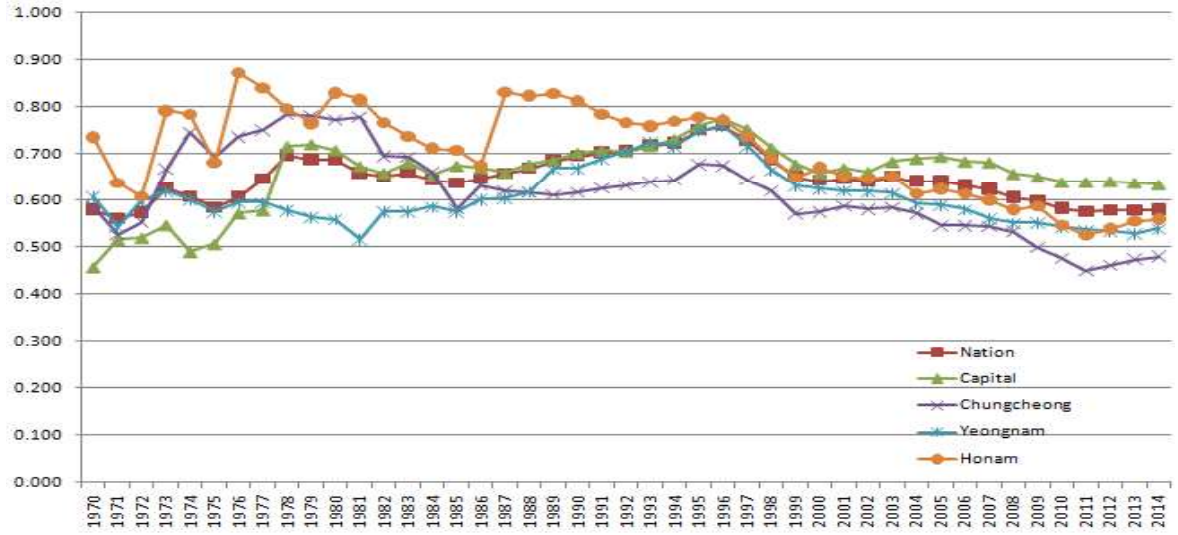
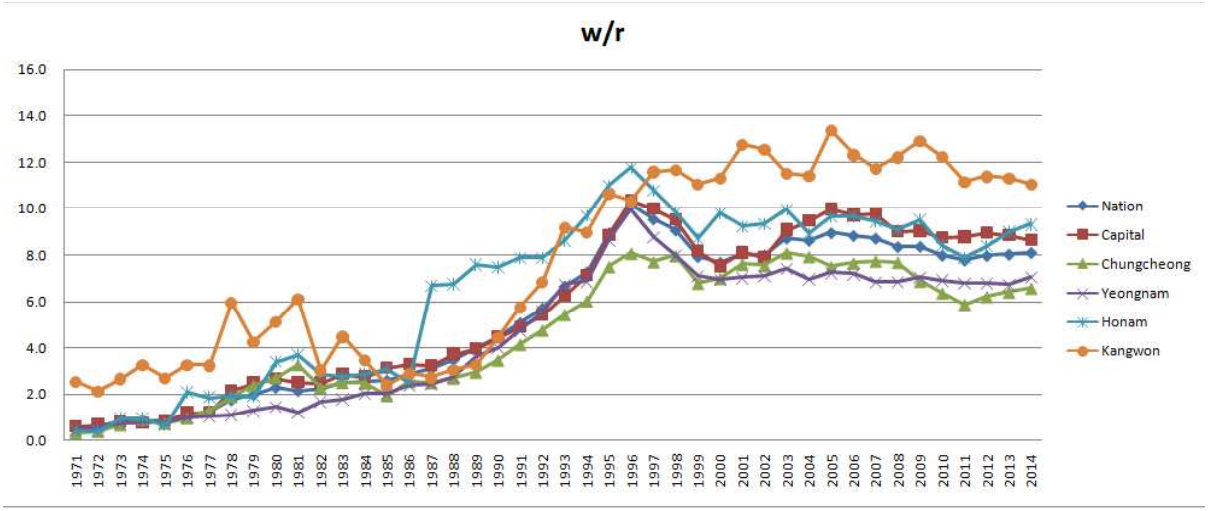


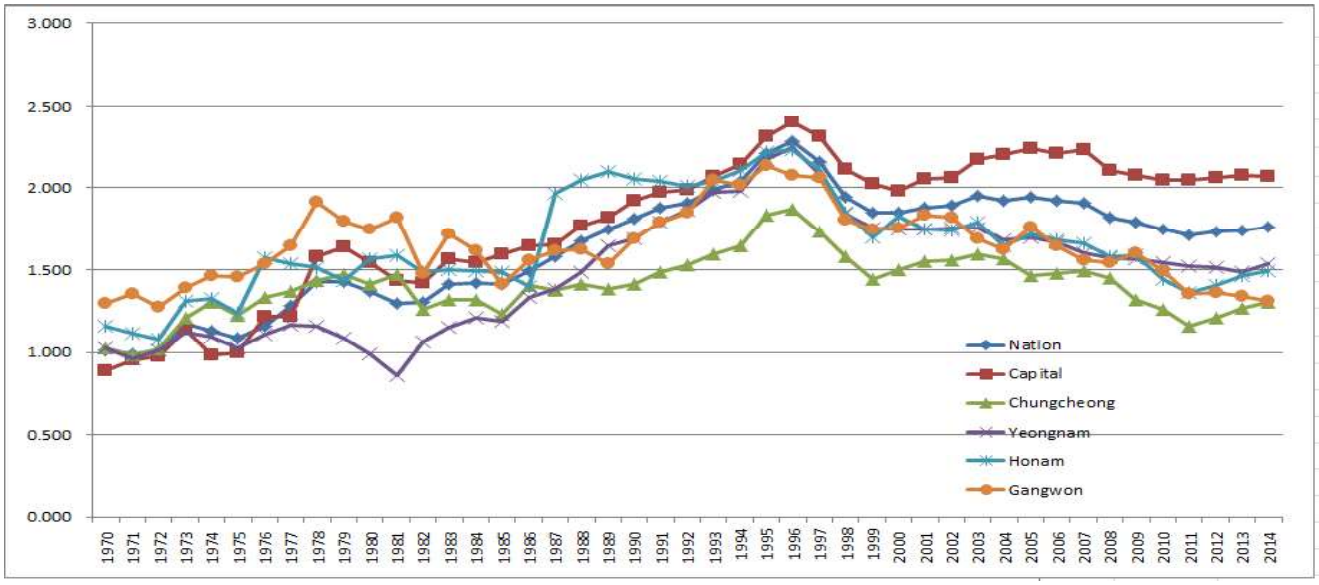
Figure 5: Relative Factor Price (w/r) in Nation and Five Regions in 1971- 2014



First, it needs to be examined which type of biased technological progress appears in five regions in Korea by periods. The type of technological progress can be judged by the trend of labor (income) share α (Acemoglu, 2001b; Jeong, 2015). If the labor share increases after technological progress, it is classified as labor-biased technological progress, and when it worsens, it is classified as capital-biased technological progress. Assuming that this technological progress is a major driver in the

factor income share, the trend of labor share in Korea shows labor-biased technological progress might appear before 1998 and capital-biased technological progress might appear after 1998, as seen in Figure 4. Jeong (2015), also using national level data, argues that A_K might appear when α strongly increases before 2000, while A_L might appear when α decreases after 2000. In addition, Acemoglu (2001b) defines technology type by w/r under the assumption that productivity is the main driver influencing w/r. If w/r increases after technological progress, it is classified as labor-biased technological progress, and if it decreases, it is capital-biased technological progress. In Table 5, the trend of w/r in Korea shows labor-biased technological progress might appear before 1998. After 1998, the labor income share apparently decreased, as seen in Figure 4, but w/r shows no apparent decreasing trend in Figure 5.

Figure 6: Regional TFP Level by Primal Method

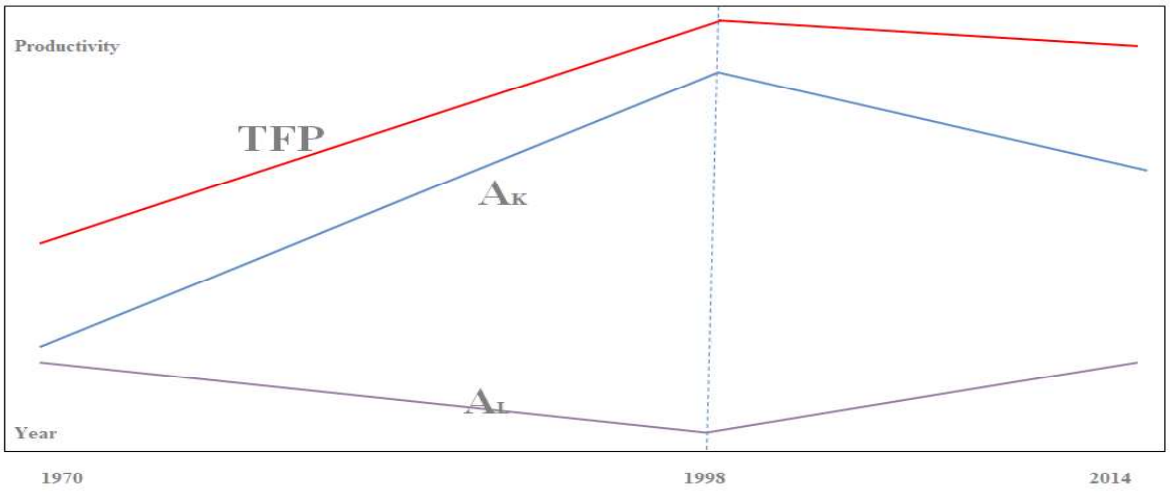


Next, a question may arise about whether the above fluctuations in w/r may be caused by technological shocks. It can be determined by conducting a regression analysis between w/r and primal TFP, which is representative measure of technological progress.

$$\ln\left(\frac{w}{r}\right) = \beta_0 + \beta_1 \ln(TFP_P) + e_{it} \quad (23)$$

The results show strong positive and statistically significant correlations between TFP_P and relative factor prices w/r in both nation and five regions before and after 1998. Moreover, AR^2 are over 90% in all regions both before and after 1998. All coefficients of TFP are statistically significant within 1% of significance level. So, it can be judged that the main driver of w/r change was the technological shocks included in TFP_P. Then, the problem should be answered that the visual trends of TFP_P and w/r levels do not seem consistent after 1998 even though these high correlations between TFP_P and w/r. As seen in Figure 5 and 6, primal TFP before 1998 increase apparently, as do w/r trends. On the contrary, after 1998, the decreasing trend of primal TFP is relatively clear, but w/r is stagnant or shows a slight increase. This inconsistency between TFP and w/r trend after 1998 implies that there is another element affecting w/r movement besides technological shocks. And succeeding part will be devoted to explanation of this problem.

Figure 7: Trade-offs between TFP, A_K, and A_L



The faster of A_K and A_L can be seen by comparison of the above TFP level in Figure 6 and the trends of w/r, the proxy variable of A_K/A_L in Figure 5. The primal TFP is influenced by the faster type because primal TFPs include A_K and A_L. As shown in Figure 7, by the judgement of the w/r and labor share α, A_K appeared until 1998 and A_L appeared after 1998. Despite the ambiguity of w/r after 1998, let's assume that A_L appeared after 1998. Because of a trade-off between the two types, the rise of A_L decreases A_K in Figure 7. The problem is to find out which of the two types has the steeper

slope. It can be easily seen that TFP trends in this study coincide with those of A_K and are opposite to that of A_L, which means that A_K is faster than A_L. The faster growth rate of A_K has a greater influence on TFP before and after 1998. To the contrary, if A_L were the faster, when A_K appears (= w/r increases), the correlation between TFP and w/r would become negative, which does not match with empirical data in this study. The superiority of A_K can also explain why the $GTFP_P$ and $GTFP_D$ are the same in previous sections. Both GTFP are the same in this study, not because the real economy behaves as CD production describes under the assumption of neutral technological progress but because the growth of w/r included in $GTFP_D$ grows positively with that of A_K/A_L in the $GTFP_P$. These two empirical findings can be expressed in the next two equations:

$$TFP_P = TFP_P\left(\frac{A_K}{A_L}\right) = TFP_P\left(\frac{w}{r}\right) \quad (24)$$

$$GTFP_P\left(\widehat{\frac{A_K}{A_L}}\right) = GTFP_D\left(\frac{\widehat{w}}{r}\right) \quad (25)$$

Here $\widehat{\frac{A_K}{A_L}}$ and $\frac{\widehat{w}}{r}$ mean the growth rate of A_K/A_L and w/r, respectively.

Now, the problem can be answered as to why visual trends of w/r after 1998 do not seem to show clear correlation with TFP_P, even though there are very strong correlations with regression analysis. The answer is closely related to explanations of mixed correlations (de Groot, Poot, & Smit, 2008). If the superiority of A_K is interpreted in terms of embodied technological progress where technology is inseparable from production factor (Lee, 2006), the faster A_K is part of capital, which produces favorable technological externality. Capital can be understood as a production factor that contributes to more future expected profits with faster technological progress than labor. So, profit-maximizing companies prefer capital to labor because expected future profits are larger. In equation (5), if there is strong capital preference, this increases the use of K (increase in K/L). In the right term $\left(\frac{K}{L}\right)^{\frac{-1}{\sigma}}$, this K/L increase pushes up w/r in equation (5). If there is capital preference, this force works consistently as an increase in K/L and w/r. Before 1998, besides the favorable A_K effect on EMP, the fast increase in K/L from capital preference creates additional EMP increase by complementarity. To

the contrary, after 1998, the EMP increase by complementarity deters EMP decreases by A_L. And capital preference can explain asymmetry in w/r before and after 1998 in Figure 5. Before 1998, w/r increase by A_K is even fortified by capital preference. To the contrary, after 1998, capital preference offsets w/r decreases by A_L. In sum, according to relative magnitudes between complementarity caused by capital preference and A_L, w/r can fall, be stagnant, or even rise just as seen in Table 5. The reason why labor share shows a relatively clear trend even after 1998 can also be explained. The w/r increase by capital preference works positively and K/L increase works negatively on labor share α. When these effects are offset, only a biased technological progress works for labor share α. Jeong (2015) argued that the worsening labor share after 2000 was mostly caused by strong capital bias (increase in K/L) rather than increases in w/r.

Here, there may be a question as to whether technological externality or the future expected returns by A_K are fully reflected in the cost of capital r. However, from the perspective of transaction cost theory, the inherent incompleteness of the capital asset market tends to undervalue long-term future returns. The transaction cost theory assumes the efficient boundary between an internal transaction and a market transaction. An internal transaction is defined that company produces capital goods through procuring raw materials and internal processing within a boundary of company. In terms of Williamson (1975, 1985), companies produce when a certain transactions such as complex facility equipment are accomplished more efficiently by internal transactions than by market transitions. Williamson (1975, 1985) found that expected return on investment mainly depends on degree of asset specificity. If more investments are made in specific assets such as facility assets, which have very limited use, the number of traders becomes a minority, market competition function weakens, and the capital price cannot properly reflect the technological externality of investment. From Williamson's (1975, 1985) point of view, companies procure capital at a lower cost than the genuine price, and the origin of productivity is the company's relative efficiency in some transactions where market fails. For example, in early 1980, only Lee, the

founder of Samsung, knew the genuine future expected profit in the semiconductor industry. He efficiently invested in semiconductor facilities through internal transactions within the group. The innovation occurs when most market participants have a pessimistic expectation of future profit.

The superiority of A_K could be a worldwide phenomenon because capital is essentially much more advantageous in accumulation and knowledge transfer than labor in terms of capital embodied technological progress theory. In a paper titled "Productivity Slowdown and Declining Labor Share" by Grossman, Helpman, Oberfield, and Sampson (2017), the global slowdown in productivity and deterioration in the labor share α has occurred globally, including in the United States, Japan, and Europe since 1980 and the authors argued that the main cause is the decrease in per capita income. Yet, one more explanation is that above phenomenon was caused by A_L because labor share decline is the most typical phenomenon of A_L appearance. And if the growth rate of A_L is slower than that of A_K, productivity slowdown also can be explained. Since 1980s, oil is capital stock, and the oil shock of the 1970s made capital relatively less abundant. And the relative capital scarcity might cause companies to reluctantly accept A_L. If capital preference exists, this can explain the usual increase in K/L for most countries. Even if r becomes relatively expensive (w/r decreases) by A_L as after 1998, the company can still increase K/L because of capital preference. The superiority of A_K can be explained in terms of RBCT. RBCT argues that positive supply shock increases the real wage rate and decreases the real interest rate, and negative supply shock decreases the real wage rate and increases the real interest rate. A_K can be regarded as a positive supply shock, and A_L can be regarded as a negative supply shock.

CHAPTER IV: SOURCES OF EMPLOYMENT GROWTH

4-1.Construction of Data

Manufacturing industries are most often the subjects of surveys on geographical concentration because productivity in manufacturing is believed to be the main driver of GRDP growth. Thus, company and employment data were mainly used in MMS and the manufacturing part of EC, which covers more detailed industrial data than the MMS was also used. In this study, for a coherent estimation, industrial structure indices are constructed along with 20 manufacturing industries in each region as seen in Table 11. This is because industry classifications differ by period and survey. For example, from 1991, 23 industry classifications were used, and from 1999, 24 industry classifications were used in regional data. Another reason is that the sub-industry items belong to different industry categories according to each SIC (standard industrial classification). For example, the office, accounting, and computing machinery industry, the electronic components industry, and the sound and image communication equipment industry were integrated into one industry in the 9th SIC. But in the case of the 6th (1991-1997) SIC, office and accounting computing machinery was an independent industry. The sound, image communication equipment, and apparatus industries were also independent and were included with electronic components.

Table 11: Reclassification of Industry in This Study

Light Industry	1. Food and beverages	5. Leather
	2. Tobacco	6. Wood and product of wood and cork + Furniture
	3. Textiles	7. Paper and paper products
	4. Wearing apparel	8. Printing and publishing
Heavy and Chemical Industry	9. Petroleum refineries and miscellaneous products of petroleum and coal	13. Basic metal industries
	10. Chemical and other chemical products	14. Fabricated metal products
	11. Rubber products and plastic products, n.e.c.	15. Machinery and equipment n.e.c.
	12. Non-metallistic mineral products	16. Electrical and electronic machinery, apparatus, appliances and supplies
Hi-tec Industry	17. Office, accounting computing machinery +electronic components + sound, and image communication equipment and apparatus.	
	18. Medical, precision and optical Instruments, watches and other purposes, except optical instruments.	
	19. Motor vehicles, trailers and semi-trailers + other transport equipment.	
	20.Manufacturing N.E.C.	

However, before 1991, MMS had manufacturing industry data classified into only nine industries regionally. Fortunately, there is data classified into over 20 industries in EC 1981, 1986, and 1991. So, regional nine industries data in the MMS from 1970 to 1981 were dissected into 20 industries using 1981 EC data; from 1982 to 1986 MMS data was dissected by 1986 EC data; and from 1987 to 1991 MMS data was dissected by 1991 EC data. These retrospective applications can be justified because a dramatic change in Korean economy happened in the late 1990s, and the error in the data compilation may not be serious because this retrospective action was to partition a given number of companies and employment of nine industries into 20 industries per region.

When the employment and number of companies' ratios in EC are applied to those of the MMS, SIC revisions were reflected. Since 1970, there have been seven revisions of the SIC: the 3rd in 1970 , the 4th in1975, the 5th in 1984, the 6th in 1991, the 7th in 1998, the 8th in 2000, and the 9th in 2008.When the revisions significantly influenced (over 5%) the employment and number of companies readjustments were carried out. For example, Table 12 shows the differences in classifications between the 5th SIC data and the 6th SIC in 1991. The number of companies and employment data was adjusted from 1991 to 1984 to reflect these revisions in MMS and EC data.

Table 12: The Important Differences of Sub-industry Classifications by the 5th SIC and 6th SIC

Industry	5th SIC	6th SIC
Corrugated paper	331Wood and cork products, except furniture 341 Paper and paper products	2102 Corrugated paper (Pulp, paper and paper products)
Rubber shoes	192 Footwear	251 Rubber products
Electric alarm and signal devices	32 television and communication equipment	319Electric equipment(devices) n.e.c
Tab, valves and similar devices	38198 Valves, fabricated pipe and pipe fittings (fabricated metal products)	2912Pumps, compressors, taps and valves (General purpose machinery)
Manufacture of metal furniture	3819 Fabricated metal product.	361 Furniture
Engines turbines(aircraft, cars)	3821Engines turbines(Machinery)	2911Engines turbines
Containers for shipping	38191Metal cans and shipping containers	342 03 Car bodies and trailers
Heating equipments	38334 Household electric heating equipment (Electrical and electronic machinery)	29304 Domestic electric heating equipment (Machinery)
Briquettes of coal	354 Miscellaneous products of petroleum and coal	101 Mining and agglomeration of hard coal

4-2.Estimation Model

4-2-1.Construction of Industrial Structure Indices

The industrial structure indices below are simple but typical indicators commonly used by researchers. These industrial structure indices are proxy variables for concentration externality. In the literature, industrial structure indices have a strong influence on technological progress and accordingly improve productivity. The following SPE, COM, and DIV indices are mainly constructed with employment data. However, only the COM index is constructed using the number of companies as well as employment data. In each index subscript, i stands for five regions, and j stands for 20 industries. EMP_{ijt} refers to employment in region i and industry j in year t (1971-2014). The SPE is expressed as deviations between the average employment ratio for the entire region and the average employment ratio for each region. The absolute value is taken so that these deviations are not canceled out. If these employment ratios are expressed by the division of the two terms, not by the deviation form used in this study, it becomes a location quotient (LQ). However, there is a criticism that LQ causes a multicollinearity problem with other explanatory variables, so the deviation form was used as seen below. This index has values between 0 and 1; a larger value represents greater industrial specialization.

$$SPE_{it} = 0.5 \sum_{j=1}^{J} \left| \frac{EMP_{ijt}}{\sum_{j=1}^{J} EMP_{ijt}} - \frac{\sum_{i=1}^{I} EMP_{ijt}}{\sum_{i=1}^{I}\sum_{j=1}^{J} EMP_{ijt}} \right| \quad (26)$$

The following is the widely used COM index, first introduced by Glaeser, Kallal, Scheinkman, and Shleifer (1992). The C is the number of companies in the region. If the number of companies per the number of employees in the region is larger than that of the average region, competition is interpreted to increase. Thus, the larger the value, the greater the competition becomes.

$$COM_{it} = \frac{\sum_{j=1}^{J} C_{ijt} / \sum_{j=1}^{J} EMP_{ijt}}{\sum_{i=1}^{I}\sum_{j=1}^{J} C_{ijt} / \sum_{i=1}^{I}\sum_{j=1}^{J} EMP_{ijt}} \quad (27)$$

The following DIV index is also a typical variable that is often used. This is the reciprocal of the Herfindahl index, or the reciprocal of the sum of squares of the employment proportions of each

industry in each region. The slight difference from the normal Herfindahl index is that only employment in its own industry j is subtracted from total local employment. The index is set for higher values to increase industrial diversity. If there is only one industry in the region, it takes a value of 1, which is the minimum value of the diversity index.

$$\mathrm{DIV_{it}} = \sum_{j=1}^{J} \left[\left(\frac{\mathrm{EMP_{ijt}}}{\mathrm{EMP_{it}} - \mathrm{EMP_{ijt}}} \right)^2 \right]^{-1} \quad (28)$$

According to researchers, regional output data are used instead of employment. In addition, complex indices are sometimes built with more detailed data, such as the size of the company, but the results so far show that delicate indices did not provide new or clearer conclusions. As noted, the above indicators are mainly constructed from the concentration of employment and the concentration of companies, and were developed on the assumption of neutral technological progress. In other words, these industrial structure indices were developed as proxy variables for concentration externalities under the assumption of neutral technological progress. When σ is less than 1, if one factor is concentrated, the other factors, namely capital, are also concentrated because of complementarity. The drawback of these indices is that they do not show whether capital or labor is concentrated more quickly. After 1998, when A_L appeared, this had a stronger effect on capital than employment. The correlation of indices with employment can be weak because employment does not respond sensitively to A_L.

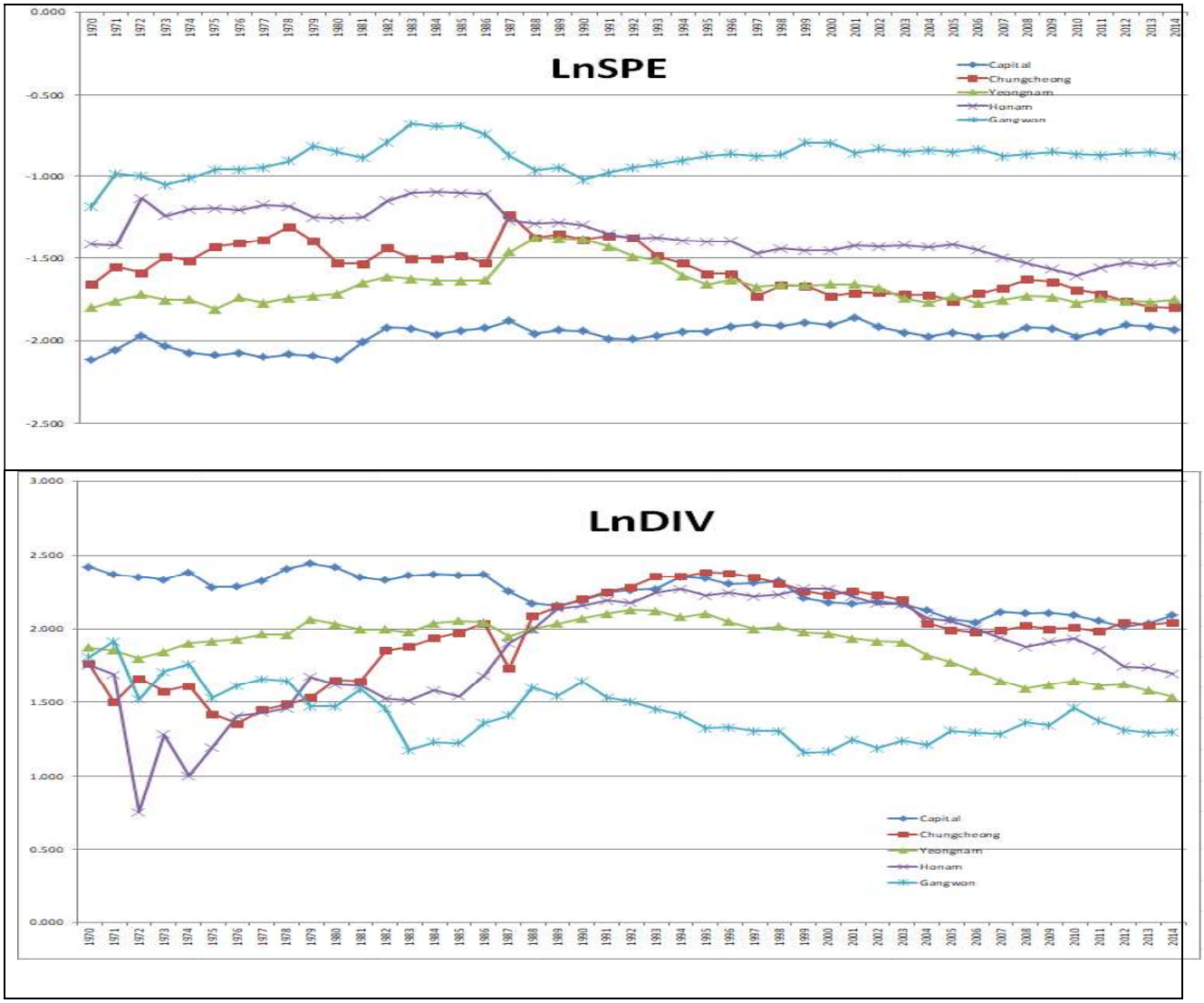
4-2-2. Regional Trends of Industrial Structure Indices

While trends in key variables, w/r, K/L, TFP and EMP, etc., show relatively clear turning points around 1998, breaking points in three indices begin in the early 1990s, as seen in the figures below. As mentioned, three indices are constructed only by manufacturing industries. This phenomenon can be explained in two ways. First, a structural change in Korean regional economies began in the early 1990s and settled with structural reforms since 1998. Second, this happened because the three indices only partially reflect biased technological progress and concentration externality. When the three indices are regressed to a TFP dependent variable, if w/r as a proxy variable for biased technological progress is added as an explanatory variable, AR^2 increases from 50% to over 90% regionally.

Let us look at the overall trend of the indices, which is both a policy variable and a proxy variable for concentration externality, focusing on SPE and DIV. Simply put, before the early 1990s, they mostly increased in all regions, as seen in Figure 8. On the other hand, they weakly decreased in most regions after the early 1990s. Additionally, after the early 1990s, the Capital and Gangwon regions showed different trends; SPE in the Capital region did not decline since 1990. In the case of COM, only the Capital region showed weak increases after the early 1990s, as seen in Figure 9 below. In the case of DIVs, only in the Gangwon region did they increase weakly and then slightly decreased from 2012. The peculiarity of the Gangwon region arises because there may be an incentive for companies to concentrate in the near Capital region due to the policy of restricting the location of the Capital region. There are overall opposite relations between SPE and DIV. Usually, when industry diversification increases, industrial specialization usually decreases. But in this study, the regions are grouped into five large regions instead of 16 *si* and *do* units to more clearly see overall biased technological progress. So, productivities can arise from diverse industries to a moderate degree, and very high productivity in one specialized industry can occur at the same time in large regions. Thus, both SPE and DIV effects can appear in a region. This coexistence of SPE and DIV can be regarded as an ideal state for local industry deployment (Henderson, 2000). SPE is the lowest in the Capital

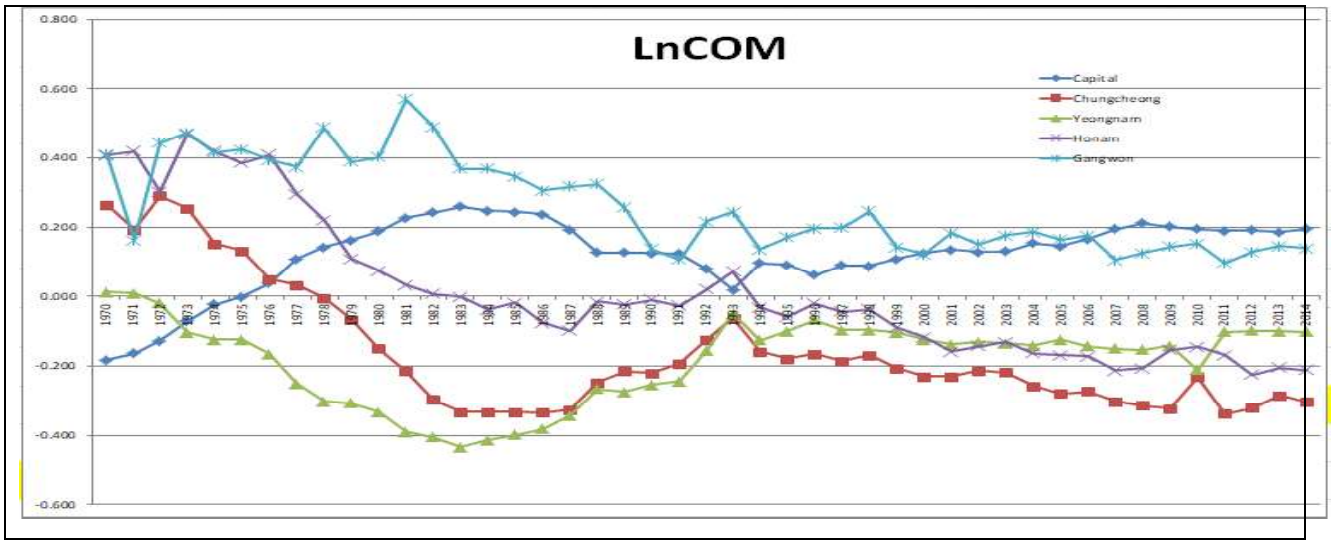
region over the entire period, followed by the Yeongnam region. As discussed later, though the level of SPE is very low in the Capital and Yeongnam regions, the positive correlations between SPE and TFP were very high before 1998. This means that a small increase in the indices strongly increased TFP before the early 1990s. On the other hand, DIVs were highest before the early 1990s in the Capital and Yeongnam regions. The Capital region maintained the highest rank in DIV before and after the early 1990s, while DIV in the Yeongnam region was ranked 4th after 1998. The decrease of DIV in the Yeongnam region shows that companies in this region might relocate to the Capital region after the early 1990s.

Figure 8: Trends of Regional SPE and DIV in 1971-2014 (log taken)



The COM can be investigated in terms of policy and company response in the market. First of all, COM represents the relative number of companies in the region. The concentration of companies in the Capital and Gangwon regions has continued to be high since the mid-late 1970s, as seen in Figure 9. COM shows the mirror image between the Capital-Gangwon region and the other regions. In other words, if in the Capital and Gangwon regions COM increases, it decreases in the rest of the regions. In the Capital region, COM increased until 1983, then slightly decreased and increased from the mid-1990s. In the Gangwon region, COM increased until 1983 and then fluctuated but with a very slight decreasing trend since the mid-1990s. On the other hand, in the rest of the regions, COM showed the nearly opposite pattern. Since the mid-1990s, a slightly increasing trend in COM has been apparent in Capital region; despite the local scattering policy of government, companies relocated to the Capital region. This means that government can move public facilities to other regions, but companies tried to concentrate in the Capital and its substitute region of Gangwon. This inconsistency should have negative effects on productivity because public facilities were located in regions where corporate administrative and legal services were relatively less needed. This may partly explain why the productivity of the Capital region was relatively high after 1998, and the productivity of Honam and Gangwon regions, where productivity was high before 1998, declined significantly after 1998.

Figure 9: Trends of Regional COM during 1971-2014 (log taken)



4-2-3. Estimation Model

In this study, the correlations of SPE, COM and DIV with w/r, TFP and EMP are investigated by next three ordinary regression models.

$$\mathrm{Ln}\left(\frac{\mathrm{w}}{\mathrm{r}}\right)_{\mathrm{it}} = \widetilde{\beta_0} + \widetilde{\beta_1}\,\mathrm{LnSPE}_{it} + \widetilde{\beta_2}\mathrm{LnCOM}_{it} + \widetilde{\beta_3}\mathrm{LnDIV}_{it} + \mathrm{e}^1_{\mathrm{it}} \quad (29)$$

$$\mathrm{LnTFP}_{\mathrm{it}} = \widetilde{\beta_0} + \widetilde{\beta_1}\mathrm{LnSPE}_{it} + \widetilde{\beta_2}\mathrm{LnCOM}_{it} + \widetilde{\beta_3}\mathrm{LnDIV}_{it} + \mathrm{e}^2_{\mathrm{it}} \quad (30)$$

$$\mathrm{LnEMP}_{\mathrm{it}} = \overline{\beta_0} + \overline{\beta_1}\,\mathrm{LnSPE}_{it} + \overline{\beta_2}\mathrm{LnCOM}_{it} + \overline{\beta_3}\mathrm{LnDIV}_{it} + \mathrm{e}^3_{\mathrm{it}} \quad (31)$$

Here, Ln (w/r), Ln TFP and Ln EMP are the log taken w/r, primal TFP and employment in region i and time t. The ordinary regression method may not consider the unobserved characteristics of the regions. This can lead to a problem of endogeneity in that the error term and regressors are correlated. Endogeneity causes the estimated coefficient to be inconsistent. So, the following model can be constructed.

$$\mathrm{Ln}\left(\frac{\mathrm{w}}{\mathrm{r}}\right)_{\mathrm{it}} = \widetilde{\beta_0} + \widetilde{\beta_1}\,\mathrm{LnSPE}_{it} + \widetilde{\beta_2}\mathrm{LnCOM}_{it} + \widetilde{\beta_3}\mathrm{LnDIV}_{it} + \alpha^1_{it} + \delta^1_{it} + \varepsilon^1_{it} \quad (32)$$

$$\mathrm{LnTFP}_{\mathrm{it}} = \widetilde{\beta_0} + \widetilde{\beta_1}\mathrm{LnSPE}_{it} + \widetilde{\beta_2}\mathrm{LnCOM}_{it} + \widetilde{\beta_3}\mathrm{LnDIV}_{it} + \alpha^2_{it} + \delta^2_{it} + \varepsilon^2_{it} \quad (33)$$

$$\mathrm{LnEMP}_{\mathrm{it}} = \overline{\beta_0} + \overline{\beta_1}\,\mathrm{LnSPE}_{it} + \overline{\beta_2}\mathrm{LnCOM}_{it} + \overline{\beta_3}\mathrm{LnDIV}_{it} + \alpha^3_{it} + \delta^3_{it} + \varepsilon^3_{it} \quad (34)$$

The α_{it} is the error term representing unobserved group heterogeneity. The δ_{it} is unobserved time heterogeneity that affects all regions equally. It can be accepted that the 1998 financial crisis had a fundamental effect on the Korean economy. So, regression was applied before and after 1998 separately to erase the effect of δ_{it}. The ε_{it} is a pure error term. The α_{it} can be assumed to have a fixed or random effect. In this study, the results with fixed and random effect models show similar results as the ordinary regression model (not listed in this paper). This means that α_{it} is trivial. And hereafter, 'Ln' in front of all variables will be omitted.

This study additionally investigates correlations of indices with w/r and TFP, not to mention employment. This study assumes that a rise in indices causes A_K, and that a fall in indices causes A_L.

So, if complementarity does not exist, when indices rise, A_K rises, and w/r and TFP rise accordingly. When indices fall, A_L rises, and w/r and TFP fall. So, there is a positive nexus among indices, w/r, and TFP. But complementarity raises EMP and w/r consistently. The complementarity fortifies the correlation of indices with w/r, TFP and EMP when A_K appears. Thus, the strong positive w/r –TFP – EMP nexus will appear. To the contrary, in the case of A_L, complementarity weakens or reverses the correlations. Even though complementarity consistently raises w/r and EMP, the degree of impact on w/r and EMP can be asymmetrical. The complementarity effect on EMP will be similar to that of A_L on average, but in terms of w/r, the complementarity effect is smaller than the A_L effect. In this case, indices still show positive correlations with w/r and TFP, but mixed correlations with EMP. But with a lower frequency, the complementarity effect on w/r can overpower A_L. In this case, indices have a negative correlation with w/r, TFP and EMP.

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4-3.Result of the Regression Model

4-3-1.Impact of Indices on Regional TFP and Employment

Table 13: Impact of Industrial Structure Indices on TFP and Employment (EMP) by Region

Indices	TFP_{pooled}	TFP_{CA}	TFP_{CC}	TFP_{YN}	TFP_{HN}	TFP_{GA}	EMP_{pooled}	EMP_{CA}	EMP_{CC}	EMP_{YN}	EMP_{HN}	EMP_{GA}
SPE	0.32***	2.3***	0.34***	3.3***	0.9***	-0.04	-2.25***	2.2***	-0.77***	2.08***	-0.13***	0.11
Std. Err.	0.08	0.71	0.18	0.77	0.22	0.6	0.12	0.57	0.13	0.52	0.05	0.11
COM	0.44***	0.79**	0.03	1.64***	-0.08	-0.11	0.1	1.28***	-0.44***	0.38*	-0.02	-0.24***
Std. Err.	0.095	0.45	0.14	0.38	0.16	0.28	0.13	0.36	0.1	0.26	0.04	0.05
DIV	0.54***	-1.31***	0.48***	-0.21	0.82***	-0.31	-0.3***	-2.18***	-0.02	-0.96***	-0.023	-0.14**
Std. Err.	0.092	0.37	0.1	0.34	0.1	0.37	0.13	0.29	0.07	0.23	0.025	0.06
_cons	1.06***	9.1***	0.99***	7.9***	1.35***	2.28***	5.04***	17.9***	6.3***	13.9***	7.6***	6.8***
Std. Err.	0.11	1.4	0.26	1.7	0.27	0.31	0.165	1.16	0.19	1.19	0.07	0.05
No. of obs	225	45	45	45	45	45	225	45	45	45	45	45
Adj R^2	16.3	54.7	40	35.8	70.4	0	75.1	78.2	62.1	30.8	10.9	66.6

Notes: ***p<0.01, **p<0.05 and *p<0.1, Pooled (Results with Pooled sample), CA (Capital), CC (Chungcheong), YN (Yeongnam), HN (Honam), GA (Gangwon)

In Table 13, for the pooled sample, SPE, COM and DIV positively affect TFP at 0.32***, 0.44*** and 0.54***. At the regional level, the impacts of SPE on TFP are most clear and are positive for all regions except Gangwon region. COM also contributes to enhancing TFP for the Capital and Yeongnam at 0.79** and 1.64***, whereas DIV is a TFP-enhancing factor for the Chungcheong and Honam at 0.48*** and 0.82***. However, the results on the indices-EMP nexus are quite mixed and show negative signs more often than in the survey of de Groot, Poot, and Smit (2008). In Table 13 above, 11 out of 18 results, 61.1%, show negative correlations, even though there are positive correlations between indices and TFP in the region. For the pooled sample, SPE and DIV negatively affect EMP at -2.25*** and -0.3***, and COM is an insignificant determinant of EMP. At the regional level, SPE shows a positive correlation in the Capital and Yeongnam at 2.2*** and 2.08***, but a negative impact in Chungcheong and Honam at -0.77*** and -0.13***. COM shows a positive correlation in the Capital and Yeongnam at 1.28*** and 0.38*, but a negative correlation in the Chungcheong and Gangwon at -0.44*** and -0.24***. Finally, DIV has negative correlations in the Capital, Yeongnam, and Gangwon at -2.18***, -0.96*** and -0.14**.

Table 14: Impact of Industrial Structural Indices on TFP

Indices	Before 1998						After 1998					
	TFPpooled	TFP_{CA}	TFP_{CC}	TFP_{YN}	TFP_{HN}	TFP_{GA}	TFPpooled	TFP_{CA}	TFP_{CC}	TFP_{YN}	TFP_{HN}	TFP_{GA}
SPE	0.82***	2.66***	0.28	2.29***	-0.3	-0.21	-0.2***	-1.63***	0.57	-0.08	0.76*	2
Std. Err.	0.11	1.07	0.43	0.63	0.67	0.69	0.06	0.51	0.62	0.32	0.52	2.13
COM	0.29***	0.69	-0.04	1.81***	-0.6**	-0.51*	1.28***	-0.8	1.76**	-0.24	-0.99	2.38*
Std. Err.	0.11	0.62	0.22	0.31	0.34	0.30	0.09	0.68	1.14	0.32	1.07	1.37
DIV	0.89***	-0.12	0.44***	3.12***	0.49**	-0.68*	0.3***	-0.34	0.1**	0.63***	0.63*	-0.65
Std. Err.	0.12	1.76	0.15	0.61	0.26	0.44	0.07	0.4	0.45	0.09	0.29	0.65
_cons	1.06	7.06**	0.98**	-0.6	0.48	2.67*	0.87***	-0.19	2.67*	0.36	1.32	3.79**
Std. Err.	0.15	3.63	0.52	1.98	0.48	0.37	0.09	1.44	1.62	0.67	1.45	1.39
No. of obs	140	28	28	28	28	28	80	16	16	16	16	16
Adj R^2	31.8	35	40	75.2	76.9	23.1	76.2	38.7	29.4	88.4	79.6	38.2

Notes: ***p<0.01, **p<0.05 and *p<0.1, Pooled (results with pooled sample), CA (Capital), CC (Chungcheong), YN (Yeongnam), HN (Honam), GA (Gangwon)

The impact of the indices on TFP will be examined by separating the periods before and after 1998 in Table 14. Overall, before 1998, among the statistically significant 12 cases, 10 show positive correlations, and regions with positive correlations with EMP also show positive correlations with TFP. For the pooled sample, before 1998, SPE, COM and DIV all positively affect TFP. At the regional level, SPE shows positive correlations at 2.66*** and 2.29*** in the Capital and Yeongnam regions. DIV shows positive correlations at 0.44***, 3.12***, and 0.49** in the Chungcheong, Yeongnam, and Honam regions, but shows negative correlations at -0.68*** in Gangwon. COM shows positive correlations at 1.81*** in the Yeongnam region, but shows negative correlations at -0.6** and -0.51* in the Honam and Gangwon. After 1998, the correlations between TFP and indices become mixed. However, positive correlations are more frequent because among the statistically significant seven outcomes, there are only two negative correlations. For the pooled sample, COM and DIV positively affect TFP, but SPE negatively affect TFP at -0.2***. At the regional level, SPE shows negative correlations at -1.63*** in the Capital region, On the other hand, in the Honam region, SPE shows a positive correlation at 0.76*. COM shows positive correlations at 1.76** and 2.38* in the Chungcheong and Gangwon. DIV shows positive correlations at 0.1***, 0.63** and 0.63* in the Chungcheong, Yeongnam and Honam.

4-3-2.Impact of Industrial Structure Indices on Regional Employment

Table 15: Impact of Industrial Structural Indices on Employment (EMP)

Indices	Before 1998						After 1998					
	EMP_{pooled}	EMP_{CA}	EMP_{CC}	EMP_{YN}	EMP_{HN}	EMP_{GA}	EMP_{pooled}	EMP_{CA}	EMP_{CC}	EMP_{YN}	EMP_{HN}	EMP_{GA}
SPE	-1.75***	2.46***	0.37*	1.27***	0.06	0.11	-2.84***	-0.05	-0.68**	-0.21	0.19	-0.49
Std. Err.	0.16	0.86	0.23	0.27	0.19	0.13	0.12	0.29	0.26	0.18	0.14	0.38
COM	-0.31**	1.18***	0.01	0.37***	0.08	-0.19***	1.6***	1.75***	-0.92**	0.24*	0.2	-0.17
Std. Err.	0.16	0.5	0.12	0.13	0.1	0.06	0.16	0.39	0.47	0.18	0.29	0.24
DIV	-0.08	-0.94	0.25***	1.42***	0.06	-0.12*	-0.4***	-0.66***	0.17	-0.15***	-0.17**	0.01
Std. Err.	0.17	1.41	0.08	0.26	0.07	0.08	0.14	0.23	0.18	0.05	0.08	0.11
_cons	5.32***	15.56***	7.55***	7.76***	7.72***	6.76***	4.47***	10.32***	6.7***	8.64***	8.44***	6.15***
Std. Err.	0.21	2.91	0.28	0.84	0.14	0.07	0.16	0.83	0.68	0.37	0.4	0.24
No. of obs	140	28	28	28	28	28	80	16	16	16	16	16
Adj R^2	69.3	58.2	39.2	81.4	-6.7	51.8	93.6	86.4	62.3	70.9	43.4	6.5

Notes: ***p<0.01, **p<0.05 and *p<0.1, Pooled (results with pooled sample), CA (Capital), CC (Chungcheong), YN (Yeongnam), HN (Honam), GA (Gangwon)

In Table 15, in pooled sample, negative correlations between EMP and indices are found very often and this will be discussed at the end of this section. Before and after 1998, quite different correlation results are found. Before 1998, among 11 statistically positive results, there are seven positive outcomes. Before 1998, regions where TFP increased and regions where employment increased by indices mostly coincide in Table 14 and 15. SPE shows positive correlations in the Capital and Yeongnam regions at 2.46*** and 1.27***, respectively. DIV shows positive correlations at 0.25*** and 1.42*** in the Chungcheong and Yeongnam, respectively. COM shows positive correlations at 1.18*** and 0.37*** in the Capital and Yeongnam, respectively. In the Gangwon, COM and DIV show negative correlations at -0.19*** and -0.12*. On the other hand, after 1998, the impacts of indices on EMP are mostly negative, and there are only three positive correlations by COM in the Capital and Yeongnam and pooled data among ten results. Another eight results are statistically insignificant. This indicates that frequent negative correlations in the whole period regression results in Table 13 were mainly caused by the negative correlations after 1998 in Table 15. SPE shows negative correlations at -0.68** in the Chungcheong region. COM shows positive correlations at 1.75*** and 0.24* in the Capital and Yeongnam region, but negative

correlations at -0.92** in the Chungcheong. DIV shows negative correlations at -0.66***, -0.15*** and -0.17** in the Capital, Yeongnam, and Honam.

Looking at the pooled regression outcomes after 1998, SPE and DIV rightly show negative correlations at -2.84*** and -0.4*** because negative correlations prevail regionally. However, before 1998, SPE, COM, and DIV show mostly negative correlations at -1.75***, -0.31**, and -0.08, even though apparent positive correlations prevail regionally. This can happen when outflow of employment resulting from strong productivity eruptions is greater than inflow to these regions. In the regression analysis, employment and indices are compiled within the region. Thus, only inflow into the Capital region where productivity occurred (reduction in employment in the surrounding region) is captured, and a large-scale employment increase that spills over into the periphery is not captured. In this respect, it could be inappropriate to conclude that insignificant SPE in pooled regression result in the survey of Glaeser, Kallal, Scheinkman, and Shleifer (1992), indicates that SPE does not positively affect TFP and EMP regionally. Rodrik (2013) argued that an important reason for the decline in manufacturing employment in many countries is increased manufacturing productivity. In this study, even before 1998, when manufacturing employment rather than total employment is used as a dependent variable (not included in Appendix), negative correlations appear between indices and manufacturing employment. In other words, the increase in productivity decreases manufacturing employment, but overall employment increases because employment is created in the non-manufacturing sector. Acemoglu and Guerrieri (2006) also argued using 60 years of US data that the increase in relative output due to the increase in productivity in the capital-intensive sectors accounts for 1/6 to 1/3 of the relative increase in employment in labor-intensive sectors.

4-4. Interpretation of Results from the Perspective of Biased Technological Progress

Table 16: Summary Table of Correlations of Indices with Employment, TFP, and w/r

Indices	Dep.	Before 1998						After 1998					
		Pooled	CA	CC	YN	HN	GA	pooled	CA	CC	YN	HN	GA
SPE	w/r	2.63***	4.7**	0.32	4.62***	1.3	-1.66	0.46***	-1.32***	0.57	-0.26	0.55	0.14
	TFP	0.82***	2.66***	0.28	2.29***	-0.3	-0.21	-0.2***	-1.63***	0.57	-0.08	0.76*	2
	EMP	-1.75***	2.46***	0.37*	1.27***	0.06	0.11	-2.84***	-0.05	-0.68**	-0.21	0.19	-0.49
COM	w/r	0.11	2.13*	-1.47**	2.32***	-1.37**	-0.83	0.63***	-0.14	1.14	-0.02	-0.21	1.05**
	TFP	0.29***	0.69	-0.04	1.81***	-0.6**	-0.51*	1.28***	-0.8	1.76**	-0.24	-0.99	2.38*
	EMP	-0.31**	1.18***	0.01	0.37***	0.08	-0.19***	1.6***	1.75***	-0.92**	0.24*	0.2	-0.17
DIV	w/r	2.63***	-0.69	1.56***	7.49***	1.88***	-1.72**	0.21***	-0.58*	0.16	0.14**	0.03	0.31
	TFP	0.89***	-0.12	0.44***	3.12***	0.49**	-0.68*	0.3***	-0.34	0.1**	0.63***	0.63*	-0.65
	EMP	-0.08	-0.94	0.25***	1.42***	0.06	-0.12*	-0.4***	-0.66***	0.17	-0.15***	-0.17**	0.01

Notes: ***p<0.01, **p<0.05 and *p<0.1, Dep.= dependent variable, Pooled (results with pooled sample), CA (Capital), CC (Chungcheong), YN (Yeongnam), HN (Honam), GA (Gangwon)

Table 16 above is the summary of correlations of three indices with w/r, TFP, and EMP. The correlations of indices with w/r are listed in Table 3 of Appendix B in detail. As seen in the productivity analysis, there are clear positive correlations between w/r and TFP. However, as will be seen, there are a few outcomes where indices have positive correlations with only either w/r or TFP. This shows that the indices do not perfectly reflect biased technological progress and TFP. So, if indices have statistically positive correlations with w/r or TFP, this study assumes that indices have positive correlations with both w/r and TFP. This study assumes that an increase in indices causes A_K, and a decrease in indices causes A_L. So, when indices rise, A_K rises, and w/r and TFP rise accordingly. When indices fall, A_L rises, and w/r and TFP fall. So, if complementarity does not exist, a positive correlation between w/r and TFP and EMP are established. However, the complementarity raises EMP and w/r consistently. The complementarity thus fortifies the correlation of indices with EMP and w/r when A_K appears. But in the case of A_L, complementarity weakens or reverses the correlations. Even though complementarity consistently raises w/r and EMP, the degree of impact on EMP and w/r should be asymmetrical. As seen in the regression results, the complementarity effect on EMP seems to be similar to that of A_L on average. However, the complementarity effect on w/r

seems to be smaller to that of A_L. When the indices still have a positive correlation with w/r, which reflects a "moderate capital preference", indices can have half and half positive and negative correlations with EMP. However, less frequently, the complementarity effect on w/r can overpower A_L. In this case, indices have a negative correlation with w/r, which can be called a "strong capital preference." When A_L appears, a strong capital preference causes capital concentration and can contribute to TFP and thus EMP. So, this strong capital preference also likely causes a negative correlation with TFP and EMP. This strong capital preference can be explained by a simple example. The location regulations or regulations on investment that decrease industrial concentrations, and accordingly indices, make a company inevitably choose A_L. In this case, the productivity of the company decreases. This worsening of profitability can make the company secure even more capital, which brings higher future profits for business survival. If indices strongly stimulate the capital preference of regional companies in this way, w/r can increase by overpowering the decreasing effect of w/r by A_L. In this case, a negative correlation can occur between both indices and w/r and EMP.

Before 1998, there were strong regional positive correlations of indices with w/r, TFP, and EMP. SPE shows positive correlations in the Capital (4.7**, 2.66***, and 2.46***) and Yeongnam (4.62***, 2.29***, and 1.27***) regions. COM shows positive correlations in the Capital (2.13*, 0.69, and 1.18***) and Yeongnam (2.32***, 1.81***, and 0.37***). DIV shows positive correlations in the Chungcheong (1.56***, 0.44***, and 0.25***) and Yeongnam (7.49***, 3.12***, and 1.42***) regions. On the other hand, in pooled sample and the Honam, even though indices have the positive correlations with w/r and TFP, indices show negative or non-correlations with EMP. In pooled sample, EMP is negatively correlated with SPE (2.63***, 0.82***, and -1.75***) and COM (0.11, 0.29***, and -0.31**) and not correlated with DIV (2.63***, 0.89***, and -0.08). Similarly, DIV shows non-correlation with EMP in the Honam (1.88***, 0.49**, and 0.06). As explained, this indicates that a strong productivity eruption causes larger employment outflows. Even though strong productivity appeared in the Honam, TFP eruptions in primary industries such as agriculture might

cause a net outflow of employment, which can reflect rural to urban migration during the 1970 and 1980s. As mentioned, these phenomena are similar to the decrease in manufacturing employment as a result of increase in manufacturing productivity. In conclusion, before 1998 a strong TFP increase by A_K pushed up w/r and EMP in all regions. This means that strong A_K and favorable complementarity caused strong positive correlations of indices with w/r, TFF, and EMP. Furthermore, in regions where A_L appeared exceptionally before 1998, positive correlations of indices with w/r, TFP and EMP disappeared.

After 1998, such strong positive w/r-TFP-EMP correlations weaken. The results are grouped from a moderate capital preference to a strong capital preference. In the group of moderate capital preference, COM and DIV mostly show a positive w/r-TFP nexus. However, even in this case, in terms of EMP, the correlation results are quite mixed. Among 11 outcomes, four positive, four negative, and three non-correlations appear. COM only shows positive correlations with EMP in pooled sample (0.63***, 1.28***, and 1.6***), negative correlation in the Chungcheong (1.14, 1.76**, and -0.92**) and non-correlation in the Gangwon (1.05**, 2.38*, and -0.17). DIV shows negative correlations in pooled sample (0.21***, 0.3***, and -0.4***), non-correlation in the Chungcheong (0.16, 0.1**, and 0.17), and negative correlation in the Yeongnam (0.14**, 0.63***, and -0.15***) and Honam (0.03, 0.63*, and -0.17**). SPE shows a negative correlation in pooled sample (0.46***, -0.2***, and -2.84***) and non-correlation in the Honam (0.55, 0.76*, and 0.19). In the case of non-correlation with w/r and TFP, COM shows positive correlations in the Capital (-0.14, -0.8, and 1.75***) and Yeongnam (-0.02, -0.24, and 0.24*). As reflected in the hypothesis, negative or non-correlations between indices and EMP are interpreted to mean that the complementarity effect on EMP is greater or the same. A positive correlation means that complementarity is smaller than the negative EMP effect by A_L.

On the other hand, in the group of a strong capital preference, indices show mostly negative correlations with w/r, TFP and EMP. Among the six outcomes, three negative and three non-

correlations between indices and EMP appear. Before 1998 overall, A_K prevailed but A_L appears by exception. COM shows non-correlation with EMP in the Chungcheong (-1.47**, -0.04, and 0.01), the Honam (-1.37**, -0.6**, 0.08), and negative correlations in the Gangwon (-0.83, -0.51*, and -0.19***). DIV shows negative correlations in the Gangwon (-1.72**, -0.68*, and -0.12*). After 1998, SPE shows non-correlations in the Capital region (-1.32***, -1.63***, and -0.05). DIV also shows negative correlations in the Capital region (-0.58*, -0.34, and -0.66***). These results are natural because when A_L appears, the strong capital preference mostly reverses positive w/r-TFP-EMP nexus.

Table 17: Vote Counts of Three Industrial Structure Indices in this Study

Statistical significance	Specialization (SPE)		Competition (COM)		Diversity (DIV)	
	count	percent	count	percent	count	percent
Negative Significant	3	25%	3	25%	5	39%
Negative Insignificant	3	25%	1	8.3%	2	16.7%
Positive Insignificant	3	25%	3	25%	3	25%
Positive Significant	3	25%	5	39%	2	16.7%
Total	12	100%	12	41.7%	12	100%

Notes: 36 correlation results between EMP and indices before and after 1998.

Table 17 above shows the 36 correlation results between employment and indices before and after 1998 in this study. In total, there are 17 (47.2%) negative correlations between the indices and employment among the 36 outcomes, which is similar to the results in de Groot, Poot, and Smit (2008). However, DIV shows considerably more frequent negative correlations than in de Groot, Poot, and Smit (2008). As seen above, this means that DIV effect on EMP by SMEs was more active after 1998 because of the strong oppression of business diversification among large companies.

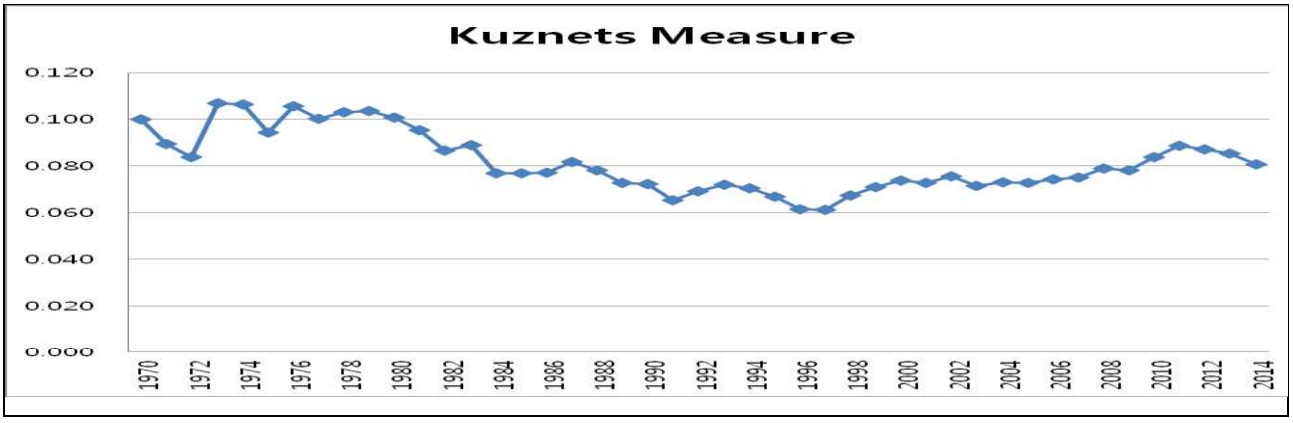
In the following part, the mixed correlations (de Groot, Poot, & Smit, 2008) will be interprets in terms of typical asymmetry in the business cycle. The mixed correlation between indices and EMP can be interpreted as asymmetry in economic fluctuations referred to mainly in Keynesian economics. The asymmetry of economic fluctuations means that the correlations between macroeconomic variables change in degree and direction between booms and depressions (Kim, 1999; Mittnik, 1994). The RBCT predicts that real wages and EMP are all clearly cyclical, but EMP in the real world is not as sensitive to fluctuations as predicted by RBCT especially in economic

recessions (Malley, Muscatelli, & Woitek, 1999). There is no disagreement that in economic boom, w apparently increases, and from embodied technological progress, there is an apparent decrease in cost of capital r in the US (Lee, 2006) as well as in Korea. On the contrary, in economic depression, r shows countercyclical behavior, though very weakly. And the "downward real wage rigidity" is observed in economic depression in Korea and Europe in corporate-level enterprise data (Babecky, Caju, Kosma, Lawless, Messina, & Room, 2009; Lee, 1999). These phenomena can be explained because the capital preference offsets an impact on w and r from A_L in economic recessions. The mixed correlation between indices and EMP (de Groot, Poot, & Smit, 2008) is interpreted as asymmetrical correlations in which EMP and indices have a positive correlation in a boom caused by A_K, but in a recession caused by A_L, a significant number of negative and uncorrelated relationships appear. Namely, this study explains the asymmetric correlations by capital preference under the assumption of biased technological progress. When A_K appears, the complementarity strengthens favorable EMP effect of A_K. So, clear positive correlations between indices and EMP appear. One the contrary, when A_L appears, this favorable EMP effect of complementarity weakens or reverses the negative EMP effect of A_L. So, mixed correlations appear according to relative magnitude between complementarity and A_L. Next, the asymmetry of the correlation of indices with w/r will be explained. With the additional increase in the K/L due to capital preference acts to further increase w/r, as shown in Equation (6). Since A_K brings w/r up, capital preference supports the w/r increase of A_K. So, positive correlations of indices between w/r and TFP are established. On the other hand, this force moves in the opposite direction as the w/r decline from A_L, w/r can drop or stagnate or sometimes even rise according to the relative size of the capital preference and A_L. So, in this case, mixed correlations of indices between w/r and TFP are established. The negative estimates of σ in this study and Jeong (2015) is closely related to negative correlations of indices with w/r in that both happen when complementarity is very strong.

IV. POLICY IMPLICATIONS

The findings of this research support embodied technological progress and RBCT. Actually, this study shows how positive and negative technological shocks are propagated to factor prices and especially employment in five Korean regions from 1970 to 2014. Thus, to activate a regional economy, the regional government should stimulate technological innovation by regional companies rather than aggregate demand management such as fiscal expansions. First, a regional government should stimulate A_K by policy inducement. The economic reforms after the 1998 financial crisis were mainly focused on restraining capital concentration in the hands of large companies. Furthermore, location regulation, especially in the Capital region, and scattering of public facilities were implemented at full scale. These government policies might have made capital more abundant before 1998 and labor more abundant after 1998. In other words, Korea's policy tenets resulted in favorable A_K before 1998 and unfavorable A_L after 1998. In terms of embodied technology, policy of fostering investment in facility assets is the most direct way of inducing A_K. And regional concentration of company and capital should be left to the function of market rather than scattering policy.

Figure 10: Trends of Regional Income Inequalities by Kuznets Measure in Korea, in 1970-2014



A balanced growth policy was executed on the assumption that it decreases efficiency to a limited extent but considerably increases regional income equality. Thus, the government tried to fix differences in regional capital concentration K/Ls. Before 1998, the Capital and Yeongnam regions were the leading capital-intensive regions with high K/Ls. However, after 1998, these two regions

became the most labor-intensive regions, and the Honam and Gangwon regions became the most capital-intensive regions because of these balanced growth policies. This study argues that not only the relative abundance of factors but also the absolute size of capital stock are further important aspects of generating technological progress because for embodied technological progress, the size of capital itself is a reflection of the size of accumulated technologies in the economy. As seen in Chapter 3 in the productivity analysis, an economy can be described by the most simple production function Y=A (K) K and, in this case, K includes human capital, the demand for which is created by the fast growth of physical capital. Silicon Valley's success is due to its massive funding for facility investment and R&D from the US Department of Defense and Wall Street. In Korea, the K/L of the Capital region has been the lowest since 1998, but the total amount of capital is still overwhelming. When the movement of companies is entrusted to the market, companies can freely concentrate, especially in the Capital region. The soaring increase in productivity quickly reduces the price of capital-intensive goods and paradoxically worsens the profitability of companies; this makes them move to the surrounding regions voluntarily, as seen in Table 1 and 2 of Appendix A. Before 1998, in addition to the Capital region, strong productivity eruptions also occurred in the Honam and Gangwon regions. In terms of embodied technological progress, the movement of capital to outside regions means technology transfer. This leads to improved GRDP in the Honam and Gangwon regions. In contrast, after 1998, the scattering policy made TFP decrease significantly in all five regions compared to the pre-1998 period. Ironically, the TFPs decreased most in the Honam and Gangwon regions, which were beneficiaries of scattering policies. This means scattering policy with resource constraints resulted in both the Capital and periphery regions failing to obtain enough capital stock for fast technological externalities to arise. The Figure 10 also shows that the active movement of companies due to A_K in the Capital region contributes to regional income equality. The Figure 10 is trends of Kuznets measures of income equality in 16 regions from 1970 to 2014. A high value means a high level of income inequality. To obtain per capita income of regions, the

Population and Housing Surveys every five years were used. The regional income disparity gradually decreased until 1998 and then inequality increased again (Gini income coefficients show similar patterns). This shows that economic efficiency and regional income fairness can be diminished by artificial scattering policy, as seen in trends of Kuznets measures after 1998.

Second, there are concerns that such policies will make the regional economy a monopolistic competitive market dominated by large companies and this undermines economic efficiency and hinders coexistence with SMEs. In a static analysis, monopolistic competition is inefficient in resource allocations, since P>MR=MC. But from a dynamic perspective, as in this research, monopolistic competition where large companies and SMEs coexist supports innovation because the higher price in monopolistic competition works as a subsidy to large companies because, with concentration externalities, large company causes are not rewarded by the government. However, the speed of price adjustment under the influence of large companies found to be very fast. In terms of AR^2, over 95% of the regional TFPs from 1970 to 2014 can be explained by two regressors, industrial structure indices and w/r. This means that monopoly profits by large companies, which can be included in TFP, if any, disappear very quickly. Large companies' quick cut of order prices for parts and material from SMEs can be a reflection of this market efficiency. Contrary to common understanding, from a dynamic perspective, there can be a symbiotic relationship between large companies and SMEs with adequate policy inducements. In the literature, SPE is influenced by large companies. On the other hand, COM is mainly influenced by SMEs. Before 1998, a simple correlation between SPE and COM indices was 60.5%. Regions with a positive correlation of SPE with TFP mostly coincide with regions with a positive correlation of COM with TFP. This implies that a large company attracts SMEs within regions because of technological spillovers. However, this symbiotic relationship between large companies and SMEs disappears after 1998.

Third, assuming that A_K is superior, the question is whether it is guided by policy and can theoretically be maintained over the long term. In economic growth theory, it is more widely

accepted that long-term growth is harmonious with A_L. The A_K is assumed to appear only temporarily in the process of transition to a long-term balanced growth path. However, this cannot explain the phenomena in the US, where the price of capital goods apparently decreased as it did in Korea before 1998, when capital embodied technological progress advances (Lee, 2006; Casey & Horii, 2019). Casey and Horii (2019) justified A_K by introducing multiple factors in addition to capital and labor. Li and Bental (2017) showed the arguments that A_L is more supportive of long-run growth can be established under very restricted assumptions, such as that the supply elasticity of capital is infinite. So, whether A_K is harmonious with long-run balanced growth, which this study argues, needs further research. However, the important point is that A_K can be guided and sustained by government policy. According to the market size effect (Acemoglu, 2001b), technological progress occurs with relatively more abundant factors. Thus, if the regions do not lose the status of relative factor abundance, there is no inevitable reason that A_K will turn into A_L.

V. CONCLUSION, LIMITS, AND FUTURE TASKS

Judging by w/r and labor share, before 1998 A_K may be present and A_L seemingly appears after 1998. Before 1998, SPE, COM, and DIV all show very strong positive correlations among w/r, TFP, and EMP in most regions. This is interpreted as meaning that when A_K appears, complementarity affects w/r and EMP in the same direction as A_K. After 1998, COM and DIV mostly show a positive w/r-TFP nexus. However, even in this case, correlations with EMP are quite mixed. Among 11 outcomes, four positive, four negative, and three non-correlations between indices and EMP appear. As seen in the hypothesis, negative or non-correlations between indices and EMP mean that the complementarity effect on EMP is larger or similar, and a positive correlation means that the complementarity effect is smaller than the negative EMP effect of A_L. Before and after 1998, negative correlations of indices with w/r and TFP were observed when A_L appeared with less frequency. Before 1998, A_L exceptionally appears according to indices and regions. In these cases, indices mostly show negative correlations with EMP. Among six outcomes, three negative and three non-correlations between indices and EMP appear. These results mean that a strong capital preference effect on w/r, TFP and EMP overpowered A_L. In total, including statistically insignificant cases, there are 17 (47.2%) negative correlations between indices and employment among 36 outcomes, which shows similar results as de Groot, Poot, and Smit (2008). However, DIV shows comparatively very frequent negative correlations as compared to the results of de Groot, Poot, and Smit (2008), which indicates that after 1998, employment increased from business diversification by SMEs. The results of de Groot, Poot, and Smit (2008) and this study can be an example of typical asymmetries of business fluctuations, such as the insensitivity of employment and downward rigidity of the real wage rate w in an economic depression.

The essential limitation of this study is that to interpret mixed correlations (de Groot, Poot, & Smit, 2008), a capital preference assumption is introduced. This is derived from the faster growth rate of A_K. However, capital preference should be tested by empirical research. Thus, this study is

one explanation or interpretation and not verification of mixed correlation results. Another limitation of this study is the insufficiency of data, namely that the number of observations in each region is under 30. In addition, before 1998, SPE, COM, and DIV show negative correlations with EMP in pooled sample, even though there were strong positive correlations with EMP regionally. This can happen when outflow of employment from a productivity increase is greater than the inflow to these regions. The flow of production factors due to this biased technological progress can be better shown by the 2x2x2 model widely used in international economics.

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Appendix.

A. Capital and Employment Outflow into Other Regions by Indices Change in Capital Region

Table 1: Capital Outflow into Other Regions by Indices Change in Capital Region

Indices	Before 1998					After1998				
	K_{CA}	K_{CC}	K_{YN}	K_{HN}	K_{KW}	K_{CA}	K_{CC}	K_{YN}	K_{HN}	K_{KW}
SPE_{CA}	6.11***	7.1***	5.5***	6.75***	5.78***	0.04	0.2	-0..1	0.34	0.08
	2.05	2.34	1.97	2.16	1.73	0.57	0.71	0.53	0.65	0.65
COM_{CA}	2.27**	2.12*	2.6***	2.05*	1.03	3.84***	4.31***	3.61***	3.89***	4.3***
	1.91	1.35	1.13	1.25	1	0.76	0.95	0.71	0.87	0.88
DIV_{CA}	-2.43	-1.53***	-2.53	-1.36	-1.1	-1.35***	-1.62***	-1.22***	-1.38***	-1.46***
	3.38	3.86	3.24	3.56	2.85	0.44	0.55	0.41	0.51	0.51
_cons	29.7***	28.1***	28.4***	27.1	23.8	16.8	15.9***	15.6***	15.8***	14.3***
	6.9	7.97	6.6	7.35	5.88	16.5	2.0	1.51	1.86	1.85
No. of Obs	28	28	28	28	28	16	16	16	16	16
Adj R^2	55.3	51.7	56.8	53.4	50.8	88.3	86.3	88.2	84.9	87.3

Note:K_i: capital in i region explained by indices change of Capital region, ***p<0.01, **p<0.05 and *p<0.1

Table 2: Employment Outflow into Other Regions by Indices Change in Capital Region

Indices	Before 1998					After1998				
	L_{CA}	L_{CC}	L_{YN}	L_{HN}	L_{KW}	L_{CA}	L_{CC}	L_{YN}	L_{HN}	L_{GW}
SPE_{CA}	2.46***	0.02	1.4***	-0.33***	0.24**	-0.06	0.32	0.02	0.31**	0.15
	0.85	0.3	0.41	0.13	0.11	0.29	0.37	0.18	0.17	0.16
COM_{CA}	1.19***	0.35**	0.35*	0.17**	0.21***	1.75***	1.47***	0.46**	0.21	0.33*
	0.49	0.17	0.23	0.07	0.06	0.39	-0.51	0.24	0.24	0.22
DIV_{CA}	-0.94	-0.99**	-0.61	-0.49**	-0.11	-0.66***	-0.49*	-0.27**	-0.14	-0.17
	1.4	0.5	0.67	0.22	0.18	0.23	0.29	0.14	0.13	0.12
_cons	15.5***	9.78***	12.55***	8.2	7.1***	10.3***	9.2***	9.3***	8.7***	7.1
	2.9	1.03	1.38	0.45	0.37	0.82	1.06	0.51	0.5	0.46
No. of Obs.	28	28	28	28	28	16	16	16	16	16
Adj R^2	58.2	23.7	58.1	16	59.7	86.4	67.6	60.3	20.5	38.2

Note: L_i: employment in i region explained by indices change of Capital region, ***p<0.01, **p<0.05 and *p<0.1

Above Table 1 and 2 of Appendix A show change of indices in the Capital region have very strong correlations with capital and labor in the other regions. The strong positive correlation means increase in indices of Capital region increase capital and labor in other regions, which is interpreted that productivity eruption of Capital region moved company, accordingly capital and labor to other regions. Before 1998, the capital and labor outflow by SPE to other regions was surprisingly high. The capital and labor outflow also arise by COM on a smaller scale before 1998. On the contrary after 98, SPE effect nearly disappears and COM and DIV mainly cause the in and out flow of capital and labor. In short, before 98, industrial specialization in Capital region caused by large company moved massive amount of capital and labor to periphery regions.

B. Key Results on Substitution Elasticity, GTFP and Biased Technological Progress

Table 1: Substitution Elasticity Results with w/r Explanatory Variable

	Before 1998						After 1998					
	Pooled	CA	CC	YN	HN	GW	Pooled	CA	CC	YN	HN	GW
w/r	**0.48*** **	**0.61*** **	**0.50*** **	**0.74*** **	**0.47*** **	**0.60*** **	**0.42** **	**-0.25**	**-0.45** **	**-0.12**	**0.04**	**-1.03** **
No. of Obs	**140**	**28**	**28**	**28**	**28**	**28**	**80**	**16**	**16**	**16**	**16**	**16**
Adj R^2	**84.0**	**97.5**	**97.8**	**98.3**	**92.0**	**89.0**	**45.5**	**87.7**	**82.0**	**96.3**	**96.3**	**74.2**

Notes: ***p<0.01, **p<0.05 and *p<0.1, CA (Capital), CC (Chungcheong), YN (Yeongnam), HN (Honam), GA (Gangwon), GTFP: Growth of TFP, No. of Obs. = No. of Observation,

Table 2: Simple Regression Result between GTFP by Primal and Dual Method

	Before 1998						After 1998					
	$GTFP_{pooled}$	**$GTFP_{CA}$**	**$GTFP_{CC}$**	**$GTFP_{YN}$**	**$GTFP_{HN}$**	**$GTFP_{KW}$**	**$GTFP_{pooling}$**	**$GTFP_{CA}$**	**$GTFP_{CC}$**	**$GTFP_{YN}$**	**$GTFP_{HN}$**	**$GTFP_{KW}$**
$GTFP_P$	**0.75*** **	**0.99*** **	**0.94*** **	**0.89*** **	**0.35*** **	**0.80*** **	**1.02*** **	**1.04*** **	**0.99*** **	**0.99*** **	**1.05*** **	**0.99*** **
	0.05	0.05	0.08	0.08	0.14	0.1	0.017	0.03	0.025	0.025	0.04	0.07
_cons	**0.005** **	**-0.001**	**0**	**0.002**	**0.02** **	**0.006**	**0**	**0.004*** **	**0.003*** **	**0.003*** **	**0.004*** **	**0.005*** **
	0.003	0.002	0.004	0.003	0.01	0.007	0	0.001	0.001	0.001	0.001	0.001
No. of Obs	**140**	**28**	**28**	**28**	**28**	**28**	**80**	**16**	**16**	**16**	**16**	**16**
Adj R^2	**64.6**	**93.3**	**84.5**	**81.3**	**15.4**	**71.8**	**97.8**	**98.9**	**99.0**	**99.0**	**98.1**	**92.2**

Notes: ***p<0.01, **p<0.05 and *p<0.1, CA (Capital), CC (Chungcheong), YN (Yeongnam), HN (Honam), GA (Gangwon), GTFP: Growth of TFP, No. of Obs. = No. of Observation, explanatory variable: **$GTFP_P$** = Primal GTFP, Dependent Varieble = Dual GTFP.

Table 3: Impact of Industrial Structure Indices on Relative Factor Price w/r

Indices	Before 1998						After 1998					
	w/r_{pooled}	**w/r_{CA}**	**w/r_{CC}**	**w/r_{YN}**	**w/r_{HN}**	**w/r_{GA}**	**w/r_{pooled}**	**w/r_{CA}**	**w/r_{CC}**	**w/r_{YN}**	**w/r_{HN}**	**w/r_{GA}**
SPE	**2.63*** **	**4.7** **	**0.32**	**4.62*** **	**1.3**	**-1.66**	**0.46*** **	**-1.32*** **	**0.57**	**-0.26**	**0.55**	**0.14**
	0.11	1.98	0.51	1.222	1.51	1.63	0.04	0.43	0.51	0.22	0.46	0.15
COM	**0.11**	**2.13***	**-1.47** **	**2.32*** **	**-1.37** **	**-0.83**	**0.63*** **	**-0.14**	**1.14**	**-0.02**	**-0.21**	**1.05** **
	0.22	1.26	0.65	0.61	0.8	0.68	0.06	-0.58	0.91	0.22	0.96	0.58
DIV	**2.63*** **	**-0.69**	**1.56*** **	**7.49*** **	**1.88*** **	**-1.72** **	**0.21*** **	**-0.58***	**0.16**	**0.14** **	**0.03**	**0.31**
	0.23	3.51	0.43	1.17	0.58	0.96	0.05	0.34	0.37	0.06	0.26	0.28
_cons	**-0.11**	**11.65***	**-1.88**	**-5.98***	**-0.44**	**2.79*** **	**2.52*** **	**0.87**	**3.57*** **	**1.25*** **	**2.93** **	**2.04*** **
	0.29	0.722	1.56	3.82	1.1	0.89	0.06	1.22	1.32	0.46	1.3	0.59
No. of Obs	**140**	**28**	**28**	**28**	**28**	**28**	**80**	**16**	**16**	**16**	**16**	**16**
Adj R^2	**51.5**	**40.8**	**70.3**	**80.4**	**84.5**	**17.7**	**82.8**	**54.9**	**4.7**	**19.5**	**14.7**	**8.7**

Notes: ***p<0.01, **p<0.05 and *p<0.1, CA (Capital), CC (Chungcheong), YN (Yeongnam), HN (Honam), GA (Gangwon), GTFP: Growth of TFP, No. of Obs. = No. of Observation

C. Change of Key Variables in Korea and 5 Regions

Table 1: Change of Key Variables in Korea

Variable	Period			
	1970-1980	1981-1990	1991-2000	2001-2014
GRDP (Unit: 1billion Won)	105,635	254,219	566,201	1,035,708
Growth of GRDP	0.089	0.098	0.070	0.041
Fixed Capital formation (Unit: 1billion Won)	33,385	89,465	221,675	349,709
Growth of Capital formation	0.121	0.116	0.055	0.034
Fixed asset	181,402	630,819	1,813,212	3,488,888
Construction asset (Unit: 1billion Won)	124,423	427,494	1,385,047	2,938,717
Facility asset (Unit: 1billion Won)	56,980	203,324	428,165	550,171
Facility/Fixed Asset	0.314	0.322	0.236	0.158
Growth of Fixed asset	0.164	0.110	0.095	0.042
Land stock (Kh) (Unit: 1billion Won)	3,263,837	3,846,232	4,438,962	5,121,944
Total Employment (Unit: 1 thousand)	11,812	15,669	20,062	23,608
Wage worker (Unit: 1 thousand Won)	5,006	8,492	12,585	16,217
Non-wage worker (Unit: 1 thousand Won)	6,806	7,176	7,477	7,391
Growth of Employment	0.036	0.028	0.016	0.015
Manufacturing employment (Unit: thousand)	1,820	3,420	3,613	3,485
Employee income (Unit: 1billion Won)	67,189	168,919	398,735	630,269
Labor share	0.624	0.661	0.707	0.613
K/L ratio	15.4	40.3	90.4	147.8
r (user cost of capital)	0.25	0.14	0.10	0.12
w (real wage rate) (Unit: 1 million Won)	5.4	10.4	19.5	26.0
w/r	0.4	1.2	3.4	3.7

Table 2. Changes of Key Variables in Capital Region

Variable	Period			
	1970-1980	1981-1990	1991-2000	2001-2014
GRDP (Unit: 1billion Won)	42,551	114,058	272,467	509,447
Growth of GRDP	0.104	0.110	0.065	0.036
Fixed Capital formation (Unit: 1billion Won)	13,755	38,410	96,653	156,506
Growth of Capital formation	0.096	0.118	0.090	0.030
Fixed asset	79,536	280,224	806,697	1,546,595
Construction asset (Unit: 1billion Won)	54,358	185,204	599,481	1,268,023
Facility asset (Unit: 1billion Won)	25,178	95,020	207,216	278,572
Facility/Fixed Asset	0.317	0.339	0.257	0.180
Growth of Fixed asset	0.163	0.112	0.097	0.041
Land stock (Kh) (Unit: 1billion Won)	1,982,582	2,386,288	2,724,786	3,137,558
Total Employment (Unit: 1 thousand)	3,553	6,236	9,107	11,601
Wage worker (Unit: 1 thousand Won)	2,263	4,238	6,404	8,559
Non-wage worker (Unit: 1 thousand Won)	1,290	1,999	2,703	3,042
Growth of Employment	0.089	0.047	0.025	0.020
Manufacturing employment (Unit: thousand)	893	1,781	1,864	1,621
Employee income (Unit: 1billion Won)	25,596	77,060	195,525	335,482
Labor share	0.575	0.673	0.719	0.661
K/L ratio	22	45	89	133
r (user cost of capital)	0.25	0.14	0.10	0.11
w (real wage rate) (Unit: 1 million Won)	6.8	11.9	21.1	28.2
w/r	0.6	1.4	3.5	4.2

Table 3. Changes of Key Variables in Chungcheong Region

Variable	Period			
	1970-1980	1981-1990	1991-2000	2001-2014
GRDP (Unit: 1billion Won)	10,852	23,844	57,217	118,728
Growth of GRDP	0.060	0.101	0.084	0.055
Fixed Capital formation (Unit: 1billion Won)	2,362	8,991	29,747	49,322
Growth of Capital formation	0.128	0.181	0.071	0.052
Fixed asset	15,492	58,901	205,575	431,335
Construction asset (Unit: 1billion Won)	11,198	43,659	163,805	374,092
Facility asset (Unit: 1billion Won)	4,293	15,241	41,770	57,244
Facility/Fixed Asset	0.277	0.259	0.203	0.133
Growth of Fixed asset	0.165	0.124	0.113	0.048
Land stock (Kh) (Unit: 1billion Won)	346,621	365,213	438,816	498,901
Total Employment (Unit: 1 thousand)	1,627	1,709	2,020	2,398
Wage worker (Unit: 1 thousand Won)	477	632	1,051	1,547
Non-wage worker (Unit: 1 thousand Won)	1,150	1,077	969	851
Growth of Employment	0.019	0.009	0.015	0.019
Manufacturing employment (Unit: thousand)	115	194	286	394
Employee income (Unit: 1billion Won)	7,660	15,200	35,831	60,899
Labor share	0.690	0.650	0.630	0.523
K/L ratio	9.5	34.5	101.8	179.9
r (user cost of capital)	0.26	0.15	0.11	0.13
w (real wage rate) (Unit: 1 million Won)	4.4	8.6	17.3	24.5
w/r	0.4	1.0	2.6	3.1

Table 4: Changes of Key Variables in Yeongnam Region

Variable	Period			
	1970-1980	1981-1990	1991-2000	2001-2014
GRDP (Unit: 1billion Won)	32,111	75,941	155,455	273,628
Growth of GRDP	0.096	0.089	0.065	0.036
Fixed Capital formation (Unit: 1billion Won)	12,503	27,306	61,437	92,774
Growth of Capital formation	0.167	0.106	0.059	0.033
Fixed asset	55,822	190,491	498,615	920,454
Construction asset (Unit: 1billion Won)	36,975	125,296	380,258	779,215
Facility asset (Unit: 1billion Won)	18,847	65,195	118,358	141,239
Facility/Fixed Asset	0.338	0.342	0.237	0.153
Growth of Fixed asset	0.178	0.101	0.087	0.039
Land stock (Kh) (Unit: 1billion Won)	548,222	678,413	802,627	955,669
Total Employment (Unit: 1 thousand)	3,525	4,609	5,679	6,219
Wage worker (Unit: 1 thousand Won)	1,439	2,498	3,479	4,111
Non-wage worker (Unit: 1 thousand Won)	2,086	2,111	2,200	2,108
Growth of Employment	0.022	0.031	0.012	0.008
Manufacturing employment (Unit: thousand)	632	1,194	1,164	1,157
Employee income (Unit: 1billion Won)	18,677	46,187	107,863	154,245
Labor share	0.584	0.598	0.698	0.568
K/L ratio	15.8	41.3	87.8	148.0
r (user cost of capital)	0.27	0.17	0.10	0.13
w (real wage rate) (Unit: 1 million Won)	5.0	9.5	18.6	24.1
w/r	0.3	1.0	3.1	3.1

Table 5: Changes of Key Variables in Honam Region

Variable	Periods			
	1970-1980	1981-1990	1991-2000	2001-2014
GRDP (Unit: 1billion Won)	14,704	27,869	58,516	97,885
Growth of GRDP	0.063	0.077	0.065	0.036
Fixed Capital formation (Unit: 1billion Won)	3,088	10,892	24,853	36,706
Growth of Capital formation	0.233	0.290	0.039	0.036
Fixed asset	19,384	69,884	214,049	409,602
Construction asset (Unit: 1billion Won)	13,419	49,547	167,768	358,819
Facility asset (Unit: 1billion Won)	5,965	20,337	46,281	50,784
Facility/Fixed Asset	0.308	0.291	0.216	0.124
Growth of Fixed asset	0.162	0.120	0.093	0.042
Land stock (Kh) (Unit: 1billion Won)	212,083	235,904	283,323	321,311
Total Employment (Unit: 1 thousand)	2,355	2,279	2,360	2,419
Wage worker (Unit: 1 thousand Won)	604	779	1,175	1,408
Non-wage worker (Unit: 1 thousand Won)	1,751	1,500	1,185	1,011
Growth of Employment	0.006	-0.002	0.001	0.005
Manufacturing employment (Unit: thousand)	144	208	244	259
Employee income (Unit: 1billion Won)	11,284	21,635	42,818	57,334
Labor share	0.758	0.771	0.737	0.592
K/L ratio	8.2	30.7	90.7	169.3
r (user cost of capital)	0.22	0.10	0.08	0.10
w (real wage rate) (Unit: 1 million Won)	4.5	9.1	17.6	22.7
w/r	0.5	1.7	3.8	3.8

Table 6: Changes of Key Variables in Gangwon Region

Variable	Periods			
	1970-1980	1981-1990	1991-2000	2001-2014
GRDP (Unit: 1billion Won)	4,322	10,062	17,099	26,618
Growth of GRDP	0.068	0.089	0.042	0.035
Fixed Capital formation (Unit: 1billion Won)	1,432	3,267	7,214	11,038
Growth of Capital formation	0.124	0.547	0.109	0.041
Fixed asset	9,007	24,096	68,542	143,223
Construction asset (Unit: 1billion Won)	7,139	18,690	57,567	126,793
Facility asset (Unit: 1billion Won)	1,868	5,406	10,975	16,430
Facility/Fixed Asset	0.207	0.224	0.160	0.115
Growth of Fixed asset	0.105	0.102	0.098	0.046
Land stock (Kh) (Unit: 1billion Won)	129,981	130,315	135,403	147,982
Total Employment (Unit: 1 thousand)	587	633	648	683
Wage worker (Unit: 1 thousand Won)	198	274	347	418
Non-wage worker (Unit: 1 thousand Won)	389	359	302	265
Growth of Employment	0.020	0.002	0.004	0.005
Manufacturing employment (Unit: thousand)	29	37	47	45
Employee income (Unit: 1billion Won)	3,631	6,810	12,146	16,086
Labor share	0.836	0.692	0.712	0.610
K/L ratio	15.4	38.1	105.7	209.7
r (user cost of capital)	0.08	0.14	0.08	0.07
w (real wage rate) (Unit: 1 million Won)	5.9	10.4	18.3	22.7
w/r	1.3	1.4	4.0	5.1

D. Compilation of Key Varaible and TFP

Table 1: Yearly Data of GDP and GRDP in Nation and 5 Regions

(Unit: 1billion Won)

Year	Region					
	Nation	Capital	Chungcheong	Yeongnam	Honam	Gangwon
1970	63,338	23,473	7,570	18,500	10,091	3,054
1971	69,867	25,107	8,267	21,126	11,432	3,195
1972	74,952	27,958	8,774	21,797	12,301	3,362
1973	85,671	34,332	9,318	25,182	12,376	3,523
1974	93,506	37,504	10,065	28,007	13,154	3,780
1975	101,182	40,633	10,625	30,277	14,308	4,115
1976	113,203	45,959	11,613	34,465	15,777	4,281
1977	125,270	52,092	12,479	37,834	16,554	5,006
1978	137,659	55,963	13,240	43,496	18,131	5,448
1979	149,814	62,510	13,955	46,792	19,137	5,934
1980	147,530	62,526	13,468	45,749	18,485	5,846
1981	158,370	66,363	14,330	50,539	19,403	6,202
1982	170,962	73,430	15,291	53,361	20,413	6,732
1983	192,875	83,128	16,754	60,966	22,847	7,264
1984	212,661	94,841	18,863	64,000	24,377	8,463
1985	229,699	99,855	23,655	68,534	25,514	10,016
1986	255,154	113,285	25,236	75,826	27,649	10,896
1987	285,960	129,353	26,957	85,242	29,741	11,999
1988	319,802	144,880	30,003	95,317	34,249	12,412
1989	341,885	158,581	32,369	98,604	35,854	13,004
1990	374,826	176,863	34,984	107,017	38,637	13,637
1991	413,287	198,196	38,812	115,449	42,723	13,907
1992	440,186	211,845	42,335	121,277	46,210	14,203
1993	471,162	228,804	46,585	127,364	49,495	14,417
1994	513,719	248,349	50,960	141,120	52,760	15,392
1995	562,377	272,546	55,545	153,505	58,417	16,667
1996	604,902	291,993	61,446	163,121	63,511	18,850
1997	640,015	304,294	65,753	176,432	67,797	19,556
1998	608,148	287,481	62,616	170,045	64,117	18,168
1999	674,374	323,612	70,708	186,422	67,913	19,521
2000	733,837	357,549	77,415	199,813	72,214	20,305
2001	766,877	377,241	79,155	208,245	74,882	20,606
2002	825,531	413,461	85,434	219,740	77,790	21,699
2003	850,783	423,455	89,137	227,004	80,416	23,047
2004	892,055	439,531	95,039	241,557	84,569	23,491
2005	928,995	456,737	100,394	250,974	88,230	24,165
2006	976,372	483,228	106,549	261,036	91,174	25,601
2007	1,033,356	510,910	113,025	275,798	97,275	27,139
2008	1,065,183	521,855	116,964	287,895	101,826	27,393
2009	1,076,430	529,271	124,272	284,640	100,699	27,634
2010	1,145,124	560,472	137,030	299,668	109,395	28,393
2011	1,185,403	574,424	147,100	308,789	114,992	29,319
2012	1,213,224	589,730	149,936	316,517	115,512	30,152
2013	1,250,079	614,171	155,792	321,848	115,490	31,164
2014	1,290,494	637,773	162,359	327,080	118,139	32,843

Table 2: Yearly Data of GRDP Growth Rates in Nation and 5 Regions

Year	Region					
	Nation	Capital	Chungcheong	Yeongnam	Honam	Gangwon
1971	0.103084	0.069626	0.092024	0.141989	0.132919	0.045871
1972	0.072784	0.113540	0.061272	0.031751	0.075977	0.052567
1973	0.143010	0.227987	0.062047	0.155311	0.006106	0.047612
1974	0.091457	0.092404	0.080202	0.112152	0.062885	0.072949
1975	0.082084	0.083416	0.055571	0.081065	0.087708	0.088825
1976	0.118806	0.131098	0.093041	0.138315	0.102692	0.040214
1977	0.106597	0.133424	0.074516	0.097764	0.049212	0.169472
1978	0.098899	0.074323	0.061063	0.149656	0.095295	0.088157
1979	0.088303	0.116987	0.053957	0.075761	0.055450	0.089248
1980	-0.015248	0.000260	-0.034927	-0.022288	-0.034045	-0.014724
1981	0.073472	0.061353	0.064030	0.104711	0.049640	0.060782
1982	0.079511	0.106496	0.067044	0.055845	0.052071	0.085455
1983	0.128176	0.132068	0.095710	0.142513	0.119224	0.079035
1984	0.102587	0.140908	0.125895	0.049767	0.066972	0.165062
1985	0.080117	0.052866	0.254051	0.070836	0.046659	0.183525
1986	0.110817	0.134499	0.066827	0.106404	0.083678	0.087842
1987	0.120737	0.141839	0.068165	0.124172	0.075658	0.101301
1988	0.118346	0.120033	0.113008	0.118201	0.151569	0.034372
1989	0.069050	0.094567	0.078880	0.034479	0.046843	0.047745
1990	0.096353	0.115284	0.080776	0.085320	0.077636	0.048634
1991	0.102609	0.120620	0.109404	0.078792	0.105758	0.019814
1992	0.065086	0.068864	0.090793	0.050484	0.081622	0.021268
1993	0.070369	0.080057	0.100387	0.050195	0.071082	0.015064
1994	0.090324	0.085421	0.093905	0.108000	0.065957	0.067624
1995	0.094717	0.097432	0.089974	0.087763	0.107220	0.082849
1996	0.075618	0.071352	0.106242	0.062647	0.087210	0.130993
1997	0.058046	0.042129	0.070093	0.081600	0.067476	0.037439
1998	-0.049791	-0.055253	-0.047710	-0.036201	-0.054276	-0.070983
1999	0.108899	0.125680	0.129224	0.096308	0.059209	0.074497
2000	0.088174	0.104872	0.094857	0.071835	0.063321	0.040152
2001	0.045024	0.055074	0.022482	0.042195	0.036950	0.014817
2002	0.076485	0.096014	0.079325	0.055203	0.038837	0.053046
2003	0.030588	0.024171	0.043348	0.033057	0.033755	0.062108
2004	0.048510	0.037964	0.066209	0.064108	0.051646	0.019272
2005	0.041411	0.039145	0.056348	0.038983	0.043286	0.028703
2006	0.050998	0.058000	0.061303	0.040095	0.033371	0.059409
2007	0.058363	0.057286	0.060783	0.056549	0.066919	0.060099
2008	0.030800	0.021422	0.034848	0.043862	0.046785	0.009355
2009	0.010558	0.014212	0.062483	-0.011306	-0.011072	0.008788
2010	0.063817	0.058951	0.102660	0.052796	0.086355	0.027458
2011	0.035174	0.024892	0.073488	0.030437	0.051164	0.032639
2012	0.023470	0.026647	0.019280	0.025027	0.004521	0.028385
2013	0.030377	0.041444	0.039053	0.016845	-0.000190	0.033594
2014	0.032330	0.038428	0.042153	0.016257	0.022940	0.053867

Table 3: Yearly Data of Real Capital Stock in Nation and 5 Regions

(Unit: 1billion Won)

Year	Region					
	Nation	Capital	Chungcheong	Yeongnam	Honam	Gangwon
1970	76,859.5	32,911.0	6,994.6	21,562.5	8,902.1	5,482.0
1971	89,279.5	38,675.6	7,652.1	25,143.0	10,414.7	6,289.9
1972	101,634.5	44,947.6	8,549.3	28,678.6	11,376.2	6,887.0
1973	117,903.1	51,859.1	9,889.4	34,955.6	12,504.4	7,375.0
1974	136,336.6	60,564.9	10,830.1	42,176.9	13,427.0	7,919.8
1975	155,558.6	70,202.2	11,872.6	49,081.6	14,653.7	8,244.2
1976	181,114.7	80,962.2	13,192.4	59,415.2	16,987.2	8,902.6
1977	215,229.1	97,332.8	18,451.1	64,052.7	23,070.6	9,304.1
1978	262,044.1	114,839.0	23,416.3	80,113.5	29,345.4	10,951.4
1979	310,829.3	133,211.0	28,370.2	98,760.1	33,641.6	12,942.9
1980	348,634.5	149,385.5	31,188.9	110,100.6	38,902.7	14,780.1
1981	382,234.5	165,971.5	33,859.3	122,152.2	40,318.3	15,322.4
1982	420,057.4	183,780.4	37,456.5	133,459.4	43,728.7	16,664.8
1983	465,660.4	203,341.5	41,912.0	146,134.2	49,747.5	19,169.8
1984	516,029.3	227,574.4	47,121.9	159,006.0	55,717.6	20,853.7
1985	567,129.8	252,954.4	51,872.5	171,700.1	62,069.2	22,436.1
1986	625,435.1	281,053.1	58,443.2	186,666.8	69,028.8	23,781.9
1987	696,130.8	317,348.6	62,603.7	208,346.9	76,191.2	23,479.4
1988	776,142.5	351,694.3	71,715.4	230,301.6	85,553.5	28,040.9
1989	868,891.0	385,920.2	84,023.5	259,676.8	96,579.7	32,677.8
1990	990,476.1	432,602.9	99,997.7	287,467.9	119,905.5	38,528.6
1991	1,130,452.6	498,977.5	119,176.2	323,420.1	132,540.5	42,798.9
1992	1,265,199.4	559,060.3	136,371.7	356,562.1	151,043.2	47,259.0
1993	1,406,437.9	626,478.4	155,452.9	394,167.3	164,837.2	49,191.1
1994	1,567,613.2	703,909.9	173,166.5	436,113.8	181,841.6	54,862.7
1995	1,745,137.6	784,912.4	195,008.7	480,246.2	204,461.1	61,683.4
1996	1,936,050.9	866,690.8	217,262.0	531,549.0	228,868.6	71,408.7
1997	2,109,532.6	937,961.7	242,128.3	577,887.1	247,511.9	81,681.7
1998	2,207,068.4	977,629.1	256,817.2	599,669.7	262,458.7	87,253.1
1999	2,316,570.2	1,026,026.4	270,811.9	626,916.6	276,437.3	92,025.0
2000	2,448,060.2	1,085,323.9	289,554.2	659,621.2	290,486.3	97,254.8
2001	2,571,428.3	1,141,965.2	304,917.5	691,203.4	303,947.0	102,047.8
2002	2,707,885.3	1,202,517.0	322,076.4	729,289.6	317,647.1	107,457.1
2003	2,853,530.4	1,267,621.0	341,010.2	766,608.5	333,159.9	114,465.1
2004	2,998,373.6	1,330,085.0	361,414.9	805,564.9	347,586.6	121,181.5
2005	3,141,200.6	1,395,576.4	380,370.3	839,992.9	363,644.0	127,546.3
2006	3,288,920.0	1,463,700.2	401,234.6	873,571.6	380,511.2	134,406.7
2007	3,447,045.0	1,530,834.0	423,275.2	914,536.9	399,878.1	141,548.8
2008	3,592,163.6	1,593,880.7	441,671.5	953,074.2	417,638.9	147,734.0
2009	3,723,576.9	1,656,141.0	456,887.2	980,881.2	436,354.7	153,893.7
2010	3,865,721.8	1,720,228.3	478,920.4	1,012,230.3	453,510.0	159,866.5
2011	3,997,038.7	1,774,236.9	505,343.7	1,039,883.5	469,956.0	165,019.5
2012	4,106,585.3	1,819,042.9	521,306.3	1,064,741.2	487,076.7	169,979.5
2013	4,217,976.7	1,856,530.6	540,518.5	1,093,071.3	504,808.5	176,327.6
2014	4,332,986.0	1,899,968.8	559,746.3	1,121,709.7	518,712.9	183,646.5

Table 4: Yearly Data of Cost of Capital in Nation and 5 Regions

Year	Region					
	Nation	Capital	Chungcheong	Yeongnam	Honam	Gangwon
1971	0.352	0.324	0.518	0.394	0.408	0.087
1972	0.323	0.308	0.466	0.315	0.431	0.101
1973	0.281	0.310	0.323	0.288	0.213	0.092
1974	0.276	0.323	0.242	0.273	0.215	0.077
1975	0.276	0.292	0.279	0.269	0.315	0.096
1976	0.257	0.254	0.241	0.249	0.130	0.091
1977	0.220	0.241	0.194	0.246	0.138	0.093
1978	0.175	0.152	0.138	0.250	0.143	0.059
1979	0.162	0.141	0.118	0.223	0.142	0.082
1980	0.137	0.128	0.102	0.190	0.086	0.067
1981	0.146	0.136	0.097	0.206	0.090	0.064
1982	0.147	0.142	0.129	0.176	0.113	0.115
1983	0.147	0.136	0.129	0.184	0.128	0.089
1984	0.153	0.151	0.142	0.173	0.132	0.122
1985	0.152	0.135	0.197	0.175	0.126	0.174
1986	0.151	0.140	0.167	0.168	0.137	0.168
1987	0.148	0.148	0.169	0.171	0.072	0.184
1988	0.145	0.141	0.170	0.167	0.079	0.170
1989	0.132	0.136	0.161	0.136	0.071	0.160
1990	0.125	0.131	0.146	0.131	0.075	0.130
1991	0.117	0.127	0.132	0.119	0.076	0.106
1992	0.110	0.120	0.123	0.107	0.079	0.093
1993	0.102	0.112	0.117	0.096	0.078	0.074
1994	0.098	0.103	0.112	0.100	0.073	0.080
1995	0.088	0.092	0.100	0.088	0.071	0.074
1996	0.083	0.084	0.100	0.081	0.071	0.081
1997	0.088	0.086	0.104	0.093	0.077	0.073
1998	0.089	0.088	0.097	0.098	0.080	0.069
1999	0.105	0.105	0.115	0.113	0.089	0.074
2000	0.111	0.116	0.118	0.117	0.085	0.072
2001	0.108	0.113	0.110	0.118	0.088	0.066
2002	0.113	0.120	0.115	0.119	0.089	0.067
2003	0.107	0.110	0.112	0.117	0.086	0.075
2004	0.110	0.106	0.116	0.126	0.096	0.074
2005	0.109	0.103	0.123	0.125	0.094	0.068
2006	0.112	0.107	0.124	0.128	0.095	0.073
2007	0.115	0.109	0.125	0.135	0.100	0.078
2008	0.119	0.115	0.126	0.138	0.105	0.076
2009	0.118	0.115	0.139	0.132	0.098	0.071
2010	0.125	0.120	0.153	0.137	0.111	0.074
2011	0.128	0.119	0.164	0.139	0.118	0.079
2012	0.126	0.118	0.157	0.140	0.111	0.079
2013	0.127	0.121	0.155	0.141	0.104	0.080
2014	0.127	0.125	0.154	0.136	0.102	0.083

Table 5: Yearly Data of Employment in Nation and 5 Regions

(Unit: 1billion Won)

Year	Region					
	Nation	Capital	Chungcheong	Yeongnam	Honam	Gangwon
1970	9,618.0	2,273.0	1,384.1	3,088.0	2,190.1	537.9
1971	9,947.0	2,646.0	1,370.8	3,121.2	2,094.0	566.8
1972	10,382.0	2,751.0	1,410.5	3,316.4	2,183.8	579.2
1973	10,942.0	3,054.1	1,476.3	3,355.6	2,351.9	546.7
1974	11,423.0	3,081.1	1,706.9	3,458.4	2,419.8	586.2
1975	11,691.0	3,343.1	1,726.7	3,553.8	2,307.4	584.3
1976	12,413.0	3,563.0	1,818.9	3,710.9	2,577.4	566.7
1977	12,813.0	4,039.1	1,768.6	3,713.8	2,501.5	615.6
1978	13,413.0	4,632.4	1,815.0	3,769.8	2,402.5	620.3
1979	13,603.0	4,800.8	1,733.2	3,806.1	2,468.5	618.1
1980	13,684.0	4,895.4	1,687.8	3,881.4	2,402.5	630.8
1981	14,025.0	5,016.9	1,699.9	4,165.5	2,339.5	615.6
1982	14,380.0	5,283.3	1,690.8	4,269.5	2,319.3	625.9
1983	14,505.0	5,485.5	1,659.2	4,294.2	2,252.6	626.1
1984	14,429.0	5,639.6	1,591.3	4,265.0	2,143.7	606.6
1985	14,970.0	5,989.0	1,607.8	4,405.4	2,152.2	628.6
1986	15,505.0	6,200.5	1,677.4	4,557.5	2,245.2	626.1
1987	16,355.0	6,655.0	1,733.1	4,803.1	2,306.6	649.8
1988	16,870.0	6,931.2	1,770.2	4,947.4	2,342.6	664.8
1989	17,561.0	7,398.0	1,820.0	5,139.0	2,334.0	647.0
1990	18,085.0	7,765.0	1,837.0	5,244.0	2,358.0	642.0
1991	18,649.0	8,224.0	1,857.0	5,380.0	2,314.0	635.0
1992	19,008.0	8,393.8	1,910.8	5,493.7	2,325.8	638.9
1993	19,234.0	8,593.6	1,943.9	5,494.7	2,313.8	642.0
1994	19,849.0	8,979.0	1,994.0	5,626.0	2,362.0	642.0
1995	20,414.0	9,326.0	2,037.0	5,778.0	2,386.0	640.0
1996	20,853.0	9,588.0	2,078.0	5,856.0	2,419.0	659.0
1997	21,214.0	9,767.0	2,130.0	5,938.0	2,452.0	668.0
1998	19,937.0	9,037.0	2,041.0	5,643.0	2,326.0	642.0
1999	20,291.0	9,324.0	2,068.0	5,682.0	2,326.0	647.0
2000	21,173.0	9,833.2	2,137.3	5,895.5	2,378.9	669.8
2001	21,614.0	10,121.3	2,175.0	5,975.2	2,411.2	663.6
2002	22,232.0	10,472.8	2,237.8	6,128.7	2,433.8	685.1
2003	22,222.0	10,593.2	2,217.6	6,071.1	2,395.4	666.6
2004	22,682.0	10,952.0	2,259.3	6,143.9	2,371.0	674.1
2005	22,831.0	11,124.8	2,257.2	6,125.8	2,374.5	669.1
2006	23,188.0	11,385.0	2,317.0	6,148.7	2,368.2	680.7
2007	23,562.0	11,664.4	2,385.2	6,171.5	2,377.2	675.3
2008	23,775.0	11,815.1	2,398.7	6,202.2	2,389.2	679.5
2009	23,688.0	11,756.8	2,400.4	6,152.1	2,401.2	686.2
2010	24,033.0	12,030.6	2,434.7	6,224.0	2,386.5	673.8
2011	24,526.0	12,347.6	2,488.7	6,298.5	2,413.9	683.9
2012	24,955.0	12,511.8	2,558.9	6,415.0	2,469.5	700.6
2013	25,299.0	12,643.1	2,673.5	6,447.1	2,523.1	704.4
2014	25,898.0	12,990.2	2,765.9	6,555.5	2,549.4	719.3
2015	26,178.0	13,107.3	2,825.2	6,589.1	2,583.2	737.9

Table 6: Yearly Data of Real Wage in Nation and 5 Regions

(Unit: 1billion Won)

Year	Region					
	Nation	Capital	Chungcheong	Yeongnam	Honam	Gangwon
1970	5,421,225	5,844,616	4,661,924	5,080,316	5,282,712	6,835,886
1971	5,576,850	5,970,483	4,790,641	5,144,549	5,352,291	6,931,100
1972	5,886,688	6,409,860	5,308,503	5,436,255	5,255,341	6,771,156
1973	7,018,616	7,643,794	6,450,974	6,409,816	6,498,987	7,755,668
1974	7,041,790	7,532,299	6,566,896	6,690,713	6,521,746	7,977,463
1975	7,072,564	7,717,003	6,215,765	6,677,172	6,294,664	8,102,596
1976	7,672,454	9,448,459	7,168,202	7,785,155	8,531,611	9,422,182
1977	8,544,107	9,079,516	7,748,641	7,992,687	8,106,263	9,528,869
1978	9,545,727	10,250,947	8,193,352	8,755,432	8,720,831	11,129,877
1979	10,031,927	11,026,486	8,797,323	8,979,587	8,509,191	11,037,158
1980	9,849,953	10,728,489	8,732,305	8,604,646	9,313,822	10,783,784
1981	9,832,994	10,689,315	9,969,961	7,818,324	10,540,784	12,285,568
1982	10,330,696	11,061,847	9,287,573	9,304,002	10,214,106	11,011,118
1983	11,541,182	12,382,950	10,137,152	10,406,092	11,202,828	12,652,216
1984	12,211,658	13,007,934	11,067,961	11,046,270	11,950,025	13,457,548
1985	12,453,767	13,269,197	11,939,499	11,109,256	12,329,322	13,272,218
1986	13,522,189	14,518,479	13,340,941	12,567,454	10,806,814	15,281,830
1987	14,437,679	15,057,455	13,227,282	13,286,434	15,223,617	15,775,282
1988	15,860,739	16,644,150	14,379,041	14,589,158	16,805,018	16,286,496
1989	16,500,526	17,102,741	14,947,656	15,666,343	17,156,811	16,510,473
1990	17,691,775	18,489,128	15,964,215	16,681,513	17,673,593	18,305,620
1991	18,854,046	19,632,576	17,291,731	17,877,068	18,816,531	19,312,683
1992	19,818,660	20,555,520	18,410,071	18,900,983	19,760,552	20,127,316
1993	21,390,246	22,139,789	20,060,269	20,466,115	21,240,390	21,563,914
1994	22,590,200	23,325,548	21,357,402	21,681,798	22,373,672	22,643,919
1995	24,932,097	25,688,291	23,743,826	24,000,828	24,667,908	24,870,581
1996	26,615,398	27,372,736	25,495,563	25,682,241	26,321,241	26,441,290
1997	26,560,001	27,210,912	25,337,490	25,841,597	26,269,834	26,701,990
1998	25,620,839	26,463,374	24,393,537	24,751,876	24,837,452	25,407,310
1999	26,248,199	27,287,315	24,708,503	25,421,117	24,548,844	25,733,049
2000	26,862,708	27,729,604	26,093,101	25,833,344	26,239,338	25,745,335
2001	27,615,761	28,928,464	26,537,123	26,205,363	25,848,424	26,792,041
2002	28,503,889	30,161,635	27,411,812	26,704,624	26,266,898	26,795,782
2003	29,618,068	31,465,571	28,685,865	27,544,075	27,222,934	27,381,994
2004	29,860,171	31,751,448	29,119,190	27,746,914	27,187,262	26,776,633
2005	30,737,548	32,540,711	29,206,809	28,715,982	28,574,886	28,713,509
2006	31,144,481	32,914,300	29,991,810	29,086,764	28,979,488	28,564,584
2007	31,726,197	33,607,577	30,579,166	29,350,803	29,713,243	29,091,242
2008	31,455,397	32,727,233	30,706,723	29,972,893	30,005,289	29,221,375
2009	31,289,422	32,789,872	30,241,705	29,586,539	29,523,954	29,193,220
2010	31,662,243	33,143,850	30,842,096	30,041,930	29,704,558	28,834,705
2011	31,430,438	32,907,721	30,443,743	29,965,461	29,353,424	27,884,166
2012	31,788,283	33,377,107	30,858,584	30,114,753	29,541,820	28,335,621
2013	32,140,073	33,991,675	31,341,206	29,969,774	29,548,457	28,542,095
2014	32,448,306	34,130,346	31,957,214	30,473,754	30,042,527	28,879,177

Table 7: Yearly Data of Labor Shares in 5 Regions

Year	Region					
	Nation	Capital	Chungcheong	Yeongnam	Honam	Gangwon
1970	0.580	0.457	0.586	0.607	0.735	0.810
1971	0.562	0.516	0.526	0.543	0.637	0.845
1972	0.574	0.520	0.553	0.597	0.606	0.805
1973	0.628	0.547	0.667	0.618	0.792	0.817
1974	0.607	0.490	0.744	0.601	0.784	0.846
1975	0.584	0.506	0.693	0.575	0.681	0.812
1976	0.607	0.571	0.735	0.595	0.872	0.823
1977	0.646	0.578	0.750	0.594	0.840	0.834
1978	0.698	0.715	0.783	0.578	0.797	0.910
1979	0.688	0.720	0.780	0.563	0.765	0.847
1980	0.689	0.707	0.772	0.558	0.830	0.848
1981	0.659	0.673	0.778	0.516	0.815	0.847
1982	0.652	0.658	0.695	0.575	0.766	0.726
1983	0.660	0.680	0.693	0.574	0.736	0.786
1984	0.644	0.654	0.660	0.585	0.712	0.713
1985	0.638	0.674	0.581	0.574	0.707	0.620
1986	0.646	0.669	0.632	0.601	0.675	0.643
1987	0.658	0.659	0.619	0.605	0.832	0.639
1988	0.669	0.676	0.617	0.617	0.823	0.652
1989	0.686	0.685	0.610	0.667	0.829	0.627
1990	0.696	0.701	0.616	0.669	0.812	0.667
1991	0.703	0.706	0.626	0.689	0.784	0.693
1992	0.706	0.705	0.632	0.705	0.766	0.710
1993	0.719	0.717	0.639	0.726	0.759	0.755
1994	0.723	0.730	0.643	0.715	0.770	0.739
1995	0.751	0.759	0.677	0.749	0.778	0.753
1996	0.759	0.774	0.673	0.760	0.772	0.727
1997	0.729	0.752	0.642	0.715	0.736	0.726
1998	0.687	0.712	0.619	0.665	0.690	0.687
1999	0.651	0.676	0.571	0.631	0.648	0.665
2000	0.643	0.658	0.574	0.624	0.670	0.667
2001	0.647	0.669	0.587	0.620	0.651	0.682
2002	0.641	0.660	0.580	0.618	0.646	0.677
2003	0.651	0.682	0.584	0.614	0.652	0.640
2004	0.642	0.689	0.571	0.591	0.613	0.629
2005	0.642	0.694	0.545	0.590	0.623	0.652
2006	0.633	0.683	0.545	0.580	0.613	0.625
2007	0.624	0.681	0.543	0.560	0.599	0.600
2008	0.606	0.657	0.533	0.551	0.579	0.600
2009	0.600	0.650	0.499	0.552	0.587	0.613
2010	0.583	0.638	0.475	0.543	0.546	0.589
2011	0.575	0.639	0.449	0.535	0.525	0.562
2012	0.578	0.640	0.461	0.534	0.538	0.563
2013	0.578	0.637	0.473	0.527	0.554	0.557
2014	0.580	0.633	0.479	0.539	0.559	0.548

Table 8: Yearly Data of Real Depreciation in 5 Regions

(Unit: 1billion Won)

real depreciation	Nation	Capital	Chungcheong	Yeongnam	Honam	Gangwon
1971	5,110.2	2,188.2	465.1	1,433.6	591.9	364.5
1972	6,145.0	2,662.3	526.4	1,730.6	716.9	432.9
1973	7,463.9	3,301.9	627.4	2,106.2	835.1	505.5
1974	5,899.1	2,595.2	494.5	1,749.8	625.1	368.5
1975	6,292.8	2,796.1	499.4	1,948.1	618.9	364.9
1976	12,199.1	5,507.2	930.0	3,851.9	1,147.4	645.0
1977	15,953.3	7,132.8	1,160.3	5,238.5	1,494.3	781.9
1978	19,198.7	8,223.3	1,355.8	6,645.1	1,915.0	898.1
1979	19,057.2	8,052.4	1,273.0	6,929.9	1,793.8	847.8
1980	15,799.7	6,525.6	1,115.2	5,923.3	1,425.2	682.1
1981	17,441.5	7,067.3	1,246.2	6,510.0	1,703.3	774.8
1982	22,054.6	8,747.4	1,636.0	8,528.6	2,093.8	873.5
1983	26,819.6	10,563.3	2,066.7	10,387.6	2,548.9	1,045.2
1984	29,633.7	12,106.8	2,236.5	10,924.2	2,734.9	1,408.4
1985	31,881.7	13,490.0	2,998.6	10,383.4	3,264.6	1,493.0
1986	39,495.6	17,195.9	3,609.9	12,667.8	3,943.2	1,783.9
1987	49,386.3	22,086.7	4,240.1	15,921.7	4,662.5	2,105.7
1988	56,608.6	25,463.2	4,814.4	18,201.1	5,507.5	2,226.3
1989	61,196.6	27,821.4	5,268.9	19,329.1	5,977.8	2,345.6
1990	70,355.6	32,695.1	6,245.3	21,419.1	6,869.7	2,589.9
1991	70,308.9	32,490.4	6,505.5	20,930.1	7,333.4	2,473.9
1992	79,460.7	36,781.3	7,738.0	23,438.3	8,258.4	2,614.7
1993	92,522.8	42,509.0	9,442.2	26,924.1	9,931.2	2,980.1
1994	102,722.3	46,906.1	10,789.5	30,104.2	10,834.2	3,213.6
1995	120,308.9	55,534.0	12,423.5	35,418.4	12,350.4	3,600.4
1996	134,162.4	62,485.7	14,163.8	38,339.1	13,930.3	4,138.2
1997	135,933.2	62,779.8	14,446.2	39,015.4	14,407.3	4,133.3
1998	156,056.7	70,442.7	16,868.6	46,089.8	16,635.3	4,744.6
1999	144,051.8	66,558.5	15,720.0	41,877.3	14,489.3	4,236.0
2000	148,968.9	68,900.7	16,494.3	43,344.3	14,895.8	4,142.7
2001	159,658.6	74,986.8	17,437.3	46,169.3	15,532.2	4,274.5
2002	169,390.5	80,239.0	18,750.3	48,416.2	16,095.2	4,508.1
2003	170,595.7	81,119.6	18,979.8	48,433.9	16,030.9	4,604.6
2004	178,329.8	84,657.6	20,212.4	50,801.2	16,462.5	4,712.0
2005	176,916.6	80,435.8	22,380.7	50,779.3	16,964.7	4,656.0
2006	172,515.8	79,462.7	22,163.6	48,484.2	16,230.7	4,484.7
2007	176,726.1	81,328.9	23,247.5	48,891.8	16,869.8	4,657.2
2008	191,081.8	86,587.1	26,130.7	52,888.5	18,693.8	4,931.9
2009	258,158.5	114,775.7	36,992.6	71,218.0	25,588.5	7,161.5
2010	207,755.5	96,555.1	29,195.2	53,925.8	20,603.9	5,444.7
2011	209,753.8	94,952.5	32,604.2	54,420.2	20,322.7	5,332.1
2012	230,331.3	103,542.6	35,589.4	60,706.7	22,251.7	5,885.4
2013	267,280.9	121,940.7	40,098.7	69,972.3	25,497.1	7,168.7
2014	275,402.2	127,765.8	40,647.7	70,893.9	25,948.4	7,398.7

Table 9: Yearly Data of Real Fixed Capital Formation

(Unit: 1billion Won)

	Nation	Capital	Chungcheong	Yeongnam	Honam	Gangwon
1970	17,497.0	8,978.4	1,346.6	4,114.1	1,176.4	1,714.7
1971	17,466.8	7,946.5	1,140.4	4,995.5	2,080.4	1,145.2
1972	17,195.5	8,388.1	1,338.5	4,897.3	1,508.5	915.2
1973	22,399.5	9,639.9	1,886.4	8,005.1	1,797.1	879.1
1974	27,430.4	12,682.9	1,728.7	9,878.9	1,861.0	1,083.9
1975	29,611.5	14,273.9	1,911.2	10,098.3	2,235.7	902.1
1976	32,462.7	13,896.2	1,899.8	12,484.4	2,970.9	998.2
1977	40,510.6	14,143.6	2,570.3	17,033.4	5,071.7	1,479.3
1978	51,398.1	20,572.0	2,731.4	22,251.7	3,640.9	1,774.5
1979	57,429.2	21,275.7	5,156.8	24,258.2	4,211.3	2,131.9
1980	53,832.1	19,503.9	4,267.9	19,514.3	7,410.8	2,728.6
1981	50,984.8	17,392.2	4,864.6	23,900.4	3,983.6	458.2
1982	56,493.7	21,388.9	5,595.9	21,734.1	5,443.5	1,959.6
1983	65,235.2	32,454.6	4,547.3	16,493.1	5,019.3	6,320.0
1984	70,736.5	38,576.9	5,919.7	18,411.6	5,463.5	1,944.0
1985	75,674.7	42,069.7	6,575.0	16,091.5	7,969.2	2,542.6
1986	83,861.3	42,453.1	8,921.6	22,270.2	7,745.6	2,077.4
1987	97,077.9	42,172.6	8,091.0	26,768.3	16,060.5	3,530.8
1988	110,236.9	43,631.9	11,070.1	38,246.5	12,995.7	3,620.0
1989	126,072.8	49,925.7	14,658.4	44,760.3	11,733.9	4,050.4
1990	158,278.3	54,032.1	19,663.5	44,381.3	32,507.0	6,167.6
1991	182,425.1	68,517.7	30,995.7	58,915.3	18,196.0	4,438.8
1992	184,127.5	69,378.9	27,505.2	50,648.7	28,299.9	6,954.7
1993	190,827.0	79,184.3	29,132.9	62,273.5	15,553.4	3,040.2
1994	211,554.2	92,624.3	26,976.3	67,814.0	16,988.2	5,880.6
1995	236,610.9	109,108.2	29,849.3	58,451.3	28,879.1	8,433.7
1996	256,711.6	116,850.4	32,712.5	63,831.1	31,858.0	9,403.0
1997	258,112.7	115,241.9	32,881.4	66,055.3	32,177.7	9,668.2
1998	209,812.8	92,203.2	27,039.7	54,828.1	25,638.6	8,362.8
1999	227,048.2	103,954.3	27,153.5	61,496.9	24,776.0	7,703.8
2000	259,524.4	119,467.4	33,227.5	70,054.1	26,167.4	8,257.0
2001	263,175.8	123,235.9	31,022.5	72,144.1	26,350.9	7,959.6
2002	280,082.0	130,390.0	33,446.6	78,672.1	26,507.4	8,523.6
2003	296,499.9	137,316.6	36,445.5	80,507.5	29,158.9	10,248.9
2004	310,527.2	141,420.9	40,000.4	86,406.1	29,356.0	10,317.2
2005	319,207.9	146,024.0	41,801.4	85,550.4	32,536.6	10,332.3
2006	334,417.8	154,025.3	45,281.5	86,942.3	34,172.8	11,052.4
2007	350,088.3	155,852.7	47,515.8	94,882.1	37,361.8	11,457.4
2008	370,236.9	164,156.6	49,548.3	102,260.5	39,828.4	11,429.4
2009	372,102.1	169,565.9	51,008.0	95,096.3	41,488.3	11,697.8
2010	385,923.6	174,937.0	57,196.9	97,420.0	41,269.0	11,606.9
2011	396,756.7	171,869.8	67,435.8	99,757.6	42,553.4	11,343.9
2012	396,811.2	172,141.0	60,209.9	103,500.8	45,206.2	11,548.8
2013	404,061.6	169,628.2	64,220.0	106,998.1	45,652.2	12,952.2
2014	416,033.4	180,518.7	65,375.3	108,694.2	42,442.7	14,061.7

Table 10: Yearly Data of Growth of Capital

	Nation	Capital	Chungcheong	Yeongnam	Honam	Gangwon
1971	0.1616	0.1752	0.0940	0.1661	0.1699	0.1474
1972	0.1384	0.1622	0.1172	0.1406	0.0923	0.0949
1973	0.1601	0.1538	0.1568	0.2189	0.0992	0.0709
1974	0.1563	0.1679	0.0951	0.2066	0.0738	0.0739
1975	0.1410	0.1591	0.0963	0.1637	0.0914	0.0410
1976	0.1643	0.1533	0.1112	0.2105	0.1592	0.0799
1977	0.1884	0.2022	0.3986	0.0781	0.3581	0.0451
1978	0.2175	0.1799	0.2691	0.2507	0.2720	0.1770
1979	0.1862	0.1600	0.2116	0.2328	0.1464	0.1819
1980	0.1216	0.1214	0.0994	0.1148	0.1564	0.1419
1981	0.0964	0.1110	0.0856	0.1095	0.0364	0.0367
1982	0.0990	0.1073	0.1062	0.0926	0.0846	0.0876
1983	0.1086	0.1064	0.1190	0.0950	0.1376	0.1503
1984	0.1082	0.1192	0.1243	0.0881	0.1200	0.0878
1985	0.0990	0.1115	0.1008	0.0798	0.1140	0.0759
1986	0.1028	0.1111	0.1267	0.0872	0.1121	0.0600
1987	0.1130	0.1291	0.0712	0.1161	0.1038	-0.0127
1988	0.1149	0.1082	0.1455	0.1054	0.1229	0.1943
1989	0.1195	0.0973	0.1716	0.1276	0.1289	0.1654
1990	0.1399	0.1210	0.1901	0.1070	0.2415	0.1790
1991	0.1413	0.1534	0.1918	0.1251	0.1054	0.1108
1992	0.1192	0.1204	0.1443	0.1025	0.1396	0.1042
1993	0.1116	0.1206	0.1399	0.1055	0.0913	0.0409
1994	0.1146	0.1236	0.1139	0.1064	0.1032	0.1153
1995	0.1132	0.1151	0.1261	0.1012	0.1244	0.1243
1996	0.1094	0.1042	0.1141	0.1068	0.1194	0.1577
1997	0.0896	0.0822	0.1145	0.0872	0.0815	0.1439
1998	0.0462	0.0423	0.0607	0.0377	0.0604	0.0682
1999	0.0496	0.0495	0.0545	0.0454	0.0533	0.0547
2000	0.0568	0.0578	0.0692	0.0522	0.0508	0.0568
2001	0.0504	0.0522	0.0531	0.0479	0.0463	0.0493
2002	0.0531	0.0530	0.0563	0.0551	0.0451	0.0530
2003	0.0538	0.0541	0.0588	0.0512	0.0488	0.0652
2004	0.0508	0.0493	0.0598	0.0508	0.0433	0.0587
2005	0.0476	0.0492	0.0524	0.0427	0.0462	0.0525
2006	0.0470	0.0488	0.0549	0.0400	0.0464	0.0538
2007	0.0481	0.0459	0.0549	0.0469	0.0509	0.0531
2008	0.0421	0.0412	0.0435	0.0421	0.0444	0.0437
2009	0.0366	0.0391	0.0345	0.0292	0.0448	0.0417
2010	0.0382	0.0387	0.0482	0.0320	0.0393	0.0388
2011	0.0340	0.0314	0.0552	0.0273	0.0363	0.0322
2012	0.0274	0.0253	0.0316	0.0239	0.0364	0.0301
2013	0.0271	0.0206	0.0369	0.0266	0.0364	0.0373
2014	0.0273	0.0234	0.0356	0.0262	0.0275	0.0415

Table 11: Yearly Data of Inflation

	Nation	Capital	Chungcheong	Yeongnam	Honam	Gangwon
1970	0.091	0.091	0.091	0.091	0.091	0.091
1971	0.086	0.086	0.086	0.086	0.086	0.086
1972	0.140	0.140	0.140	0.140	0.140	0.140
1973	0.069	0.069	0.069	0.069	0.069	0.069
1974	0.421	0.421	0.421	0.421	0.421	0.421
1975	0.265	0.265	0.265	0.265	0.265	0.265
1976	0.121	0.121	0.121	0.121	0.121	0.121
1977	0.090	0.090	0.090	0.090	0.090	0.090
1978	0.117	0.117	0.117	0.117	0.117	0.117
1979	0.187	0.187	0.187	0.187	0.187	0.187
1980	0.390	0.390	0.390	0.390	0.390	0.390
1981	0.204	0.204	0.204	0.204	0.204	0.204
1982	0.047	0.047	0.047	0.047	0.047	0.047
1983	0.002	0.002	0.002	0.002	0.002	0.002
1984	0.007	0.007	0.007	0.007	0.007	0.007
1985	0.009	0.009	0.009	0.009	0.009	0.009
1986	-0.015	-0.015	-0.015	-0.015	-0.015	-0.015
1987	0.005	0.005	0.005	0.005	0.005	0.005
1988	0.027	0.027	0.027	0.027	0.027	0.027
1989	0.015	0.015	0.015	0.015	0.015	0.015
1990	0.042	0.042	0.042	0.042	0.042	0.042
1991	0.047	0.047	0.047	0.047	0.047	0.047
1992	0.022	0.022	0.022	0.022	0.022	0.022
1993	0.015	0.015	0.015	0.015	0.015	0.015
1994	0.027	0.027	0.027	0.027	0.027	0.027
1995	0.047	0.047	0.047	0.047	0.047	0.047
1996	0.032	0.032	0.032	0.032	0.032	0.032
1997	0.038	0.038	0.038	0.038	0.038	0.038
1998	0.122	0.122	0.122	0.122	0.122	0.122
1999	-0.021	-0.021	-0.021	-0.021	-0.021	-0.021
2000	0.021	0.021	0.021	0.021	0.021	0.021
2001	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005
2002	-0.003	-0.003	-0.003	-0.003	-0.003	-0.003
2003	0.022	0.022	0.022	0.022	0.022	0.022
2004	0.061	0.061	0.061	0.061	0.061	0.061
2005	0.021	0.021	0.021	0.021	0.021	0.021
2006	0.009	0.009	0.009	0.009	0.009	0.009
2007	0.014	0.014	0.014	0.014	0.014	0.014
2008	0.085	0.085	0.085	0.085	0.085	0.085
2009	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002
2010	0.038	0.038	0.038	0.038	0.038	0.038
2011	0.067	0.067	0.067	0.067	0.067	0.067
2012	0.007	0.007	0.007	0.007	0.007	0.007
2013	-0.016	-0.016	-0.016	-0.016	-0.016	-0.016
2014	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005

Table 12: Yearly Data of Rate of Capital Return

rate of capital return	Nation	Capital	Chungcheong	Yeongnam	Honam	Gangwon
1970	0.346	0.387	0.448	0.337	0.300	0.106
1971	0.286	0.258	0.452	0.327	0.341	0.021
1972	0.254	0.239	0.398	0.246	0.362	0.032
1973	0.207	0.236	0.250	0.215	0.139	0.019
1974	0.226	0.273	0.192	0.223	0.165	0.027
1975	0.230	0.246	0.233	0.223	0.269	0.050
1976	0.179	0.175	0.163	0.170	0.052	0.013
1977	0.132	0.153	0.106	0.158	0.050	0.005
1978	0.086	0.067	0.065	0.146	0.060	-0.037
1979	0.089	0.071	0.063	0.137	0.080	0.005
1980	0.086	0.079	0.063	0.130	0.044	0.014
1981	0.096	0.088	0.057	0.147	0.047	0.011
1982	0.089	0.089	0.081	0.106	0.061	0.058
1983	0.083	0.079	0.073	0.107	0.070	0.027
1984	0.089	0.091	0.089	0.098	0.077	0.049
1985	0.091	0.075	0.133	0.109	0.068	0.103
1986	0.081	0.072	0.097	0.094	0.073	0.089
1987	0.069	0.069	0.096	0.085	0.004	0.095
1988	0.063	0.061	0.093	0.080	0.006	0.075
1989	0.053	0.057	0.088	0.052	0.002	0.077
1990	0.044	0.047	0.072	0.049	0.003	0.051
1991	0.047	0.051	0.067	0.046	0.014	0.042
1992	0.039	0.046	0.058	0.035	0.017	0.032
1993	0.028	0.036	0.048	0.020	0.012	0.011
1994	0.025	0.028	0.043	0.023	0.007	0.015
1995	0.011	0.013	0.028	0.007	0.003	0.008
1996	0.006	0.004	0.027	0.002	0.002	0.014
1997	0.018	0.014	0.037	0.020	0.014	0.015
1998	0.015	0.013	0.027	0.018	0.012	0.011
1999	0.039	0.037	0.054	0.043	0.034	0.025
2000	0.046	0.049	0.057	0.048	0.031	0.027
2001	0.043	0.044	0.050	0.048	0.035	0.022
2002	0.047	0.050	0.053	0.049	0.036	0.023
2003	0.044	0.042	0.053	0.051	0.036	0.032
2004	0.047	0.039	0.057	0.059	0.047	0.033
2005	0.050	0.043	0.061	0.062	0.045	0.029
2006	0.057	0.050	0.066	0.070	0.050	0.038
2007	0.061	0.053	0.067	0.079	0.055	0.044
2008	0.064	0.058	0.065	0.080	0.058	0.041
2009	0.046	0.043	0.055	0.057	0.037	0.023
2010	0.070	0.062	0.089	0.082	0.064	0.039
2011	0.074	0.063	0.096	0.086	0.073	0.046
2012	0.069	0.060	0.087	0.082	0.064	0.043
2013	0.062	0.054	0.078	0.075	0.051	0.038
2014	0.061	0.056	0.079	0.071	0.050	0.041

Table 13: Yearly Data of Growth of Cost of Capital

	Nation	Capital	Chungcheong	Yeongnam	Honam	Gangwon
1972	-0.084	-0.048	-0.100	-0.200	0.058	0.159
1973	-0.130	0.005	-0.307	-0.086	-0.507	-0.087
1974	-0.017	0.043	-0.252	-0.051	0.013	-0.164
1975	0.001	-0.096	0.152	-0.016	0.462	0.241
1976	-0.070	-0.131	-0.136	-0.075	-0.588	-0.047
1977	-0.145	-0.052	-0.195	-0.010	0.061	0.021
1978	-0.205	-0.370	-0.288	0.015	0.041	-0.364
1979	-0.075	-0.069	-0.149	-0.107	-0.014	0.387
1980	-0.152	-0.094	-0.133	-0.150	-0.390	-0.188
1981	0.063	0.060	-0.049	0.087	0.047	-0.045
1982	0.006	0.045	0.333	-0.148	0.253	0.811
1983	0.002	-0.039	-0.004	0.050	0.133	-0.226
1984	0.040	0.106	0.104	-0.062	0.030	0.372
1985	-0.004	-0.106	0.386	0.010	-0.043	0.425
1986	-0.010	0.041	-0.153	-0.039	0.081	-0.037
1987	-0.016	0.056	0.012	0.017	-0.473	0.092
1988	-0.025	-0.046	0.007	-0.022	0.093	-0.076
1989	-0.089	-0.034	-0.053	-0.186	-0.091	-0.053
1990	-0.051	-0.037	-0.091	-0.034	0.043	-0.190
1991	-0.061	-0.035	-0.095	-0.093	0.013	-0.183
1992	-0.066	-0.054	-0.074	-0.100	0.048	-0.125
1993	-0.074	-0.068	-0.047	-0.105	-0.017	-0.200
1994	-0.032	-0.075	-0.040	0.039	-0.062	0.075
1995	-0.104	-0.111	-0.107	-0.118	-0.029	-0.075
1996	-0.061	-0.090	-0.002	-0.072	-0.003	0.098
1997	0.063	0.029	0.042	0.141	0.090	-0.102
1998	0.015	0.019	-0.069	0.054	0.035	-0.055
1999	0.172	0.201	0.190	0.151	0.119	0.071
2000	0.056	0.105	0.023	0.041	-0.052	-0.024
2001	-0.020	-0.030	-0.065	0.004	0.046	-0.078
2002	0.040	0.066	0.040	0.008	0.007	0.016
2003	-0.048	-0.090	-0.022	-0.011	-0.029	0.115
2004	0.020	-0.033	0.035	0.070	0.112	-0.013
2005	-0.009	-0.026	0.062	-0.004	-0.025	-0.086
2006	0.027	0.039	0.006	0.021	0.011	0.080
2007	0.032	0.015	0.008	0.056	0.052	0.071
2008	0.035	0.054	0.011	0.022	0.050	-0.036
2009	-0.007	0.000	0.100	-0.043	-0.064	-0.055
2010	0.060	0.046	0.102	0.038	0.136	0.041
2011	0.019	-0.012	0.070	0.017	0.057	0.062
2012	-0.013	-0.005	-0.041	0.004	-0.054	-0.004
2013	0.004	0.028	-0.016	0.006	-0.068	0.016
2014	0.000	0.028	-0.006	-0.034	-0.018	0.034

Table 14: Yearly Data of Employment (Nonwage Worker)

(Unit: 1billion Won)

employment(non)	Nation	Capital	Chungcheong	Yeongnam	Honam	Gangwon
1970	5,872.0	877.5	951.0	1,851.1	1,684.6	376.1
1971	6,024.0	968.5	1,020.2	1,921.2	1,597.9	385.2
1972	6,377.0	1,013.8	1,076.8	2,072.9	1,696.6	394.0
1973	6,789.0	1,217.5	1,123.9	2,063.4	1,857.9	386.4
1974	6,979.0	1,297.9	1,222.3	2,093.3	1,815.1	401.4
1975	6,940.0	1,345.4	1,195.9	2,186.4	1,684.2	378.4
1976	7,273.0	1,410.0	1,242.7	2,186.7	1,902.4	381.9
1977	7,099.0	1,435.5	1,243.2	2,119.6	1,756.3	393.4
1978	7,171.0	1,482.1	1,256.7	2,161.0	1,721.9	399.2
1979	7,124.0	1,521.7	1,171.4	2,115.3	1,788.5	384.6
1980	7,220.0	1,615.6	1,145.3	2,174.1	1,750.1	393.8
1981	7,420.0	1,706.4	1,215.1	2,208.1	1,760.0	392.9
1982	7,541.0	1,855.6	1,188.8	2,242.7	1,719.3	395.3
1983	7,335.0	1,891.9	1,132.9	2,169.3	1,623.6	384.3
1984	6,798.0	1,814.8	1,031.2	2,003.5	1,474.2	349.2
1985	6,866.0	1,927.2	1,013.0	2,003.6	1,441.2	355.3
1986	7,072.0	2,034.4	1,032.8	2,051.3	1,465.0	358.9
1987	7,164.0	2,114.5	1,030.5	2,071.7	1,456.2	358.5
1988	7,260.0	2,183.7	1,035.6	2,091.5	1,453.4	360.3
1989	7,171.0	2,207.0	1,065.0	2,127.0	1,322.0	327.0
1990	7,135.0	2,250.0	1,021.0	2,137.0	1,284.0	312.0
1991	6,950.0	2,349.0	957.0	2,055.0	1,174.0	293.0
1992	7,097.0	2,427.3	969.7	2,123.4	1,163.7	295.9
1993	7,290.0	2,557.6	983.9	2,139.7	1,189.8	296.0
1994	7,370.0	2,614.0	992.0	2,133.0	1,206.0	303.0
1995	7,515.0	2,769.0	980.0	2,157.0	1,194.0	293.0
1996	7,653.0	2,844.0	971.0	2,210.0	1,207.0	300.0
1997	7,810.0	2,920.0	993.0	2,281.0	1,203.0	292.0
1998	7,641.0	2,766.0	954.0	2,304.0	1,179.0	320.0
1999	7,628.0	2,830.0	943.0	2,275.0	1,159.0	310.0
2000	7,817.0	2,952.3	944.7	2,321.5	1,173.3	313.9
2001	7,955.0	3,095.3	939.0	2,318.2	1,179.2	307.6
2002	8,026.0	3,165.0	950.5	2,311.9	1,177.6	304.4
2003	7,773.0	3,154.0	892.2	2,239.7	1,081.1	286.4
2004	7,746.0	3,186.1	879.4	2,225.9	1,058.3	274.9
2005	7,645.0	3,144.3	860.1	2,200.5	1,043.5	272.1
2006	7,580.0	3,106.8	861.7	2,185.2	1,031.3	277.3
2007	7,467.0	3,075.6	873.5	2,132.1	999.5	272.1
2008	7,418.0	3,088.6	846.4	2,103.3	998.3	268.7
2009	7,102.0	2,980.0	812.7	1,985.0	963.8	248.8
2010	6,922.0	2,949.3	774.2	1,944.0	923.5	224.1
2011	6,930.0	2,953.4	786.4	1,935.2	911.9	231.8
2012	7,034.0	2,954.3	785.3	1,988.4	943.7	252.3
2013	6,934.0	2,839.4	814.3	1,990.8	929.3	245.2
2014	6,939.0	2,896.2	834.9	1,947.0	906.7	242.9

Table 15: Yearly Data of Employment (Wage Worker)

	Nation	Capital	Chungcheong	Yeongnam	Honam	Gangwon
1970	3,746.0	1,395.5	433.1	1,236.9	505.5	161.8
1971	3,923.0	1,677.5	350.6	1,200.1	496.1	181.6
1972	4,005.0	1,737.2	333.7	1,243.5	487.2	185.2
1973	4,153.0	1,836.6	352.5	1,292.2	494.1	160.3
1974	4,444.0	1,783.2	484.6	1,365.1	604.8	184.8
1975	4,751.0	1,997.7	530.8	1,367.4	623.1	205.8
1976	5,140.0	2,153.0	576.2	1,524.3	675.0	184.8
1977	5,714.0	2,603.6	525.4	1,594.2	745.2	222.2
1978	6,242.0	3,150.3	558.3	1,608.9	680.5	221.1
1979	6,479.0	3,279.1	561.8	1,690.8	680.0	233.5
1980	6,464.0	3,279.8	542.6	1,707.3	652.5	237.0
1981	6,605.0	3,310.5	484.8	1,957.5	579.5	222.7
1982	6,839.0	3,427.8	502.0	2,026.8	600.0	230.6
1983	7,170.0	3,593.7	526.3	2,124.9	629.1	241.8
1984	7,631.0	3,824.7	560.1	2,261.5	669.5	257.4
1985	8,104.0	4,061.8	594.8	2,401.7	711.0	273.3
1986	8,433.0	4,166.1	644.6	2,506.1	780.3	267.2
1987	9,191.0	4,540.5	702.6	2,731.4	850.4	291.2
1988	9,610.0	4,747.5	734.6	2,855.9	889.2	304.5
1989	10,390.0	5,191.0	755.0	3,012.0	1,012.0	320.0
1990	10,950.0	5,515.0	816.0	3,107.0	1,074.0	330.0
1991	11,699.0	5,875.0	900.0	3,325.0	1,140.0	342.0
1992	11,911.0	5,966.5	941.1	3,370.3	1,162.1	343.0
1993	11,944.0	6,036.0	960.0	3,355.0	1,124.0	346.0
1994	12,479.0	6,365.0	1,002.0	3,493.0	1,156.0	339.0
1995	12,899.0	6,557.0	1,057.0	3,621.0	1,192.0	347.0
1996	13,200.0	6,744.0	1,107.0	3,646.0	1,212.0	359.0
1997	13,404.0	6,847.0	1,137.0	3,657.0	1,249.0	376.0
1998	12,296.0	6,271.0	1,087.0	3,339.0	1,147.0	322.0
1999	12,663.0	6,494.0	1,125.0	3,407.0	1,167.0	337.0
2000	13,356.0	6,880.9	1,192.6	3,573.9	1,205.6	355.9
2001	13,659.0	7,026.0	1,236.0	3,657.0	1,232.0	356.0
2002	14,206.0	7,307.9	1,287.3	3,816.7	1,256.2	380.7
2003	14,449.0	7,439.2	1,325.3	3,831.5	1,314.3	380.2
2004	14,936.0	7,765.8	1,379.9	3,918.0	1,312.7	399.1
2005	15,186.0	7,980.5	1,397.1	3,925.3	1,331.1	397.0
2006	15,608.0	8,278.2	1,455.3	3,963.5	1,336.9	403.5
2007	16,095.0	8,588.7	1,511.7	4,039.4	1,377.7	403.1
2008	16,357.0	8,726.6	1,552.3	4,098.8	1,390.8	410.8
2009	16,586.0	8,776.9	1,587.6	4,167.2	1,437.4	437.5
2010	17,111.0	9,081.3	1,660.6	4,280.0	1,463.0	449.7
2011	17,596.0	9,394.2	1,702.3	4,363.3	1,502.0	452.1
2012	17,921.0	9,557.5	1,773.7	4,426.6	1,525.8	448.2
2013	18,365.0	9,803.8	1,859.2	4,456.3	1,593.8	459.3
2014	18,959.0	10,094.0	1,931.0	4,608.5	1,642.7	476.4
2015	19,402.0	10,283.2	2,003.8	4,726.9	1,679.9	492.4

Table 16: Yearly Data of Employment Income (NonWage Worker)

(Unit: 1billion Won)

	Nation	Capital	Chungcheong	Yeongnam	Honam	Gangwon
1970	16,443,355,366.3	2,575,398,798.2	2,419,692,047.7	4,946,394,854.5	4,749,470,997.9	1,368,293,478.4
1971	17,366,318,492.7	2,943,492,738.4	2,665,249,652.1	5,290,946,782.1	4,631,684,592.1	1,441,785,694.3
1972	19,419,977,830.4	3,395,475,039.7	3,076,876,484.2	6,242,713,795.5	4,900,287,700.9	1,454,498,098.4
1973	24,625,037,648.9	4,729,161,980.6	3,944,676,279.3	7,292,453,101.0	6,588,518,570.0	1,635,136,292.9
1974	25,505,922,293.9	4,932,435,497.3	4,309,274,277.8	7,702,291,192.5	6,364,273,248.0	1,721,919,504.0
1975	25,505,229,139.5	5,156,624,894.3	4,063,706,222.6	8,264,733,966.8	5,828,299,654.5	1,674,209,654.1
1976	29,234,003,127.5	5,921,438,566.2	4,407,402,890.8	8,624,186,755.8	7,995,058,245.0	1,779,568,577.7
1977	32,152,572,295.5	6,475,379,251.1	5,289,648,819.1	9,715,269,798.8	7,868,796,458.9	2,058,343,945.9
1978	36,443,372,852.7	7,746,265,239.0	5,795,227,661.5	11,033,305,283.2	8,507,077,966.4	2,497,545,830.4
1979	38,102,606,256.8	8,838,847,452.7	5,946,373,499.9	11,163,101,397.5	8,852,795,358.6	2,447,658,954.3
1980	37,967,989,261.3	9,026,019,770.4	5,660,750,153.8	10,841,394,499.6	9,272,033,135.3	2,401,491,105.8
1981	39,396,948,600.4	9,260,851,938.5	6,320,506,237.4	10,756,700,762.8	9,712,810,177.5	2,517,723,866.6
1982	40,882,422,168.9	10,417,289,711.7	5,962,099,774.4	11,851,560,708.8	9,511,460,598.2	2,347,044,403.2
1983	44,580,033,091.0	12,061,110,694.5	6,272,266,464.6	12,894,530,606.2	9,771,000,971.0	2,650,841,282.7
1984	43,810,290,654.6	12,242,440,694.2	6,247,734,022.4	12,470,903,903.5	9,343,990,434.5	2,569,448,172.1
1985	45,556,015,978.5	13,407,554,783.0	6,638,673,915.0	12,687,955,786.2	9,276,321,392.6	2,587,415,510.1
1986	50,858,583,022.3	15,325,520,375.4	7,341,846,495.4	14,096,052,513.1	10,230,731,642.0	2,923,399,896.7
1987	55,528,880,113.5	16,875,136,690.5	7,393,913,581.2	15,239,415,924.4	11,794,827,932.1	3,069,129,339.5
1988	61,600,323,705.9	18,972,006,867.5	7,948,960,386.4	17,116,428,658.3	13,254,592,091.0	3,131,980,867.3
1989	63,197,515,939.7	19,888,836,625.7	8,459,926,108.4	18,608,478,897.9	12,359,045,969.8	2,866,353,396.1
1990	66,999,970,025.9	22,073,259,898.5	8,515,790,495.8	19,742,399,351.4	12,380,936,123.3	3,049,862,411.9
1991	69,826,344,646.0	24,669,826,673.2	8,724,543,113.5	20,131,553,638.9	12,037,745,817.0	3,029,411,198.0
1992	74,701,200,986.5	26,652,002,138.4	9,415,258,608.1	21,777,412,708.0	12,446,868,861.8	3,179,982,346.5
1993	83,085,413,647.4	30,314,624,740.1	10,489,551,055.2	23,762,760,125.9	13,709,116,995.6	3,420,262,874.5
1994	89,399,261,123.1	32,924,867,244.2	11,375,528,809.5	25,175,591,159.3	14,755,223,525.2	3,702,346,164.1
1995	100,539,287,744.5	38,393,411,435.0	12,501,300,323.0	28,029,093,039.8	16,072,897,000.0	3,926,734,875.7
1996	107,930,247,923.5	41,484,168,879.6	13,152,794,245.1	30,274,123,910.6	17,110,609,144.2	4,219,380,672.3
1997	110,437,295,692.7	42,477,321,330.8	13,420,331,041.3	31,594,284,916.0	17,114,785,908.2	4,162,365,354.4
1998	103,038,622,783.3	38,835,297,578.5	12,254,136,182.9	30,370,441,230.1	15,721,905,625.6	4,308,225,076.4
1999	106,485,707,039.3	41,673,552,121.7	12,564,132,701.9	31,019,416,095.6	15,387,875,429.9	4,302,034,370.0
2000	112,763,336,623.6	44,421,725,852.5	13,304,017,870.6	32,328,593,162.0	16,777,484,109.1	4,382,739,941.6
2001	118,871,987,973.2	48,979,320,671.8	13,663,661,967.8	33,203,115,688.3	16,890,828,736.4	4,513,421,387.9
2002	124,180,929,641.5	52,617,074,222.1	14,271,510,353.6	33,863,192,567.7	17,245,745,584.7	4,496,999,840.3
2003	125,500,989,130.1	54,917,350,567.3	14,002,875,346.4	33,914,821,481.0	16,627,939,956.7	4,333,711,998.8
2004	126,492,174,755.7	56,250,428,914.9	14,110,140,426.5	34,150,278,862.8	16,180,201,020.0	4,089,379,882.0
2005	129,327,302,885.1	57,066,700,772.7	13,884,136,131.4	35,275,619,597.9	16,909,580,033.0	4,359,489,259.2
2006	131,501,701,160.8	57,746,514,365.9	14,382,786,112.1	36,011,688,055.7	17,144,424,418.5	4,474,694,296.9
2007	134,334,786,232.6	59,492,963,252.2	15,190,864,913.0	36,015,971,025.1	17,358,067,335.4	4,561,526,021.5
2008	130,702,219,104.1	57,102,113,556.5	14,624,075,360.2	35,655,032,146.1	17,221,141,446.2	4,444,248,074.3
2009	126,420,795,912.7	56,071,610,515.2	14,025,807,424.0	33,812,108,579.3	16,647,179,951.5	4,171,881,598.6
2010	126,317,423,236.5	56,816,776,757.1	13,863,219,745.9	34,024,500,776.1	16,243,339,266.6	3,755,160,646.9
2011	128,633,776,878.8	57,918,410,712.2	14,274,154,879.8	34,586,848,871.7	16,318,426,957.2	3,860,150,829.5
2012	131,681,917,103.2	58,672,401,810.7	14,415,569,874.5	35,616,306,201.6	17,022,038,439.2	4,268,104,571.7
2013	132,876,878,240.8	58,271,501,856.7	15,435,206,507.8	36,173,021,260.7	16,944,161,811.9	4,241,541,547.0
2014	133,912,072,774.7	59,412,615,095.2	16,041,103,478.9	35,792,827,706.4	16,658,371,440.0	4,223,881,492.6

Table 17: Yearly Data of Employment Income (Wage Worker)

(Unit: 1billion Won)

	Nation	Capital	Chungcheong	Yeongnam	Honam	Gangwon
1970	20,307,907,532	8,156,357,458	2,018,952,532	6,283,731,499	2,670,636,841	1,105,985,093
1971	21,877,983,361	10,015,306,146	1,679,631,022	6,173,808,689	2,655,414,715	1,258,463,550
1972	23,576,185,457	11,135,150,911	1,771,352,526	6,759,855,469	2,560,186,811	1,253,698,674
1973	29,148,311,647	14,038,763,550	2,273,735,129	8,282,447,236	3,211,006,297	1,243,521,134
1974	31,293,713,191	13,431,722,128	3,182,454,538	9,133,750,726	3,944,095,938	1,474,525,505
1975	33,601,751,060	15,416,144,649	3,299,048,848	9,130,381,519	3,922,493,806	1,667,713,509
1976	39,436,415,930	20,342,273,504	4,130,108,955	11,866,759,054	5,758,997,278	1,741,379,289
1977	48,821,025,419	23,639,200,216	4,071,163,403	12,741,848,441	6,040,807,306	2,117,305,810
1978	59,584,429,843	32,293,680,126	4,574,082,686	14,086,538,030	5,934,786,280	2,460,521,845
1979	64,996,856,307	36,156,491,959	4,941,933,014	15,182,484,100	5,786,057,723	2,577,553,910
1980	63,670,097,122	35,187,147,569	4,737,894,562	14,690,451,815	6,076,838,715	2,555,844,669
1981	64,946,928,083	35,386,973,523	4,833,582,227	15,304,156,955	6,108,256,358	2,736,600,718
1982	70,651,629,550	37,917,610,655	4,662,272,999	18,857,553,843	6,128,645,484	2,539,612,180
1983	82,750,273,318	44,500,406,970	5,335,043,306	22,112,087,921	7,047,228,433	3,059,349,770
1984	93,187,160,112	49,751,995,604	6,199,431,918	24,981,589,376	8,000,586,344	3,463,305,340
1985	100,925,329,498	53,897,025,765	7,102,125,861	26,681,322,290	8,766,175,292	3,627,323,777
1986	114,032,622,952	60,485,143,831	8,600,133,259	31,495,514,927	8,432,064,384	4,083,518,693
1987	132,696,711,395	68,369,097,401	9,293,300,631	36,290,296,071	12,945,974,703	4,594,275,073
1988	152,421,699,881	79,018,813,506	10,563,064,229	41,665,148,260	14,942,267,231	4,959,388,682
1989	171,440,464,117	88,780,326,958	11,285,480,098	47,187,024,208	17,362,693,084	5,283,351,520
1990	193,724,941,552	101,967,539,533	13,026,799,316	51,829,460,980	18,981,438,989	6,040,854,670
1991	220,573,480,912	115,341,381,727	15,562,557,457	59,441,252,576	21,450,845,588	6,604,937,472
1992	236,060,059,703	122,644,528,966	17,325,331,470	63,701,659,252	22,963,689,004	6,904,249,134
1993	255,485,097,610	133,635,764,935	19,257,858,490	68,663,817,370	23,874,198,459	7,461,114,213
1994	281,903,107,570	148,467,110,790	21,400,116,832	75,734,519,039	25,863,965,068	7,676,288,567
1995	321,599,124,877	168,438,121,155	25,097,223,636	86,906,998,994	29,404,146,088	8,630,091,638
1996	351,323,257,314	184,601,729,660	28,223,587,697	93,637,451,657	31,901,344,243	9,492,423,197
1997	356,010,255,270	186,313,114,229	28,808,725,848	94,502,720,643	32,811,022,311	10,039,948,206
1998	315,033,836,335	165,951,816,347	26,515,774,293	82,646,514,532	28,488,557,103	8,181,153,907
1999	332,380,946,808	177,203,820,687	27,797,065,643	86,609,745,696	28,648,501,166	8,672,037,362
2000	358,778,322,473	190,805,716,361	31,119,749,123	92,326,553,948	31,635,166,910	9,162,595,093
2001	377,203,677,949	203,251,385,801	32,799,883,553	95,833,010,853	31,845,258,355	9,537,966,521
2002	404,926,241,894	220,417,019,307	35,286,275,796	101,923,986,873	32,996,758,407	10,200,347,825
2003	427,951,470,400	234,078,624,672	38,017,692,646	105,534,107,353	35,778,424,104	10,411,643,042
2004	445,991,518,343	246,576,584,524	40,180,994,051	108,712,894,973	35,688,481,596	10,687,152,318
2005	466,780,403,785	259,691,977,370	40,804,598,817	112,717,650,839	38,035,677,627	11,400,013,898
2006	486,103,054,178	272,472,204,523	43,647,523,993	115,284,647,835	38,742,163,026	11,525,051,884
2007	510,633,138,565	288,645,507,805	46,227,772,482	118,558,793,782	40,935,927,642	11,727,577,773
2008	514,515,934,077	285,596,141,754	47,666,978,532	122,854,047,802	41,732,542,883	12,003,913,972
2009	518,966,349,417	287,791,811,780	48,012,796,919	123,291,973,358	42,438,909,556	12,771,499,667
2010	541,772,641,029	300,989,311,406	51,215,974,655	128,580,017,261	43,456,871,770	12,966,367,782
2011	553,049,994,749	309,143,135,226	51,822,905,159	130,749,698,979	44,088,447,631	12,606,797,231
2012	569,677,812,029	319,000,427,449	54,733,414,328	133,306,706,945	45,074,739,545	12,700,800,463
2013	590,252,435,001	333,245,905,925	58,269,891,395	133,552,817,543	47,092,940,547	13,107,990,399
2014	615,187,428,129	344,511,749,029	61,709,377,027	140,438,437,514	49,351,323,770	13,758,846,951

Table 18: Yearly Data of GTFP in 5 Regions by Primal Method

Year	Region					
	Nation	Capital	Chungcheong	Yeongnam	Honam	Gangwon
1971	0.01304	(0.09982)	0.05247	0.06021	0.09928	(0.02233)
1972	(0.01130)	0.01502	(0.00718)	(0.06228)	0.01364	0.01650
1973	0.04956	0.09806	(0.02127)	0.06450	(0.07550)	0.08046
1974	0.00338	0.00240	(0.06035)	0.01133	0.02430	0.00046
1975	0.00975	(0.03819)	0.01797	(0.00443)	0.09027	0.08387
1976	0.01672	0.02783	0.02437	0.02666	(0.01976)	0.05070
1977	0.01916	(0.02913)	(0.00437)	0.06558	0.01675	0.09009
1978	0.00045	(0.08195)	(0.01783)	0.03501	0.07149	0.06530
1979	0.02050	0.04600	0.04265	(0.03135)	0.00001	0.06439
1980	(0.05718)	(0.04924)	(0.03737)	(0.08407)	(0.03838)	(0.05379)
1981	0.02418	0.00832	0.03947	0.01395	0.06431	0.07559
1982	0.02860	0.03487	0.03837	0.00218	0.03891	0.04934
1983	0.08554	0.07201	0.07209	0.09876	0.10407	0.04659
1984	0.06748	0.08128	0.11062	0.01720	0.06676	0.16212
1985	0.02033	(0.02526)	0.20579	0.01796	0.01048	0.13223
1986	0.05135	0.07412	(0.00719)	0.05089	0.01805	0.06893
1987	0.04602	0.04950	0.02050	0.04566	0.03547	0.08177
1988	0.05925	0.05693	0.04405	0.05928	0.11702	(0.04829)
1989	0.00345	0.01779	(0.00520)	(0.03381)	0.02784	0.00276
1990	0.03300	0.04436	0.00198	0.03621	0.02382	(0.00590)
1991	0.03868	0.03382	0.03082	0.02205	0.09761	(0.00668)
1992	0.01645	0.01876	0.01934	0.00534	0.04510	(0.01336)
1993	0.03041	0.02882	0.03877	0.02113	0.05300	0.00148
1994	0.03544	0.01935	0.03666	0.06059	0.02619	0.03751
1995	0.04511	0.04036	0.03462	0.04211	0.07176	0.05454
1996	0.03295	0.02608	0.05542	0.02671	0.04928	0.06642
1997	0.02113	0.00769	0.01307	0.04672	0.03596	(0.01186)
1998	(0.02286)	(0.01418)	(0.04494)	(0.01582)	(0.03759)	(0.06555)
1999	0.08002	0.08818	0.09829	0.07518	0.04048	0.05098
2000	0.03996	0.04917	0.04613	0.02878	0.03131	(0.00225)
2001	0.01376	0.01819	(0.00977)	0.01560	0.01194	0.00540
2002	0.03910	0.05507	0.03894	0.01828	0.01683	0.01401
2003	0.01208	(0.00086)	0.02414	0.01909	0.02702	0.05590
2004	0.01704	(0.00070)	0.02980	0.03626	0.04115	(0.00954)
2005	0.02013	0.01311	0.03299	0.02318	0.02494	0.01524
2006	0.02383	0.02656	0.02188	0.02112	0.01707	0.02836
2007	0.03023	0.02596	0.01971	0.03386	0.04423	0.04367
2008	0.00873	(0.00121)	0.01152	0.02219	0.02518	(0.01185)
2009	(0.00190)	0.00373	0.04488	(0.01993)	(0.03255)	(0.01342)
2010	0.03942	0.03009	0.07053	0.03184	0.07184	0.02222
2011	0.00894	(0.00328)	0.03315	0.01133	0.02792	0.01006
2012	0.00179	0.00905	(0.01076)	0.00401	(0.02471)	0.00153
2013	0.01097	0.02728	(0.00154)	0.00163	(0.02843)	0.01395
2014	0.00715	0.01246	0.00707	(0.00489)	0.00495	0.02354

Table 19: Yearly Data of GTFP in 5 Regions by Dual Method

Year	Region					
	Nation	Capital	Chungcheong	Yeongnam	Honam	Gangwon
1971	0.01423	(0.10015)	0.05561	0.06521	0.10975	(0.02398)
1972	(0.01187)	0.01480	(0.00837)	(0.06439)	0.01441	0.01796
1973	0.04669	0.09747	(0.02758)	0.06223	(0.07756)	0.07972
1974	0.00452	0.00693	(0.05800)	0.01285	0.02449	0.00043
1975	0.01112	(0.03881)	0.02014	(0.00262)	0.09731	0.08462
1976	0.01557	0.02498	0.02315	0.02500	(0.02377)	0.05013
1977	0.01606	(0.02936)	(0.00756)	0.06562	0.02286	0.09033
1978	(0.00391)	(0.08421)	(0.02183)	0.03690	0.07830	0.05886
1979	0.02131	0.04573	0.04302	(0.02974)	0.00188	0.07025
1980	(0.05723)	(0.04860)	(0.03686)	(0.08384)	(0.04436)	(0.05385)
1981	0.02525	0.00980	0.03922	0.01471	0.06477	0.07561
1982	0.02884	0.03527	0.04303	0.00016	0.04120	0.05364
1983	0.08516	0.07126	0.07223	0.09881	0.10657	0.04207
1984	0.06838	0.08250	0.11334	0.01668	0.06883	0.16649
1985	0.02053	(0.02576)	0.20936	0.01822	0.01072	0.13406
1986	0.05107	0.07431	(0.00931)	0.05018	0.01916	0.06821
1987	0.04567	0.04978	0.02074	0.04556	0.02947	0.08165
1988	0.05880	0.05635	0.04417	0.05882	0.11748	(0.04942)
1989	0.00278	0.01766	(0.00470)	(0.03605)	0.02747	0.00518
1990	0.03249	0.04379	0.00146	0.03614	0.02581	(0.00963)
1991	0.03829	0.03358	0.02991	0.02104	0.09934	(0.00828)
1992	0.01628	0.01884	0.01900	0.00471	0.04628	(0.01421)
1993	0.02978	0.02825	0.03834	0.02003	0.05333	0.00067
1994	0.03527	0.01880	0.03645	0.06103	0.02576	0.03841
1995	0.04393	0.03927	0.03286	0.04086	0.07127	0.05364
1996	0.03257	0.02550	0.05558	0.02621	0.04964	0.06808
1997	0.02223	0.00840	0.01447	0.04836	0.03716	(0.01179)
1998	(0.02066)	(0.01186)	(0.04376)	(0.01364)	(0.03497)	(0.06347)
1999	0.08060	0.08850	0.09928	0.07583	0.04158	0.05151
2000	0.04001	0.04920	0.04608	0.02883	0.03100	(0.00228)
2001	0.01369	0.01807	(0.01001)	0.01567	0.01226	0.00497
2002	0.03918	0.05515	0.03904	0.01831	0.01692	0.01406
2003	0.01182	(0.00134)	0.02402	0.01920	0.02683	0.05764
2004	0.01717	(0.00075)	0.03005	0.03670	0.04217	(0.00929)
2005	0.02013	0.01303	0.03369	0.02322	0.02473	0.01455
2006	0.02397	0.02669	0.02188	0.02130	0.01731	0.02886
2007	0.03036	0.02598	0.01973	0.03427	0.04455	0.04443
2008	0.00903	(0.00086)	0.01173	0.02237	0.02558	(0.01186)
2009	(0.00177)	0.00389	0.04545	(0.01995)	(0.03271)	(0.01362)
2010	0.03961	0.03018	0.07095	0.03194	0.07277	0.02291
2011	0.00900	(0.00328)	0.03358	0.01139	0.02817	0.01029
2012	0.00178	0.00904	(0.01078)	0.00402	(0.02479)	0.00152
2013	0.01097	0.02729	(0.00150)	0.00170	(0.02856)	0.01405
2014	0.00714	0.01245	0.00707	(0.00494)	0.00491	0.02363

Table 20: Yearly Data of TFP in 5 Regions by Primal Method

Year	Region					
	Nation	Capital	Chungcheong	Yeongnam	Honam	Gangwon
1970	1.012	0.884	1.029	1.027	1.157	1.296
1971	0.987	0.952	0.981	0.958	1.116	1.357
1972	1.004	0.977	1.022	1.012	1.079	1.277
1973	1.173	1.136	1.210	1.121	1.313	1.387
1974	1.129	0.979	1.302	1.094	1.322	1.462
1975	1.082	0.995	1.225	1.025	1.236	1.455
1976	1.156	1.219	1.329	1.104	1.570	1.533
1977	1.282	1.214	1.368	1.164	1.535	1.645
1978	1.430	1.578	1.433	1.154	1.512	1.915
1979	1.423	1.635	1.472	1.086	1.434	1.796
1980	1.371	1.546	1.412	0.989	1.568	1.747
1981	1.297	1.437	1.469	0.860	1.590	1.819
1982	1.303	1.419	1.257	1.064	1.488	1.476
1983	1.409	1.564	1.320	1.151	1.500	1.719
1984	1.418	1.542	1.320	1.207	1.491	1.620
1985	1.414	1.594	1.233	1.186	1.488	1.412
1986	1.493	1.644	1.403	1.331	1.397	1.558
1987	1.579	1.649	1.378	1.385	1.969	1.620
1988	1.676	1.769	1.412	1.486	2.047	1.624
1989	1.745	1.820	1.384	1.649	2.095	1.537
1990	1.813	1.925	1.411	1.690	2.057	1.691
1991	1.878	1.977	1.482	1.793	2.041	1.793
1992	1.908	1.989	1.526	1.863	2.014	1.853
1993	1.991	2.066	1.593	1.971	2.036	2.048
1994	2.042	2.144	1.648	1.983	2.107	2.017
1995	2.207	2.306	1.832	2.169	2.212	2.133
1996	2.277	2.400	1.868	2.243	2.229	2.076
1997	2.159	2.306	1.736	2.085	2.103	2.061
1998	1.947	2.113	1.582	1.841	1.849	1.808
1999	1.849	2.026	1.440	1.755	1.694	1.744
2000	1.848	1.984	1.498	1.749	1.829	1.754
2001	1.881	2.052	1.553	1.744	1.747	1.834
2002	1.890	2.065	1.556	1.754	1.739	1.824
2003	1.948	2.169	1.597	1.755	1.795	1.690
2004	1.922	2.199	1.563	1.679	1.646	1.625
2005	1.941	2.234	1.461	1.694	1.717	1.760
2006	1.920	2.210	1.481	1.665	1.685	1.645
2007	1.907	2.226	1.494	1.603	1.658	1.557
2008	1.824	2.104	1.449	1.575	1.578	1.546
2009	1.791	2.074	1.318	1.562	1.586	1.602
2010	1.747	2.047	1.257	1.545	1.442	1.493
2011	1.714	2.047	1.153	1.520	1.361	1.353
2012	1.731	2.062	1.206	1.515	1.402	1.361
2013	1.743	2.074	1.268	1.484	1.463	1.341
2014	1.761	2.066	1.305	1.538	1.491	1.313

Table 21: 10-Year Data of Primal GTFP

TFP	Nation	Capital	Chungcheong	Yeongnam	Honam	**Gangwon**
1971~2014	0.023	0.019	0.026	0.021	0.031	0.029
1971~1980	0.006	(0.011)	(0.002)	0.009	0.020	0.037
1981~1990	0.042	0.041	0.053	0.030	0.051	0.057
1991~2000	0.032	0.030	0.033	0.031	0.042	0.011
2001~2010	0.020	0.017	0.029	0.020	0.025	0.015
2011-2014	0.007	0.011	0.007	0.003	(0.005)	0.012

Table 22: 10-Year Data of Dual GTFP

TFP	Nation	Capital	Chungcheong	Yeongnam	Honam	**Gangwon**
1971~2014	0.021	0.021	0.025	0.019	0.032	0.030
1971~1980	0.005	0.004	(0.001)	0.003	0.030	0.043
1981~1990	0.037	0.040	0.057	0.029	0.058	0.066
1991~2000	0.029	0.029	0.026	0.031	0.036	0.009
2001~2010	0.016	0.014	0.023	0.016	0.020	0.010
2011-2014	0.005	0.008	0.005	0.001	(0.008)	0.012

E. Result of Growth Contributions in Nation and 5 Regions

Table 1: Yearly Data of Growth Contributions (Nation)

Year	Growth Contributions			
	GRDP	Capital	Labor	TFP
1971	100.0	69.9	18.4	11.7
1972	100.0	86.8	32.6	(19.5)
1973	100.0	47.4	21.7	30.8
1974	100.0	68.5	28.8	2.7
1975	100.0	73.0	16.4	10.6
1976	100.0	57.2	30.5	12.3
1977	100.0	67.1	18.7	14.1
1978	100.0	78.0	30.6	(8.5)
1979	100.0	71.5	10.6	17.9
1980	100.0	(273.5)	(25.7)	399.1
1981	100.0	45.3	22.2	32.5
1982	100.0	44.2	20.5	35.2
1983	100.0	30.3	4.4	65.4
1984	100.0	38.2	(3.3)	65.0
1985	100.0	46.4	29.2	24.3
1986	100.0	34.6	20.2	45.2
1987	100.0	33.8	29.0	37.2
1988	100.0	33.7	17.4	48.9
1989	100.0	57.3	39.7	3.0
1990	100.0	46.2	21.1	32.7
1991	100.0	42.7	21.0	36.3
1992	100.0	56.2	20.5	23.3
1993	100.0	47.5	11.8	40.7
1994	100.0	37.0	25.1	37.9
1995	100.0	33.0	21.8	45.3
1996	100.0	37.1	21.1	41.7
1997	100.0	41.2	21.9	37.0
1998	100.0	(28.0)	84.4	43.6
1999	100.0	15.5	10.7	73.7
2000	100.0	23.5	31.3	45.2
2001	100.0	41.2	29.2	29.6
2002	100.0	25.6	23.6	50.8
2003	100.0	64.6	(0.9)	36.3
2004	100.0	38.5	27.0	34.5
2005	100.0	42.8	10.0	47.2
2006	100.0	34.8	19.1	46.1
2007	100.0	32.0	16.9	51.1
2008	100.0	54.8	17.6	27.7
2009	100.0	142.6	(20.4)	(22.2)
2010	100.0	25.3	13.2	61.5
2011	100.0	42.2	32.8	24.9
2012	100.0	51.5	41.7	6.8
2013	100.0	39.2	25.4	35.3
2014	100.0	37.0	41.1	21.9

Table 2: Yearly Data of Growth Contributions (Capital Region)

Year	Growth Contributions			
	GRDP	Capital	Labor	TFP
1971	100.0	131.1	112.9	(144.0)
1972	100.0	70.2	17.8	12.0
1973	100.0	32.2	25.2	42.5
1974	100.0	89.4	4.9	5.7
1975	100.0	97.7	49.7	(47.4)
1976	100.0	54.5	26.8	18.7
1977	100.0	65.2	57.1	(22.3)
1978	100.0	88.7	125.2	(113.9)
1979	100.0	40.9	21.8	37.3
1980	100.0	-	-	-
1981	100.0	58.1	27.5	14.4
1982	100.0	34.5	32.8	32.7
1983	100.0	27.5	19.1	53.4
1984	100.0	29.1	13.1	57.8
1985	100.0	73.3	76.5	(49.8)
1986	100.0	28.0	17.4	54.7
1987	100.0	31.4	33.8	34.7
1988	100.0	30.8	22.8	46.4
1989	100.0	33.6	47.9	18.4
1990	100.0	33.0	29.5	37.5
1991	100.0	38.7	34.1	27.2
1992	100.0	52.9	20.9	26.2
1993	100.0	44.9	20.9	34.3
1994	100.0	41.4	37.5	21.2
1995	100.0	31.3	29.1	39.5
1996	100.0	35.4	29.8	34.7
1997	100.0	47.9	33.4	18.6
1998	100.0	(21.1)	97.9	23.2
1999	100.0	12.4	17.3	70.3
2000	100.0	18.9	34.2	46.9
2001	100.0	32.9	34.7	32.4
2002	100.0	19.2	23.6	57.2
2003	100.0	76.3	31.4	(7.7)
2004	100.0	42.4	60.1	(2.5)
2005	100.0	40.5	27.4	32.2
2006	100.0	27.3	27.2	45.4
2007	100.0	26.6	28.6	44.8
2008	100.0	66.3	39.5	(5.9)
2009	100.0	99.0	(22.2)	23.3
2010	100.0	24.3	24.9	50.8
2011	100.0	47.5	66.0	(13.5)
2012	100.0	35.7	31.1	33.2
2013	100.0	18.8	15.8	65.5
2014	100.0	23.2	44.2	32.6

Table 3: Yearly Data of Growth Contributions (Chungcheong Region)

Year	Growth Contributions			
	GRDP	Capital	Labor	TFP
1971	100.0	47.6	(5.6)	58.0
1972	100.0	93.3	24.2	(17.5)
1973	100.0	106.7	43.5	(50.2)
1974	100.0	38.8	131.1	(69.8)
1975	100.0	54.1	14.4	31.5
1976	100.0	35.8	40.2	24.0
1977	100.0	146.7	(26.9)	(19.8)
1978	100.0	121.8	31.1	(52.9)
1979	100.0	106.2	(60.9)	54.8
1980	100.0	(78.6)	54.2	124.4
1981	100.0	34.5	8.3	57.2
1982	100.0	45.4	(5.7)	60.3
1983	100.0	41.7	(12.9)	71.2
1984	100.0	34.9	(21.0)	86.1
1985	100.0	16.1	2.4	81.5
1986	100.0	78.7	37.9	(16.6)
1987	100.0	41.2	29.5	29.3
1988	100.0	51.7	11.4	37.0
1989	100.0	87.6	21.3	(8.9)
1990	100.0	94.7	6.9	(1.6)
1991	100.0	69.1	6.0	24.8
1992	100.0	61.3	19.6	19.1
1993	100.0	52.9	10.7	36.4
1994	100.0	45.5	17.2	37.3
1995	100.0	49.9	15.4	34.6
1996	100.0	36.5	12.5	51.0
1997	100.0	58.0	23.0	19.0
1998	100.0	(48.5)	54.2	94.3
1999	100.0	17.6	6.0	76.4
2000	100.0	32.2	19.8	48.1
2001	100.0	102.4	44.4	(46.8)
2002	100.0	30.6	20.7	48.7
2003	100.0	58.8	(11.8)	53.0
2004	100.0	39.5	16.0	44.5
2005	100.0	42.5	(0.9)	58.4
2006	100.0	42.1	22.9	35.0
2007	100.0	42.7	25.5	31.8
2008	100.0	59.6	8.5	31.9
2009	100.0	27.5	0.6	71.9
2010	100.0	24.8	6.6	68.6
2011	100.0	41.5	13.5	45.0
2012	100.0	91.8	64.4	(56.2)
2013	100.0	51.8	51.7	(3.5)
2014	100.0	45.7	37.6	16.7

Table 4: Yearly Data of Growth Contributions (Yeongnam Region)

Year	Growth Contributions			
	GRDP	Capital	Labor	TFP
1971	100.0	51.7	4.2	44.0
1972	100.0	200.0	108.0	(208.0)
1973	100.0	58.7	4.4	36.9
1974	100.0	75.9	16.1	8.0
1975	100.0	87.5	19.3	(6.8)
1976	100.0	64.8	18.4	16.9
1977	100.0	33.2	0.5	66.3
1978	100.0	73.7	5.6	20.6
1979	100.0	141.2	6.9	(48.1)
1980	100.0	(241.6)	(47.1)	388.8
1981	100.0	50.3	36.3	13.4
1982	100.0	77.4	23.8	(1.2)
1983	100.0	29.5	2.3	68.3
1984	100.0	77.4	(7.7)	30.3
1985	100.0	49.2	26.2	24.6
1986	100.0	34.9	18.6	46.5
1987	100.0	38.3	25.6	36.1
1988	100.0	35.8	15.2	49.0
1989	100.0	136.6	70.9	(107.4)
1990	100.0	43.1	15.7	41.2
1991	100.0	52.8	22.0	25.2
1992	100.0	63.8	28.7	7.5
1993	100.0	62.3	0.3	37.4
1994	100.0	28.8	15.7	55.5
1995	100.0	32.4	22.1	45.4
1996	100.0	44.0	16.0	40.0
1997	100.0	29.3	12.5	58.3
1998	100.0	(33.4)	93.2	40.3
1999	100.0	17.1	4.6	78.3
2000	100.0	28.0	32.2	39.9
2001	100.0	44.4	19.5	36.1
2002	100.0	39.5	28.1	32.4
2003	100.0	61.6	(17.1)	55.5
2004	100.0	32.6	11.0	56.4
2005	100.0	46.5	(4.4)	57.9
2006	100.0	42.9	5.3	51.8
2007	100.0	37.0	3.6	59.3
2008	100.0	44.2	6.1	49.7
2009	100.0	(119.6)	38.3	181.4
2010	100.0	28.4	11.8	59.9
2011	100.0	42.9	20.5	36.6
2012	100.0	46.2	38.1	15.7
2013	100.0	77.2	15.2	7.7
2014	100.0	78.3	53.2	(31.5)

Table 5: Yearly Data of Growth Contributions (Honam Region)

Year	Growth Contributions			
	GRDP	Capital	Labor	TFP
1971	100.0	43.7	(21.7)	78.0
1972	100.0	53.0	31.8	15.2
1973	100.0	568.0	819.9	(1287.9)
1974	100.0	26.8	35.4	37.8
1975	100.0	31.8	(36.8)	105.0
1976	100.0	36.9	86.9	(23.7)
1977	100.0	99.6	(51.7)	52.1
1978	100.0	66.3	(31.9)	65.6
1979	100.0	73.7	35.7	(9.5)
1980	100.0	(119.0)	58.2	160.8
1981	100.0	15.5	(41.6)	126.1
1982	100.0	34.8	(13.0)	78.2
1983	100.0	28.2	(18.2)	90.0
1984	100.0	50.2	(52.0)	101.7
1985	100.0	76.9	5.8	17.3
1986	100.0	44.7	34.4	20.9
1987	100.0	36.8	26.4	36.7
1988	100.0	14.3	8.5	77.2
1989	100.0	46.9	(6.5)	59.6
1990	100.0	55.4	10.9	33.7
1991	100.0	20.3	(14.0)	93.7
1992	100.0	41.8	4.7	53.5
1993	100.0	33.3	(5.3)	72.1
1994	100.0	39.6	23.6	36.8
1995	100.0	28.3	7.2	64.5
1996	100.0	33.1	12.0	54.9
1997	100.0	31.6	14.9	53.5
1998	100.0	(33.4)	66.3	67.1
1999	100.0	30.9	0.0	69.1
2000	100.0	28.7	23.1	48.2
2001	100.0	44.9	23.6	31.5
2002	100.0	42.3	15.3	42.4
2003	100.0	52.4	(29.8)	77.4
2004	100.0	32.2	(12.2)	80.0
2005	100.0	42.6	2.1	55.3
2006	100.0	55.6	(4.8)	49.2
2007	100.0	31.6	3.3	65.1
2008	100.0	40.8	6.1	53.1
2009	100.0	(174.6)	(25.9)	300.5
2010	100.0	20.5	(3.9)	83.4
2011	100.0	34.5	11.5	54.0
2012	100.0	396.1	259.1	(555.1)
2013	100.0	(9121.9)	(6006.2)	15228.1
2014	100.0	56.0	24.3	19.7

Table 6: Yearly Data of Growth Contributions (Gangwon Region)

Year	Growth Contributions			
	GRDP	Capital	Labor	TFP
1971	100.0	65.1	93.4	(58.5)
1972	100.0	37.8	32.9	29.4
1973	100.0	33.6	(91.1)	157.5
1974	100.0	20.7	78.8	0.5
1975	100.0	9.4	(3.0)	93.6
1976	100.0	39.2	(59.8)	120.6
1977	100.0	5.0	41.3	53.7
1978	100.0	34.5	7.2	58.4
1979	100.0	35.5	(3.3)	67.8
1980	100.0	(196.5)	(111.5)	407.9
1981	100.0	11.1	(32.3)	121.2
1982	100.0	24.0	14.9	61.0
1983	100.0	51.7	0.3	48.0
1984	100.0	14.8	(13.7)	98.8
1985	100.0	14.8	12.7	72.5
1986	100.0	26.5	(2.7)	76.2
1987	100.0	(4.7)	23.2	81.5
1988	100.0	210.7	42.1	(152.8)
1989	100.0	129.9	(35.0)	5.1
1990	100.0	135.1	(10.1)	(25.0)
1991	100.0	187.2	(36.6)	(50.6)
1992	100.0	153.3	20.1	(73.4)
1993	100.0	76.7	22.5	0.8
1994	100.0	46.0	0.1	53.9
1995	100.0	40.7	(2.7)	62.1
1996	100.0	33.1	16.4	50.5
1997	100.0	110.1	26.0	(36.2)
1998	100.0	(29.5)	38.0	91.4
1999	100.0	24.9	6.9	68.2
2000	100.0	49.6	56.9	(6.6)
2001	100.0	114.2	(40.7)	26.5
2002	100.0	33.9	40.3	25.8
2003	100.0	37.8	(27.8)	90.0
2004	100.0	116.7	35.9	(52.5)
2005	100.0	69.1	(16.0)	46.9
2006	100.0	34.5	18.1	47.4
2007	100.0	36.1	(7.9)	71.8
2008	100.0	196.3	38.7	(135.0)
2009	100.0	195.7	66.3	(162.0)
2010	100.0	59.1	(38.6)	79.5
2011	100.0	43.9	25.6	30.5
2012	100.0	48.7	46.4	4.9
2013	100.0	51.5	8.9	39.6
2014	100.0	36.3	20.7	43.0

Table 7: Yearly Data of Growth Decomposition (Nation)

Year	Growth Decomposition			
	GDP	Capital	Labor	TFP
1971	10.3	6.9	2.0	1.4
1972	7.3	6.0	2.5	(1.2)
1973	14.3	6.4	3.2	4.7
1974	9.1	6.0	2.7	0.5
1975	8.2	5.7	1.4	1.1
1976	11.9	6.6	3.7	1.6
1977	10.7	7.0	2.0	1.6
1978	9.9	7.1	3.1	(0.4)
1979	8.8	5.7	1.0	2.1
1980	(1.5)	3.8	0.4	(5.7)
1981	7.3	3.1	1.7	2.5
1982	8.0	3.4	1.7	2.9
1983	12.8	3.7	0.6	8.5
1984	10.3	3.8	(0.3)	6.8
1985	8.0	3.6	2.4	2.1
1986	11.1	3.7	2.3	5.1
1987	12.1	3.9	3.6	4.6
1988	11.8	3.9	2.1	5.9
1989	6.9	3.9	2.8	0.3
1990	9.6	4.3	2.1	3.2
1991	10.3	4.3	2.2	3.8
1992	6.5	3.5	1.4	1.6
1993	7.0	3.2	0.8	3.0
1994	9.0	3.2	2.3	3.5
1995	9.5	3.0	2.1	4.4
1996	7.6	2.7	1.6	3.3
1997	5.8	2.3	1.3	2.2
1998	(5.0)	1.3	(4.3)	(2.1)
1999	10.9	1.6	1.2	8.1
2000	8.8	2.0	2.8	4.0
2001	4.5	1.8	1.3	1.4
2002	7.6	1.9	1.8	3.9
2003	3.1	1.9	(0.0)	1.2
2004	4.9	1.8	1.3	1.7
2005	4.1	1.7	0.4	2.0
2006	5.1	1.7	1.0	2.4
2007	5.8	1.8	1.0	3.0
2008	3.1	1.6	0.6	0.9
2009	1.1	1.5	(0.2)	(0.2)
2010	6.4	1.6	0.9	4.0
2011	3.5	1.4	1.2	0.9
2012	2.3	1.2	1.0	0.2
2013	3.0	1.1	0.8	1.1
2014	3.2	1.1	1.4	0.7

Table 8: Yearly Data of Growth Decomposition (Capital Region)

Year	Growth Decomposition			
	GDP	Capital	Labor	TFP
1971	0.070	0.090	0.080	(0.100)
1972	0.114	0.078	0.021	0.015
1973	0.228	0.072	0.059	0.097
1974	0.092	0.081	0.005	0.007
1975	0.083	0.080	0.042	(0.039)
1976	0.131	0.071	0.035	0.025
1977	0.133	0.086	0.077	(0.029)
1978	0.074	0.064	0.095	(0.084)
1979	0.117	0.045	0.026	0.046
1980	0.000	0.035	0.014	(0.049)
1981	0.061	0.034	0.017	0.010
1982	0.106	0.036	0.035	0.035
1983	0.132	0.035	0.026	0.071
1984	0.141	0.040	0.019	0.083
1985	0.053	0.037	0.041	(0.026)
1986	0.134	0.036	0.024	0.074
1987	0.142	0.043	0.049	0.050
1988	0.120	0.036	0.028	0.056
1989	0.095	0.031	0.046	0.018
1990	0.115	0.037	0.034	0.044
1991	0.121	0.045	0.042	0.034
1992	0.069	0.035	0.015	0.019
1993	0.080	0.035	0.017	0.028
1994	0.085	0.034	0.032	0.019
1995	0.097	0.029	0.029	0.039
1996	0.071	0.024	0.022	0.025
1997	0.042	0.019	0.014	0.008
1998	(0.055)	0.011	(0.055)	(0.012)
1999	0.126	0.015	0.022	0.088
2000	0.105	0.019	0.036	0.049
2001	0.055	0.018	0.019	0.018
2002	0.096	0.018	0.023	0.055
2003	0.024	0.018	0.008	(0.001)
2004	0.038	0.015	0.023	(0.001)
2005	0.039	0.015	0.011	0.013
2006	0.058	0.015	0.016	0.027
2007	0.057	0.015	0.017	0.026
2008	0.021	0.014	0.009	(0.001)
2009	0.014	0.014	(0.003)	0.004
2010	0.059	0.014	0.015	0.030
2011	0.025	0.011	0.017	(0.003)
2012	0.027	0.009	0.009	0.009
2013	0.041	0.007	0.007	0.027
2014	0.038	0.009	0.017	0.012

Table 9: Yearly Data of Growth Decomposition (Chungcheong Region)

Year	Growth Decomposition			
	GDP	Capital	Labor	TFP
1971	0.092	0.042	(0.005)	0.056
1972	0.061	0.054	0.016	(0.008)
1973	0.062	0.061	0.028	(0.028)
1974	0.080	0.028	0.110	(0.058)
1975	0.056	0.027	0.008	0.020
1976	0.093	0.032	0.038	0.023
1977	0.075	0.103	(0.021)	(0.008)
1978	0.061	0.063	0.020	(0.022)
1979	0.054	0.046	(0.035)	0.043
1980	(0.035)	0.022	(0.020)	(0.037)
1981	0.064	0.019	0.006	0.039
1982	0.067	0.028	(0.004)	0.043
1983	0.096	0.036	(0.013)	0.072
1984	0.126	0.040	(0.028)	0.113
1985	0.254	0.038	0.006	0.209
1986	0.067	0.050	0.026	(0.009)
1987	0.068	0.027	0.021	0.021
1988	0.113	0.056	0.013	0.044
1989	0.079	0.066	0.017	(0.005)
1990	0.081	0.074	0.006	0.001
1991	0.109	0.073	0.007	0.030
1992	0.091	0.054	0.018	0.019
1993	0.100	0.051	0.011	0.038
1994	0.094	0.041	0.017	0.036
1995	0.090	0.043	0.014	0.033
1996	0.106	0.037	0.014	0.056
1997	0.070	0.039	0.016	0.014
1998	(0.048)	0.022	(0.026)	(0.044)
1999	0.129	0.022	0.008	0.099
2000	0.095	0.030	0.019	0.046
2001	0.022	0.022	0.010	(0.010)
2002	0.079	0.023	0.017	0.039
2003	0.043	0.025	(0.005)	0.024
2004	0.066	0.025	0.011	0.030
2005	0.056	0.023	(0.001)	0.034
2006	0.061	0.025	0.014	0.022
2007	0.061	0.025	0.016	0.020
2008	0.035	0.020	0.003	0.012
2009	0.062	0.017	0.000	0.045
2010	0.103	0.025	0.007	0.071
2011	0.073	0.030	0.010	0.034
2012	0.019	0.017	0.013	(0.011)
2013	0.039	0.020	0.021	(0.001)
2014	0.042	0.019	0.016	0.007

Table 10: Yearly Data of Growth Decomposition (Yeongnam Region)

Year	Growth Decomposition			
	GDP	Capital	Labor	TFP
1971	0.142	0.071	0.006	0.065
1972	0.032	0.061	0.036	(0.064)
1973	0.155	0.086	0.007	0.062
1974	0.112	0.081	0.019	0.013
1975	0.081	0.067	0.016	(0.003)
1976	0.138	0.087	0.026	0.025
1977	0.098	0.032	0.000	0.066
1978	0.150	0.104	0.009	0.037
1979	0.076	0.100	0.005	(0.030)
1980	(0.022)	0.050	0.011	(0.084)
1981	0.105	0.051	0.039	0.015
1982	0.056	0.042	0.014	0.000
1983	0.143	0.040	0.003	0.099
1984	0.050	0.037	(0.004)	0.017
1985	0.071	0.034	0.019	0.018
1986	0.106	0.036	0.020	0.050
1987	0.124	0.046	0.032	0.046
1988	0.118	0.041	0.018	0.059
1989	0.034	0.046	0.025	(0.036)
1990	0.085	0.036	0.014	0.036
1991	0.079	0.040	0.018	0.021
1992	0.050	0.031	0.015	0.005
1993	0.050	0.030	0.000	0.020
1994	0.108	0.030	0.017	0.061
1995	0.088	0.027	0.020	0.041
1996	0.063	0.026	0.010	0.026
1997	0.082	0.023	0.010	0.048
1998	(0.036)	0.012	(0.034)	(0.014)
1999	0.096	0.016	0.004	0.076
2000	0.072	0.019	0.024	0.029
2001	0.042	0.018	0.008	0.016
2002	0.055	0.021	0.016	0.018
2003	0.033	0.020	(0.006)	0.019
2004	0.064	0.020	0.007	0.037
2005	0.039	0.017	(0.002)	0.023
2006	0.040	0.017	0.002	0.021
2007	0.057	0.020	0.002	0.034
2008	0.044	0.019	0.003	0.022
2009	(0.011)	0.013	(0.004)	(0.020)
2010	0.053	0.014	0.006	0.032
2011	0.030	0.013	0.006	0.011
2012	0.025	0.011	0.010	0.004
2013	0.017	0.012	0.003	0.002
2014	0.016	0.012	0.009	(0.005)

Table 11: Yearly Data of Growth Decomposition (Honam Region)

Year	Growth Decomposition			
	GDP	Capital	Labor	TFP
1971	0.133	0.053	(0.030)	0.110
1972	0.076	0.035	0.027	0.014
1973	0.006	0.030	0.054	(0.078)
1974	0.063	0.016	0.023	0.024
1975	0.088	0.024	(0.034)	0.097
1976	0.103	0.036	0.091	(0.024)
1977	0.049	0.052	(0.025)	0.023
1978	0.095	0.049	(0.032)	0.078
1979	0.055	0.032	0.021	0.002
1980	(0.034)	0.032	(0.021)	(0.044)
1981	0.050	0.006	(0.022)	0.065
1982	0.052	0.018	(0.007)	0.041
1983	0.119	0.034	(0.022)	0.107
1984	0.067	0.033	(0.035)	0.069
1985	0.047	0.033	0.003	0.011
1986	0.084	0.035	0.030	0.019
1987	0.076	0.026	0.021	0.029
1988	0.152	0.021	0.013	0.117
1989	0.047	0.022	(0.003)	0.027
1990	0.078	0.043	0.008	0.026
1991	0.106	0.021	(0.015)	0.099
1992	0.082	0.031	0.004	0.046
1993	0.071	0.022	(0.004)	0.053
1994	0.066	0.024	0.016	0.026
1995	0.107	0.028	0.008	0.071
1996	0.087	0.027	0.011	0.050
1997	0.067	0.020	0.010	0.037
1998	(0.054)	0.017	(0.037)	(0.035)
1999	0.059	0.018	0.000	0.042
2000	0.063	0.017	0.015	0.031
2001	0.037	0.016	0.009	0.012
2002	0.039	0.016	0.006	0.017
2003	0.034	0.017	(0.010)	0.027
2004	0.052	0.016	(0.006)	0.042
2005	0.043	0.018	0.001	0.025
2006	0.033	0.018	(0.002)	0.017
2007	0.067	0.020	0.002	0.045
2008	0.047	0.018	0.003	0.026
2009	(0.011)	0.019	0.003	(0.033)
2010	0.086	0.017	(0.003)	0.073
2011	0.051	0.017	0.006	0.028
2012	0.005	0.017	0.012	(0.025)
2013	(0.000)	0.017	0.012	(0.029)
2014	0.023	0.012	0.006	0.005

Table 12: Yearly Data of Growth Decomposition (Gangwon Region)

Year	Growth Decomposition			
	GDP	Capital	Labor	TFP
1971	0.046	0.025	0.044	(0.024)
1972	0.053	0.017	0.018	0.018
1973	0.048	0.013	(0.045)	0.080
1974	0.073	0.012	0.060	0.000
1975	0.089	0.007	(0.003)	0.085
1976	0.040	0.015	(0.025)	0.050
1977	0.169	0.008	0.071	0.090
1978	0.088	0.023	0.007	0.059
1979	0.089	0.022	(0.003)	0.070
1980	(0.015)	0.022	0.017	(0.054)
1981	0.061	0.006	(0.020)	0.076
1982	0.085	0.019	0.013	0.054
1983	0.079	0.037	0.000	0.042
1984	0.165	0.022	(0.023)	0.166
1985	0.184	0.025	0.024	0.134
1986	0.088	0.022	(0.002)	0.068
1987	0.101	(0.005)	0.024	0.082
1988	0.034	0.069	0.015	(0.049)
1989	0.048	0.060	(0.017)	0.005
1990	0.049	0.063	(0.005)	(0.010)
1991	0.020	0.036	(0.007)	(0.008)
1992	0.021	0.031	0.004	(0.014)
1993	0.015	0.011	0.003	0.001
1994	0.068	0.029	0.000	0.038
1995	0.083	0.032	(0.002)	0.054
1996	0.131	0.041	0.022	0.068
1997	0.037	0.039	0.010	(0.012)
1998	(0.071)	0.020	(0.028)	(0.063)
1999	0.074	0.018	0.005	0.052
2000	0.040	0.019	0.023	(0.002)
2001	0.015	0.016	(0.006)	0.005
2002	0.053	0.017	0.022	0.014
2003	0.062	0.022	(0.018)	0.058
2004	0.019	0.021	0.007	(0.009)
2005	0.029	0.019	(0.005)	0.015
2006	0.059	0.019	0.011	0.029
2007	0.060	0.021	(0.005)	0.044
2008	0.009	0.017	0.004	(0.012)
2009	0.009	0.016	0.006	(0.014)
2010	0.027	0.015	(0.011)	0.023
2011	0.033	0.014	0.009	0.010
2012	0.028	0.013	0.014	0.002
2013	0.034	0.016	0.003	0.014
2014	0.054	0.019	0.012	0.024

Table 13: Contribution of Capital, Labor and TFP by Fixed and Total Asset Basis in Korea

Year	Growth rate by Fixed Asset Basis				Growth rate by Total Asset Basis			
	GRDP	Capital	Labor	TFP	GRDP	Capital	Labor	TFP
1971-2014	7.2	3.4	1.5	2.3	7.2	1.5	1.5	4.2
1970-1980	8.9	6.1	2.2	0.6	8.9	2.1	2.2	4.6
1981-1990	9.8	3.7	1.9	4.2	9.8	1.7	1.9	6.2
1991-2000	7.0	2.7	1.1	3.2	7.0	1.3	1.1	4.6
2001-2010	4.6	1.7	0.8	2.0	4.6	1.0	0.8	2.8
2011-2014	3.0	1.2	1.1	0.7	3.0	0.8	1.1	1.2
	Growth contributions (%)				Growth contributions (%)			
1971-2014	100.0	46.9	20.5	32.6	100.0	20.3	20.5	59.2
1971-1980	100.0	68.9	24.8	6.3	100.0	23.3	24.8	51.9
1981-1990	100.0	38.0	19.2	42.8	100.0	17.8	19.2	63.0
1991-2000	100.0	38.6	16.2	45.2	100.0	18.0	16.2	65.7
2001-2010	100.0	37.7	17.8	44.5	100.0	21.7	17.8	60.5
2011-2014	100.0	40.2	36.0	23.8	100.0	25.8	36.0	38.3

Note: Total Asset = Fixed Asset + Land Stock

Table 14: Growth and Contribution of capital, labor and TFP in Capital Region

Year	Growth rate				Growth contributions (%)			
	GRDP	capital	Labor	TFP	GRDP	capital	Labor	TFP
1971-2014	7.9	3.5	2.6	1.9	100.0	43.9	32.6	23.5
1971-1980	10.4	7.0	4.5	(1.1)	100.0	67.2	43.5	(10.7)
1981-1990	11.0	3.7	3.2	4.1	100.0	33.3	28.9	37.7
1991-2000	7.4	2.7	1.7	3.0	100.0	36.3	23.5	40.3
2001-2010	4.6	1.5	1.4	1.7	100.0	33.4	29.8	36.8
2011-2014	3.3	0.9	1.2	1.1	100.0	27.7	37.7	34.6

Table 15: Growth and Contribution of capital, labor and TFP in Chungcheong

Year	Growth rate				Growth contributions (%)			
	GRDP	Capital	Labor	TFP	GRDP	Capital	Labor	TFP
1971-2014	7.3	3.7	1.0	2.6	100.0	51.0	13.1	35.9
1971-1980	6.0	4.8	1.4	(0.2)	100.0	79.8	23.3	(3.1)
1981-1990	10.1	4.3	0.5	5.3	100.0	42.8	5.0	52.2
1991-2000	8.4	4.1	1.0	3.3	100.0	49.2	11.6	39.2
2001-2010	5.9	2.3	0.7	2.9	100.0	39.0	12.4	48.6
2011-2014	4.3	2.1	1.5	0.7	100.0	49.0	34.7	16.3

Table1 16: Growth and Contribution of capital, labor and TFP in Yeongnam Region

Year	Growth rate				Growth contributions (%)			
	GRDP	Capital	Labor	TFP	GRDP	Capital	Labor	TFP
1971-2014	6.8	3.7	1.0	2.1	100.0	54.1	15.3	30.5
1971-1980	9.6	7.4	1.4	0.9	100.0	76.8	14.1	9.1
1981-1990	8.9	4.1	1.8	3.0	100.0	45.7	20.3	34.0
1991-2000	6.5	2.5	0.8	3.1	100.0	39.1	12.9	48.1
2001-2010	4.2	1.8	0.3	2.0	100.0	43.2	7.9	48.9
2011-2014	2.2	1.2	0.7	0.3	100.0	54.7	31.6	13.7

Table 17: Growth and Contribution of Capital, Labor and TFP in Honam Region

Year	Growth rate				Growth contributions (%)			
	GRDP	Capital	Labor	TFP	GRDP	Capital	Labor	TFP
1971-2014	5.8	2.5	0.2	3.1	100.0	42.6	4.1	53.2
1971-1980	6.3	3.6	0.7	2.0	100.0	56.5	11.4	32.1
1981-1990	7.7	2.7	(0.1)	5.1	100.0	35.3	(1.7)	66.4
1991-2000	6.5	2.3	0.1	4.2	100.0	34.5	1.3	64.2
2001-2010	4.3	1.7	0.0	2.5	100.0	40.8	0.6	58.7
2011-2014	2.0	1.6	0.9	(0.5)	100.0	79.9	46.0	(25.8)

Table 18: Growth and Contribution of Capital, Labor and TFP in Gwangwon Region

Year	Growth rate				Growth contributions (%)			
	GRDP	Capital	Labor	TFP	GRDP	Capital	Labor	TFP
1971-2014	5.6	2.3	0.5	2.9	100.0	40.4	9.0	50.6
1971-1980	6.8	1.6	1.4	3.7	100.0	24.0	20.9	55.1
1981-1990	8.9	3.2	0.1	5.7	100.0	35.5	0.9	63.5
1991-2000	4.2	2.8	0.3	1.1	100.0	65.7	7.5	26.8
2001-2010	3.4	1.8	0.1	1.5	100.0	53.9	1.6	44.5
2011-2014	3.7	1.5	0.9	1.2	100.0	41.7	25.0	33.3

F. Source of Data for Construction of TFP and Indices and Compilation results

Table 1: Source of Data for Construction of TFP and Indices

Objective	Item	Statistics	Agent	Period
TFP	GRDP	Annual Report on Gross Regional Product (ARGRP)	Economic Planning Board	1970-1978 and 1983-1986.
	Wage worker	Economic Activity Census (EAC),	National Statistical Office	1970-2014
		Establishment Census (EC)	Economic Planning Board	1981, 1986 and 1991
		Census on Establishment(COE)	National Statistical Office	1993-2014
		Actual Labor Conditions at Establishment(ALCAE)	Ministry of Labor	1971-93
	Non-wage worker	ARGRP	Economic Planning Board	1970-1977
		Wholesale and retail trade survey(WARS)	Economic Planning Board	1968, 1971, 1976 and 1979
	Wage rates	Report on occupational wage	Ministry of Labor	1970-1992
		Report on the monthly labor survey	Ministry of Labor	1970-1992
	Facility asset	National wealth survey (NWS)	National Statistical Office	1968, 1977, 1987, 1997
		Mining and Manufacturing Survey (MMS)	National Statistical Office	1978~2014
	Construction Asset	Construction Works Completed(CWC)	Construction Association of Korea	1978-1985
Industrial Structure Indices	SPE, COM and DIV	MMS, IC, EC and COE	above	1970-2014
		Industrial Census(IC)	above	1973, 1978, 1983 and 1988

Table 2: Industrial Classification Used in This Study

1. Agriculture, forestry, and fishing	5. Wholesale and retail trade, restaurants, and hotels
2. Mining and quarrying+ Manufacturing	6. Transportation and storage+ Information and communication
3. Electricity, gas, and water supply	7. Finance and insurance ~ Cultural and other services
4. Construction	

Table 3: Fixed and Facility Assets by Institution Sectors by User and Ownership Basis

(Unit: 1 billion Won)

Sector	Section	Capital stocks	1977		1987		1997	
			Ownership	User	Ownership	User	Ownership	User
Nation		Facility assets	7,385.0	-	58,445.8	-	345,495.3	-
		National fixed assets	24,183.4	-	191,365.5	-	1,212,860.7	-
Industries(company)		Facility assets	7,111.3	7,384.5	56,986.3	58,615.1	316,337.4	336,713.8
		Fixed assets	19,178.0	23,696.8	159,553.7	195,899.9	931,616.4	1,100,899
	1.Agriculture, forestry and fishing	Facility assets	1,495.5	1,512.0	5,036.6	5,138.7	21,598.6	22,331.7
		Fixed assets	1,798.0	2,517.3	8,646.9	12,124.8	56,506.7	58,952.5
	2.Mining and quarrying+ Manufacturing	Facility assets	3,466.3	3,487.5	29,134.5	30,295.4	139,581.7	141,130.0
		Fixed assets	5,902.0	6,053.5	50,524.9	52,788.4	269,627.1	277,141.1
	3.Electricity, gas and water supply	Facility assets	373.4	388.9	4,511.7	4,516.4	16,990.4	18,779.7
		Fixed assets	802.7	1,023.8	9,975.6	10,045.7	41,681.3	48,116.4
	4.Construction	Facility assets	266.3	266.0	1,200.5	1,068.8	7,799.2	8,286.5
		Fixed assets	619.6	627.9	3,087.9	2,768.5	28,184.7	17,098.9
	5.Wholesale and retail trade, restaurants and hotels	Facility assets	360.4	361.8	3,358.9	3,443.5	56,858.4	58,015.5
		Fixed assets	1,320.3	1,551.0	9,881.0	12,954.7	113,038.4	189,382.0
	6.Transportation and storage+ Information and communication	Facility assets	912.3	943.6	8,714.1	8,860.7	42,148.1	45,689.9
		Fixed assets	1,453.6	3,581.7	17,449.8	18,175.5	61,626.8	66,641.3
	7.Finance and insurance~ Cultural and other services,	Facility assets	237.1	424.7	5,030.0	5,291.6	31,361.0	42,480.5
		Fixed assets	7,281.8	8,341.6	59,987.6	87,042.3	360,951.4	443,567.6
Government		Facility assets	273.7	-	1,459.5	-	29,157.9	-
		Fixed assets	5,005.4	-	31,811.8	-	281,244.3	-

Note: User Basis=Ownership Basis + lease of Asset.

Table 4: Comparison of ALCAE and COE by the No. Company and Employment in 1981 and 1986

(Unit: 1 company, 1 person)

Industry(Group)	ALCAE				COE			
	1981	1981	1986	1986	1981	1981	1986	1986
	NOC	NOE	NOC	NOE	NOC	NOE	NOC	NOE
Whole Industry	72,070	3,139,272	107,412	4,461,250	1,263,976	6,603,303	1,676,609	8,856,648
Agriculture, Forestry, Hunting and Fishing	1,422	18,073	2,457	31,549	311	13,537	702	19,694
Mining	570	72,381	1,178	86,815	2,486	83,768	2,655	92,777
Manufacturing	31,710	1,946,871	43,594	2,568,486	189,011	2,559,345	218,952	3,290,035
Electricity, gas	242	20,477	303	34,523	672	24,577	971	36,738
Construction	2,642	196,433	5,579	291,542	10,220	570,758	23,384	598,630
Wholesale and Retail Trade andRestaurant and Hotel	20,062	224,125	27,739	355,543	800,122	1,761,000	1,005,331	2,452,759
Transport, Storage and Communication	3,661	262,445	6,454	439,659	12,604	316,625	22,401	456,250
Financing, Insurance, Real estate and Business	6,087	209,684	11,260	326,079	49,559	402,049	80,670	614,881
Community Social and Personal Services	5,674	188,783	8,848	327,054	198,991	871,644	321,543	1,294,884

Note: NOC is No. of Company, NOE is No. of Employment

Table 5: Comparison between No. of Company and Employment between ALCOE and COE

Region	81-81	81-81	86-86	86-86
	No. of Company	No. Employment	No. of Company	No. Employment
Nation	0.601	0.828	0.566	0.809
Seoul	0.770	0.808	0.804	0.853
Busan	0.360	0.906	0.251	0.878
Daegu	0.269	0.858	0.238	0.807
Incheon	0.336	0.951	0.383	0.930
Gyeonggi	0.242	0.925	0.142	0.912
Gangwon	0.889	0.371	0.872	0.307
Chungbuk	0.564	0.592	0.350	0.566
Chungnam	0.338	0.657	0.553	0.559
Jeonbuk	0.476	0.616	0.558	0.601
Jeonnam	0.777	0.528	0.678	0.502
Gyeonbuk	0.353	0.739	0.238	0.743
Gyeongnam	0.456	0.874	0.340	0.887
Jeju	0.527	0.375	0.074	0.401
Average Correlation	0.497	0.716	0.432	0.697

Table 6: Comparison of Employment by EC, COE and EAC

(Unit: 1 thousand person)

Survey	Year														
	1981	1986	1991		1993	1995	1997	1999	2001	2003	2005	2007	2009	2011	2013
EC	6,603	8,857	11,356	EOS	12,245	13,634	13,470	12,920	14,110	14,729	15,147	15,944	16,818	18,093	19,173
EAC	6,605	8,433	11,699	EAC	11,944	12,899	13,404	12,663	13,659	14,402	15,185	15,970	16,454	17,397	18,195

Table 7: Comparison of Employee Incomes in ECOS with Estimates (after adjustment)

(Unit: 1 billion won)

region	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Nation	262,353	286,958	316,002	345,189	372,823	402,053	426,548	457,531	481,846	500,055	537,340	568,667	598,393	629,642	663,158
Seoul	71,533	78,373	85,511	92,311	99,448	107,167	114,458	124,007	128,113	129,134	138,269	145,221	152,962	158,040	163,842
Gyeonggi	54,101	60,677	69,263	77,221	85,430	93,403	100,499	107,845	115,132	119,790	130,600	138,614	145,962	155,067	164,499
Chungnam	7,849	8,530	9,532	10,674	12,108	12,993	13,947	14,790	16,127	17,197	19,548	20,932	22,619	25,490	26,940
Jeonnam	7,247	7,797	8,373	9,041	9,507	10,188	10,479	11,103	11,775	12,318	12,997	13,515	14,062	15,516	16,587
Gyeongnam	14,545	15,959	17,663	19,450	21,080	22,560	24,025	25,898	28,076	29,259	31,010	32,988	34,012	36,525	38,765
Nation	259,269	286,843	316,073	346,028	375,762	400,860	424,218	454,040	482,134	498,537	540,761	579,243	609,415	626,537	653,486
Seoul	68,706	78,623	86,799	94,567	101,519	107,519	112,326	119,589	126,162	125,136	133,515	148,051	150,470	158,472	161,318
Gyeonggi	54,631	59,630	67,749	76,265	85,835	93,506	102,244	111,765	113,993	119,858	131,118	139,451	153,816	154,892	163,562
Chungnam	8,158	9,189	9,937	11,174	12,360	12,667	13,865	15,326	17,891	17,144	19,838	21,844	24,285	27,011	27,812
Jeonnam	8,023	8,748	9,655	10,749	10,550	11,545	11,830	12,569	13,726	15,423	15,826	17,304	18,047	18,185	18,996
Gyeongnam	14,824	16,482	17,614	19,701	21,650	22,952	23,956	25,334	28,138	29,336	31,349	34,387	34,931	35,329	37,258

Table 8: Comparison of Fixed Asset by NWS and KOSIS

(Unit: 1 billion Won)

Source	Year			
	1968	1977	1987	1997
NWS	2,468.6	25,528.6	205,988	1,528,702.8
KOSIS	-	27,413.	216,665.4	1,311,058.8

Table 9: Facility Assets by NWS and MMS in Mine and Manufacturing Industries

(Unit: 1 billion Won)

Region	NWS			MMS			Differences		
	1977	1987	1997	1977	1987	1997	1977	1987	1997
Nation	3,466.3	29,134.5	139,581.7	2,850.7	21,618.8	112,673.0	615.6	7,515.7	26,908.7
Seoul	1,195.0	4,474.0	9,322.1	393.5	1,892.2	4,318.9	801.5	2,581.8	5,003.2
Busan	320.4	2,219.2	3,928.1	257.6	1,182.4	2,797.5	62.8	1,036.8	1,130.6
Daegu	-	934.0	3,956.3	-	728.5	3,142.0	-	205.5	814.3
Incheon	-	1,934.2	7,893.3	-	1,883.6	7,408.6	-	50.6	484.7
Gwangju	-	356.9	1,808.1	-	310.1	1,884.4	-	46.8	-76.3
Daejun	-	-	1,166.4	-	-	1,844.4	-	-	-678.0
Ulsan	-	-	17,040.2	-	-	12,694.6	-	-	4,345.6
Gyeonggi	518.4	6,478.2	29,735.0	560.1	4,795.4	24,988.3	-41.7	1,682.8	4,746.7
Gangwon	59.3	407.6	3,230.7	89.2	766.4	2,837.3	-29.9	-358.8	393.4
chungbuk	44.0	1,036.6	10,415.3	117.5	755.5	7,309.9	-73.5	281.1	3,105.4
Chungnam	120.2	749.7	10,847.8	117.6	814.6	8,895.7	2.6	-64.9	1,952.1
Jeonbuk	55.5	583.2	5,623.4	54.1	464.2	5,630.5	1.4	119.0	-7.1
Jeonnam	68.6	1,866.5	7,821.0	214.3	1,640.8	7,494.6	-145.7	225.7	326.4
Gyeongbuk	630.1	3,447.3	17,546.0	571.7	2,339.3	12,579.9	58.4	1,108.0	4,966.1
Gyeongnam	452.7	4,626.8	9,107.0	472.0	4,028.0	8,731.0	-19.3	598.8	376.0
Jeju	2.6	19.9	140.8	2.4	18.0	115.4	0.2	1.9	25.4

Table 10: Yearly Data for Land Asset

(Unit: 1billion Won)

	Nation	Capital	Chungcheong	Yeongnam	Honam	Gangwon
1970	375,985	223,806.835	41,859.185	63,150.110	25,780.779	15,931.781
1971	395,259	236,232.421	43,581.619	66,306.027	26,814.945	16,658.807
1972	368,574	221,829.818	40,137.236	61,504.903	24,662.121	15,276.194
1973	393,511	237,523.261	42,604.048	65,563.430	26,147.074	16,157.506
1974	395,337	238,979.946	42,389.807	66,088.499	26,005.297	16,407.824
1975	394,379	240,216.830	41,809.920	65,520.653	25,621.142	15,842.587
1976	390,104	238,052.663	41,063.915	65,106.089	25,108.118	15,512.067
1977	484,905	295,759.801	51,107.109	80,974.115	31,193.992	19,345.452
1978	662,725	405,204.925	69,455.589	110,447.618	42,435.183	26,321.559
1979	663,990	406,354.446	68,161.375	113,290.206	41,903.667	25,320.591
1980	580,751	356,609.727	59,277.145	98,622.848	36,535.208	21,930.936
1981	545,199	330,794.900	53,114.762	101,687.956	32,721.778	19,617.613
1982	566,343	345,361.518	55,313.747	103,481.358	34,152.827	20,438.032
1983	697,218	432,397.251	66,163.514	124,115.100	40,996.480	24,405.520
1984	805,614	500,377.700	76,245.553	143,232.181	47,295.982	27,921.105
1985	900,857	560,097.177	84,974.528	160,101.818	52,830.472	31,097.694
1986	1,025,730	638,724.438	96,250.195	182,643.857	59,915.543	34,804.287
1987	1,212,641	754,237.886	112,002.669	213,313.115	76,547.212	40,551.037
1988	1,534,862	956,399.480	140,811.376	269,471.052	96,871.418	51,050.786
1989	2,021,870	1,237,649.227	213,677.104	345,970.159	133,026.667	65,495.559
1990	2,462,620	1,518,102.267	246,269.372	425,467.156	161,692.626	79,466.205
1991	2,821,505	1,739,752.399	280,911.711	489,273.388	184,801.091	90,570.505
1992	2,709,529	1,670,352.695	270,314.530	469,893.451	177,196.146	87,009.254
1993	2,398,875	1,482,192.051	237,425.045	415,806.896	156,185.558	76,619.757
1994	2,325,313	1,434,677.464	232,762.865	402,825.133	151,310.269	74,040.732
1995	2,479,555	1,529,845.074	248,494.347	430,253.239	161,319.712	78,037.697
1996	2,489,700	1,513,355.097	247,299.095	465,814.186	158,411.959	74,984.073
1997	2,479,084	1,510,044.121	245,206.798	463,299.136	156,710.448	74,319.943
1998	2,161,078	1,315,565.656	213,147.067	404,965.211	137,186.293	64,649.436
1999	2,339,715	1,425,141.184	230,206.417	437,209.919	149,667.343	69,845.817
2000	2,435,880	1,482,761.928	239,919.829	456,048.446	155,758.653	72,588.009
2001	2,498,897	1,521,394.632	245,251.516	468,936.881	159,652.565	74,126.301
2002	2,824,736	1,722,107.702	276,657.923	529,361.684	179,501.154	83,646.352
2003	3,070,937	1,873,495.774	301,058.667	574,133.929	194,934.401	90,848.986
2004	3,396,492	2,075,809.421	332,079.799	633,212.409	214,580.131	100,367.212
2005	3,889,573	2,380,976.771	379,488.128	722,928.110	245,096.743	114,649.098
2006	4,543,235	2,780,753.340	443,248.541	844,196.401	286,765.669	133,709.717
2007	5,105,559	3,127,668.080	497,601.889	948,166.378	321,251.449	149,632.445
2008	5,111,274	3,130,597.261	496,514.775	950,398.827	322,702.544	149,500.506
2009	5,162,117	3,159,949.720	500,784.029	961,765.476	327,279.471	150,311.641
2010	5,244,590	3,213,418.135	507,769.781	975,097.727	333,071.286	152,249.349
2011	5,430,536	3,325,466.649	526,671.788	1,010,973.707	344,554.023	157,688.372
2012	5,580,045	3,400,720.029	566,684.946	1,032,703.417	352,343.313	161,008.262
2013	5,700,166	3,476,801.899	578,145.095	1,053,665.182	359,977.909	163,758.363
2014	5,962,835	3,637,168.495	604,228.277	1,104,332.235	375,432.171	170,411.124

Table 11: Yearly Data for Facility Asset

(Unit: 1billion Won)

real facility	Nation	Capital	Chungcheong	Yeongnam	Honam	Gangwon
1970	19,417.6	8,956.1	1,667.8	5,260.7	2,759.0	562.2
1971	23,923.2	11,289.6	1,817.1	6,736.7	3,168.4	669.9
1972	29,696.2	13,648.2	2,307.3	8,642.8	3,925.5	875.6
1973	36,807.7	16,346.4	2,673.5	11,396.2	4,760.2	1,276.4
1974	43,112.8	18,836.2	3,286.8	13,631.3	5,603.1	1,355.0
1975	47,747.0	23,070.0	3,804.2	13,902.2	5,120.1	1,431.9
1976	55,956.3	28,700.4	4,077.8	15,162.1	5,807.1	1,700.6
1977	67,844.2	29,023.8	5,300.6	23,470.4	6,107.6	2,448.9
1978	84,734.7	36,020.4	6,409.4	30,103.9	7,753.5	2,803.7
1979	102,612.3	42,809.1	7,653.0	37,840.0	9,141.7	3,413.0
1980	114,923.5	48,254.9	8,230.1	41,171.3	11,472.5	4,012.8
1981	128,416.1	54,308.9	9,121.0	46,734.7	12,585.4	3,861.6
1982	142,713.3	61,005.6	10,408.5	51,380.2	13,911.7	4,137.4
1983	155,766.1	68,168.2	11,210.1	54,460.9	15,112.8	4,856.1
1984	171,920.4	78,257.8	12,680.3	57,451.1	16,340.7	5,148.3
1985	190,062.1	88,645.4	14,053.3	61,729.0	18,086.5	5,423.4
1986	213,426.2	101,790.7	16,443.0	67,469.3	19,805.7	5,684.9
1987	236,199.5	114,492.5	17,537.9	71,890.6	24,122.0	5,961.3
1988	253,309.2	124,469.1	19,042.9	77,345.1	24,141.1	6,060.0
1989	264,692.3	127,696.8	20,292.3	83,053.5	24,934.3	6,337.0
1990	276,738.2	131,362.3	21,622.3	80,436.0	34,330.2	6,588.9
1991	294,712.4	140,119.6	25,784.9	85,195.5	34,402.0	6,717.8
1992	322,655.7	150,975.5	29,697.2	90,414.5	41,029.4	7,828.5
1993	349,136.2	163,725.1	34,158.2	98,414.7	41,478.3	8,299.5
1994	379,015.6	181,618.2	36,346.2	106,110.7	42,848.2	8,880.0
1995	414,490.9	202,023.1	41,871.4	112,120.6	45,816.1	9,480.5
1996	458,567.8	219,975.3	46,351.0	128,400.1	49,870.8	10,582.3
1997	511,363.7	245,841.2	53,298.2	140,199.5	57,268.3	11,178.2
1998	509,080.6	250,050.7	48,716.9	141,532.7	48,594.9	15,235.4
1999	507,814.6	251,958.4	49,301.2	137,484.7	49,456.3	15,094.0
2000	534,811.4	265,876.7	52,173.9	143,704.3	52,041.5	16,453.2
2001	532,880.9	265,411.7	51,634.4	143,330.9	51,791.9	16,158.2
2002	524,801.8	265,072.8	49,764.4	137,764.5	51,570.8	15,572.1
2003	515,236.7	263,219.9	48,163.7	134,592.0	48,870.2	15,499.9
2004	512,305.6	271,727.8	46,740.1	129,401.8	45,260.8	14,492.7
2005	512,182.7	265,353.2	52,627.8	127,673.9	46,672.8	15,190.4
2006	509,428.1	259,607.1	52,118.6	133,416.3	44,804.1	13,727.1
2007	519,702.3	262,487.3	53,605.2	135,962.1	45,560.4	16,179.9
2008	559,277.1	279,314.2	59,036.5	144,535.0	51,970.8	17,689.3
2009	570,462.7	287,607.2	60,284.4	145,982.9	51,929.3	18,026.8
2010	569,916.8	282,391.2	60,264.8	151,646.6	51,242.2	17,823.1
2011	584,643.2	289,590.3	64,574.3	149,360.9	55,482.3	18,774.0
2012	595,591.3	299,960.5	67,484.4	148,957.0	55,307.0	17,196.4
2013	595,175.4	301,669.1	67,392.1	147,368.9	55,212.6	16,803.4
2014	600,794.7	306,594.4	67,719.4	147,353.1	55,294.3	16,880.8

Table 12: Employment Comparison by MMS (left, 1~) and EC (Right: 1~)

(Unit: 1 person)

Region	MMS				EC			
	1981	1986	1991	1993	1981	1986	1991	1993(COE)
Nation	2,381,047	3,007,544	3,316,241	3,266,273	2,559,345	3,290,035	4,231,080	3,935,686
Seoul	530,821	584,726	567,748	523,268	722,131	880,229	1,133,346	1,148,624
Busan	373,781	406,894	354,752	302,787	376,640	457,047	457,042	309,126
Daegu	160,888	191,308	193,619	183,173	178,628	196,365	212,655	185,460
Incheon	159,517	213,350	241,949	238,608	161,544	204,626	287,641	242,963
Gwangju	-	44,541	53,313	55,373	-	28,387	63,713	56,530
Daejeon	-	-	58,656	55,508	-	-	67,511	53,085
Gyeonggi	382,468	609,101	763,657	778,963	372,290	588,512	840,435	793,972
Gangwon	30,946	34,561	43,390	47,138	37,606	41,984	50,704	50,128
Chungbuk	46,876	69,103	95,205	103,724	47,515	62,701	99,211	102,859
Chungnam	104,647	126,529	97,561	112,525	114,895	122,530	92,874	112,494
Jeonbuk	67,534	82,921	89,606	88,212	64,099	84,820	100,266	92,678
Jeonnam	106,797	60,533	83,902	89,446	90,668	81,598	98,764	86,898
Gyeongbuk	137,740	189,262	233,611	242,460	142,726	181,411	256,033	256,537
Gyeongnam	272,891	373,693	431,994	437,609	244,908	353,890	461,418	436,492
Jeju	6,141	6,615	7,278	7,479	5,695	5,935	9,467	7,840

Table 13: No. of Company and ratios by industries in MMS (left, 1~), MMS (middle, 5~), EC (right, 5~)

(Unit: 1 company)

Region / Industry	Year											
Nation	1981	1986	1981	1986	1981	1986	1981	1986	1981	1986	1981	1986
	No. of Company		Ratios		No. of Company		Ratios		No. of Company		Ratios	
	936	2,342	0.068	0.073	364	265	0.042	0.017	3,162	4,419	0.059	0.065
Food, beverages and tobacco	8,904	13,745	0.541	0.376	2,623	5,883	0.300	0.386	24,573	25,931	0.460	0.382
Wearing apparel and leather	1,238	1,829	0.085	0.072	457	416	0.052	0.027	3,903	3,451	0.073	0.051
Wood and wood products incl. furniture	1,016	3,773	0.038	0.060	1,180	1,977	0.135	0.130	4,551	7,118	0.085	0.105
Paper and paper product printing and publishing	579	1,869	0.053	0.068	815	1,117	0.093	0.073	2,869	3,525	0.054	0.052
Chemicals and of chemical petroleum, coal, rubber and plastic products	240	618	0.016	0.015	308	318	0.035	0.021	1,059	1,166	0.020	0.017
Non-metallic mineral products, except products of petroleum and coal	113	361	0.014	0.013	214	151	0.024	0.010	442	681	0.008	0.010
Metal	2,169	7,724	0.134	0.238	2,352	4,060	0.269	0.266	9,080	14,572	0.170	0.215
Fabricated metal products, machinery and equipment	1,762	3,744	0.053	0.085	442	1,056	0.050	0.069	3,758	7,063	0.070	0.104
Other manufacturing	16,957	36,006	1.000	1.000	8,755	15,243	1.000	1.000	53,397	67,926	1.000	1.000
Seoul	4,157	2,793	0.424	0.178	476	603	0.096	0.058	3,883	4,725	0.215	0.178
Food, beverages and tobacco	3,222	4,136	0.329	0.264	1,014	1,873	0.205	0.179	6,267	6,997	0.347	0.264
Wearing apparel and leather	627	1,270	0.064	0.081	283	689	0.057	0.066	1,328	2,148	0.074	0.081
Wood and wood products incl. furniture	144	617	0.015	0.039	238	471	0.048	0.045	602	1,044	0.033	0.039
Paper and paper product printing and publishing	126	1,153	0.013	0.074	690	1,537	0.139	0.147	1,046	1,950	0.058	0.074
Chemicals and of chemical petroleum, coal, rubber and plastic products	533	783	0.054	0.050	514	795	0.104	0.076	1,082	1,324	0.060	0.050
Non-metallic mineral products, except products of petroleum and coal	9	221	0.001	0.014	192	373	0.039	0.036	156	374	0.009	0.014
Metal	749	3,426	0.076	0.219	1,287	3,512	0.260	0.335	2,697	5,795	0.149	0.219
Fabricated metal products, machinery and equipment	230	1,267	0.023	0.081	254	620	0.051	0.059	988	2,144	0.055	0.081
Other manufacturing	9,796	15,666	1.000	1.000	4,948	10,473	1.000	1.000	18,049	26,501	1.000	1.000

Table 14: Employment and ratio by industries in MMS (left, 1~), MMS (middle, 5~), EC (right, 5~)

(Unit: 1 person)

Region / Industry	Year											
Nation	1981	1986	1981	1986	1981	1986	1981	1986	1981	1986	1981	1986
	Employment		Ratios		Employment		Ratios		Employment		Ratios	
Food, beverages and tobacco	39,026	34,125	0.074	0.058	34,456	30,532	0.081	0.057	50,033	51,371	0.069	0.058
Wearing apparel and leather	188,447	205,882	0.355	0.352	150,510	202,732	0.352	0.376	289,911	309,928	0.401	0.352
Wood and wood products incl. furniture	10,100	11,629	0.019	0.020	6,710	5,389	0.016	0.010	17,259	17,506	0.024	0.020
Paper and paper product printing and publishing	45,214	56,658	0.085	0.097	41,318	53,325	0.097	0.099	61,127	85,291	0.085	0.097
Chemicals and of chemical petroleum, coal, rubber and plastic products	47,639	57,177	0.090	0.098	39,772	42,989	0.093	0.080	68,356	86,073	0.095	0.098
Non-metallic mineral products, except products of petroleum and coal	12,622	11,946	0.024	0.020	10,839	8,771	0.025	0.016	19,641	17,983	0.027	0.020
Metal	11,049	8,900	0.021	0.015	8,792	7,440	0.021	0.014	12,329	13,398	0.017	0.015
Fabricated metal products, machinery and equipment	142,509	155,220	0.268	0.265	108,420	147,320	0.253	0.273	161,688	233,663	0.224	0.265
Other manufacturing	34,215	43,189	0.064	0.074	27,166	40,737	0.063	0.076	41,787	65,016	0.058	0.074
Seoul	530,820	584,726	1.000	1.000	427,983	539,235	1.000	1.000	722,131	880,229	1.000	1.000
Food, beverages and tobacco	32,283	51,792	0.073	0.085	22,214	37,463	0.066	0.064	28,813	50,041	0.077	0.085
Wearing apparel and leather	113,747	129,946	0.256	0.213	93,799	117,440	0.277	0.202	103,639	125,554	0.278	0.213
Wood and wood products incl. furniture	19,812	22,492	0.045	0.037	7,090	17,041	0.021	0.029	10,112	21,732	0.027	0.037
Paper and paper product printing and publishing	18,161	27,790	0.041	0.046	16,019	23,796	0.047	0.041	18,071	26,851	0.049	0.046
Chemicals and of chemical petroleum, coal, rubber and plastic products	45,788	64,119	0.103	0.105	34,618	68,637	0.102	0.118	37,892	61,952	0.102	0.105
Non-metallic mineral products, except products of petroleum and coal	30,757	33,763	0.069	0.055	24,606	34,866	0.073	0.060	24,935	32,622	0.067	0.055
Metal	13,827	10,321	0.031	0.017	7,731	13,933	0.023	0.024	5,390	9,972	0.014	0.017
Fabricated metal products, machinery and equipment	146,525	235,809	0.330	0.387	114,854	239,040	0.339	0.410	125,835	227,838	0.338	0.387
Other manufacturing	23,323	33,068	0.053	0.054	17,651	30,402	0.052	0.052	17,603	31,950	0.047	0.054
Gyeonggi	444,223	609,101	1.000	1.000	338,582	582,618	1.000	1.000	372,290	588,512	1.000	1.000

Table 15: Correlation of Establishment and Employment of Industries within Region by IC and EC

	No. of Company			Employment		
Region	81-81	83-86	88-91	81-81	83-86	88-91
Nation	0.89	0.83	0.84	0.99	0.99	0.99
Seoul	0.99	0.94	0.94	0.98	1.00	0.94
Gyeonggi	0.85	0.80	0.55	0.39	0.99	1.00
Gangwon	0.98	0.99	0.97	0.96	0.86	0.96
Chungbuk	0.99	0.98	0.96	0.96	0.99	0.98
Chungnam	0.98	0.99	0.96	0.98	0.98	0.94
Jeonbuk	0.98	0.99	0.99	0.98	0.99	0.97
Jeonnam	0.62	0.81	0.96	0.81	0.96	0.97
Gyeongbuk	0.82	0.96	0.93	0.57	0.97	0.99
Gyeongnam	0.97	0.90	0.79	0.95	0.95	0.94
Jeju	0.96	0.98	0.93	0.84	0.94	0.98
M(mean of corr.)	0.91	0.92	0.89	0.86	0.97	0.97

Table 16: Specification of Indices in Regression Analysis

	Period	1970~1980					1981~1990					1991~1997					1998~2014				
Variable	Region	CA	CC	YN	HN	GA	CA	CC	YN	HN	GA	CA	CC	YN	HN	GA	CA	CC	YN	HN	GA
SPE		0.126	0.229	0.173	0.290	0.380	0.145	0.233	0.198	0.317	0.464	0.148	0.220	0.204	0.255	0.389	0.145	0.180	0.178	0.227	0.427
	STDEV.	0.006	0.024	0.005	0.026	0.036	0.007	0.024	0.008	0.021	0.041	0.005	0.020	0.012	0.014	0.024	0.005	0.009	0.008	0.014	0.010
	MAX.	0.139	0.271	0.179	0.322	0.441	0.156	0.286	0.215	0.334	0.506	0.155	0.239	0.220	0.278	0.422	0.156	0.196	0.191	0.242	0.451
	MIN.	0.120	0.190	0.164	0.242	0.307	0.134	0.216	0.192	0.287	0.411	0.139	0.177	0.187	0.229	0.351	0.138	0.165	0.169	0.200	0.414
COM		1.015	1.120	0.863	1.387	1.493	1.275	0.731	0.670	0.970	1.485	1.176	0.789	0.803	0.926	1.146	1.196	0.769	0.879	0.854	1.165
	STDEV.	0.134	0.158	0.109	0.176	0.118	0.012	0.036	0.013	0.053	0.158	0.109	0.082	0.121	0.071	0.100	0.102	0.038	0.025	0.042	0.042
	MAX.	1.208	1.338	1.012	1.598	1.629	1.296	0.806	0.687	1.034	1.768	1.282	0.939	0.952	1.074	1.276	1.555	0.845	0.907	0.963	1.280
	MIN.	0.834	0.861	0.717	1.077	1.177	1.256	0.698	0.648	0.876	1.328	1.019	0.693	0.675	0.850	0.987	1.092	0.714	0.810	0.799	1.101
DIV		10.667	4.730	6.853	4.175	5.236	10.498	6.511	7.450	5.108	3.892	10.304	9.812	7.916	8.920	4.351	8.375	8.164	5.876	7.581	3.626
	STDEV.	0.592	0.575	0.552	1.166	0.776	0.222	0.036	0.013	0.053	0.158	0.369	0.082	0.121	0.071	0.100	0.662	1.004	0.984	1.429	0.286
	MAX.	11.527	5.840	7.879	5.780	6.781	10.716	0.806	0.687	1.034	1.768	10.922	0.939	0.952	1.074	1.276	10.202	10.039	7.503	9.701	4.315
	MIN.	9.799	3.881	6.057	2.127	4.356	10.135	0.698	0.648	0.876	1.328	9.649	0.693	0.675	0.850	0.987	7.509	7.207	4.651	5.463	3.196

Notes: CA (capital Region), CC (Chungcheong Region), YN (Yeongnam Region), HN (Honam Region), GA (Gangwon Region), Above indices values are not log taken values.

G. GTFP by Primal and Dual Method and Trend of Regional GRDP and Employment

Figure 1: Regional TFP Growth Rates by Primal Method

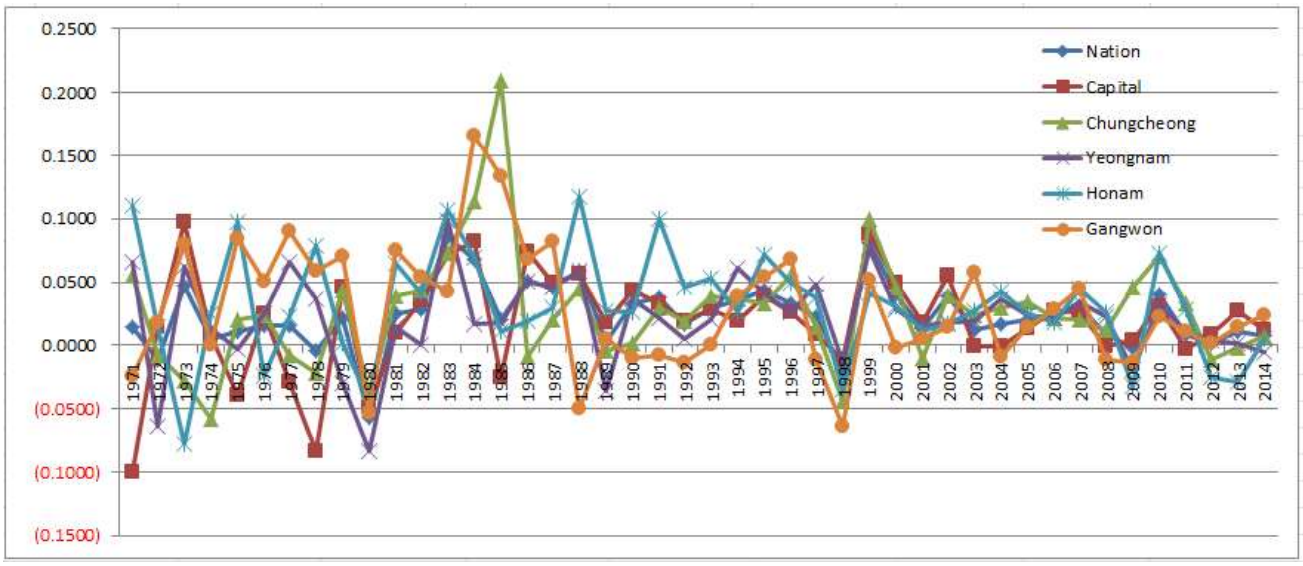

Figure 2: Regional TFP Growth Rates by Dual Method

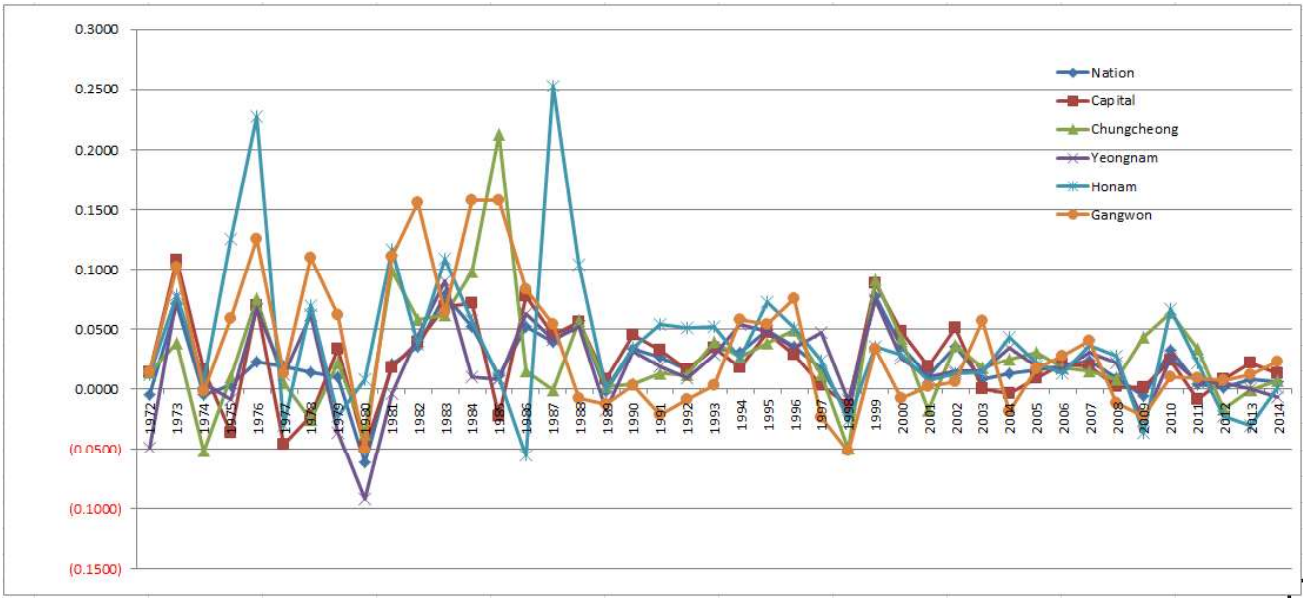

Figure 3(above): Trend of Regional GRDP

Figure 4(below): Trend of regional Employment