Sectoral Decomposition of Regional Income Inequality in Indonesia
A Comparison with Postwar Japan[*]

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Abstract

Even after excluding mining activities, which are distributed very unevenly, Indonesia still has very large regional income disparities. By the Theil T index, regional inequalities in per capita GDP and labor productivity after excluding the mining sector were, respectively, 0.14 and 0.16 in 1999. The ratio between the largest and smallest per capita GDP was also very large at 8.2 in 1999. Japan has much smaller regional inequalities in per capita GDP and labor productivity. In the postwar period (1955-2000), Japan's regional inequality in per capita GDP, as measured by the Theil T index, ranged between 0.03 and 0.06. The ratio between the largest and smallest per capita GDP was 3.4 in 1955, but declined to 2.8 in 2000. According to the sectoral inequality decomposition analysis based on the weighted coefficient of variation, Indonesia's present pattern of regional inequalities corresponds to Japan's inequality pattern in the 1950s or before, in which the primary sector had the smallest regional inequality in per capita GDP among the three sectors. In Japan, per capita GDP was about $500 in current U.S. dollars and the share of the primary sector was 16% in GDP and 41% in employment in 1955, whereas in Indonesia, per capita GDP was about $1,000 in current U.S. dollars and the share of the primary sector was 17% in GDP and 42% in employment after excluding the mining sector in 1997. Japan was successful in reducing its regional inequalities in the 1960s and 1970s, during which secondary and tertiary sectors' inequalities in per capita GDP declined steadily, while primary sector's inequality rose rapidly. In the period, there was a marked shift in GDP from the primary sector to the secondary sector, in which the secondary sector raised its share by more than 10 percentage points. Whether Indonesia could reduce its regional inequality in per capita GDP in the near future as Japan did in the 1960s and 1970s is uncertain.

1. Introduction

This paper employs provincial data on GDP by sector to measure regional inequalities in per capita GDP and labor productivity in Indonesia from 1993 to 1999 by the weighted coefficient of variation and the Theil T index, and investigates factors determining regional income inequality by using sectoral decomposition techniques of regional inequality. It compares Indonesia's pattern of regional inequalities in 1993-1999 with Japan's pattern in the postwar period and predicts the future pattern in Indonesia.

This paper is organized as follows. The next section presents the method and the data used in this study. Section 3 discusses the results, while Section 4 compares Indonesia and Japan in terms of regional inequalities in per capita GDP and labor productivity.

2. Method and The Data

2.1. Methods

This section presents several indices of regional inequality that are employed in this study. Since this study uses regional per capita GDP to measure disparities in regional income levels, we start with a multiplicative decomposition of per capita GDP, which relates per capita GDP to labor productivity and labor participation rate. In a three-sector economy consisting of the primary, secondary, and tertiary sectors, we also show that labor productivity in a region is additively decomposed into three sectoral labor productivity components, where each component is the product of sectoral labor productivity and employment share. Therefore, regional inequality in per capita GDP can be ascribed to regional disparities in labor participation rate, sectoral labor productivities, and sectoral employment shares.

There are several indices that are used to measure regional income inequalities. Among them are the Gini coefficient, the coefficient of variation, the weighted coefficient of variation (Williamson, 1965), the variance of logarithmic income, and Theil indices (Theil, 1967). This study employs the weighted coefficient of variation and a Theil index, called the Theil T index, to measure regional inequalities.[1] This section first presents the Theil T index, which is defined in terms of both per capita GDP and labor productivity. We show that the Theil T index for labor productivity using sectoral GDP and employment figures can be

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decomposed into the within-sector inequality and between-sector inequality components. Based on the Theil T index, we also present the linear relationship between regional inequalities in per capita GDP and labor productivity.

We next present the weighted coefficient of variation, which is defined in terms of per capita GDP and labor productivity. In a three-sector economy, we show that the square of the weighted coefficient of variation is additively decomposed into six components: three components refer to the sectoral weighted coefficient of variation and the other three components denote the weighted coefficient of covariation between sectors. By using this method, we can analyze the extent to which each component contributes to the square of the overall weighted coefficient of variation.

Multiplicative Decomposition of Per Capita GDP into Labor Productivity and Labor Participation Rate

Let $Y_i, E_i,$ and P_i be GDP, employment, and population in region i, respectively, where there are n regions in the nation. Then per capita GDP in region i is given by $y_i = \dfrac{Y_i}{P_i}$, and can be multiplicatively decomposed into two components: labor productivity and labor participation rate.

$$y_i = x_i e_i \tag{1}$$

where $\quad x_i = \dfrac{Y_i}{E_i}$ is labor productivity in region i and

$\quad e_i = \dfrac{E_i}{P_i}$ is labor participation rate in region i.[2]

Suppose that the economy is divided into the following three sectors: primary, secondary, and tertiary sectors. Then total GDP is the sum of GDP from these three sectors, i.e.,

$$Y_i = Y_{1i} + Y_{2i} + Y_{3i} \tag{2}$$

where $Y_{1i}, Y_{2i},$ and Y_{3i} are GDP from the primary, secondary, and tertiary sectors in region i, respectively. Similarly total employment is the sum of employment in these three sectors, i.e.,

$$E_i = E_{1i} + E_{2i} + E_{3i} \tag{3}$$

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where E_{1i}, E_{2i}, and E_{3i} are region i's employment in the primary, secondary, and tertiary sectors, respectively.

Let $y_{ji} = \dfrac{Y_{ji}}{P_i}$ be per capita GDP from sector j in region i. Then, we have

$$y_i = y_{1i} + y_{2i} + y_{3i} .$$

y_{ji} can be multiplicatively decomposed into three components as follows

$$y_{ji} = q_{ji}e_i = x_{ji}s_{ji}e_i \quad \text{for j} = 1, 2, \text{ and } 3, \tag{4}$$

where $q_{ji} = \dfrac{Y_{ji}}{E_i}$ is sector j's GDP in region i per regional employment,

$x_{ji} = \dfrac{Y_{ji}}{E_{ji}}$ is the labor productivity of sector j in region i, and

$s_{ji} = \dfrac{E_{ji}}{E_i}$ is the share of sector j in employment in region i.

Using equations (2) and (4), equation (1) is reduced to

$$y_i = \left(\frac{Y_{1i} + Y_{2i} + Y_{3i}}{E_i} \right)e_i = (q_{1i} + q_{2i} + q_{3i})e_i = (x_{1i}s_{1i} + x_{2i}s_{2i} + x_{3i}s_{3i})e_i . \tag{5}$$

Therefore, regional inequality in per capita GDP can be attributed to regional disparities in labor participation rate, sectoral labor productivities, and sectoral employment shares.

Theil T Index and Its Decomposition into Between-Sector and Within-Sector Components

To measure regional inequalities, we employ the Theil T index. Using GDP and population figures, the Theil T index is given by

$$T_{PG} = \sum_{i=1}^{n} \left(\frac{Y_i}{Y} \right) \log\left(\frac{Y_i/Y}{P_i/P} \right)$$

where n is the number of regions and Y and P are, respectively, total national GDP and population. If we let $\bar{y} = \dfrac{Y}{P}$ be national per capita GD, then this equation can be rewritten as

$$T_{PG} = \sum_{i=1}^{n} \left(\log(y_i) - \log(\bar{y}) \right) \frac{Y_i}{Y} , \tag{6}$$

and thus this Theil T index measures regional inequality in per capita GDP.

Using GDP and employment figures, we can also measure regional inequality in labor productivity as follows.

$$T_{LP} = \sum_{i=1}^{n} \left(\frac{Y_i}{Y}\right) \log\left(\frac{Y_i/Y}{E_i/E}\right) = \sum_{i=1}^{n} \left(\log(x_i) - \log(\overline{x})\right)\frac{Y_i}{Y} . \tag{7}$$

In this equation, $\overline{x} = \dfrac{Y}{E}$ is national labor productivity, where E is national total employment.

This equation compares labor productivity in region i with the national labor productivity.

Next, in a three-sector economy, we can measure regional inequality in labor productivity as follows.

$$T = \sum_{j=1}^{3} \sum_{i=1}^{n} \left(\frac{Y_{ji}}{Y}\right) \log\left(\frac{Y_{ji}/Y}{E_{ji}/E}\right) = \sum_{j=1}^{3} \sum_{i=1}^{n} \left(\log(x_{ji}) - \log(\overline{x})\right)\frac{Y_{ji}}{Y} , \tag{8}$$

where $x_{ji} = \dfrac{Y_{ji}}{E_{ji}}$ is defined in equation (4) above. As opposed to equation (7), this equation

compares each sector's labor productivity in region i with the national labor productivity.

The additive decomposability of Theil indices enables us to decompose the Theil T index in equation (8) into two components: the within-sector inequality component (T_W) and the between-sector inequality component (T_B) as follows.[3]

$$T = \sum_{j=1}^{3} \left(\frac{Y_j}{Y}\right) T_j + \sum_{j=1}^{3} \left(\frac{Y_j}{Y}\right) \log\left(\frac{Y_j/Y}{E_j/E}\right) = T_W + T_B \tag{9}$$

where T_j is defined by

$$T_j = \sum_{i=1}^{n} \frac{Y_{ji}}{Y_{jt}} \log\left(\frac{Y_{ji}/Y_{jt}}{E_{ji}/E_{jt}}\right) = \sum_{i=1}^{n} \left(\log(x_{ji}) - \log(\overline{x}_j)\right)\frac{Y_{ji}}{Y_{jt}} \quad \text{for } j = 1, 2, \text{ and } 3. \tag{10}$$

In equation (10), $\overline{x}_j = \dfrac{Y_{jt}}{E_{jt}}$ is sector j's labor productivity in the nation, where Y_{jt} and E_{jt}

are, respectively, sector j's GDP and employment in the nation. Since T_j measures regional

inequality in labor productivity in sector j, T_W is the weighted average of regional inequalities in labor productivity within each sector. On the other hand, T_B presents inequality in labor productivity between sectors, since it is rewritten as

$$T_B = \sum_{j=1}^{3}\left(\frac{Y_j}{Y}\right)\log\left(\frac{Y_j/Y}{E_j/E}\right) = \sum_{j=1}^{3}\left(\log(\overline{x}_j) - \log(\overline{x})\right)\frac{Y_j}{Y},$$

Relationship between Regional Inequalities in Per Capita GDP and Labor Productivity by Theil T Index

Now we consider $y_i = x_i e_i$ in (1). If we take the log of both sides of $y_i = x_i e_i$, we have

$$\log(y_i) = \log(x_i) + \log(e_i) \tag{11}$$

We also have

$$\log(\overline{y}) = \log(\overline{x}) + \log(\overline{e}) \tag{12}$$

where $\overline{y} = \dfrac{Y}{P}$, $\overline{x} = \dfrac{Y}{E}$, and $\overline{e} = \dfrac{E}{P}$. Using equations (11) and (12), we obtain

$$\sum_{i=1}^{n}\left(\log(y_i) - \log(\overline{y})\right)\frac{Y_i}{Y} = \sum_{i=1}^{n}\left(\log(x_i) - \log(\overline{x})\right)\frac{Y_i}{Y} + \sum_{i=1}^{n}\left(\log(e_i) - \log(\overline{e})\right)\frac{Y_i}{Y}.$$

We can rewrite this equation as follows.

$$\sum_{i=1}^{n}\left(\frac{Y_i}{Y}\right)\log\left(\frac{Y_i/Y}{P_i/P}\right) = \sum_{i=1}^{n}\left(\frac{Y_i}{Y}\right)\log\left(\frac{Y_i/Y}{E_i/E}\right) + \sum_{i=1}^{n}\left(\frac{Y_i}{Y}\right)\log\left(\frac{E_i/E}{P_i/P}\right) \tag{13}$$

The left hand side of equation (13) presents regional inequality in per capita GDP as measured by the Theil T index (equation (6)), while the first term of the right hand side presents regional inequality in labor productivity as measured by the Theil T index (equation (7)). In other words, we have

$$T_{PG} = T_{LP} + \sum_{i=1}^{n}\left(\frac{Y_i}{Y}\right)\log\left(\frac{E_i/E}{P_i/P}\right)$$

It should be noted that the second term of the right hand side of equation (13) is not the Theil T index for the labor participation rate, since it uses GDP shares as weights, rather than employment shares.

Weighted Coefficient of Variation for Per Capita GDP and Labor Productivity and Its Sectoral Decomposition

Using population shares as weights, the weighted coefficient of variation for per capita GDP is given by

$$V = \frac{1}{\overline{y}} \sqrt{\sum_{i=1}^{n} (y_i - \overline{y})^2 \frac{P_i}{P}} \; . \tag{14}$$

This equation measures regional income inequality in per capita GDP.

If the economy is divided into the primary, secondary, and tertiary sectors, we have $\overline{y} = \overline{y}_1 + \overline{y}_2 + \overline{y}_3$ and $y_i = y_{1i} + y_{2i} + y_{3i}$, where $\overline{y}_j$ is sector j's per capita GDP in the nation (j = 1, 2, and 3). Using these relations, the square of the weighted coefficient of variation V^2 can be written as

$$V^2 = \frac{1}{\overline{y}^2} \left[\sum_{i=1}^{n} \left((y_{1i} - \overline{y}_1) + (y_{2i} - \overline{y}_2) + (y_{3i} - \overline{y}_3) \right)^2 \frac{P_i}{P} \right]$$

$$= \frac{1}{\overline{y}^2} \left[\sum_{i=1}^{n} \left((y_{1i} - \overline{y}_1)^2 + (y_{2i} - \overline{y}_2)^2 + (y_{3i} - \overline{y}_3)^2 + 2(y_{1i} - \overline{y}_1)(y_{2i} - \overline{y}_2) + 2(y_{1i} - \overline{y}_1)(y_{3i} - \overline{y}_3) + 2(y_{2i} - \overline{y}_2)(y_{3i} - \overline{y}_3) \right) \frac{P_i}{P} \right]$$

Now, let z_j be the share of sector j in total national GDP. Then, we have $z_j = \frac{\overline{y}_j}{\overline{y}}$, and thus

$$\frac{1}{\overline{y}^2} = \frac{\overline{y}_j^2}{\overline{y}^2} \frac{1}{\overline{y}_j^2} = z_j^2 \left(\frac{1}{\overline{y}_j^2} \right) \text{ for each j (j = 1, 2, and 3), and}$$

$$\frac{1}{\overline{y}^2} = \frac{\overline{y}_j}{\overline{y}} \frac{\overline{y}_k}{\overline{y}} \left(\frac{1}{\overline{y}_j \overline{y}_k} \right) = z_j z_k \left(\frac{1}{\overline{y}_j \overline{y}_k} \right) \text{ for each j and k (j, k = 1, 2, and 3; } j \neq k \text{).}$$

Using these relations, the square of the weighted coefficient of variation can be decomposed into[4]

$$V^2 = z_1^2 V_1^2 + z_2^2 V_2^2 + z_3^2 V_3^2 + 2z_1 z_2 W_{12} + 2z_1 z_3 W_{13} + 2z_2 z_3 W_{23}. \tag{15}$$

In equation (15), V_j is the weighted coefficient of variation for sector j (j = 1, 2, and 3), given by

$$V_j = \frac{1}{\overline{y}_j} \sqrt{\sum_{i=1}^{n} (y_{ji} - \overline{y}_j)^2 \frac{P_i}{P}} \; , \tag{16}$$

while W_{jk} is the weighted coefficient of covariation between sector j and sector k (j, k = 1, 2,

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and 3; $j \neq k$), given by

$$W_{jk} = \frac{1}{\overline{y}_j} \frac{1}{\overline{y}_k} \sum_{i=1}^{n} (y_{ji} - \overline{y}_j)(y_{ki} - \overline{y}_k) \frac{P_i}{P} \tag{17}$$

2.2. The Data

In order to measure regional inequalities in per capita GDP and labor productivity in Indonesia, we used provincial data on GDP by industrial origin, employment by industrial origin, and population. Provincial GDP data were obtained from *Gross Regional Domestic Product of Provinces in Indonesia by Industrial Origin* (CBS, various issues), provincial population data were from *Statistical Yearbook of Indonesia* (CBS, various issues), and provincial employment data were from *National Labor Force Survey* (CBS, various issues). It should be noted that GDP figures are at 1993 constant prices, and employment in this study is defined as population 15 years of age and over who worked during the previous week at the time of survey.

Regional GDP shows the amount of income generated within a region, rather than the income received by the region's inhabitants. Much of the value added generated by a resource-rich region through extracting activities has not historically accrued to its population, but has gone instead to other regions or abroad. For example, the bulk of income derived from oil and gas accrues to the central government, with only a small portion going to the governments and people of the producing regions. This is less so since the implementation in 2001 of Law No.25/1999 on the financial balance between the center and regional governments. However, it was the case for the years included in the present study, i.e., from 1993 through 1999. For this reason, unless noted otherwise, we exclude the mining sector in the estimation of regional inequalities, where the mining sector consists of oil/gas mining, non-oil/gas mining, and quarrying, but does not include oil refinery and LNG, which are included in the manufacturing sector.

In order to measure regional inequalities in Japan, we used prefectural data on GDP by industrial origin, employment by industrial origin, and population. Prefectural GDP data for the period of 1955-1974 were obtained from *Retroactive Estimation of Prefectural Accounts, 1955-1974* (ERI, 1991), which was compiled by the Economic Research Institute of the Economic Planning Agency based on the 1968 System of National Accounts (68 SNA). On the other hand, prefectural GDP data for the period of 1975-1999 were obtained from *Annual*

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Report on Prefectural Accounts 2002 (ESRI, 2002), compiled by the Economic and Social Research Institute of the Cabinet Office based on the 68 SNA. Finally, prefectural GDP data for the year of 2000 was obtained from *Annual Report on Prefectural Accounts 2003* (ESRI, 2003), compiled by the Economic and Social Research Institute of the Cabinet Office based on the 93 SNA.

In this study, nominal GDP figures were converted into those at the 1990 constant prices using national-level sectoral GDP deflators, which were obtained from *Annual Report on National Accounts* (ESRI, various issues).

Annual prefectural population data were obtained either from *Population Census* (Statistics Bureau, various issues) or *Intercensal Population Estimates* (Statistics Bureau, various issues), whereas prefectural data on employment by industrial origin were from *Population Census*. It should be noted that employment data are available only every five years, since *Population Census* has been conducted every five years. Therefore, regional inequality in labor productivity was measured every five years from 1955 to 2000.

3. Regional Inequalities in Indonesia

Regional Inequality in Per Capita GDP by the Weighted Coefficient of Variation

Figure 3.1 presents regional inequality in per capita GDP for 1993-1999, as measured by the weighted coefficient of variation presented in (14) in the previous section. When the mining sector is included, regional inequality in per capita GDP (VM) was very stable at little above 0.7 over the period. Reflecting a very unequal geographical distribution of mining activities, it was larger than regional inequality in per capita GDP after excluding the mining sector (V), which was stable until 1997, but declined slightly afterward.

As the capital city, Jakarta had the highest per capita GDP after excluding the mining sector throughout the period, while East Nusa Tenggara registered the smallest. Their ratio was 9.7 in 1993; but after the ratio increased to 9.9 in 1997, it fell significantly to 8.4 in 1998, due to the economic crisis that afflicted urban Java, especially Jakarta. In 1999, Jakarta had a per capital GDP of Rp 5,960 thousand in 1993 constant prices, while East Nusa Tenggara had Rp 730 thousand. Their ratio became 8.2 in1999.

In order to examine whether there was a β-convergence in per capita GDP among provinces over the 1993-1999 period, we conducted a simple regression analysis between

the growth rate of per capita GDP and the logarithm of per capita GDP in 1993.[5] However, no statistically significant relationship was observed between them whether the mining sector was included or excluded.

Sectoral Decomposition Analysis of Regional Inequality in Per Capita GDP by the Weighted Coefficient of Variation

In a three-sector economy consisting of the primary, secondary, and tertiary sectors, we can measure regional inequality in per capita GDP for each of these sectors, as shown in equation (16) in the previous section.[6] Figure 3.2a shows the weighted coefficient of variation of each sector. Primary sector had the smallest inequality, while tertiary sector had the largest. In 1993-1999, primary sector's regional inequality rose from 0.37 to 0.45, while tertiary sector's regional inequality declined from 0.94 to 0.89. On the other hand, secondary sector's regional inequality declined until 1997, and then increased slightly afterward.

In the three-sector economy, we can also calculate the weighted coefficient of covariation between sectors, as shown in equation (17). Figure 3.2b presents the result. The weighted coefficients of covariation between the primary and secondary sectors (W_{12}) and between the primary and tertiary sectors (W_{13}) were both negative over the period, showing that provinces having smaller per capita GDP in the primary sector tend to have larger per capita GDP in the other two sectors. This indicates a shift in economic resources from the primary sector to the other two sectors. On the other hand, the weighted coefficient of covariation between the secondary and tertiary sectors (W_{23}) had very large positive values, though showing a slight declining trend, indicating that these two sectors were complementary in their development.

In order to examine which sector contributes most to the regional inequality in per capita GDP (V), we need to consider the share of each sector in national GDP (see equation (15) in the previous section). Figure 3.3 shows that there was a shift in GDP from the primary sector to the secondary sector until 1997, but this was reversed afterward; their GDP shares retreated to their 1993 levels. In the period, the tertiary sector had the largest GDP share at around 48%, and this was followed by the secondary sector and the primary sector.

Figure 3.4 presents the result of a sectoral decomposition analysis, performed as described in equation (15) in the previous section, where shares are the percentage shares of each component in equation (15). It is clear that tertiary sector's variation and covariation

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terms, particularly the V_3 and W_{23} terms, accounted for most of the squared coefficient of variation in per capita GDP (V^2). Secondary sector's variation term (i.e., the V_2 term) also contributed to V^2, but the contribution was only 15-17%. These observations signify that tertiary sector's very unequal geographical distribution relative to the distribution of population, facilitated by disproportionate spatial development of the secondary sector, was responsible for a still very large regional inequality in per capita GDP in Indonesia.

Regional Inequality in Labor Productivity by the Theil T Index

As discussed in the previous section, regional inequality in per capita GDP can be explained by regional disparities in labor participation rate and labor productivity. Figure 3.5 compares regional inequalities in per capita GDP and labor productivity, as measured by the Theil T index (see equations (6) and (7) in the previous section). Regional inequality in labor productivity was very high, though it exhibited a slight declining trend. Jakarta had the biggest labor productivity until 1998, but was replaced by East Kalimantan in 1999. This was due to the fact that while Jakarta raised its employment in 1999, its GDP remained the same as in 1998. On the other hand, East Nusa Tenggara registered the smallest labor productivity throughout the period. The ratio between the largest labor productivity and the smallest was 14.0 in 1993; but it decreased gradually to 12.1 in 1997. Due to the economic crisis, it declined significantly to 9.3 in 1999, when East Kalimantan and Jakarta had Rp 15,400 and Rp 15,130 thousand per employment, respectively, while East Nusa Tenggara had Rp 1,660 thousand per employment.

Regional inequality in labor productivity was larger than regional inequality in per capita GDP throughout the period, though the difference was getting smaller. According to equation (13), the difference is accounted for by the term that reflects, to some extent, inequality in labor participation rate. However, since this term uses GDP shares as weights, rather than employment shares, it is not the Theil T index for labor participation rate. Therefore, it can take both positive and negative values. A negative value occurs when provinces having larger GDP shares tend to have smaller labor participation rates. Since Jakarta, having the largest GDP share, had much smaller labor participation rate than the national average labor participation rate of around 0.42, the negative difference is due in large part to its small labor participation rate. However, since Jakarta increased its labor

participation rate from 0.33 in 1993 to 0.39 in 1999, the difference narrowed. It should be noted that Jakarta's employment share was about 4%, which was very small compared to its GDP share (16-17%).

Regional Inequalities in Labor Productivity and Employment Share by Sector

According to equation (5) in the previous section, regional inequality in labor productivity can be explained by inequalities in sectoral labor productivity and sectoral employment share. Figures 3.6 and 3.7 present these regional inequalities, as measured by the Theil T index. Secondary sector's inequality in labor productivity was very large. While it showed a declining trend until 1997, it returned to the 1993 level in 1999. The largest labor productivity was registered by East Kalimantan, while the smallest was by East Nusa Tenggara. It is surprising to note that the ratio between the largest and the smallest was 38 in 1999, though this is due primarily to the existence of a very large oil and gas manufacturing activity in East Kalimantan since the secondary sector includes oil/gas manufacturing. Besides Jakarta, relatively large labor productivity was registered by the oil/gas rich provinces of Aceh, Riau, and Irian Jaya.

Tertiary sector's inequality in labor productivity was smaller than secondary sector's and exhibited a slight declining trend after 1994. In the tertiary sector, the largest labor productivity was registered by Jakarta, which was followed by East Kalimantan and North Sumatra. On the other hand, West Nusa Tenggara had the smallest labor productivity in the tertiary sector. The ratio between the largest and the smallest was little less than 5. Primary sector had even smaller inequality in labor productivity. It is interesting to note that the oil/gas rich province of East Kalimantan had the largest labor productivity in the primary sector, while the smallest was by East Nusa Tenggara.

From 1993-97, the secondary and tertiary sectors increased their employment shares: the secondary sector from 15% to 18% and the tertiary sector from 34% to 41%. However, after 1997, they reduced their shares slightly, while the primary sector raised its share to 44% from 41%. Regional inequality in employment share was much smaller than inequality in labor productivity in the secondary and tertiary sectors. In 1999, Central Java had the largest secondary sector's share at 22%, which was followed by West Java and Jakarta, whereas Bengkulu and Irian Jaya had the smallest at 5%. On the other hand, Jakarta had the largest tertiary sector's share at 77%, which was followed by Yogyakarta and West Java, whereas

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East Nusatenggara had the smallest at 18%.

The main reason why the tertiary sector had larger inequality in per capita GDP than the secondary sector (see Figure 3.2a) in spite of its much smaller inequality in labor productivity (see Figure 3.6) is that those provinces with larger labor productivity in the tertiary sector, such as Jakarta and East Kalimantan, tend to have larger tertiary sector's employment share. We should note also that regional inequality in labor participation rate is very small.

Decomposition of Theil T Index into Between-Sector and Within-Sector Components

If overall regional inequality in labor productivity is defined by equation (8) in the previous section, we can decompose it additively into the between-sector and within-sector components, as shown in equation (9). Figure 3.8 and Table 3.1 present the result of this decomposition.

The overall inequality was 0.40 in 1993, but it declined to 0.31 in 1999. Since the within-sector component is the weighted average of regional inequalities of the primary, secondary, and tertiary sectors with the weights being GDP shares, it had a similar movement to tertiary sector's inequality in labor productivity with the exception of 1999 when secondary sector's inequality in labor productivity rose significantly to 0.26; it fluctuated between 0.15 and 0.17 in 1993-99. On the other hand, the between-sector component was very large in 1993 at 0.23, and thus accounted for 59% of the overall regional inequality. However, it declined to 0.15 in 1999; its contribution also decreased to 49%. Consequently, the contribution of the within-sector component increased from 41% to 51%.

Figure 3.9 shows each sector's labor productivity in the nation, as compared to the national labor productivity (= 1.0). Primary sector's labor productivity was very small, less than 50% of the national productivity, but showed a slight rising trend over the period. By contrast, secondary sector's labor productivity was very large, twice as much as the national average. Tertiary sector's productivity was also larger than the national productivity, but seems to have been declining. These observations suggest that a fall in the between-sector inequality is due mainly to the decrease in disparity between the primary and tertiary sectors.

Figure 3.1
Regional Inequality in Per Capita GDP
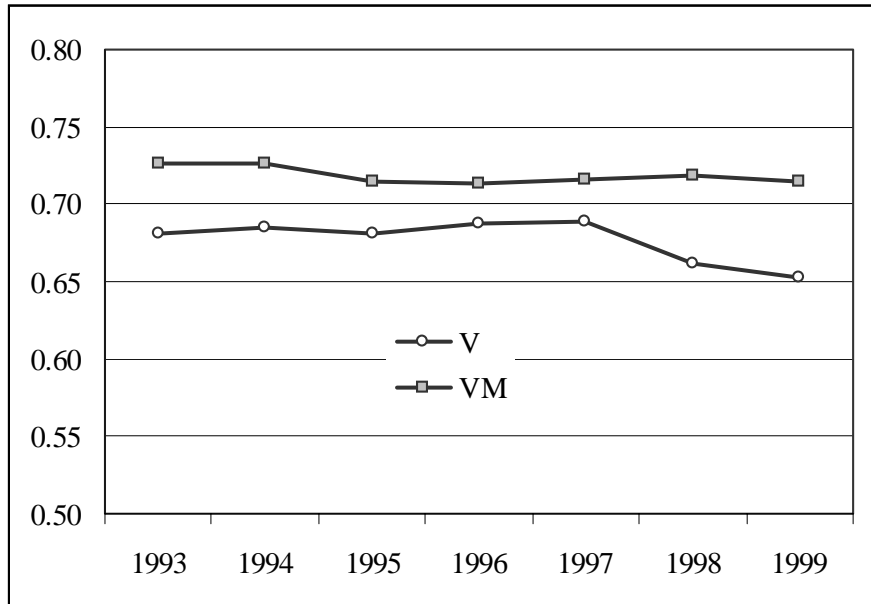**Weighted Coefficient of Variation**

Figure 3.2a
Regional Inequality in Per Capita GDP
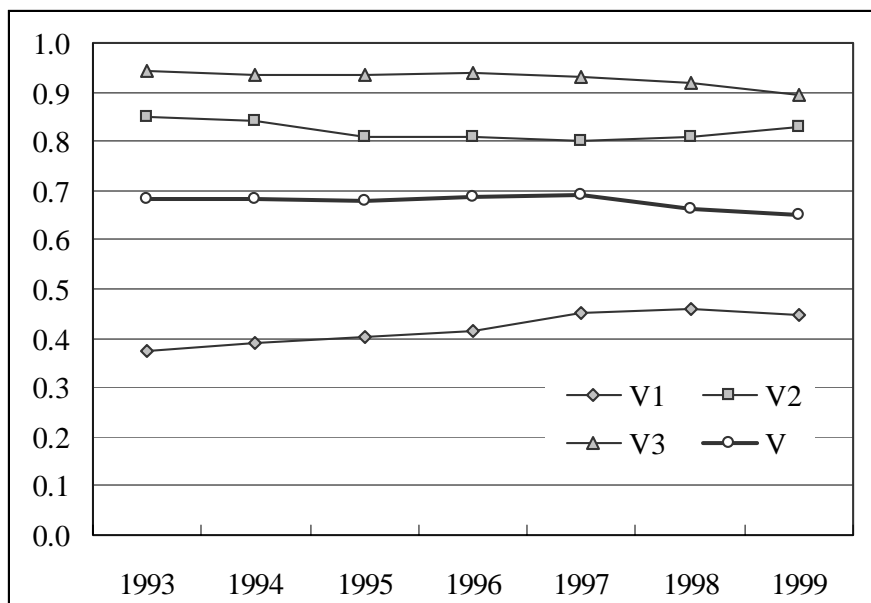**Weighted Coefficient of Variation by Sector**

Figure 3.2b
Regional Inequality in Per Capita GDP
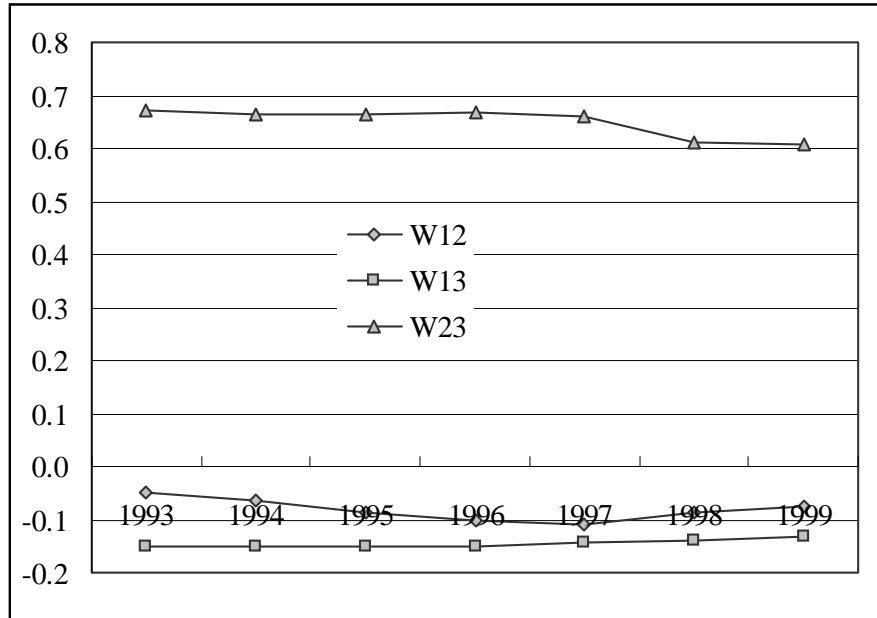**Weighted Coefficient of Covariation Between Sectors**
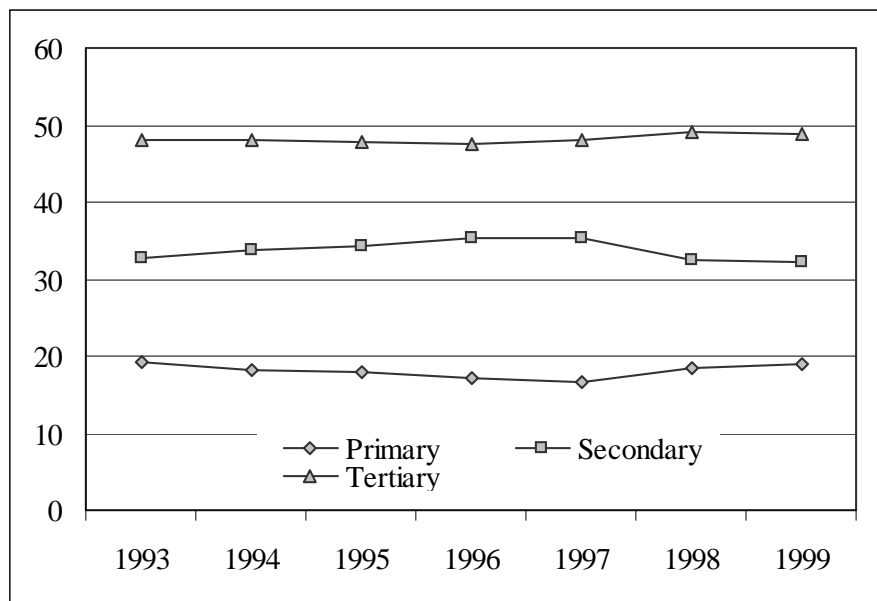

Figure 3.3
GDP Share of Each Sector

Figure 3.4
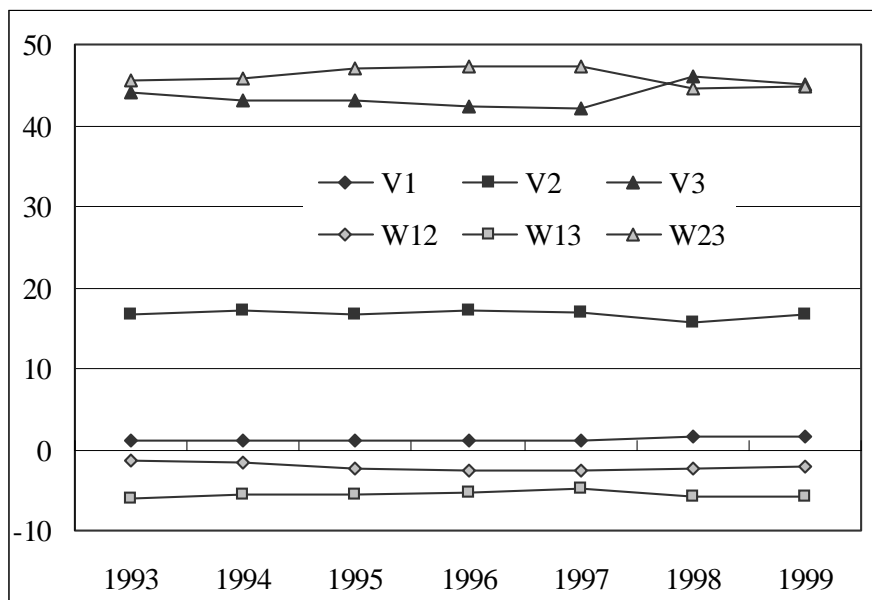**Share of Each Component in the Squared Weighted Coefficient of Variation of Per Capita GDP**

Figure 3.5
Regional Inequality in Per Capita GDP and Labor Productivity Theil T Index
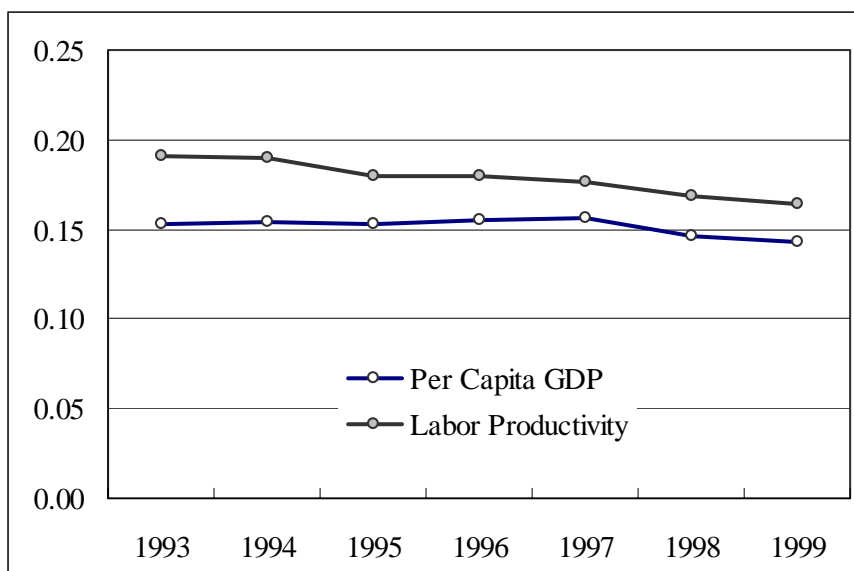
Figure 3.6
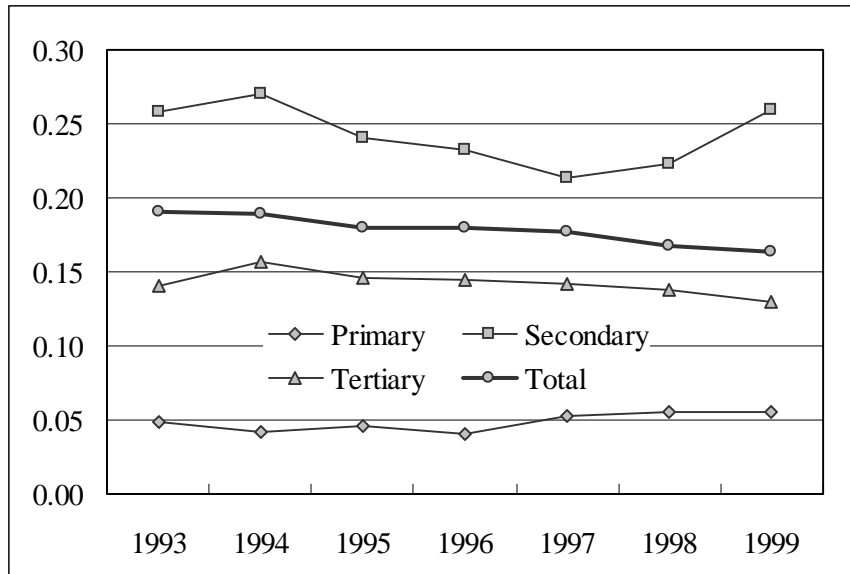**Regional Inequality in Labor Productivity by Sector**
Theil T Index

Figure 3.7
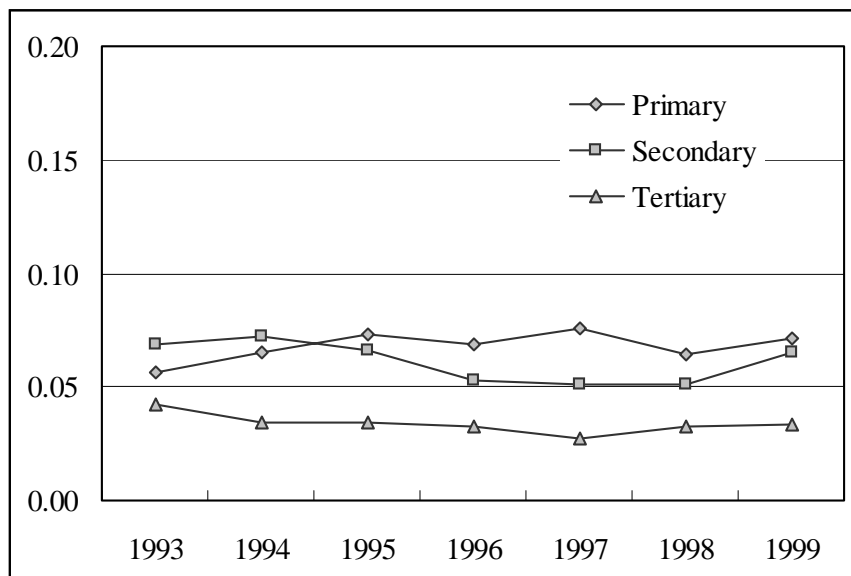**Regional Inequality in the Employment Share of Each Sector**
Theil T Index

Figure 3.8
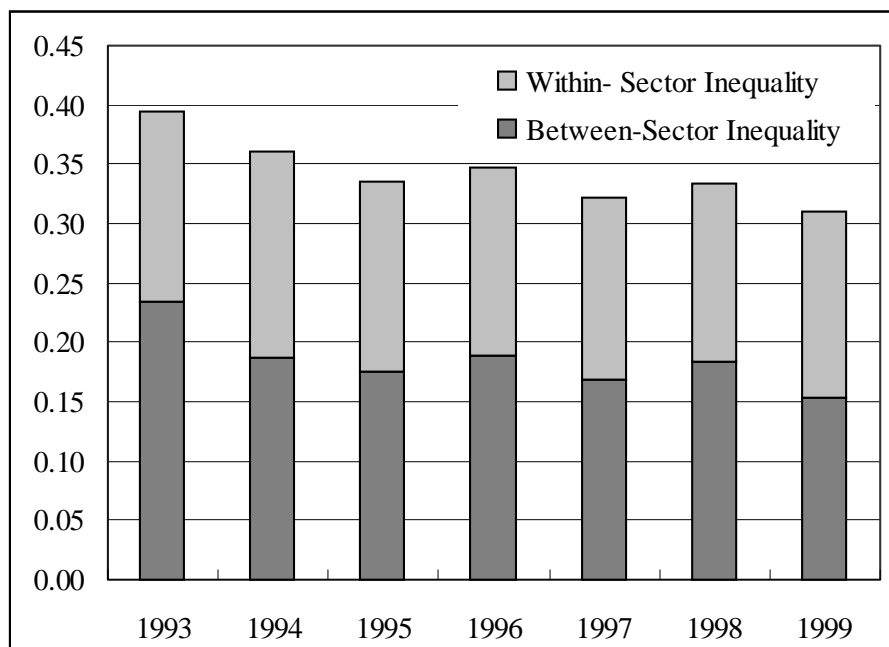**Decomposition of Theil T Index for Labor Productivity**

Table 3.1
**Decomposition of Theil T Index for Labor Productivity**

Sector			1993	1994	1995	1996	1997	1998	1999
Primary	Inequality	(1)	0.049	0.042	0.045	0.040	0.053	0.055	0.056
	GDP Share (%)	(A)	19.3%	18.3%	17.9%	17.2%	16.6%	18.5%	19.0%
Secondary	Inequality	(2)	0.258	0.271	0.241	0.232	0.214	0.222	0.259
	GDP Share (%)	(B)	32.7%	33.7%	34.4%	35.2%	35.4%	32.5%	32.1%
Tertiary	Inequality	(3)	0.140	0.156	0.146	0.144	0.142	0.138	0.130
	GDP Share (%)	(C)	48.0%	48.0%	47.7%	47.5%	48.0%	49.0%	48.9%
Within- Sector Inequality			0.161	0.174	0.160	0.157	0.152	0.150	0.157
Between-Sector Inequality			0.234	0.186	0.175	0.190	0.169	0.183	0.153
Overall Inequality			0.395	0.360	0.336	0.347	0.322	0.333	0.310

Contribution of Each Component to Overall Inequality (in %)

		1993	1994	1995	1996	1997	1998	1999
Primary Sector	(1) x (A)	2.4%	2.1%	2.4%	2.0%	2.7%	3.0%	3.4%
Secondary Sector	(2) x (B)	21.4%	25.3%	24.7%	23.6%	23.5%	21.7%	26.8%
Tertiary Sector	(3) x (C)	17.0%	20.8%	20.7%	19.7%	21.1%	20.2%	20.4%
Within-Sector Component		40.8%	48.2%	47.8%	45.3%	47.4%	45.0%	50.7%
Between-Sector Component		59.2%	51.8%	52.2%	54.7%	52.6%	55.0%	49.3%

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Figure 3.9
Labor Productivity by Sector

National labor productivity = 1.0
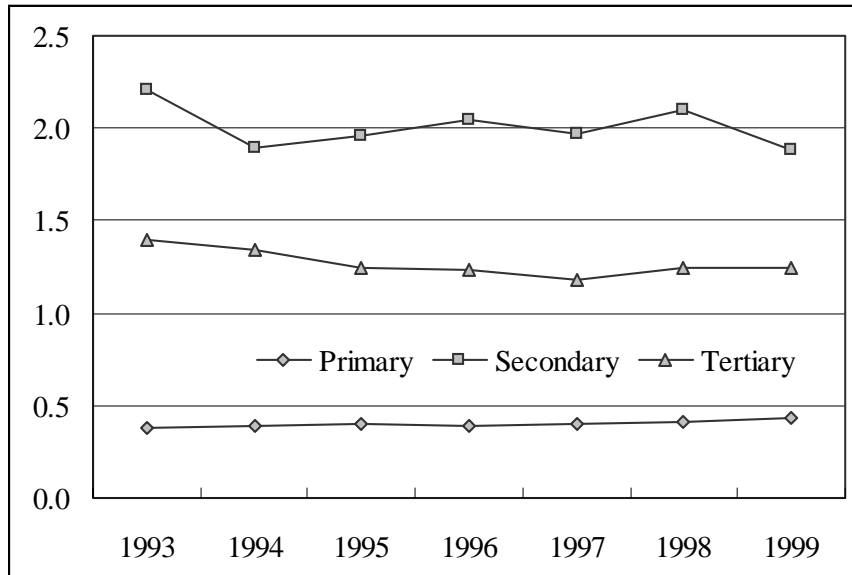
4. Comparison with Regional Inequalities in Postwar Japan

Regional Inequalities in Postwar Japan, 1955-2000

Japan has much smaller regional inequalities in per capita GDP and labor productivity. Figure 4.1 presents that in the postwar period (1955-2000), Japan's regional inequality in per capita GDP, as measured by the Theil T index, ranged between 0.03 and 0.06. The ratio between the largest and smallest per capita GDP was 3.4 in 1955, but declined to 2.8 in 2000.

Figure 4.2 shows Japan's regional inequality in per capita GDP in the primary, secondary, and tertiary sectors in addition to regional inequality in Japan as a whole, as measured by the weighted coefficient of variation. Japan's regional inequality in per capita GDP (V) first increased and reached a peak in 1958 at 0.38. It then declined steadily and hit the bottom at 0.25 in 1979. After 1979, it rose again and reached a peak in 1990 at 0.37. There is a declining trend after 1990. In 1955, primary sector's regional inequality (V_1) was the smallest at 0.43, but it rose rapidly and reached 0.74 in 1975. V_1 exhibited an increasing trend even after 1975, but the increase was not as large as before and V_1 became stable in the 1990s at around 0.8. On the other hand, secondary sector's regional inequality (V_2) was the largest in 1955 at 0.51. After it rose slightly, it gradually decreased and hit the bottom in 1977 at 0.27. It exhibited a slight increasing trend after 1977, but became stable in the 1990s at around 0.3.

These observations indicate that the primary sector has been distributed increasingly unevenly relative to population distribution, as urbanization has proceeded and manufacturing activities have gradually spread over the Japanese archipelago in tandem with the construction of new networks of trunk railway lines, expressways, and communications, and the establishment of large-scale industrial bases around the new networks. But this process seems to have slowed down in the 1970s, in which a hike in oil prices caused by the two oil shocks brought about a structural shift away from heavy and chemical industries to high-tech and service industries and to knowledge-intensive service industries.

In 1955, tertiary sector's regional inequality (V_3) was somewhere in between V_1 and V_2, but gradually decreased until 1965. After it became stable in 1965-1980 at around

0.33-0.34, it started to rise rapidly and reached a peak in 1990 at 0.50, the same level as in 1958, and then gradually decreased to 0.4. It should be noted that V_1 exceeded V_2 and V_3 for the first time in 1959, one year after the regional inequality in per capita GDP (V) hit the first peak, and that V_3 surpassed V_2 in 1972 when it registered 0.36, and since then, V_2 has been the smallest until now.

It is interesting to note that the rising and declining trend of V_3 in the late 1980s and the early 1990s corresponds closely to the rise and collapse of the bubble economy. In the late 1980s, financial institutions increased their loan for investment in stocks and real estate, especially in the Tokyo metropolitan area[7], as it became one of the major international financial and information centers in the world, following the deregulation and liberalization of the financial sector in Japan. As a result, the prices of stocks and real estate increased conspicuously, and their respective capital gain brought huge wealth to the investors. However, this bubble economy collapsed in the early 1990s with a drastic fall in the prices of stocks and real estate, and the Japanese economy entered a period of long recession. Geographically, the bubble period and the subsequent period of long recession were associated with the rise and fall of the Tokyo metropolitan area. In terms of per capita GDP, the Tokyo metropolitan area grew at 6.2 % in 1985-1990, in which Japan as a whole grew at 5.1%. However, in 1990-2000, the growth rate of the Tokyo metropolitan area dropped substantially to -0.4%, while Japan as a whole registered a growth rate of 0.7%.

Comparison between Indonesia and Japan

Even after excluding mining activities, which are distributed very unevenly, Indonesia still has very large regional income disparities. By the Theil T index, regional inequalities in per capita GDP and labor productivity after excluding the mining sector were, respectively, 0.14 and 0.16 in 1999. The ratio between the largest and smallest per capita GDP was also very large at 8.2 in 1999.

Though some adjustments may be necessary to make a comparison between Indonesia and Japan since Indonesia has much larger land area and is much richer in natural resources, Figures 3.2a and 4.2 indicate that Indonesia's present pattern of regional inequalities corresponds to Japan's inequality pattern in the 1950s or before, in which the primary sector had the smallest regional inequality in per capita GDP among the three sectors. It should be

noted that in Japan, in 1955, per capita GDP was about $500 in current U.S. dollars and the share of the primary sector was 16% in GDP and 41% in employment. On the other hand, in Indonesia, per capita GDP was about $1,000 in current U.S. dollars and the share of the primary sector was 17% in GDP and 42% in employment after excluding the mining sector in 1997.

As discussed in the previous section, Japan was successful in reducing its regional inequalities in the 1960s and 1970s, during which secondary and tertiary sectors' inequalities in per capita GDP (V_2 and V_3) declined steadily, while primary sector's inequality (V_1) rose rapidly (see Figures 4.1 and 4.2). In the period, there was a marked shift in GDP from the primary sector to the secondary sector, in which the secondary sector raised its share by more than 10 percentage points (see Figure 4.3). In other words, the primary sector has been distributed increasingly unevenly in the period, as manufacturing activities together with some service industries such as finance, trade, and transportation have gradually spread over the Japanese archipelago.

An interesting question now is whether Indonesia could reduce its regional inequality as Japan did in the 1960s and 1970s, given the fact that Indonesia's current pattern of regional inequalities corresponds to Japan's pattern in the 1950s or before. Japan's experience in the postwar period suggests that Indonesia's regional inequalities would follow the pattern depicted in Figure 4.4. If so, when will the secondary and tertiary sectors start to decrease their regional inequalities in per capita GDP (i.e., year X in Figure 4.4)? To answer this, it is instructive to examine regional inequalities in labor productivity and employment share in each sector. Figures 4.5 and 4.6 present regional inequalities in labor productivity and employment share in postwar Japan, as measured by the Theil T index. Compared to Indonesia (Figure 3.6), Japan's regional inequalities in labor productivity are very low in the secondary and tertiary sectors, which were, respectively, 0.03 and 0.03 in 1955. On the other hand, Indonesia's corresponding values were, respectively, 0.21 and 0.14 in 1997. Therefore, reducing labor productivity inequalities is imperative to reduce regional inequalities in per capita GDP in the secondary and tertiary sectors. Since Japan has successfully reduced regional inequalities in employment share in these two sectors in the postwar period (see Figure 4.6), another task facing Indonesia would be the reduction of regional inequalities in employment share.

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In sum, Indonesia needs to gradually disperse manufacturing and service activities over the Indonesian archipelago in accordance with the dynamically changing spatial pattern of comparative advantages and disadvantages. In view of large disparities in labor productivity between sub-sectors within the secondary and tertiary sectors, it would not be easy to reduce regional inequalities in labor productivity since each region tends to specialize in a certain set of sub-sectors, especially at the early stages of economic development. Nonetheless, the central as well as local governments need to strive for the dispersion of manufacturing and service activities, in which the construction of new transportation and communication networks should be vital.

Figure 4.1
Regional Inequality in Per Capita GDP and Labor Productivity in Japan,
Theil T Index
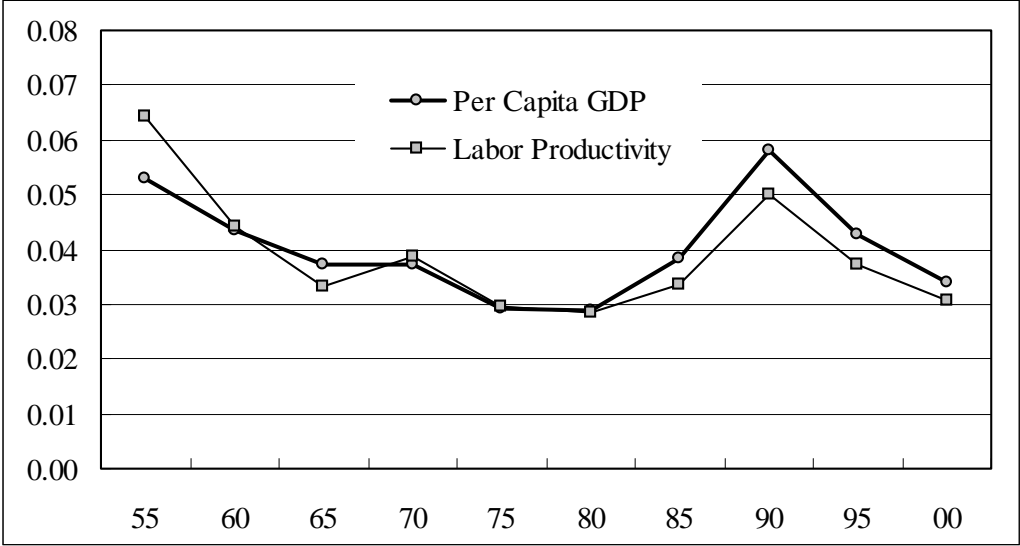
Figure 4.2
Regional Inequality in Per Capita GDP in Japan
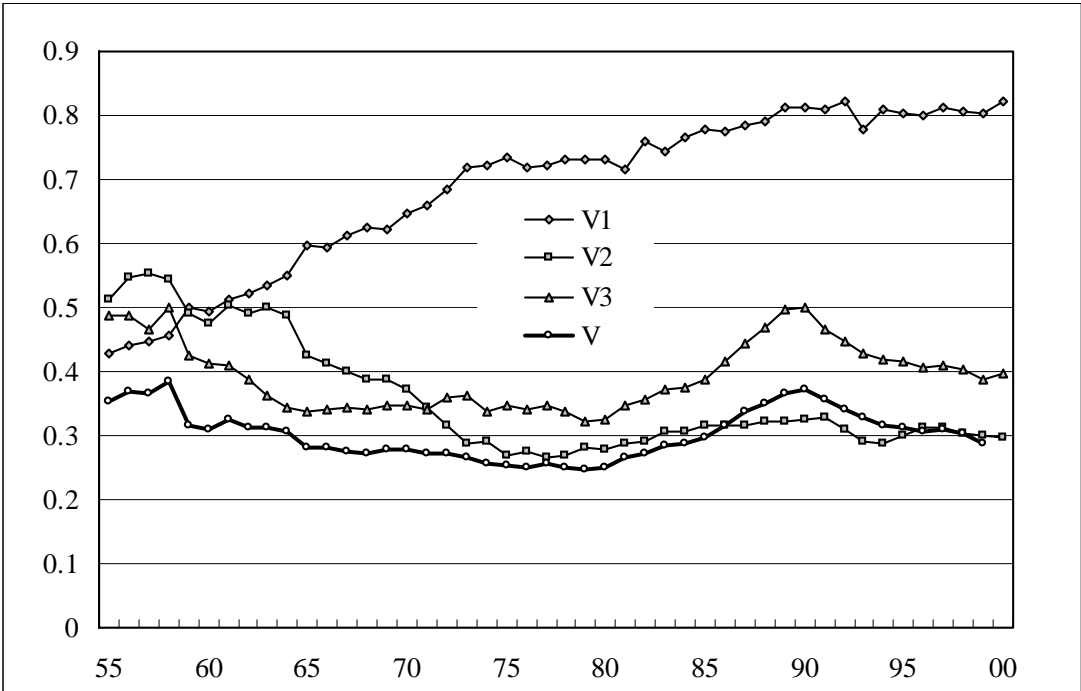**Weighted Coefficient of Variation by Sector**

Figure 4.3
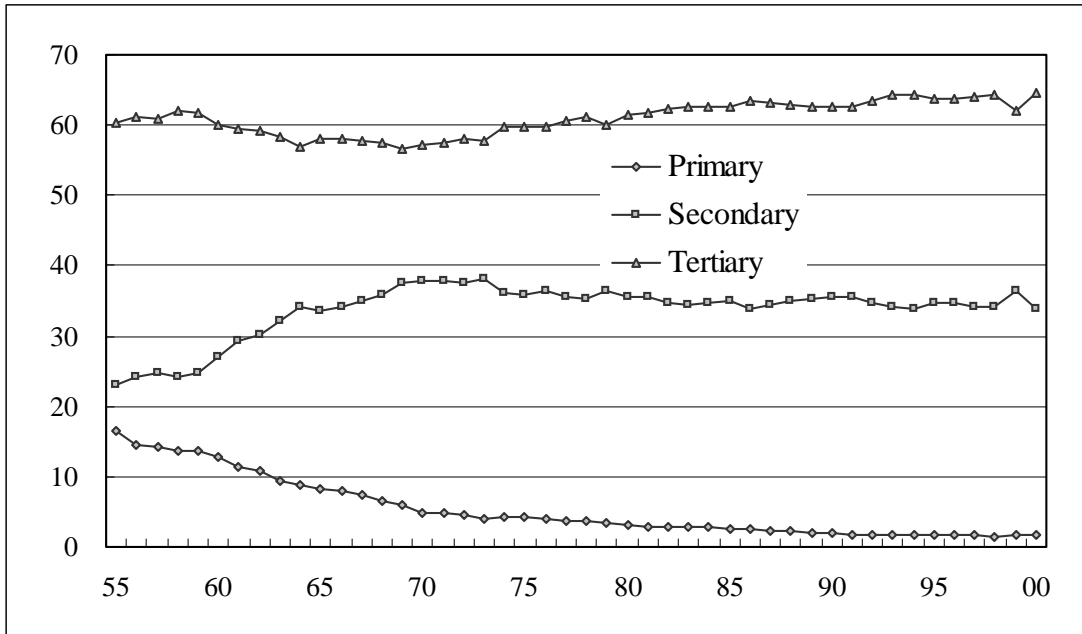**GDP Share of Each Sector in Japan**

Figure 4.4
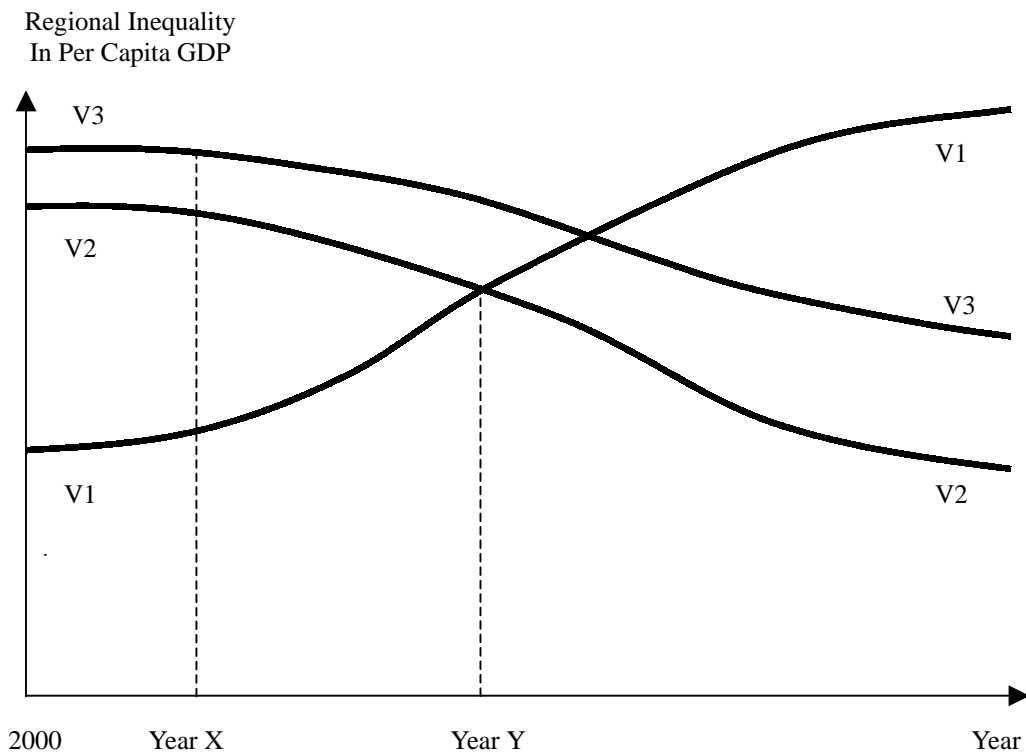**Future Pattern of Regional Inequalities in Per Capita GDP in Indonesia**

Figure 4.5
Regional Inequality in Labor Productivity by Sector in Japan
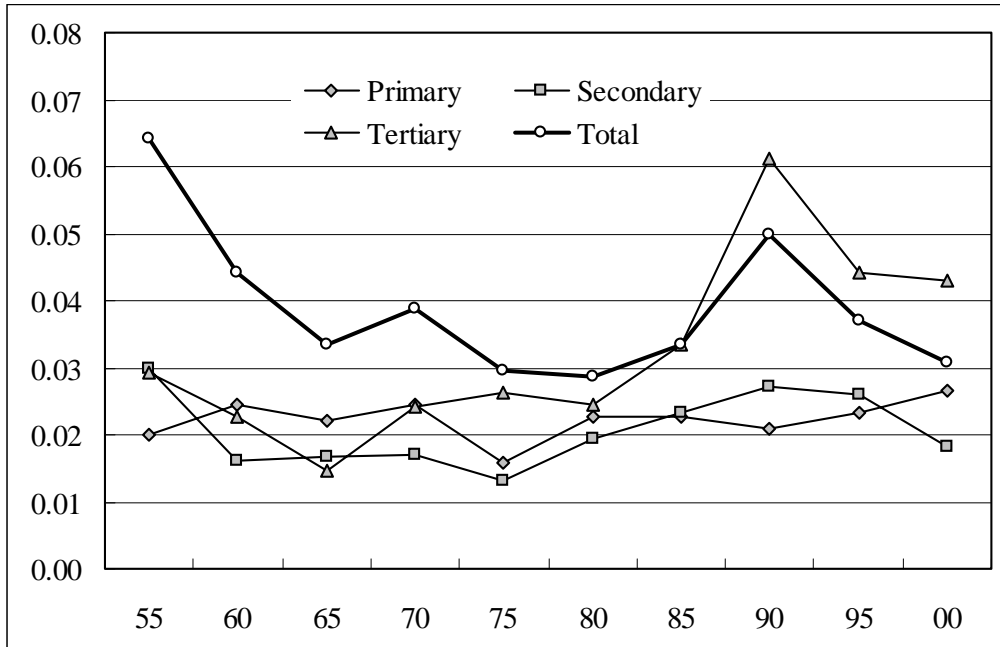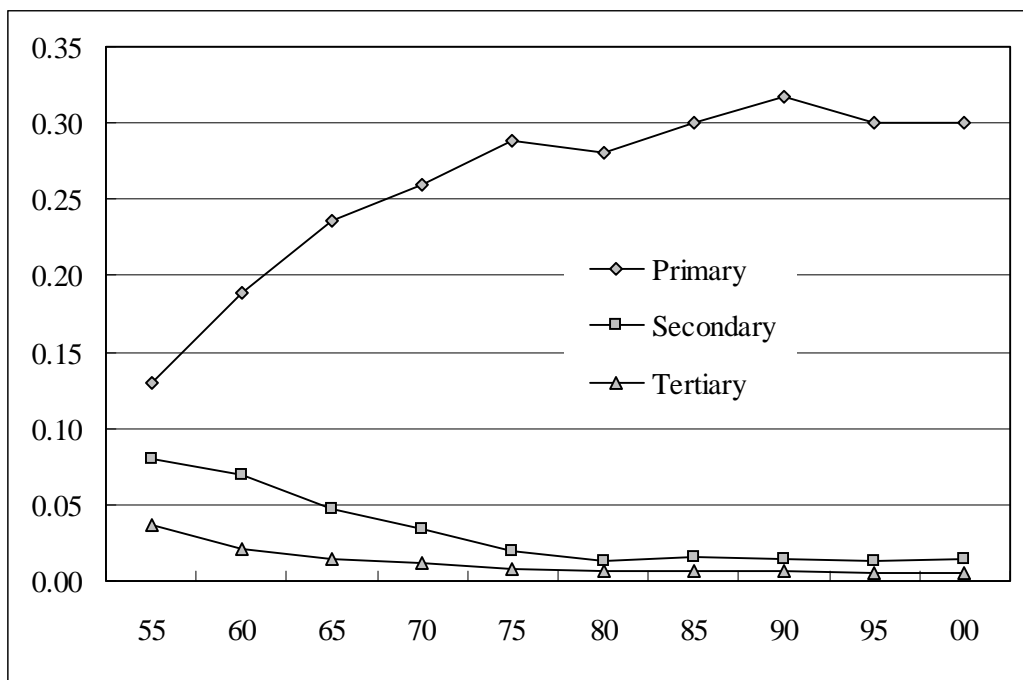**Theil T Index**

Figure 4.6
Regional Inequality in the Employment Share of Each Sector in Japan
Theil T Index

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1 Since the work by Williamson (1965), the weighted coefficient of variation has been widely used as a measure of regional income inequality. See, for example, Green (1969), Jensen (1969), Esmara (1975), Gilbert and Goodman (1976), Mathur (1983), Uppal and Budiono (1986), Tabuchi (1988), Mutlu (1991), Akita and Lukman (1995).

2 Precisely speaking, e_i denotes (1 – unemployment rate) times labor participation rate. But, for simplicity, the term, labor participation rate, is used to refer to e_i in this study.

3 An inequality index is said to be additively decomposable if total inequality can be written as the sum of between-group and within-group inequality. For the additive decomposability of Theil indices, please see, for example, Bourguignon (1979), Shorrocks (1980), and Anand (1983).

4 Akita and Lukman (1995) and Kalirajan and Akita (2002) used this decomposition equation to analyze regional income inequality in Indonesia and India, respectively.

5 For convergence, please see Barro and Sala-I-Martin (1995).

6 The primary sector consists of agriculture, livestock, forestry, and fishery; the secondary sector consists of manufacturing and construction, where manufacturing includes both oil/gas manufacturing (oil refinery and liquid natural gas) and non-oil/gas manufacturing; and the tertiary sector consists of the remaining sectors, excluding the mining sector.

7 The Tokyo metropolitan area includes the prefectures of Tokyo, Kanagawa, Saitama, and Chiba.