# Has regional disparity been reduced in Korea?: A sectoral approach

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**Abstract**

Since mid-1980s, notably after the Democratization Movement in 1987, Korea had moved from an unbalanced regional development policy to a more balanced one. As the first study for Korea, this paper examines the contribution of sectors to output disparity for 15 Korea's regions for 1989-2012. The major finding is that, quite contrary to the experiences of the OECD countries presented in Bernard and Jones (1996), the services industry in Korea shows no sign of labor productivity convergence, while the manufacturing industry mostly drives labor productivity divergence, leading to the aggregate non-convergence result for 1989-2012. Thus, contrary to the popular expectation, a rapid decentralization of industries did not contribute to the reduction of output disparity across Korea's regions. The potential impacts of economic liberalization realized after joining the OECD in 1996 and the aftermath of financial crisis in late 1997 contributed to increases in the regional disparity in Korea.

*Keywords*: convergence, divergence, decentralization of industries, regional growth, regional disparity, financial crisis

*JEL Classification*: O18, O53, R12

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# 1 Introduction

Korea has experienced a rapid industrialization since early 1960s, which had transformed the economy from the one with traditional light industries to that with industrially more sophisticated heavy industries. In a country in which no significant trade barriers would exist among regions, natural or artificially-induced comparative advantage is likely to lead to regional specializations of manufacturing production within the country. Korea's early industrialization, especially during 1970s, was benefited much from the central government's discretionary credit policies in favor of heavy and chemical industries. During this period, the beneficiaries of the Heavy Machinery and Chemical Industries Promotion Plan were the export industries in the periphery of the so-called *Capital Region industrial complex*, comprising Seoul (the capital of Korea), Incheon and the surrounding areas in the Gyeonggi province, and new factories located largely in the industrial estates along the *South-eastern Industrial Belt* of Korea. The drive for heavy and chemical industries, however, happened to result in huge over-investment, and a severe recession following the assassination of the late President Park in October of 1979 and the second Oil Shock during 1980-81, hit a final blow to the drive. As a natural consequence, the Korean government shifted its selectively intervening industrial policy to a more market-determined one since early 1980s.

The Korean economy began to recover in around 1984-85 thanks to a favorable international economic environment to peak during 1988-90 and remained in boom until 1993. During 1986-88, the Korean economy had experienced for the first time in its history a substantial amount of current account surplus and a surge of foreign exchanges into the country, which was not managed adequately by the government at the time. The adverse by-products were substantial across-the-board increases in real estate prices in Korea. Responding to the price hike, many firms had relocated from major metropolitan areas to suburban areas, and even to remote rural areas. On the other hand, immediately after the Democratization Movement in June of 1987, labor disputes spread instantaneously all over the country. Since then, most of firms had undergone restructuring in the face of rapid increases in wages, changes in labor and industrial relations, and

shortages of production workers. Since 1993, the long-waited local autonomy has been established, which would foster favorable environment for the reduction of regional disparity, and policy priorities regarding regional development were on restricting the excessive concentration of the Capital Region, comprising Seoul, Incheon and the Gyeonggi province.

In a similar regional development context, but without utilizing an econometric analysis, Fujita and Tabuchi (1997) studied how industrial shifts in postwar Japan brought about fast regional transformation (or shift) across Japanese regions. They showed that an industrial shift from light to heavy industries resulted in the regional transformation from the Tokyo-Osaka bipolar system to the much wider Pacific industrial belt system, and another industrial shift from heavy to high-tech and service industries induced the second regional transformation to the Tokyo monopolar system. They also claimed that the development in telecommunications and transportation technologies in mid-1990s tended to agglomerate knowledge-intensive activities in the core regions of Japan while dispersing mass-production activities to non-metropolitan regions and overseas.

Researches on convergence of regional income disparity were initiated by Barro and Sala-i-Martin (1991, 1992) and Sala-i-Martin (1996), who found evidence of strong convergence of per-capita regional incomes across the U.S. states for 1950-85, across the Japanese prefectures for 1950-87, and across West European provinces for 1950-85, respectively.[3] That is, poorer regions have grown faster than richer regions in these countries. Quite a few researchers have found similar results.[4] Persson (1997) found evidence of convergence in income per-capita across Swedish countries for 1911-93. He also found that using cost-of-living adjusted incomes as opposed to non-adjusted incomes yielded a faster rate of convergence. Borsi and Metiu (2013) found that real income per capita convergence was observed for 1970-2010 among Eurozone countries only, and that there was a clear separation between Central and Eastern European countries and old EU members.

[3] Literature on convergence and divergence also covers other aspects than income or output. Estrada, Gali and Lopez-Salido (2013) have examined the patterns of convergence and divergence in unemployment rates, inflation, relative prices and current account balances among euro area countries over the past quarter century.

[4] Higashikata (2013) also found that Japanese prefectures experienced a diminishing regional income disparity during the high economic growth period of 1955-73.

More interestingly, regional income (output) convergence tends to be less evident in developing countries than developed countries. Hossain (2000) found strong convergence of per-capita output levels for most of the regions of Bangladesh during 1982-91, but no evidence for regional convergence during 1991-97 that coincided with opening up the economy. Studies on China's regional income disparity, in general, found no convergence before 1978 but a mild convergence since the economic reforms initiated in 1978, followed by the more recent income divergence in the 1990s due to splendid growth performance of the coastal regions (Zhang, Liu and Yao, 2001). Kumar and Subramanian (2011) found that India experienced regional income divergence across Indian states from 2001 to 2009.

In the seminal paper that first studied the contribution of individual sectors to aggregate productivity convergence, Bernard and Jones (1996) showed that while aggregate productivity was converging for 14 OECD countries during 1970-89, individual sectors show disparate behavior. They observed cross-country convergence of productivity in services, but not in manufacturing industries. This finding for services, together with the declining share of manufacturing in all 14 OECD countries, could explain the convergence phenomenon observed at the aggregate level in 14 OECD countries. Gouyette and Perelman (1997) also showed that, contrary to the manufacturing sector, productivity levels converge in the services sector of 13 OECD countries for 1970-89.

We have 15 Korea's regions in our data set, consisting of nine provinces (Gyeonggi, Gangwon, Chungbuk, Chungnam, Jeonbuk, Jeonnam, Gyeongbuk, Gyeongnam and Jeju) and six metropolitan cities, Seoul, Busan, Daegu, Incheon, Gwangju and Daejeon. The National Statistical Office of Korea provides official statistics for the Gross Regional Domestic Product (GRDP) of Korea's provinces and metropolitan cities. This paper aims at empirically analyzing whether the Korean government's regional development policy of decentralization of industries from the traditional metropolitan areas to suburban areas has indeed reduced regional disparity over the period 1989-2012, for which detailed regional and sectoral output data are available for Korea.[5]

The National Statistical Office of Korea has provided the data on a

[5] The GRDP data are available since 1985. However, the data for Gwangju and Daejeon are available only since 1989. Thus, we choose to use 15 regions in exchange for a somewhat shortened sample period.

sectoral basis since 1992. The seven sectors are agriculture, mining, manufacturing, construction, trade/food/lodging, electricity/transport/storage/finance, and other services & government. The data for three broad sectors, agriculture, mining & manufacturing and services, are available from as early as 1989.[6] As the first study of its kind for Korea, a newly industrialized economy, this paper examines the contribution of individual sectors to aggregate output disparity for 15 Korea's regions during 1989-2012.

Section 2 describes and examines the historical evolution of economic powers of Korea's regions. In Section 3, we start by analyzing whether regional disparity across 15 Korea's regions have been converging for the last seventeen years, 1989-2012, and then we examine the reasons for the phenomenon by examining a disaggregated sectoral data in Section 4. Section 5 concludes the paper.

## 2 Korea's regions and GRDP per capita

Table 1 shows relative levels and growth rates of GRDP per capita across Korea's regions. The initial GRDP per capita in 1989 was the highest for Seoul, the capital city of Korea, followed by Incheon and Gyeongnam. The poorest regions were Jeonbuk, Busan, Daegu and Gwangju. After 23 years, Chungnam was named by far the wealthiest region with somewhat distant followers being Jeonnam and Gyeongnam. The Chungnam province made a stellar performance during the 1989-2012 period of growing at an annual average of 6.8 percent and jumped from the ninth in 1989 up to the richest region in 2012. On the other hand, Incheon, the second richest in 1989 fell to the eighth place in 2012. Seoul's rank fell from the richest in 1989 to the fifth place in the nation in 2012. The poorest region, Jeonbuk, produced GRDP per capita just 60 percent as much as Seoul, the richest region, did in 1989. In contrast, Daejeon, the poorest underdog in 2012, produced GRDP per capita only 42 percent as much as

[6] More disaggregated data on outputs of the SITC two-digit level manufacturing industries are available for a few selected years such as used in Lee and Zang (1998). But, the data does not provide information on output per employee but only output per man-hour.

Chungnam, the richest region, did. Regional disparity in GRDP per capita seems to be widening during 1989-2012.

An interesting observation on comparing the growth rate of GRDP per capita for 1989-97 with that of 1997-2008 is that only the Gyeonggi province maintained the growth rate of about 4 percent for the two periods on the average, while all other provinces or metropolitan cities lost due to the aftermath of the financial crisis of 1997. On the contrary, the financial crisis of 2008 seemed not to affect Korea's regions so seriously as the 1997 financial crisis had done. Incheon, Gwangju, Chungbuk, Jeonnam, Gyeongnam and especially Jeju recorded at least as good performance in 2008-12 as 1997-2008. A back of the envelope calculation suggests that the 1997 financial crisis would be more damaging.

Table 1. Relative levels and growth rates of GRDP per capita

| | GRDP in 1989* (rank) | Growth rate (%) 89-2012 | GRDP in 2012* (rank) | Growth rate (%) 89-97 | Growth rate (%) 97-2008 | Growth rate (%) 2008-12 |
|---|---|---|---|---|---|---|
| Seoul | 100.0(1) | 4.0 | 100.0(5) | 6.9 | 2.5 | 2.1 |
| Busan | 63.7(14) | 4.2 | 66.8(12) | 6.1 | 3.5 | 2.3 |
| Daegu | 71.4(13) | 2.9 | 55.3(15) | 5.0 | 1.7 | 1.8 |
| Incheon | 98.3(2) | 2.9 | 76.0(8) | 3.9 | 2.2 | 2.5 |
| Gwangju | 72.2(12) | 3.3 | 61.9(14) | 5.6 | 2.0 | 2.1 |
| Daejeon | 87.1(5) | 2.6 | 63.3(13) | 3.4 | 2.2 | 2.0 |
| Gyeonggi | 82.5(6) | 4.0 | 82.5(7) | 4.1 | 4.0 | 3.8 |
| Gangwon | 81.2(7) | 3.6 | 73.8(9) | 6.2 | 2.4 | 1.5 |
| Chungbuk | 74.0(10) | 4.9 | 92.2(6) | 7.9 | 3.2 | 3.7 |
| Chungnam | 77.7(9) | 6.8 | 149.9(1) | 8.3 | 6.1 | 5.8 |
| Jeonbuk | 60.4(15) | 4.7 | 71.3(11) | 7.8 | 3.2 | 2.6 |
| Jeonnam | 73.6(11) | 5.9 | 115.1(2) | 10.3 | 3.6 | 3.6 |
| Gyeongbuk | 87.5(4) | 5.0 | 110.0(4) | 6.7 | 5.3 | 0.6 |
| Gyeongnam | 95.3(3) | 4.7 | 112.1(3) | 7.1 | 3.7 | 2.7 |
| Jeju | 77.9(8) | 3.7 | 73.3(10) | 5.6 | 2.3 | 3.9 |
| Nat'l Avg. | 84.2 | 4.2 | 89.6 | 6.3 | 3.3 | 2.8 |

Source: Calculated from the data set provided by the National Statistical Office of Korea.
Note *: GRDP per capita for Seoul=100.

An important development in the industrial structure of Korea after the outbreak of the financial crisis during 1997-98 was the increasing share of manufacturing and the declining share of services. This trend-breaking phenomenon was achieved due to the substantial increase in the contribu-

tion of exports to gross output of Korea. The financial crisis inhibited any significant investment and consumption expenditures in Korea. The only outlet for the suffering Korean economy was via increasing exports, which could be made possible through the heavily depreciated Korean currency. This reversal of industrial structure trend should have affected regional income dispersion. Regions hosting plenty of manufacturing industries, such as Gyeonggi and Chungnam tend to get most out of the changes in macroeconomic environment, while regions specializing in services, i.e. Gangwon, Daejeon, Daegu, Gwangju and Seoul would not reap the benefits. The second wave of financial crisis for Korea during 2008-09 would have affected regional dispersion in a similar way. Likewise, we have every reason to look at sectoral levels in analyzing aggregate phenomena.

## 3 Has GRDP per capita converged across Korea's regions?

In this Section, we employ a standard test for convergence of GRDP per capita across Korea's regions. Following Barro and Sala-i-Martin (1991, 1992), to test for $\beta$-convergence we estimate the non-linear least squares regression (NLLS) equation,

$$(1/T)\log(y_{it}/y_{i,t\text{-}T}) = a - (1-e^{-\beta T})(1/T)\log y_{i,t\text{-}T} + X_{i,t} + u_{it}, \qquad (1)$$

where $y_{it}$ and $y_{i,t\text{-}T}$ are region $i$'s GRDP at year $t$ and $t$–$T$, respectively. $a$ is the intercept and $\beta$ is the rate of convergence parameter. $X_{i,t}$ denotes other variables, such as net migration rate, and $u_{it}$ is the error term. In this setting, a positive and higher $\beta$ implies a faster convergence rate across regions.

Table 2 displays non-linear least squares regression (NLLS) estimates of the convergence coefficient, $\beta$, for the sample period 1989-2012. Recall that a positive coefficient corresponds to regions with lower GRDP per capita growing faster than those with higher GRDP per capita. The estimated $\beta$ coefficient for the whole sample period, 1989-2012 is −0.007 with $t$ statistics of −0.49, which implies the non-existence of $\beta$ convergence across the Korea's regions. When we break the sample period into two sub-periods

(1989-97 and 1997-2012), we find statistically significant $\beta$-*divergence* for the period 1997-2012 ($\beta=-0.024$, $t=-2.08$). The estimated rate of divergence for the period is as fast as 2.4 percent per year. This $\beta$-*divergence* is estimated to be greatest for the period 1996-2001 ($\beta=-0.044$, $t=-2.47$). The estimated rate of divergence for the period is as fast as 4.4 percent per year.

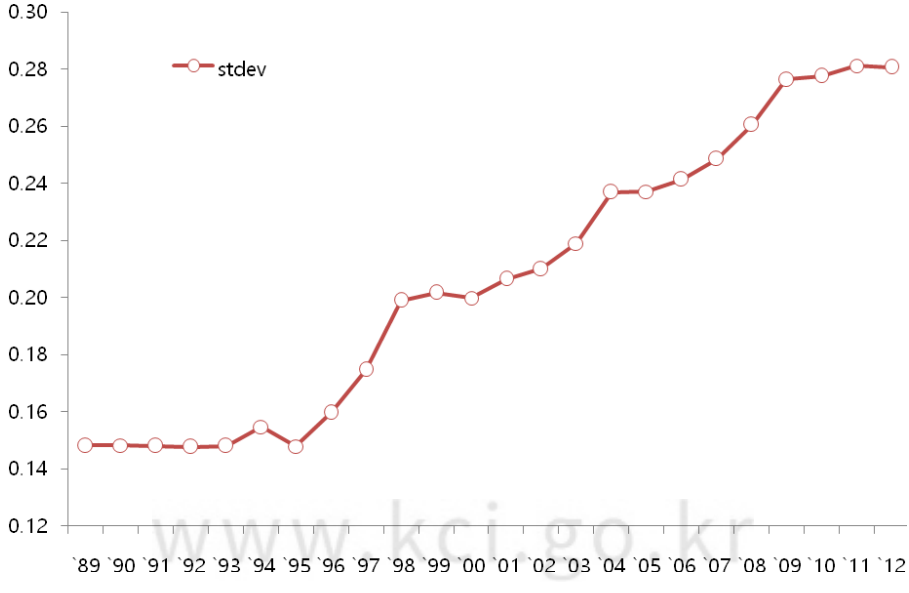
Table 2. Nonlinear regressions for GRDP per capita across 15 Korea's regions

| Period | Estimated coefficient ($\beta$) | $R^2$ |
|---|---|---|
| 1989~2012 | −0.007 (−0.49) | 0.556 |
| 1989~1997 | −0.001 (−0.07) | 0.691 |
| 1997~2008 | −0.028* (−1.99) | 0.218 |
| 1997~2012 | −0.024* (−2.08) | 0.246 |
| 1996~2001 | −0.044** (−2.47) | 0.306 |

Note: *, **, and *** represent the 10%, 5%, and 1% significance level, respectively. $t$-ratios are in the parentheses.

A positive (negative) $\beta$ coefficient does not necessarily imply that the cross-sectional dispersion of RGDP decreases (increases) over time. Combining the $\beta$-convergence and $\sigma$-convergence results allows us to avoid po-

Figure 1. Regional dispersion of GRDP per capita ($\sigma$-convergence)



tential problems associated with Galton's fallacy that positive coefficients on $\beta$ can go along with a non-converging cross-section distribution (see Quah, 1993). $\beta$-convergence relates to the phenomenon of poorer regions growing faster than richer ones, while $\sigma$-convergence means a decline over time in the regional dispersion of income. The $\sigma$-convergence in this study is measured by the unweighted cross-sectional standard deviation of the log of RGDP per capita in Korea's regions (See Figure 1).[7]

In terms of the degree and variability of regional dispersion of GRDP per capita, those observed for Korea during 1989-2012 are similar to other countries or regions during 1950-1985/7. The standard deviation was as low as 0.148 in 1989 and as high as 0.281 in 2012. According to Barro and Sala-i-Martin (1991), $\sigma_t$'s for income per capita across U.S. states during 1950-85 were in the range of 0.14 in 1974 and 0.24 in 1950. The corresponding range for European regions was between 0.28 in 1950 and 0.18 in 1985. In the case of Japanese prefectures, Barro and Sala-i-Martin (1992b) reported that the cross-prefecture dispersion of personal income for the period 1950-87 was in the range of 0.29 in 1950 and 0.13 in 1980.

However, our result is qualitatively different from those of other industrialized countries, including the U.S., Japan, the Western Europe, and Sweden. While previous studies on those countries showed a decline in the dispersion of regional income disparity, the $\sigma_t$ for Korea's regions for the period 1989-2012 shows a more or less flat pattern during 1989-95 with several ups and downs. Moreover, the regional dispersion of GRDP started to rise in 1996-97 and continued to rise steadily until 2012. The substantial rise in $\sigma_t$ since 1996 would probably be due to the impacts of the first wave of liberalization signified neatly by Korea's entrance into the OECD, which had resulted in a significant liberalization and thus increase in the trade intensity of Korea.

According to the data provided by the Bank of Korea, the composition of exports in total expenditures soared from around 24 percent in 1994, when front-loading liberalizations of trade and services had begun in order to be qualified for the entrance into the OECD, to around 35 percent in 1997. A more opening up of markets would favor the country's higher productive industries and so regions with higher productivity, for the case

[7] Another measure of dispersion, coefficient of variation, gave rise to very similar results to the $\sigma$-convergence results.

of Korea, that host more of manufacturing industries rather than services industries. It is also likely that the financial crisis of late 1997 would affect negatively the regional output disparity in Korea. In the next Section, we will try to explain the issue by analyzing the individual sectors.

## 4 Disaggregated sectoral analysis

Before the financial crisis erupted in late 1997, Korea's industrial structure had clear time-series patterns: the share of agriculture, forestry & fishing has been continuously declining since 1960s, while that of services increasing. National averages for 1989 were 6.8 percent for agriculture, forestry & fishing, 27.7 percent for mining & manufacturing, and 65.5 percent for services. Comparing figures for 1989 with those for 1996, the share of agriculture, forestry & fishing dropped from 7.2 percent to 4.4 percent and that of mining & manufacturing also decreased from 27.7 percent to 24.6 percent. The share of services showed the opposite pattern: it increased from 65.5 percent in 1989 to 71.0 percent in 1996. This pattern has completely changed since the outbreak of the financial crisis in 1997. The share of service has steadily decreased from 71.0 percent in 1996 to 65.0 percent in 2012, whereas that of mining & manufacturing increased rapidly from 24.6 percent in 1996 to 32.2 percent in 2012 (Table 3).

The rapid economic recovery of the Korean economy during 1999-2001 came from, among others, enormous growth in exports thank to the substantial devaluation resulting from the worst financial crisis ever of 1997/98. According to the data provided by the Bank of Korea, after the onset of the financial crisis in late 1997, the Korean Won-US Dollar exchange rate increased rapidly from below 900 in the third quarter of 1997 to over 1,600 in the first quarter of 1998. The exchange rate hike subsided as Korea recovered from the worst condition, but it continued until early 2000s. As a favorable response to the devaluation of the Korean currency, the composition of exports in total expenditures soared from an average of 32 percent in 1996 to around 53 percent in the first quarter of 2001. Major tradables of Korea have been produced in the manufacturing sector, which should have got the most out of the recovery boom.

Table 3. Korea's regional industrial structure (% of GRDP)

| | 1989 | | | 1996 | | | 2012 | | |
|---|---|---|---|---|---|---|---|---|---|
| Region | Agri. | M&M | Serv. | Agri. | M&M | Serv. | Agri. | M&M | Serv. |
| Seoul | 1.0 | 12.7 | 86.3 | 0.3 | 9.0 | 90.7 | 0.2 | 4.3 | 95.5 |
| Busan | 3.0 | 28.0 | 69.0 | 2.2 | 20.9 | 76.9 | 0.9 | 19.5 | 79.6 |
| Daegu | 0.5 | 37.5 | 62.0 | 0.6 | 31.4 | 68.0 | 0.4 | 23.5 | 76.1 |
| Incheon | 1.4 | 46.1 | 52.6 | 1.3 | 41.2 | 57.5 | 0.5 | 27.4 | 72.1 |
| Gwangju | 3.0 | 26.2 | 70.8 | 1.4 | 19.7 | 78.9 | 0.8 | 29.0 | 70.3 |
| Daejeon | 2.0 | 21.6 | 76.5 | 0.5 | 15.5 | 84.0 | 0.1 | 17.1 | 82.7 |
| Gyeonggi | 7.0 | 33.3 | 59.7 | 3.3 | 27.0 | 69.7 | 1.4 | 44.2 | 54.4 |
| Gangwon | 10.1 | 20.5 | 69.4 | 7.5 | 16.5 | 76.0 | 6.5 | 16.0 | 77.5 |
| Chungbuk | 13.3 | 28.1 | 58.6 | 8.8 | 33.3 | 57.9 | 5.3 | 44.9 | 49.8 |
| Chungnam | 17.7 | 29.5 | 52.8 | 12.9 | 27.4 | 59.7 | 5.5 | 58.1 | 36.5 |
| Jeonbuk | 19.8 | 22.5 | 57.7 | 13.2 | 19.6 | 67.1 | 11.0 | 24.5 | 64.5 |
| Jeonnam | 17.6 | 32.2 | 50.2 | 14.0 | 33.7 | 52.3 | 9.3 | 39.7 | 51.0 |
| Gyeongbuk | 14.1 | 40.8 | 45.1 | 10.0 | 37.4 | 52.6 | 6.5 | 49.4 | 44.1 |
| Gyeongnam | 7.6 | 47.5 | 44.9 | 5.0 | 47.5 | 47.5 | 2.9 | 53.1 | 44.0 |
| Jeju | 33.9 | 5.7 | 60.4 | 20.2 | 4.2 | 75.6 | 15.3 | 3.5 | 81.3 |
| Nat'l Avg. | 6.8 | 27.7 | 65.5 | 4.4 | 24.6 | 71.0 | 2.8 | 32.2 | 65.0 |

Source: Calculated from the data set provided by the National Statistical Office of Korea.
Note: Agri., M&M and Serv. stand for agriculture, forestry & fishing, mining & manufacturing and services industry, respectively.

As mentioned previously, Chungnam and Gyeonggi were the two fastest growing regions after the financial crisis. The main driving force for it was sound manufacturing growth. During 1996-2008, manufacturing output per worker of the Chungnam (Gyeonggi) province grew at an annual rate of 9.7 percent (9.3 percent), whereas its services sector output per worker grew only an annual rate of 1.2 percent (0.5 percent). In 2012, the share of value added of manufacturing in the Chungnam province reached to the highest level at 58.1 percent among Korea's regions, surpassing the level of the Gyeongnam province at 53.1 percent.

Table 4. Per-worker output growth rates of industries by region

| | Manufacturing | | | | Services | | | |
|---|---|---|---|---|---|---|---|---|
| Region | 1989 ~1996 | 1996 ~2008 | 2008 ~2012 | 1989 ~2012 | 1989 ~1996 | 1996 ~2008 | 2008 ~2012 | 1989 ~2012 |
| Seoul | 6.0 | 2.5 | 1.7 | 3.4 | 4.1 | 1.7 | 0.9 | 2.3 |
| Busan | 7.1 | 5.2 | 1.6 | 5.2 | 3.3 | 2.4 | 1.4 | 2.5 |
| Daegu | 4.3 | 1.4 | 0.5 | 2.1 | 1.9 | 1.5 | 0.7 | 1.5 |
| Incheon | 4.8 | 1.1 | 1.9 | 2.4 | 0.5 | 2.5 | 0.6 | 1.5 |
| Gwangju | 5.1 | 4.9 | -0.4 | 4.0 | 2.7 | 0.6 | 0.8 | 1.3 |
| Daejeon | 5.4 | 2.9 | 3.8 | 3.8 | 0.7 | 1.0 | 1.0 | 0.9 |
| Gyeonggi | 4.7 | 9.3 | 10.0 | 8.0 | 1.9 | 0.5 | 0.1 | 0.8 |
| Gangwon | 7.1 | 5.3 | 3.6 | 5.5 | 1.5 | 1.3 | 0.1 | 1.2 |
| Chungbuk | 7.7 | 5.2 | 3.8 | 5.7 | 3.6 | 1.0 | 0.9 | 1.8 |
| Chungnam | 2.4 | 9.7 | 5.4 | 6.7 | 3.3 | 1.2 | 0.5 | 1.7 |
| Jeonbuk | 4.7 | 6.4 | 0.3 | 4.8 | 4.0 | 1.7 | 1.1 | 2.3 |
| Jeonnam | 5.9 | 7.4 | 6.9 | 6.9 | 7.1 | 1.4 | 1.9 | 3.2 |
| Gyeongbuk | 5.4 | 8.2 | -7.6 | 4.6 | 4.0 | 0.8 | 2.3 | 2.1 |
| Gyeongnam | 8.0 | 4.2 | 2.7 | 5.1 | 3.0 | 2.2 | 0.7 | 2.2 |
| Jeju | -0.5 | 2.5 | 2.6 | 1.6 | 3.9 | 1.1 | 5.3 | 2.7 |
| Nat'l Avg. | 6.7 | 6.8 | 5.0 | 6.4 | 3.0 | 1.3 | 0.8 | 1.7 |

Source: Calculated from the data set provided by the National Statistical Office of Korea.

Tests of $\beta$-convergence for manufacturing and services industries in Korea yield the results reported in Table 5. Recall that a negative coefficient corresponds to regions with lower output per worker growing slower than those with higher output per worker, indicating divergence. For the whole sample period of 1989-2012, we find non-existence of $\beta$-divergence of manufacturing output per worker across regions ($\beta=-0.009$, $t=-1.18$). When we break the sample period into three sub-periods (1989-96, 1996-2001 and 2001-12), we obtain *$\beta$-divergence* for the two sub-periods 1996-2001 and 2001-12. The estimated $\beta$ coefficients for the periods are –0.045 with $t$-statistics of –3.16 and –0.014 with $t$-statistics of –2.01, respectively. The estimated rate of divergence for the period 1996-2001 is as fast as 4.5 percent per year. The divergent trend of manufacturing output per worker was mitigated somewhat after 2001 with the estimated rate of divergence at 1.45 percent for the period 2001-12.

For Korea's services industry, the estimated $\beta$ coefficient for the whole period is 0.019 ($t=0.99$), implying the rejection of convergence of services output per worker across Korea's regions When we break the sample period into three sub-periods (1989-96, 1996-2001 and 2001-12), we obtain $\beta$-

*divergence* for the sub-period 2001-2012 with t statistics of –1.96.

Table 5. Nonlinear regressions for regional value-added output per-worker across 15 Korea's regions

| | Manufacturing industry | | Services industry | |
|---|---|---|---|---|
| Period | est. coefficient, $\beta$ | $R^2$ | est. coefficient, $\beta$ | $R^2$ |
| 1989∼2012 | -0.009<br>(-1.18) | 0.080 | 0.019<br>(0.99) | 0.105 |
| 1989∼1996 | 0.004<br>(0.41) | 0.014 | 0.020<br>(0.76) | 0.051 |
| 1996∼2001 | -0.045***<br>(-3.16) | 0.381 | 0.021<br>(1.06) | 0.088 |
| 2001∼2012 | -0.014*<br>(-2.01) | 0.210 | -0.016*<br>(-1.96) | 0.199 |

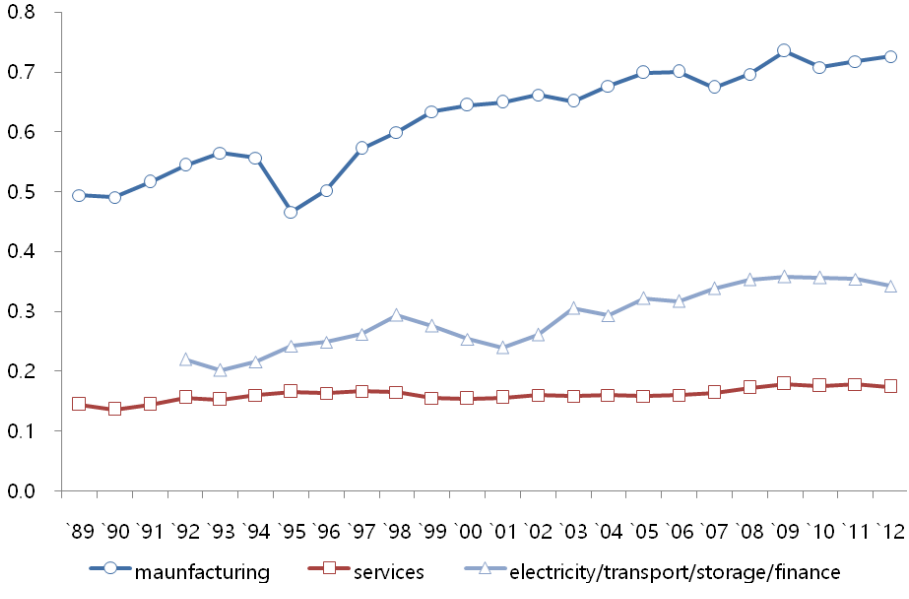
Note: *, **, and *** represent the 10%, 5%, and 1% significance level, respectively. t-ratios are in the parentheses.

According to Bernard and Jones (1996), $\sigma_t$'s for labor productivity of the OECD manufacturing industries during 1970-87 ranged between 0.18 and 0.24. In sharp contrast to the result, $\sigma_t$'s for manufacturing labor productivity across 15 Korea's regions during 1989-2012 ranged between 0.466 ('95) and 0.735 ('09). In most cases, capital and technology would be more mobile within a country than across countries, which would make convergence to be more likely within countries. Nonetheless, the disparity in manufacturing labor productivity was much greater for Korea's 'regions' than that for OECD 'countries'. Furthermore, $\sigma_t$'s for manufacturing labor productivity are on the increasing trend from 0.493 in 1989 to as high as 0.726 in 2012 (Figure 2).

Bernard and Jones (1996) also reports that services and electricity/gas/water display substantial evidence of $\sigma$-convergence, as $\sigma$ declined throughout 1970-87 from 0.22 to 0.14 for services and from 0.40 to 0.31 for electricity etc. They also find that manufacturing shows no or little sign of labor productivity convergence with $\sigma$ fluctuating between 0.18 and 0.24. This finding for services, together with the declining share of manufacturing, can explain the convergence phenomenon observed at the aggregate level in all 14 OECD countries. For the services industry of Korea, quite different from the result of Bernard and Jones (1996), a substantial de-

cline in the standard deviation of labor productivity was not observed at all. The standard deviation increased, rather than decreased, from 0.144 in 1989 to 0.174 in 2012. For Korean industry of electricity etc., the standard deviation increased steadily from 0.220 in 1989 to 0.342 in 2012.

Figure 2. Dispersion of value-added output per worker across 15 Korea's regions ($\sigma$-convergence)




Summing up with $\beta$-convergence and $\sigma$-convergence results, value-added output per worker in manufacturing industries across 15 Korea's regions had displayed a divergent pattern for 1996-2012, while those in service industries did not counteract the divergent pattern at all. Instead, even the services industry seemed to on the divergent path since 2001. Because of the rapidly increasing share of manufacturing industry since 1997, due to exploding exports, together with the fact that manufacturing had shown divergence, the aggregate non-convergence phenomenon would be observed.

# 5 Conclusions

Korea has experienced a rapid industrialization since early 1960s, which had transformed the economy from the one with traditional light industries to that with industrially more sophisticated heavy industries. Since mid-1980s, notably after the Democratization Movement in 1987, Korea had moved from an unbalanced regional development policy to a more balanced one. This paper intends to examine if she achieved the objective.

As the first study of its kind for Korea, a newly industrialized economy, this paper examines the contribution of sectors to aggregate output disparity for 15 Korea's regions during 1989-2012. The major finding is that, quite contrary to the experiences of the OECD countries presented in Bernard and Jones (1996), the services industry in Korea shows no or little sign of labor productivity convergence, while the manufacturing industry mostly drives labor productivity divergence, leading to the aggregate non-convergence result for 1989-2012. Value-added outputs per worker in manufacturing industries across Korea's regions had displayed a divergent pattern for 1996-2012, while those in service industries did not counteract the divergent pattern at all. Further, the magnitude of regional disparity of manufacturing in Korea is found to be much greater than those of other countries.

We conclude that labor productivity convergence in services, a common feature for OECD countries, has not been observed for Korea's regions, and that manufacturing labor productivity divergence did play a role in regional output non-convergence since 1996 in Korea. Thus, contrary to the popular expectation, a rapid decentralization of industries after the Democratization Movement in mid-1980s would not contribute to the reduction of output disparity across Korea's regions. The potential impacts of economic liberalization realized after joining the OECD in 1996 and the aftermath of financial crisis in late 1997 contributed to increases in the regional disparity in Korea.

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