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Abstract

The COVID-19 pandemic has exerted an enormous impact on the Indonesian economy. In 2020, the country contracted by 2.7%. But, the impact has been spatially heterogeneous. Based on provincial GDP by industrial sectors, this study examines how structural changes caused by the pandemic have affected the determinants of inter-provincial inequality in Indonesia by conducting a bi-dimensional inequality decomposition analysis. It also investigates how the pandemic has affected provincial economies by performing a panel data regression analysis. According to the regression analysis, the pandemic appears to have affected the convergence speed of provincial economies. Provinces with larger GDP shares of the tourism sector were affected more severely by the pandemic. Meanwhile, the impact of the financial sector on provincial growth was not affected. According to the decomposition analysis, after the outbreak of the COVID-19, the tourism sector reduced its contribution to inter-provincial inequality. On the other hand, the IC and financial services sectors were not affected by the pandemic and raised their contributions. When Indonesia will recover from the pandemic, it is likely that the tourism sector will regain its position as an important determinant of inter-provincial inequality. However, the most important sectors in determining inter-provincial inequality will be IC, financial and business services sectors, particularly in the Java-Bali region. With the rapid advancement of IC, financial and e-business technologies, the roles of these high-inequality sectors are likely to increase unless policies that could facilitate spatial dispersion of these services activities are implemented.

Key words: Indonesia, COVID-19 pandemic, structural changes, inter-provincial income inequality, bi-dimensional inequality decomposition analysis
JEL classifications: I14, O15, R12

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1. Introduction

Since the outbreak of novel coronavirus disease (COVID-19) in early 2020, the number of confirmed COVID-19 cases has increased exponentially in Indonesia. As of August 2021, 4.1 million people have been infected, meaning that at least 15 out of 1,000 people have been infected. The COVID-19 pandemic hit the Indonesian economy severely. In 2020, real GDP decreased by 2.7% (Figure 1). Since the annual average growth rate was 5.3% between 2010 and 2019, the impact of the COVID-19 pandemic is enormous. The COVID-19 pandemic had however differential impacts on regional economies (Figure 2). While tourist destination provinces such as Bali and Riau Islands experienced a large decrease in per capita GDP, the impact appears to have been relatively small in such eastern provinces as Central Sulawesi, North Maluku and Papua (Figure 3 for the map of Indonesia).

Figures 1, 2 and 3

How has the COVID-19 pandemic affected regional economies? How have structural changes caused by the COVID-19 pandemic affected the determinants of regional income inequality? This study addresses these questions by using provincial GDP by industrial sectors in Indonesia. Using a panel dataset of 33 provinces for the period from 2010 to 2020, it first conducts a panel data regression analysis to investigate the impacts of the COVID-19 pandemic on regional economies. It then uses a bi-dimensional inequality decomposition method to explore the determinants of inter-provincial inequality in per capita GDP before and after the outbreak of COVID-19.

The bi-dimensional inequality decomposition method employs the squared population-weighted coefficient of variation (squared *WCV*) as a measure of inequality and decomposes inter-provincial inequality in per capita GDP in two dimensions, that is, by regions and by GDP components.[1] The squared *WCV* satisfies several desirable properties as a measure of inequality,

[1] The population-weighted coefficient of variation, introduced by Williamson (1965), has been used by many

such as anonymity, income homogeneity, population homogeneity and the Pigou-Dalton transfer principle (Anand, 1983; Fields, 2001). Since the squared *WCV* is a member of the generalized entropy class of inequality measures, inter-provincial inequality in per capita GDP, as measured by the squared *WCV*, can be decomposed additively by regions, that is, decomposed into the within-region and between-region inequality components (Shorrocks, 1980).[2] Furthermore, by the squared *WCV*, inter-provincial inequality can be decomposed by GDP components, that is, expressed as the sum of contributions from GDP components (Shorrocks, 1982).[3] Using the squared *WCV*, the bi-dimensional inequality decomposition method combines these two decomposition properties. It can thus analyze the contribution of each GDP component to overall inter-provincial inequality in GDP per capita through within-region and between-region inequalities in a coherent framework.

To the best of our knowledge, only a few studies have investigated the impact of the COVID-19 pandemic on the distribution of income in Indonesia. Among them are Suryahadi, Al Izzati and Suryadarma (2020) and Gibson and Olivia (2020). Suryahadi, Al Izzati and Suryadarma (2020) estimated the impact of the pandemic on poverty in Indonesia by conducting a simulation analysis based on a past pattern of economic shocks. They found that under the worst case scenario of economic growth, in which the economy contracts by 3.5%, the poverty headcount ratio increases from 9.2% in 2019 to 16.6% by the end of 2020. This means that 19.7 million people become poor, bringing the country back to 2004 when the poverty headcount ratio was 16.7%.

Gibson and Olivia (2020) also investigated the impact of the COVID-19 pandemic on poverty in Indonesia. Unlike Suryahadi, Al Izzati and Suryadarma (2020), they estimated the impact at the provincial level using mobility data from Google. They found that the impact varies substantially across provinces. Provinces with lower initial poverty headcount ratios tend to have a larger increase in the headcount ratio. For example, in Bali, one of the richest provinces, the poverty headcount ratio increases by 13 percentage points, while in the poorest provinces of Papua and East Nusa Tenggara, it increases by 3 percentage points. They thus argued that the social assistance program needs to be expanded in places where people have not widely relied on it previously.

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researchers to measure regional income inequality. See, for example, Mathur (1983), Tabuchi (1988), Mutlu (1991), Akita and Lukman (1995), Fujita and Hu (2001), and Hill and Vidyattama (2016).

[2] Here, provinces are classified into mutually exclusive and collectively exhaustive regions.

[3] Here, total GDP consists of several GDP components (GDP from several industrial sectors).

On the other hand, numerous studies have been conducted to analyze regional income inequality in Indonesia using provincial GDP. They include Akita and Lukman (1995), Garcia and Soelistianingsih (1998), Hill, Resosudarmo and Vidyattama (2008), Akita, Kurniawan and Miyata (2011), Vidyattama (2013), Hill and Vidyattama (2016), and Alisjahbana and Akita (2020).

Akita and Lukman (1995) used provincial GDP by industrial sectors to explore the determinants of inequality in per capita GDP from 1975 to 1992. They conducted an inequality decomposition analysis by industrial sectors using the WCV. Hill and Vidyattama (2016) used an updated dataset of provincial GDP to analyze inequality in per capita GDP from 1975 to 2010. On the other hand, Garcia and Soelistianingsih (1998) investigated β-convergence using provincial GDP from 1975 to 1993. Hill, Resosudarmo and Vidyattama (2008) also examined β-convergence using an updated provincial GDP data set from 1975 to 2002. Vidyattama (2013) employed a spatial econometric approach to investigate the impact of the neighborhood effect on the speed of β-convergence using provincial and district-level GDP from 1999 to 2008.

Using provincial GDP by industrial sectors from 1983 to 2004, Akita, Kurniawan and Miyata (2011) performed a bi-dimensional inequality decomposition analysis to explore the determinants of inter-provincial inequality in per capita GDP. Alisjahbana and Akita (2020) used an updated dataset of provincial GDP by industrial sectors from 2005 to 2013 to examine how economic tertiarization and concurrent output deindustrialization have affected the determinants of inter-provincial inequality in per capita GDP by conducting a bi-dimensional inequality decomposition analysis. Our study is similar to these studies in terms of the method. But, it uses provincial GDP by industrial sectors from 2010 to 2020 and analyzes the initial impacts of the COVID-19 pandemic on inter-provincial inequality in per capita GDP. Our study also differs from theirs in that it uses a 52-sector classification, while Akita, Kurniawan and Miyata (2011) and Alisjahbana and Akita (2020) used, respectively, 9-sector and 33-sector classifications (see Table 1 for the sector classifications). Thus, our study can analyze the impact of structural changes on inter-provincial inequality in more detail.

Table 1

Next section presents the data and the methods used in this study. Section 3 discusses the results, while section 4 provides concluding remarks.

2. Data and Methods

2.1. Data

This study uses provincial GDP by 52 industrial sectors for the period from 2010 to 2020, compiled by the Indonesian Central Bureau of Statistics (CBS, 2021). The data set includes GDP at constant 2010 prices for 33 provinces. In a bi-dimensional inequality decomposition analysis, these 33 provinces are divided into three mutually exclusive and collectively exhaustive regions: region 1 (Sumatra and Kalimantan provinces); region 2 (Java provinces and Bali); and region 3 (West and East Nusa Tenggara, Sulawesi provinces, Maluku, North Maluku, West Papua and Papua) (see Figure 3).

A bi-dimensional inequality decomposition analysis is performed first using 9 main sectors, which are created by aggregating 52 sectors. These main sectors are (1) agriculture, (2) mining, (3) manufacturing, (4) electricity, gas and water, (5) construction, (6) trade, hotel and restaurant, (7) transportation and communication, (8) financial and business services, (9) government and other services (see the first column of Table 1). Since the manufacturing and services sectors play an important role in determining inter-provincial inequality in per capita GDP, in the second step, we conduct decomposition analyses for (1) manufacturing subsectors, (2) trade, transportation and IC (information and communication) subsectors, and (3) finance, business and government services subsectors (see the second column of Table 1).

2.2. Methods

Panel Data Regression Analysis

Using the following panel data regression model, this study conducts a panel data regression analysis to examine how the COVID-19 pandemic has affected regional economies.

$$\ln\left(\frac{y_{it+1}}{y_{it}}\right) = \beta \ln(y_{it}) + \boldsymbol{x}_{it}\boldsymbol{\gamma} + \alpha_i + u_{it}. \quad (1)$$

where y_{it}, y_{it+1}, α_i and u_{it} are per capita GDP of province *i* in year *t*, per capita GDP of province *i* in year *t*+1, unobserved province-specific effects and the error term, respectively, while $\boldsymbol{x}_{it}$ is a vector of other independent variables which may affect the dependent variable. Since $\ln\left(\frac{y_{it+1}}{y_{it}}\right)$ is the growth rate of per capita GDP of province *i*, $\beta < 0$ indicates that after controlling for conditioning variables, the growth rate of per capita GDP decreases as per capita GDP increases.

We should note that in the neoclassical growth model, a declining growth rate of per capita GDP for a region indicates a process toward the region's steady state per capita GDP (Solow,

1956). Bianchi, Calidoni and Menegatti (2009) claimed however that panel data regression techniques used in estimating β are unable to unravel the possible occurrence of the two different phenomena: (1) tendency for poorer regions to grow faster than richer ones and (2) decreasing growth rates of per capita GDP within regions.[4] The first phenomenon is related to the classical concept of β-convergence in a cross-section of regions (Barro and Sala-i-Martin, 1991; Sala-i-Martin, 1996).

Other independent variables include the share of the financial sector in total GDP and the share of the tourism sector in total GDP.[5] Accessibility to financial institutions is considered one of the important factors for economic growth; thus, provinces with larger GDP shares of the financial sector tend to grow faster. On the other hand, the tourism sector may not be an important factor for economic growth. But, it has been severely affected by the COVID-19 pandemic; thus, in provinces with higher GDP shares of the tourism sector, the pandemic should have exerted a more negative impact on their economic growth. To examine the impact of the COVID-19 pandemic on economic growth, we include the time dummy variable for 2019-20. With these factors, $\boldsymbol{x}_{it}\boldsymbol{\gamma}$ is rewritten as follows.

$$\boldsymbol{x}_{it}\boldsymbol{\gamma} = \gamma_1 \text{fshare}_{it} + \gamma_2 \text{tshare}_{it} + \gamma_3 D_t \ln(y_{it}) + \gamma_4 D_t \text{fshare}_{it} + \gamma_5 D_t \text{tshare}_{it}, \qquad (2)$$

where fshare_{it} and tshare_{it} are the GDP share of the financial sector and the GDP share of the tourism sector, respectively, while D_t is the time dummy variable where $D_t = 1$ for the period 2019-20 and $D_t = 0$ otherwise.

We expect that (1) $\beta < 0$, that is, the growth rate of per capita GDP declines as per capita GDP increases, (2) $\gamma_1 > 0$, that is, provinces with larger GDP shares of the financial sector tend to grow faster, (3) γ_2 is unknown, (4) $\gamma_3 < 0$, that is, the COVID-19 pandemic exerts a negative impact on economic growth, (5) γ_4 is unknown, and (6) $\gamma_5 < 0$, that is, provinces with larger GDP shares of the tourism sector tend to grow slower during the pandemic.

Bi-dimensional Inequality Decomposition Analysis

To analyze the effects of changes in industrial and spatial structures on inter-provincial inequality in per capita GDP, we conduct a bi-dimensional inequality decomposition analysis using the squared population-weighted coefficient of variation (squared *WCV*). Suppose that a country

[4] Lopez-Rodriguez (2008) argued also that in a panel data regression analysis, the concept of β is somewhat different from the one in a cross-section regression analysis.

[5] The financial sector includes sectors s1, s2 and s3 in the second column of Table 1, whereas the tourism sector includes sector t2 in the second column of Table 1.

consists of m regions and region i is composed of n_i provinces. Let y_{ij}, p_{ij}, y and p be, respectively, per capita GDP and population of province *j* in region *i* and per capita GDP and total population of the country. Then, inter-provincial inequality in per capita GDP can be measured by the following squared *WCV*.

$$WCV^2 = \frac{1}{y^2}\sum_{i=1}^{m}\sum_{j=1}^{n_i}\frac{p_{ij}}{p}\left(y_{ij}-y\right)^2, \quad (3)$$

where $y = \sum_{i=1}^{m}\sum_{j=1}^{n_i}\frac{p_{ij}}{p}y_{ij}$.

Let y_i, p_i and $WCV_i^2 = \frac{1}{y_i^2}\sum_{j=1}^{n_i}\frac{p_{ij}}{p_i}\left(y_{ij}-y_i\right)^2$ be, respectively, per capita GDP, population and the squared population-weighted coefficient of variation of region *i*. Then, the squared *WCV* can be decomposed into the within- and between-region inequality components as follows (Shorrocks, 1980).

$$WCV^2 = WCV_W + WCV_B. \quad (4)$$

In equation 4, $WCV_W = \sum_{i=1}^{m}\left(\frac{p_i}{p}\right)\left(\frac{y_i}{y}\right)^2 WCV_i^2$ is the within-region inequality component, while WCV_B=$\frac{1}{y^2}\sum_{i=1}^{m}\frac{p_i}{p}(y_i-y)^2$ is the between-region inequality component. It should be noted that WCV_W is not a weighted average of WCV_i^2, since the weights, $\left(\frac{p_i}{p}\right)\left(\frac{y_i}{y}\right)^2$, do not sum to unity.

Suppose next that total provincial GDP is composed of *K* GDP components (GDP from *K* industrial sectors), that is, $y_{ij} = \sum_{k=1}^{K} y_{ijk}$, where y_{ijk} is per capita GDP from component *k* of province *j* in region *i*. Since squared *WCV* can also be decomposed by GDP components, region *i*'s within-region inequality can be expressed as follows (Shorrocks, 1982).

$$WCV_i^2 = \sum_{k=1}^{K} w_{ik} WCOV_{ik}. \quad (5)$$

In equation 5, w_{ik} is GDP share of component *k* in region *i*, while $WCOV_{ik} = \frac{1}{y_i y_{ik}}\sum_{j=1}^{n_i}\frac{p_{ij}}{p_i}(y_{ij}-y_i)(y_{ijk}-y_{ik})$ is the population-weighted coefficient of covariation between total per capita GDP and per capita GDP from component *k* in region *i*, where, y_{ik} is per capita GDP from component *k* in region *i*.

Similarly, the between-region inequality can be decomposed by GDP components as follows.

$$WCV_B = \sum_{k=1}^{K} w_k WCOV_k. \quad (6)$$

In equation 6, w_k is GDP share of component *k* in the country, while $WCOV_k = \frac{1}{(y)(y_{\cdot k})}\sum_{i=1}^{m}\frac{p_i}{p}(y_i-y)(y_{ik}-y_{\cdot k})$ is the population-weighted coefficient of covariation between

total per capita GDP and per capita GDP from component *k*, where $y_{.k}$ is per capita GDP from component *k* in the country.

Substituting equations 5 and 6 into equation 4, we obtain the following bi-dimensional inequality decomposition equation.

$$WCV^2 = \sum_{i=1}^{m} \left(\frac{p_i}{p}\right) \left(\frac{y_i}{y}\right)^2 \sum_{k=1}^{K} w_{ik}\, WCOV_{ik} + \sum_{k=1}^{K} w_k WCOV_k. \quad (7)$$

Dividing this equation by WCV^2 results in

$$1 = \sum_{i=1}^{m} \left(\frac{p_i}{p}\right) \left(\frac{y_i}{y}\right)^2 \sum_{k=1}^{K} w_{ik}\, g_{ik} + \sum_{k=1}^{K} w_k g_k = \sum_{i=1}^{m} \sum_{k=1}^{K} c_{ik} + \sum_{k=1}^{K} c_k \quad (8)$$

where $g_{ik} = \frac{WCOV_{ik}}{WCV^2}$ and $g_k = \frac{WCOV_k}{WCV^2}$. In equation 8, $c_{ik} = \left(\frac{p_i}{p}\right) \left(\frac{y_i}{y}\right)^2 w_{ik} g_{ik}$ is the contribution of region *i*'s within-region inequality for component *k* to overall inequality, while $c_k = w_k g_k$ is the contribution of between-region inequality for component *k* to overall inequality.

In this study, Indonesia is divided into 3 regions, that is, $m = 3$ (see Figure 3). If there are 9 GDP components (9 industrial sectors), then, including components for the between-region inequality, there are (3 + 1) × 9 = 36 components in equation 8.

3. Results

3.1. Trends of Inter-provincial Inequality in Per Capita GDP and *β*-convergence across Provinces for the Period 2010-20

Prior to a panel data regression analysis, we first examine the trend of inter-provincial inequality in per capita GDP across 33 provinces for the period 2010-20 by using the Gini coefficient and the Theil *L* and *T* indices (Figure 4).[6] All inequality measures exhibit a declining trend, implying that inter-provincial inequality in per capita GDP has been decreasing over the study period 2010-20. In other words, the provinces exhibit *σ*-convergence (Barro and Sala-i-Martin, 1991). To examine which provinces are responsible for the declining inequality, we next perform a *β*-convergence analysis across 33 provinces before and during the COVID-19 pandemic (2010-19 and 2019-20, respectively).

[6] The Gini coefficient is defined by $\text{Gini} = \frac{2}{n\mu}\text{cov}(\boldsymbol{y}, i(\boldsymbol{y}))$ where n is the total number of provinces, y_i is per capita GDP of province *i*, $\mu = \frac{1}{n}\sum_{i=1}^{n} y_i$ is simple average of per capita GDP, $\boldsymbol{y} = (y_1, y_2, \cdots, y_n)$ is a vector of per capita GDP, and $i(\boldsymbol{y})$ is the ranking of provinces in terms of per capita GDP. The Theil *L* and *T* indices are defined, respectively, by $L = \frac{1}{n}\sum_{i=1}^{n} \ln\left(\frac{\mu}{y_i}\right)$ and $T = \frac{1}{n}\sum_{i=1}^{n} \frac{y_i}{\mu} \ln\left(\frac{y_i}{\mu}\right)$. These inequality measures satisfy anonymity, income homogeneity, population homogeneity and the Pigou-Dalton transfer principle (Anand, 1983; Fields, 2001).

Figure 4

Figure 5 presents per capita GDP in 2010 and annual average growth rate of per capita GDP by province before the pandemic (2010-19). In 2010, East Kalimantan had the largest per capita GDP, which was followed by Jakarta, Riau, Riau Islands and West Papua. Except Jakarta, these provinces are resource-rich provinces. On the other hand, East Nusa Tenggara registered the smallest per capita GDP, followed by Maluku, North Maluku, West Sulawesi and Gorontalo. All these provinces are in region 3 (see Figure 3). Between 2010 and 2019, Sulawesi provinces performed relatively well in terms of per capita GDP growth. Central Sulawesi recorded the highest growth rate at 8.5%, which was followed by South Sulawesi, West Sulawesi, South East Sulawesi and Gorontalo.[7] Meanwhile, resource-rich provinces, such as Aceh, Riau, East Kalimantan and Papua, were stagnant. Papua had the smallest per capita GDP growth, which was followed by Riau, East Kalimantan and Aceh. Their average annual growth rates were below 1%.

Figure 5

Figure 6 exhibits a scatterplot of the average annual growth rate of per capita GDP for 2010-19 against the natural logarithm of per capita GDP in 2010. There appears to be a negative relationship between these two variables with the simple correlation coefficient of -0.42. This indicates that there was absolute β-convergence in a cross section of 33 provinces, that is, poorer provinces tend to grow faster than richer provinces during the 2010-19 period.[8]

Figure 6

In 2019, Jakarta moved to the top position in terms of per capita GDP, and it was followed by East Kalimantan, Riau Islands and Riau (Figure 7). On the other hand, East Nusa Tenggara, Maluku and North Maluku were still among the poorest provinces. The COVID-19 pandemic which started in early 2020 exerted an enormous impact on the Indonesian economy. The country's GDP declined by 2.7% in 2020. However, the pandemic had differential impacts on provincial economies. While tourist destination provinces such as Riau Islands and Bali experienced a large decrease in per capita GDP, some provinces in the eastern part of Indonesia, such as Central Sulawesi and North Maluku, recorded a positive growth. Figure 8 depicts a scatterplot of the

[7] Central Sulawesi's exceptionally high growth is attributable to the rapid development of the basic metal products sector. In 2020, the sector accounted for 16% of the province's total GDP.

[8] If, in a cross-section of provinces, there is a negative relationship between the initial per capita GDP and subsequent growth without controlling for any conditioning variables, then there is absolute β-convergence across these provinces (Barro and Sala-i-Martin, 1991). On the other hand, if a negative relationship exists between them after controlling for some conditioning variables, then the provinces exhibit conditional β-convergence.

growth rate of per capita GDP for 2019-20 against the natural logarithm of per capita GDP in 2019. No discernible pattern is observed in the relationship between these two variables, indicating that there was no absolute β-convergence across provinces during the pandemic. This does not however rule out the possibility of conditional β-convergence across these provinces (see footnote 8 for the concept of conditional β-convergence).

Figures 7 and 8

3.2. Impacts of the COVID-19 Pandemic on Provincial Economies: A Panel Data Regression Analysis

To examine how the COVID-19 pandemic has affected provincial economies, we next conduct a panel data regression analysis using a panel dataset of 33 provinces for the period 2010-20. Table 2 gives summary statistics of the dependent and independent variables, while Table 3 presents panel data regression results for fixed and random effects models. According to a Hausman test, the fixed effects model is preferable to the random effects model because the chi-squared statistic is 19.7 and thus we can reject the null hypothesis that the random effects model is appropriate. Therefore, we discuss the result of the fixed effects model. To show province-specific fixed effects, Table 3 also presents the OLS estimates of the dummy-variable model.

Tables 2 and 3

First, the coefficient of the logarithm of per capita GDP is significant at a 1% significance level and has an expected sign, indicating that the growth rate of per capita GDP tend to decline as per capita GDP increases. This result is consistent with the proposition of the Solow growth model, which postulates that as per capita GDP moves closer to the steady state, the growth rate declines. Secondly, the coefficient of the GDP share of the financial sector is significant at a 1% significance level and has an expected sign, meaning that provinces with larger GDP shares of the financial sector tend to grow faster. This confirms the importance of accessibility to financial institutions in accelerating economic growth. Thirdly, the coefficient of the GDP share of the tourism sector is also significant though at a 5% significance level. It is positive, signifying that provinces with larger GDP shares of the tourism sector tend to grow faster.

How has the COVID-19 pandemic affected provincial economies? First, the coefficient of the logarithm of per capita GDP multiplied by the time dummy is significant at a 1% significance level. The negative coefficient means that the coefficient of the logarithm of per capita GDP is more negative in the pandemic than in the period before the pandemic. This suggests that the

COVID-19 pandemic affected the convergence speed of provincial economies to some extent. Second, the coefficient of the GDP share of the tourism sector multiplied by the time dummy is significant at a 1% level and has a negative sign. This implies that provinces with larger GDP shares of the tourism sector were affected more severely by the pandemic. On the other hand, the coefficient of the GDP share of the financial sector multiplied by the time dummy is not significant, suggesting that the impact of the financial sector on provincial growth was not affected by the pandemic. We should note that according to the result of OLS estimates of the dummy variable model, out of 33 provinces, 20 provinces have significant province-specific fixed effects either at 1%, 5% or 10% significance level. This confirms the validity of the fixed effects model.

3.3. Bi-dimensional Inequality Decomposition Analysis

3.3.1. Before the Outbreak of the COVID-19

To analyze the effects of changes in industrial and spatial structures on inter-provincial inequality in per capita GDP, we conduct a bi-dimensional inequality decomposition analysis before and after the outbreak of the COVID-19. The result for 9 main sectors is shown in Table 4, where the values are the % contributions to overall inter-provincial inequality (see equations 7 and 8).[9] By the population-weighted coefficient of variation (WCV), Table 5 provides inter-provincial inequalities by industrial sectors within each region.

Tables 4 and 5

Some major changes can be observed between 2010 and 2019. First, region 2 raised its contribution to overall inter-provincial inequality conspicuously from 60.6% to 77.3%. The transportation and IC sector and the financial and business services sector are mainly responsible for this increase; the combined contribution of these two sectors has risen from 23.9% to 35.7%. We should note that the transportation and IC sector not only raised its inter-provincial inequality (Table 5) but also its GDP share in region 2. On the other hand, the financial and business services sector raised its GDP share, though its inter-provincial inequality remained constant at a high level in region 2 (Table 5). Second, region 1 lowered its contribution from 33.6% to 18.4%. The main contributor is the mining sector. While mining sector's inter-provincial inequality remained constant at a high level (Table 5), its GDP share has declined notably from 22.6% to 17.6% in region 1. Thus, region 1's mining sector reduced its contribution substantially from 17.4% to 8.8%. Another contributor is region 1's manufacturing sector. Unlike mining, the manufacturing sector

[9] These 9 main sectors are shown in the first column of Table 1.

lowered its inter-provincial inequality (Table 5). Though its GDP share remained almost constant in region 1, its contribution to overall inter-provincial inequality has declined from 9.1% to 5.0%.

Since the manufacturing and services sectors have played an important role in determining inter-provincial inequality in per capita GDP, we next conduct bi-dimensional inequality decomposition analyses for (1) manufacturing subsectors, (2) trade, transportation and IC subsectors, and (3) finance, business and government services subsectors.[10] The results are presented in Tables 6, 7, and 8, respectively. On the other hand, Tables 9, 10 and 11 provide inter-provincial inequalities within each region for (1), (2) and (3), respectively.

Tables 6, 7 and 8

Tables 9, 10 and 11

Within the manufacturing sector, region 1 is the main contributor to the sector's overall inter-provincial inequality (Table 6). But, it lowered its contribution in the 2010-19 period (from 57.0 to 47.9%). The coal and refined petroleum products sector is mainly responsible for this decrease. Its inter-provincial inequality is very high in region 1 due to very uneven spatial distribution of the sector's activities (Table 9). But, its GDP share has declined substantially in region 1 from 23.6% to 15.0%, resulting in a large reduction in the contribution to manufacturing's overall inter-provincial inequality (from 28.0% to 11.8%). In region 1, the food, tobacco and beverages sector raised its contribution from 8.8% to 13.6% in the 2010-19 period owing to the increase in its GDP share. But, this could not offset the large reduction of the contribution of the coal and refined petroleum products sector. From these observations, the decrease in the manufacturing sector's contribution to overall inter-provincial inequality is attributable mainly to the declining role of the coal and refined petroleum products sector in region 1 (see Table 4).

Within the trade, transportation and IC sector, region 2 dominates by accounting for 91% of the sector's overall inter-provincial inequality (Table 7). The IC sector raised its contribution substantially from 24.4% to 33.3% in the 2010-19 period; but, region 2's IC sector is mostly responsible for this increase. In region 2, the IC sector has a very large inter-provincial inequality because its activities are concentrated in a few major cities in the Java island, such as Jakarta and Surabaya (Table 10). It grew very rapidly at an annual average rate of 9.9%; its GDP share has increased from 17.0% to 22.4% in region 2. This, together with a rising inequality, made the contribution of region 2's IC sector to increase from 22.9% to 31.0%. We should note that region

[10] These subsectors are shown in the second column of Table 1.

2 accounts for 75% of total GDP generated by the IC sector in 2019. On the other hand, the wholesale and retail trade sector reduced its contribution from 46.2% to 38.7% in region 2 (Table 7). As discussed before, the transportation and IC sector raised its contribution to overall inter-provincial inequality (Table 4). But, this is attributable mainly to a rapid growth of the IC sector in region 2.

Like the trade, transportation and IC sector, region 2 dominates in the finance, business and government services sector by accounting for 98% of the sector's overall inter-provincial inequality (Table 8). The business services sector raised its contribution from 18.3% to 22.4% in the 2010-19 period; but, region 2's business services sector is mostly responsible for this increase. Reflecting very uneven spatial distribution of knowledge-intensive business services, the sector has an exceptionally high inter-provincial inequality in region 2 (Table 11).[11] It grew very rapidly at an annual average rate of 8.1%. While its GDP share has increased only slightly from 11.2% to 13.2% in region 2, the contribution of region 2's business services sector has risen from 17.9% to 21.8%. The financial sector also increased its contribution from 13.9% to 14.9%. Like the business services sector, region 2's financial sector is responsible for this increase. We should note that region 2 accounts for 91.4% of total GDP generated by the business services sector and 74.3% of total GDP generated by the financial sector in 2019. As discussed before, the finance, business and government services sector raised its contribution to overall inter-provincial inequality (Table 4). But, this is attributable mainly to a rapid growth of the business services sector in region 2.

3.3.2. After the Outbreak of the COVID-19

The COVID-19 pandemic had differential impacts on industrial sectors. How have structural changes caused by the pandemic affected inter-provincial inequality in per capita GDP? To answer this question, we conduct bi-dimensional inequality decomposition analyses for the year 2020. The results are presented in Tables 4, 6, 7 and 8. We can observe some major changes between 2019 and 2020.

Within the trade, transportation and IC sector, the hotel and restaurant sector lowered its contribution substantially from 15.1% to 12.7% (Table 7). Region 2's hotel and restaurant sector is mainly responsible for this decrease. In region 2, the sector contracted substantially due to the pandemic (-13.5%) and its GDP share declined from 14.7% to 13.4%. On the other hand, the IC sector was not affected by the pandemic and raised its contribution from 33.3% to 37.8% (Table

[11] Jakarta dominates in the business services sector by accounting for half of region 2's total GDP.

7). Region 2's IC sector is mainly responsible for this increase. In region 2, the IC sector grew very rapidly even in the pandemic (at 13.5%) and its GDP share increased notably from 22.4% to 26.5%.

Within the finance, business and government services sector, the financial services sector raised its contribution from 14.9% to 15.6% (Table 8). Region 2's financial services sector is wholly responsible for this increase. In region 2, the sector grew at 3.5% and its GDP share increased, though slightly from 14.1% to 14.5%. The health services sector also increased its contribution from 4.0% to 4.9%. Like the financial services sector, region 2's health services sector is wholly responsible for this increase. In region 2, the sector grew very rapidly (at 10.3%) and its GDP share rose from 5.3% to 5.9%. We should note that the health services sector grew rapidly in all regions owing to increasing demands for health services during the pandemic.[12]

On the other hand, the business services sector reduced its contribution from 22.4% to 21.7% (Table 8). Region 2's business services sector is responsible for this decrease. Business services are concentrated in a few cities in region 2; Jakarta accounts for three quarters of total GDP generated by the business services sector in 2020. The sector has a very high inter-provincial inequality in region 2 (Table 11). Unlike the IC sector, the business services sector was affected by the pandemic. In region 2, the sector contracted by 3.4% and its GDP share declined from 13.2% to 12.7%. We should note that the public administration sector also lowered its contribution as it contracted by 1.4%; but, its contribution is not large (8.2% in 2020) because it has a much smaller inter-provincial inequality than the business services sector (Table 11).

Tourism sectors were hit very hard by the COVID-19 pandemic. Besides the hotel and restaurant sector, the textile and apparel, transport equipment and air transportation sectors contracted substantially; their GDP growth rates were, respectively, -9.7%, -15.3% and -15.8% in 2020.[13] They lowered their contributions to overall inter-provincial inequality, though slightly. Provinces with a higher GDP share of tourism sectors, such as Bali and Riau Islands, recorded a large negative growth. As discussed above, the IC and financial services sectors were not affected by the pandemic. These two sectors have a high inequality in per capita GDP, particularly in region

[12] During the pandemic, most education services were provided using online remote teaching; thus, the education services sector was relatively unaffected by the pandemic. Though the growth rate was much smaller than health services sector's, the sector grew at 2.6% and its contribution remained constant in 2020 (see Table 8).

[13] Among transportation sectors, air transportation was hit hardest due to restricted movement between Indonesian islands and between countries.

2; by the *WCV*, their inequalities are 1.5 and 1.9 in region 2, respectively (Tables 10 and 11). Thus, they have played an increasingly important role in determining inter-provincial inequality in per capita GDP.

4. Concluding Remarks

Based on provincial GDP by industrial sectors, this study investigated how the COVID-19 pandemic has affected provincial economies in Indonesia by performing a panel data regression analysis. It also examined how structural changes caused by the pandemic have affected the determinants of inter-provincial inequality in per capita GDP by conducting a bi-dimensional inequality decomposition analysis.

Major findings are summarized as follows. First, inter-provincial inequality in per capita GDP, as measured by the Gini coefficient and the Theil indices, has been decreasing over the study period 2010-20. Before the COVID-19 pandemic (2010-19), relatively poor Sulawesi provinces grew faster than other provinces, while resource-rich provinces (such as Aceh, Riau, East Kalimantan and Papua) were stagnant, indicating there was absolute β-convergence across Indonesian provinces. By contrast, no absolute β-convergence was observed across these provinces during the pandemic (2019-20), though this does not rule out the possibility of conditional β-convergence.

Second, according to a panel data regression analysis for 33 provinces over the period 2010-20, the provincial growth of per capita GDP tend to decline as the per capita GDP increases. This is consistent with the proposition of the Solow growth model. The panel data regression result shows also that provinces with larger GDP shares of the financial sector tend to grow faster, confirming the importance of accessibility to financial institutions in accelerating economic growth. Third, the COVID-19 pandemic appears to have affected the convergence speed of provincial economies. The panel data regression result also shows that provinces with larger GDP shares of the tourism sector were affected more severely by the pandemic. On the other hand, the impact of the financial sector on provincial growth was not affected by the pandemic.

Fourth, the result of a bi-dimensional inequality decomposition analysis shows that before the outbreak of the COVID-19, the Java-Bali region (region 2) raised its contribution to overall inter-provincial inequality from 61% to 77%. The IC (information and communication), financial services and business services sectors are mainly responsible for this increase; these three sectors

have very large inter-provincial inequalities and grew very rapidly in region 2. On the other hand, the Sumatra and Kalimantan region (region 1) lowered its contribution to overall inequality from 34% to 18%. The main contributors are the mining sector and the coal and refined petroleum products sector. While these two sectors have very large inter-provincial inequalities, they lowered their GDP shares substantially in region 1, resulting in the large reduction of their contributions to overall inequality.

Fifth, after the outbreak of the COVID-19, the hotel and restaurant sector, one of tourism sectors, lowered its contribution to overall inter-provincial inequality prominently. Region 2 is responsible for this decrease, where the sector contracted substantially (-14%) and its GDP share declined. Other tourism sectors, such as textile and apparel, transport equipment and air transportation, also contracted substantially and lowered their contributions. By contrast, the IC and financial services sectors were not affected by the pandemic and raised their contributions to overall inequality. These two sectors have a high inter-provincial inequality, particularly in region 2. They have played an increasingly important role in determining overall inequality. Owing to increasing demands for health services, the health services sector grew very rapidly; but, its contribution to overall inequality is not large. On the other hand, the business services sector was affected by the pandemic severely. It experienced a negative growth and lowered its contribution. However, with its very large inter-provincial inequality in region 2, it still services as one of the main contributors to overall inequality.

The COVID-19 pandemic has exerted an enormous impact on the Indonesian economy. In 2020, the country contracted by 2.7% in real GDP. But, the impact has been spatially heterogeneous. Many provinces, particularly those relying on tourism experienced a large negative growth, while some poorer provinces in the eastern part of Indonesia escaped from a severe economic downturn. When Indonesia will recover from the pandemic, an important policy question is whether inter-provincial inequality in per capita GDP will further decrease or not. Another important policy question is which industrial sectors will serve to determine inter-provincial inequality. It is likely that the mining sector and the coal and refined petroleum products sector will further reduce their significance as their GDP shares will decrease. It is also likely that the tourism sector will regain its position as an important determinant of inter-provincial inequality. However, the most important sectors in determining inter-provincial inequality will be IC, financial and business services sectors. With the rapid advancement of IC, financial and e-business

technologies, the roles of these high-inequality services sectors are likely to increase in determining inter-provincial inequality unless policies that could facilitate spatial dispersion of these services activities are implemented. On the other hand, the manufacturing sector is likely to reduce inter-provincial inequality as the GDP share of inequality-reducing manufacturing sectors such as food processing will increase.

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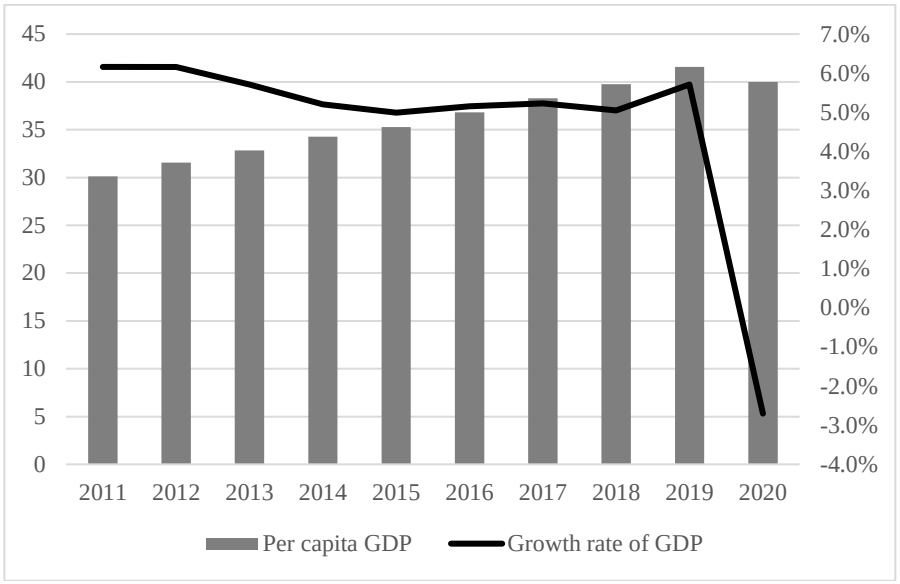
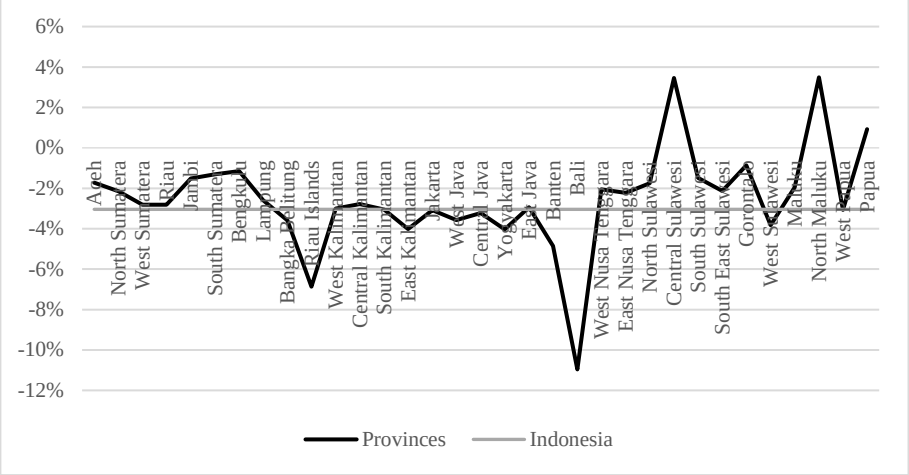
Figure 1. Growth Rate of GDP and per capita GDP (at constant 2010 prices), 2010 - 2020



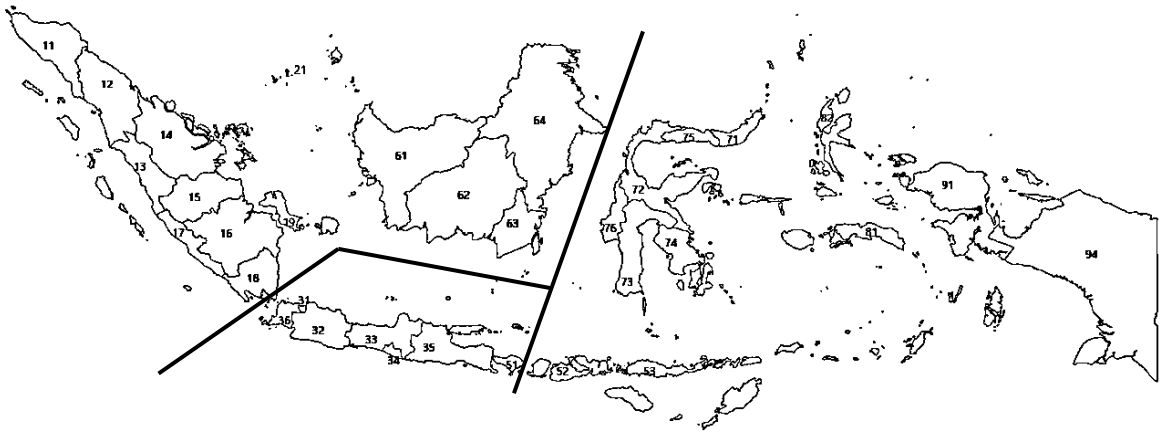
(Note) Per capita GDP is in million Rupiah.
(Source) Authors' calculation based on Central Bureau of Statistics (2021).

Figure 2. Growth Rate of per capita GDP by Province, 2019-20



(Source) Authors' calculation based on Central Bureau of Statistics (2021).

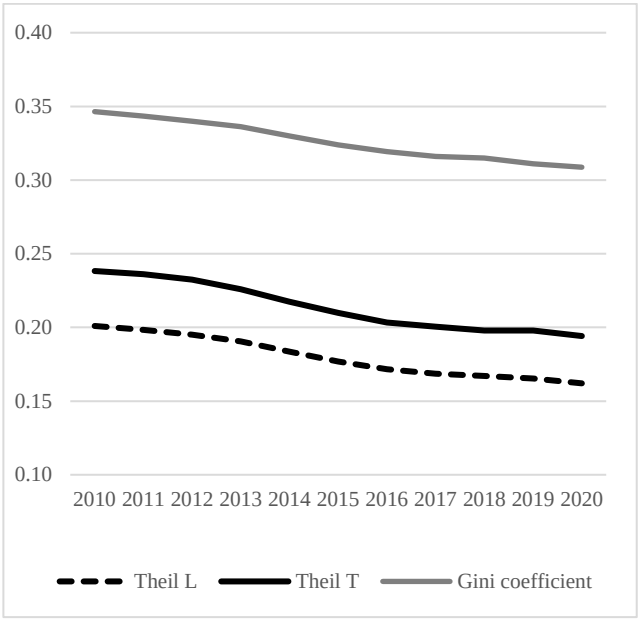
Figure 3. Map of Indonesia



(Note) Classification of provinces.

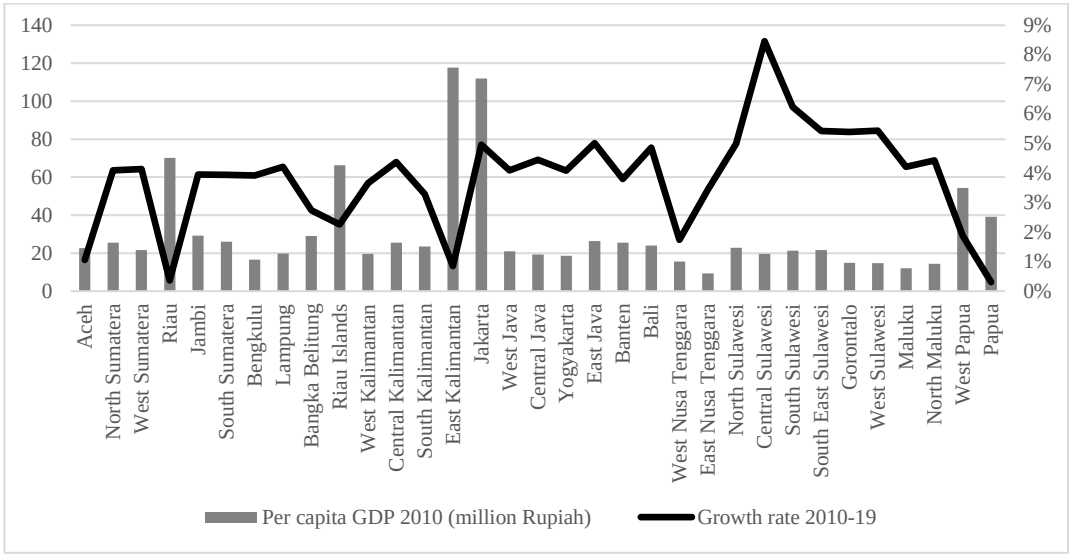
Region	Province code	Province	Region	Province code	Province
Region 1	11	Aceh	Region 2	31	Jakarta
	12	North Sumatera		32	West Java
	13	West Sumatera		33	Central Java
	14	Riau		34	Yogyakarta
	15	Jambi		35	East Java
	16	South Sumatera		36	Banten
	17	Bengkulu		51	Bali
	18	Lampung	Region 3	52	West Nusa Tenggara
	19	Bangka Belitung		53	East Nusa Tenggara
	21	Riau Islands		71	North Sulawesi
	61	West Kalimantan		72	Central Sulawesi
	62	Central Kalimantan		73	South Sulawesi
	63	South Kalimantan		74	S.E. Sulawesi
	64	East Kalimantan		75	Gorontalo
				76	West Sulawesi
				81	Maluku
				82	North Maluku
				91	West Papua
				94	Papua

Figure 4. Inequality in Per Capita GDP, 2010 – 2020



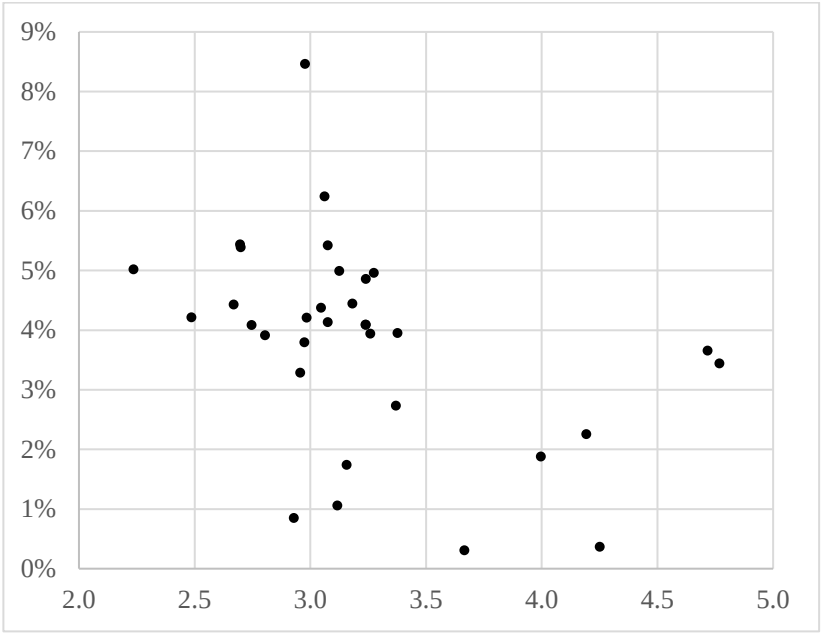
(Source) Authors' calculation based on Central Bureau of Statistics (2021).

Figure 5. Per Capita GDP in 2010 and Annual Average Growth Rate of Per Capita GDP from 2010 to 2019 by Province



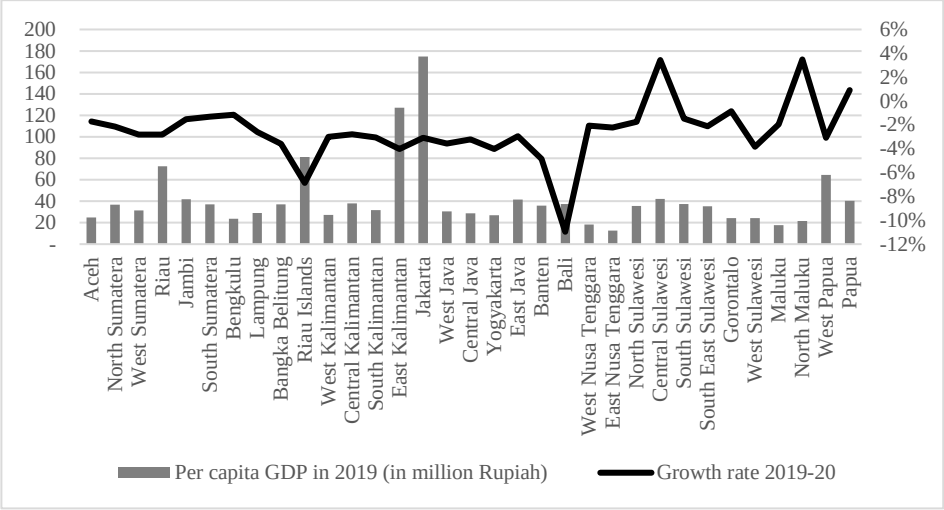
(Source) Authors' calculation based on Central Bureau of Statistics (2021).

Figure 6. Scatterplot of Growth Rate of Per Capita for 2010–19 against Log of Per Capita GDP in 2010



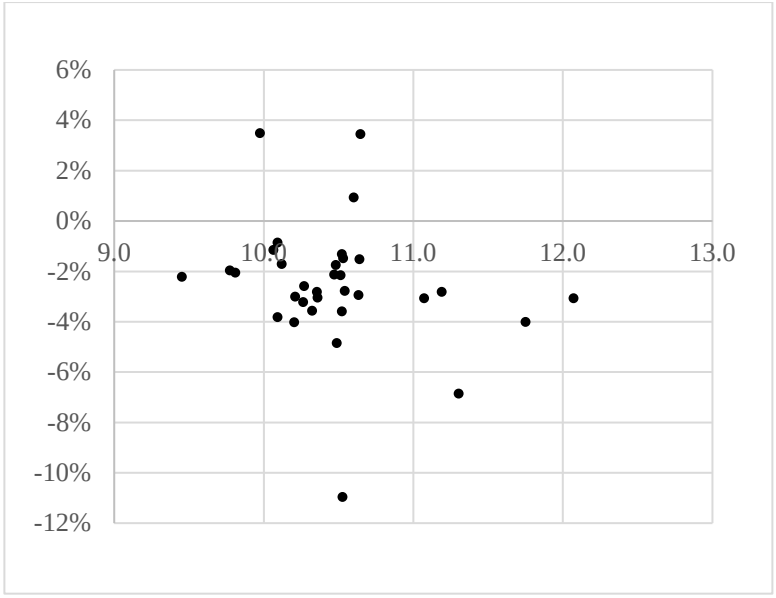
(Note) The annual average growth rate of per capita GDP for 2010-19 is on the vertical axis, while natural logarithm of per capita GDP in 2010 is on the horizontal axis.
(Source) Authors' calculation based on Central Bureau of Statistics (2021).

Figure 7. Per Capita GDP in 2019 and Annual Average Growth Rate of Per Capita GDP from 2019 to 2020 by Province



(Source) Authors' calculation based on Central Bureau of Statistics (2021).

Figure 8. Scatterplot of Growth Rate of Per Capita for 2019–20 against Log of Per Capita GDP in 2019



(Note) The annual average growth rate of per capita GDP for 2019-20 is on the vertical axis, while natural logarithm of per capita GDP in 2019 is on the horizontal axis.
(Source) Authors' calculation based on Central Bureau of Statistics (2021).

Table 1. Sector Classifications

	9 main sectors		Manufacturing and services		52 sectors
1	Agriculture			1	Food crops
				2	Horticultural crops
				3	Plantation crops
				4	Livestock
				5	Agriculture services and hunting
				6	Forestry and logging
				7	Fishery
2	Mining			8	Crude petroleum, natural gas, and geothermal
				9	Coal and lignite mining
				10	Iron ore mining
				11	Other mining and quarrying
3	Manufacturing	m1	Coal and refined petroleum products	12	Coal and refined petroleum products
		m2	Food, tobacco and beverages	13	Food products and beverages
				14	Tobacco products
		m3	Textiles, wearing apparel and leather products	15	Textiles; and wearing Apparel
				16	Leather and related products and footwear
		m4	Wood products, furniture and paper products	17	Wood products and cork
				18	Paper products and printing
				19	Furniture
		m5	Chemical, rubber and other non-metallic mineral products	20	Chemicals products
				21	Rubber and plastics products
				22	Other non-metallic mineral products
		m6	Basic metals and fabricated metal products	23	Basic metals
				24	Fabricated metal and optical products and computer
		m7	Machinery and equipment	25	Machinery and equipment
		m8	Transport equipment	26	Transport equipment
		m9	Other manufacturing	27	Other manufacturing products
4	Electricity/gas/water			28	Electricity
				29	Gas
				30	Water
5	Construction			31	Construction
6	Trade/hotel/restaurant	t1	Wholesale and retail trade	32	Wholesale and retail trade
				33	Other wholesale and retail trade
		t2	Hotels and restaurants	34	Hotels
				35	Restaurants
7	Transportation/communication	t3	Railway transportation	36	Railway transportation
		t4	Land transportation	37	Land transportation
		t5	Sea transportation	38	Sea transportation
		t6	River and lake transportation	39	River and lake transportation
		t7	Air transportation	40	Air transportation
		t8	Support services for transportation	41	Support services for transportation
		t9	Information and communication	42	Information and communication
8	Financial & business services	s1	Financial intermediary services	43	Financial intermediary services
		s2	Insurance and pension fund	44	Insurance and pension fund
		s3	Other financial services	45	Other financial services
				46	Financial supporting services
		s4	Real estate	47	Real estate
		s5	Business services	48	Business services
9	Other services	s6	Public administration	49	Public administration and defense
		s7	Education services	50	Education
		s8	Health services	51	Health and social work
		s9	Other services	52	Other services

(Source) Central Bureau of Statistics (2021).

Table 2. Summary Statistics of Dependent and Independent Variables (Panel Data): Between and Within Variations

Variable		Mean	STD	Min	Max	Observations	
Growth rate of per capita GDP	overall	0.0318	0.0352	-0.1855	0.1816	N	330
	between		0.0161	0.0005	0.0796	n	33
	within		0.0314	-0.1573	0.1999	T	10
Log of per capita GDP (lpcg)	overall	3.4061	0.5563	2.2366	5.1637	N	330
	between		0.5504	2.3938	4.9402	n	33
	within		0.1218	3.0491	3.8105	T	10
Share of financial sector (fshare)	overall	0.0288	0.0152	0.0076	0.1048	N	330
	between		0.0152	0.0090	0.1005	n	33
	within		0.0019	0.0202	0.0352	T	10
Share of tourism sector (tshare)	overall	0.0244	0.0351	0.0024	0.2037	N	330
	between		0.0355	0.0024	0.1968	n	33
	within		0.0013	0.0188	0.0313	T	10

(Note) STD is standard deviation, N is the total number of observations, n is the number of provinces, and T is the number of periods.
(Source) Authors' calculation based on Central Bureau of Statistics (2021).

Table 3. Panel Data Regression Analysis

	Fixed effects model			Random effects model			OLS for dummy-variable model		
	Coefficient		Std. error	Coefficient		Std. error	Coefficient		Std. error
ln(pcg)	-0.0768	***	0.0153	-0.0124	***	0.0028	-0.0768	***	0.0153
fshare	2.4797	***	0.8222	0.5005	***	0.1150	2.4797	***	0.8222
tshare	2.9720	**	1.3321	0.0176		0.0492	2.9720	**	1.3321
D*ln(pcg)	-0.0108	***	0.0028	-0.0106	***	0.0031	-0.0108	***	0.0028
D*fshare	-0.0285		0.3231	-0.3257		0.3543	-0.0285		0.3231
D*tshare	-0.5984	***	0.1415	-0.4975	***	0.1507	-0.5984	***	0.1415
North Sumatera							-0.0176		0.0189
West Sumatera							0.0051		0.0154
Riau							0.1171	***	0.0266
Jambi							0.0460	***	0.0133
South Sumatera							0.0234	*	0.0130
Bengkulu							-0.0398	**	0.0191
Lampung							0.0123		0.0118
Bangka Belitung							0.0057		0.0175
Riau Islands							0.0434	**	0.0188
Jakarta							-0.1490	**	0.0698
West Java							-0.0273		0.0211
Central Java							-0.0562	*	0.0290
Yogyakarta							-0.2632	**	0.1085
East Java							-0.0753		0.0513
Banten							-0.0223		0.0193
Bali							-0.5576	**	0.2430
West Nusa Tenggara							-0.0708	***	0.0195
East Nusa Tenggara							-0.0762	***	0.0267
West Kalimantan							-0.0551	**	0.0225
Central Kalimantan							-0.0026		0.0162
South Kalimantan							-0.0262		0.0172
East Kalimantan							0.1405	***	0.0301
North Sulawesi							-0.0323		0.0222
Central Sulawesi							0.0886	***	0.0155
South Sulawesi							0.0102		0.0175
South East Sulawesi							0.0579	***	0.0149
Gorontalo							-0.0629	**	0.0261
West Sulawesi							0.0382	**	0.0164
Maluku							-0.0780	***	0.0249
North Maluku							0.0028		0.0185
West Papua							0.1045	***	0.0225
Papua							0.0574	***	0.0168
Constant	0.1550	***	0.0435	0.0652	***	0.0097	0.1810	***	0.0411
Number of observations	330			330			330		
R-squared (within)	0.4528			0.4153					
R-squared (between)	0.0724			0.2773					
R-squared (overall)	0.0485			0.3865					
Adjusted R-squared							0.5079		

(Note) *, **, *** indicate coefficients are significant at 10%, 5% and 1% significance levels, respectively. Aceh is the reference province.

(Source) Authors' calculation based on Central Bureau of Statistics (2021).

Table 4. Bi-dimensional Inequality Decomposition Analysis: 9 Main Sectors (Contribution to Overall Inter-provincial Inequality in %)

2010	1	2	3	4	5	6	7	8	9	Total	GDP share
Total	1.2	19.5	16.2	0.2	12.0	15.4	7.3	17.7	10.4	100.0	100.0
Between-region	0.6	1.1	1.2	0.0	0.2	0.3	0.1	0.1	-0.2	3.5	
Within-region	0.5	18.4	15.0	0.2	11.8	15.1	7.3	17.6	10.6	96.5	
Region 1	2.1	17.4	9.1	0.0	2.3	1.3	0.5	0.3	0.5	33.6	31.8
Region 2	-1.7	-0.2	5.4	0.2	9.3	13.7	6.7	17.2	10.0	60.6	58.6
Region 3	0.1	1.2	0.4	0.0	0.2	0.1	0.1	0.1	0.1	2.3	9.6
2019	1	2	3	4	5	6	7	8	9	Total	GDP share
Total	-0.2	9.0	11.8	0.3	11.7	18.2	13.3	23.7	12.1	100.0	100.0
Between-region	-0.2	0.0	1.3	0.0	0.1	0.6	0.2	0.4	-0.1	2.3	
Within-region	0.0	9.1	10.6	0.3	11.6	17.6	13.1	23.4	12.2	97.7	
Region 1	1.2	8.8	5.0	0.0	1.6	0.9	0.4	0.2	0.4	18.4	29.4
Region 2	-1.4	-0.2	5.1	0.3	9.7	16.5	12.6	23.1	11.7	77.3	60.5
Region 3	0.2	0.4	0.5	0.0	0.3	0.2	0.1	0.1	0.2	2.1	10.1
2020	1	2	3	4	5	6	7	8	9	Total	GDP share
Total	-0.1	8.7	11.0	0.3	11.4	16.9	14.6	24.7	12.5	100.0	100.0
Between-region	-0.2	-0.1	1.1	0.0	0.1	0.5	0.2	0.3	-0.1	2.0	
Within-region	0.0	8.8	9.9	0.3	11.3	16.3	14.4	24.4	12.6	98.0	
Region 1	1.3	8.4	5.0	0.0	1.6	0.8	0.4	0.2	0.3	18.0	29.5
Region 2	-1.5	-0.2	4.4	0.3	9.4	15.3	13.9	24.2	12.1	77.8	60.1
Region 3	0.3	0.5	0.6	0.0	0.3	0.2	0.1	0.1	0.2	2.2	10.4

(Note)

1 Agriculture
2 Mining
3 Manufacturing
4 Electricity/gas/water
5 Construction
6 Trade/hotel/restaurant
7 Transportation/Information/communication
8 Financial & business services
9 Government & other services

(Source) Authors' calculation based on Central Bureau of Statistics (2021).

Table 5. Population-weighted Coefficient of Variation (*WCV*): 9 Main Sectors

	2010	1	2	3	4	5	6	7	8	9	Total
Total		0.65	2.60	0.68	0.97	1.05	0.89	0.95	2.23	1.11	0.78
Region 1		0.46	1.75	1.02	1.41	0.69	0.33	0.45	0.32	0.30	0.74
Region 2		0.38	0.61	0.32	0.73	1.21	0.90	1.07	2.21	1.36	0.79
Region 3		0.29	1.56	1.47	0.50	0.42	0.32	0.30	0.39	0.23	0.46
	2019	1	2	3	4	5	6	7	8	9	Total
Total		0.69	2.45	0.59	1.02	0.88	0.86	1.15	2.29	1.07	0.75
Region 1		0.44	1.72	0.90	1.27	0.61	0.30	0.44	0.29	0.32	0.58
Region 2		0.41	0.82	0.27	0.85	1.03	0.87	1.23	2.22	1.29	0.83
Region 3		0.34	1.04	1.14	0.46	0.49	0.40	0.38	0.44	0.27	0.40
	2020	1	2	3	4	5	6	7	8	9	Total
Total		0.70	2.39	0.59	0.94	0.87	0.83	1.21	2.30	1.07	0.75
Region 1		0.45	1.71	0.91	1.16	0.59	0.30	0.43	0.28	0.33	0.57
Region 2		0.41	0.82	0.26	0.80	1.02	0.85	1.26	2.24	1.31	0.83
Region 3		0.34	1.07	1.18	0.46	0.51	0.41	0.40	0.43	0.27	0.40

(Note) See Table 4 for the sector classification.
(Source) Authors' calculation based on Central Bureau of Statistics (2021).

Table 6. Bi-dimensional Inequality Decomposition Analysis: Manufacturing (Main Sector 3)
(Contribution to the Sector's Overall Inter-provincial Inequality in %)

2010	m1	m2	m3	m4	m5	m6	m7	m8	m9	Total	GDP share
Total	30.5	9.7	5.0	8.0	9.9	16.2	2.4	17.0	1.4	100.0	100.0
Between-region	0.1	4.7	2.8	1.8	2.7	3.9	0.9	3.7	0.3	20.9	
Within-region	30.4	5.0	2.3	6.2	7.2	12.3	1.5	13.2	1.1	79.1	
Region 1	28.0	8.8	0.2	6.0	2.9	8.0	0.9	1.3	0.9	57.0	26.3
Region 2	-1.1	-4.1	2.1	0.0	4.1	4.3	0.6	11.9	0.2	18.0	70.2
Region 3	3.5	0.3	0.0	0.2	0.2	0.0	0.0	0.0	0.0	4.1	3.5
2019	m1	m2	m3	m4	m5	m6	m7	m8	m9	Total	GDP share
Total	13.0	18.6	6.5	7.6	10.2	20.2	2.8	19.5	1.5	100.0	100.0
Between-region	-0.9	6.5	4.9	2.2	3.5	3.9	1.3	5.9	0.3	27.6	
Within-region	14.0	12.1	1.7	5.4	6.7	16.3	1.4	13.6	1.2	72.4	
Region 1	11.8	13.6	0.3	4.7	2.9	11.2	0.9	1.6	1.0	47.9	24.1
Region 2	-1.1	-2.0	1.4	0.5	3.4	3.7	0.5	12.0	0.3	18.7	71.2
Region 3	3.2	0.5	0.0	0.2	0.4	1.4	0.0	0.0	0.0	5.8	4.7
2020	m1	m2	m3	m4	m5	m6	m7	m8	m9	Total	GDP share
Total	13.4	21.3	5.8	7.9	10.5	21.5	2.8	15.2	1.6	100.0	100.0
Between-region	-1.0	6.6	4.2	2.0	3.8	2.8	1.1	4.9	0.3	24.7	
Within-region	14.5	14.7	1.6	5.9	6.7	18.8	1.6	10.3	1.3	75.3	
Region 1	11.7	15.3	0.3	5.1	3.0	12.6	1.2	1.7	1.0	51.8	24.7
Region 2	-0.8	-1.1	1.2	0.6	3.3	3.4	0.5	8.7	0.3	16.1	70.1
Region 3	3.5	0.5	0.0	0.3	0.4	2.7	0.0	0.0	0.0	7.4	5.1

(Note)

m1	Coal and refined petroleum products	m6	Basic metals and fabricated metal products
m2	Food, tobacco and beverages	m7	machinery and equipment
m3	Textiles, wearing apparel and leather products	m8	Transport equipment
m4	Wood products, furniture and paper products	m9	Other manufacturing
m5	Chemical products, rubber products and other non-metallic mineral products		

(Source) Authors' calculation based on Central Bureau of Statistics (2021).

Table 7. Bi-dimensional Inequality Decomposition Analysis: Trade, Transportation, Information and Communication (Main Sectors 6 and 7)
(Contribution to the Sector's Overall Inter-provincial Inequality in %)

2010	t1	t2	t3	t4	t5	t6	t7	t8	t9	Total	GDP share
Total	51.1	17.0	0.1	2.6	1.3	0.0	0.0	3.6	24.4	100.0	100.0
Between-region	3.4	1.7	0.0	0.1	-0.1	-0.1	-0.1	0.2	1.2	6.3	
Within-region	47.7	15.3	0.1	2.5	1.4	0.0	0.1	3.4	23.2	93.7	
Region 1	1.2	0.2	0.0	0.1	0.1	0.0	0.2	0.2	0.2	2.1	22.6
Region 2	46.2	15.1	0.1	2.4	1.2	0.0	-0.1	3.2	22.9	91.1	69.5
Region 3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.5	7.9
2019	t1	t2	t3	t4	t5	t6	t7	t8	t9	Total	GDP share
Total	42.6	15.1	0.1	3.0	0.7	0.0	1.2	4.0	33.3	100.0	100.0
Between-region	2.7	1.7	0.0	0.2	-0.1	-0.1	-0.1	0.2	1.9	6.5	
Within-region	39.9	13.3	0.1	2.8	0.9	0.0	1.3	3.8	31.4	93.5	
Region 1	0.7	0.1	0.0	0.1	0.1	0.0	0.1	0.2	0.2	1.4	21.8
Region 2	38.7	13.2	0.1	2.7	0.8	0.0	1.1	3.6	31.0	91.2	69.6
Region 3	0.5	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.2	0.8	8.6
2020	t1	t2	t3	t4	t5	t6	t7	t8	t9	Total	GDP share
Total	40.7	12.7	0.1	3.1	0.7	0.0	0.6	4.3	37.8	100.0	100.0
Between-region	2.6	1.6	0.0	0.2	-0.1	-0.1	-0.1	0.2	2.4	6.7	
Within-region	38.1	11.1	0.1	2.9	0.8	0.0	0.7	4.1	35.5	93.3	
Region 1	0.7	0.1	0.0	0.1	0.1	0.0	0.1	0.2	0.2	1.4	21.6
Region 2	36.9	11.0	0.1	2.8	0.7	0.0	0.6	3.9	35.0	91.1	69.9
Region 3	0.5	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.9	8.5

(Note)

t1	Wholesale and retail trade	t6	River and lake transportation
t2	Hotels and restaurants	t7	Air transportation
t3	Railway transportation	t8	Support services for transportation
t4	Road transportation	t9	Information and communication
t5	Sea transportation		

(Source) Authors' calculation based on Central Bureau of Statistics (2021).

Table 8. Bi-dimensional Inequality Decomposition Analysis: Finance, Business and Government Services (Main Sectors 8 and 9)
(Contribution to the Sector's Overall Inter-provincial Inequality in %)

2010	s1	s2	s3	s4	s5	s6	s7	s8	s9	Total	GDP share
Total	13.9	9.2	3.9	18.0	18.3	12.4	12.8	3.8	7.7	100.0	100.0
Between-region	0.3	0.2	0.1	0.3	0.4	-0.2	0.2	0.0	0.2	1.4	
Within-region	13.6	9.0	3.8	17.7	17.9	12.5	12.6	3.8	7.5	98.6	
Region 1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.4	20.5
Region 2	13.5	9.0	3.8	17.7	17.9	12.3	12.5	3.8	7.5	98.0	68.7
Region 3	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.2	10.9
2019	s1	s2	s3	s4	s5	s6	s7	s8	s9	Total	GDP share
Total	14.9	9.3	3.7	16.1	22.4	8.9	11.0	4.0	9.7	100.0	100.0
Between-region	0.4	0.2	0.1	0.3	0.6	-0.2	0.3	0.0	0.3	1.9	
Within-region	14.5	9.1	3.6	15.8	21.8	9.2	10.7	4.0	9.4	98.1	
Region 1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.3	19.7
Region 2	14.5	9.1	3.6	15.7	21.8	9.0	10.6	4.0	9.4	97.5	68.9
Region 3	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.3	11.4
2020	s1	s2	s3	s4	s5	s6	s7	s8	s9	Total	GDP share
Total	15.6	9.6	3.6	16.2	21.7	8.2	11.1	4.9	9.3	100.0	100.0
Between-region	0.4	0.2	0.1	0.3	0.5	-0.3	0.3	0.0	0.3	1.8	
Within-region	15.2	9.3	3.5	15.9	21.1	8.5	10.8	4.8	8.9	98.2	
Region 1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.3	19.7
Region 2	15.2	9.3	3.5	15.8	21.1	8.3	10.7	4.8	8.9	97.6	68.7
Region 3	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.3	11.5

(Note)

- s1 Financial intermediary services
- s2 Insurance and pension fund
- s3 Other financial services
- s4 Real estate
- s5 Business services
- s6 Public administration
- s7 Education services
- s8 Health services
- s9 Other services

(Source) Authors' calculation based on Central Bureau of Statistics (2021).

Table 9. Population-weighted Coefficient of Variation (*WCV*): Manufacturing (Main Sector 3)

2010	m1	m2	m3	m4	m5	m6	m7	m8	m9	Total
Total	3.39	0.86	1.15	0.93	0.71	1.62	1.85	2.47	1.97	0.68
Region 1	2.84	0.96	2.26	1.43	0.53	3.71	4.27	4.53	4.56	1.02
Region 2	1.10	0.63	0.68	0.50	0.62	0.81	1.32	1.86	0.45	0.32
Region 3	6.48	0.78	0.52	1.16	1.47	1.84	5.52	1.02	0.46	1.47
2019	m1	m2	m3	m4	m5	m6	m7	m8	m9	Total
Total	3.00	0.85	1.12	0.86	0.69	1.64	1.84	2.33	2.06	0.59
Region 1	2.69	0.93	2.29	1.37	0.70	3.91	3.99	4.40	4.29	0.90
Region 2	1.16	0.66	0.63	0.49	0.52	0.73	1.31	1.71	0.54	0.27
Region 3	5.23	0.83	0.44	1.04	1.43	2.57	5.55	1.05	0.33	1.14
2020	m1	m2	m3	m4	m5	m6	m7	m8	m9	Total
Total	3.10	0.86	1.11	0.87	0.70	1.73	1.86	2.24	1.98	0.59
Region 1	2.66	0.96	2.32	1.39	0.73	3.97	4.26	4.33	4.24	0.91
Region 2	1.08	0.65	0.62	0.47	0.52	0.73	1.30	1.64	0.59	0.26
Region 3	5.29	0.84	0.43	1.09	1.43	2.62	5.56	1.06	0.33	1.18

(Note) See Table 6 for the sector classification.
(Source) Authors' calculation based on Central Bureau of Statistics (2021).

Table 10. Population-weighted Coefficient of Variation (*WCV*): Trade, Transportation, Information and Communication (Main Sectors 6 and 7)

2010	t1	t2	t3	t4	t5	t6	t7	t8	t9	Total
Total	0.83	1.36	1.27	0.60	1.42	2.24	1.21	1.48	1.38	0.90
Region 1	0.33	0.53	1.34	0.68	0.99	1.53	0.97	1.36	0.36	0.30
Region 2	0.88	1.14	1.02	0.55	1.82	3.76	1.56	1.44	1.41	0.95
Region 3	0.31	0.56	0.00	0.52	0.95	0.95	0.47	0.51	0.40	0.29
2019	t1	t2	t3	t4	t5	t6	t7	t8	t9	Total
Total	0.79	1.30	1.18	0.61	1.34	2.28	1.08	1.61	1.55	0.95
Region 1	0.30	0.51	1.38	0.69	1.07	1.45	0.86	1.30	0.38	0.27
Region 2	0.85	1.08	0.90	0.56	1.46	4.14	1.33	1.58	1.51	0.99
Region 3	0.40	0.61	0.00	0.54	1.06	0.95	0.50	0.59	0.52	0.38
2020	t1	t2	t3	t4	t5	t6	t7	t8	t9	Total
Total	0.78	1.21	1.49	0.65	1.41	2.35	1.10	1.74	1.52	0.96
Region 1	0.30	0.45	1.44	0.68	1.12	1.51	1.02	1.40	0.38	0.28
Region 2	0.84	0.99	1.28	0.62	1.54	4.28	1.34	1.70	1.46	1.00
Region 3	0.41	0.61	0.00	0.55	1.12	0.92	0.50	0.60	0.53	0.40

(Note) See Table 7 for the sector classification.
(Source) Authors' calculation based on Central Bureau of Statistics (2021).

Table 11. Population-weighted Coefficient of Variation (*WCV*): Finance, Business and Government Services (Main Sectors 8 and 9)

2010	s1	s2	s3	s4	s5	s6	s7	s8	s9	Total
Total	1.77	3.42	1.94	1.74	3.51	0.96	1.22	1.14	1.43	1.62
Region 1	0.34	1.42	0.66	0.29	0.87	0.33	0.34	0.48	0.40	0.26
Region 2	1.81	2.98	2.07	1.88	2.94	1.30	1.40	1.47	1.36	1.80
Region 3	0.33	0.85	0.53	0.47	1.16	0.42	0.28	0.44	0.19	0.24
2019	s1	s2	s3	s4	s5	s6	s7	s8	s9	Total
Total	1.88	3.43	1.81	1.62	3.70	0.92	1.02	1.10	1.66	1.64
Region 1	0.28	1.27	0.62	0.32	0.86	0.33	0.40	0.46	0.40	0.25
Region 2	1.89	2.95	1.91	1.75	3.03	1.28	1.14	1.37	1.54	1.79
Region 3	0.27	0.79	0.73	0.56	1.15	0.49	0.35	0.50	0.31	0.29
2020	s1	s2	s3	s4	s5	s6	s7	s8	s9	Total
Total	1.92	3.46	1.80	1.63	3.77	0.89	1.02	1.21	1.71	1.65
Region 1	0.28	1.22	0.62	0.33	0.86	0.32	0.41	0.46	0.42	0.25
Region 2	1.94	2.96	1.90	1.75	3.07	1.25	1.13	1.50	1.57	1.80
Region 3	0.26	0.80	0.75	0.57	1.17	0.49	0.37	0.52	0.30	0.28

(Note) See Table 8 for the sector classification.
(Source) Authors' calculation based on Central Bureau of Statistics (2021).