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The Effect of Industrial Agglomeration on Economic Growth in East Java, Indonesia

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Abstract

Industrial agglomeration policy is a strategy that is expected to accelerate economic growth to transform an impoverished region into a prosperous one. However, industrial agglomeration also has the potential to exacerbate development inequality due to the concentration of economic development activities in certain areas. Therefore, this study aims to investigate what strategies are best to minimize the adverse effects of industrial agglomeration. This study uses econometric analysis with panel data covering 38 districts/cities in East Java during the 2011–2019 period. The results showed that the combination of industrial agglomeration policies coupled with accelerated sectoral growth, hard infrastructure development, and soft infrastructure provided the best policy outcome, improving regional inequality and accelerating economic growth in East Java. Based on the analysis, we find that East Java's economic growth characteristics are convergent but relatively long. Therefore, the East Java economic development policy during 2010–2019 should be reviewed due to the relatively long convergence period. Furthermore, this study also found that industrial agglomeration slows down the convergence and economic growth of East Java. In the future, the deployment of Industrial Development Centers (PPI) outside the existing eight districts/cities is needed to accelerate the spread of economic activity in East Java.

Keywords: Industrial Agglomeration, Sectoral Growth, Infrastructure, Economic Growth, East Java, Indonesia

JEL Classifications Code: O47, P25, R11

1. Introduction

The idea of economic transformation was put forward in the mid-1900s by various economists. Economic transformation is a change in production structure followed by a change in resource allocation patterns because of changes in the economy and demand (Herrendorf et al., 2013). There is currently an economic transformation from the agricultural sector to the industrial sector, which we call industrialization. The industrialization process appears to have taken place in East Java, as indicated by the increasing contribution of the industrial sector to East Java's GRDP (Figure 1A). Since 2008, the industrial sector has, on average, contributed 30% of East Java's GRDP (Figure 1B). The positive impact of industrialization in East Java can be indicated from the economic growth of East Java which is always above the national average (Figure 1C).

One of the industrialization strategies that are widely used in developing countries is industrial agglomeration. There are three main reasons why industrial agglomeration strategies are applied in developing countries (Krugman, 1991; Grossman & Rogoff, 1995; Fujita et al., 1999; Rosenthal & Strange, 2004; Deichmann et al., 2008) namely: (1) Limited capital owned by the state; (2) As an effort to increase competitiveness; and (3) as an effort to form industrial clusters. The East Java industrialization strategy seems to be based on the concept of industrial agglomeration, as indicated by the massive contribution of eight districts/cities to the entire industrial sector in East Java, which is as much as 80% (Figure 2A). On the one

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Figure 1: Industrialization in East Java

Source: World Bank, (2011) and Indonesian Statistics (2019).

hand, the agglomeration strategy will accelerate the growth of the industrial sector. But on the other hand, agglomeration also has the potential to increase inequality between regions because of the concentration of economic development activities in certain regions. High income regions may eventually cause uneven growth; thus triggers economic disparity (Prawoto & Cahyani, 2020) Such is in line with the Kuznets hypothesis, which states the relationship between economic growth and regional development inequality in the inverted U curve (Herrendorf et al., 2013). The increasing inequality is quite a concern that some economist seems to favour inequality reduction over increase in economic growth (Suhendra et.al, 2020).

It is suspected that the agglomeration strategy in East Java impacts increasing inequality between regions (Figure 2B), as evidenced by the increasing interregional inequality on East Java since 2013. In fact, as of 2015, East Java interregional inequality is higher than that of Indonesia. The worsening inequality between regions indicates a divergence in the economic development of East Java.

However, it seems that the future development strategy in East Java is designed to overcome divergence in economic growth as a result of industrial agglomeration, based on the 2011–2031 East Java Regional Spatial Plan (RTRW). Therefore, this study focuses on finding out the best strategy

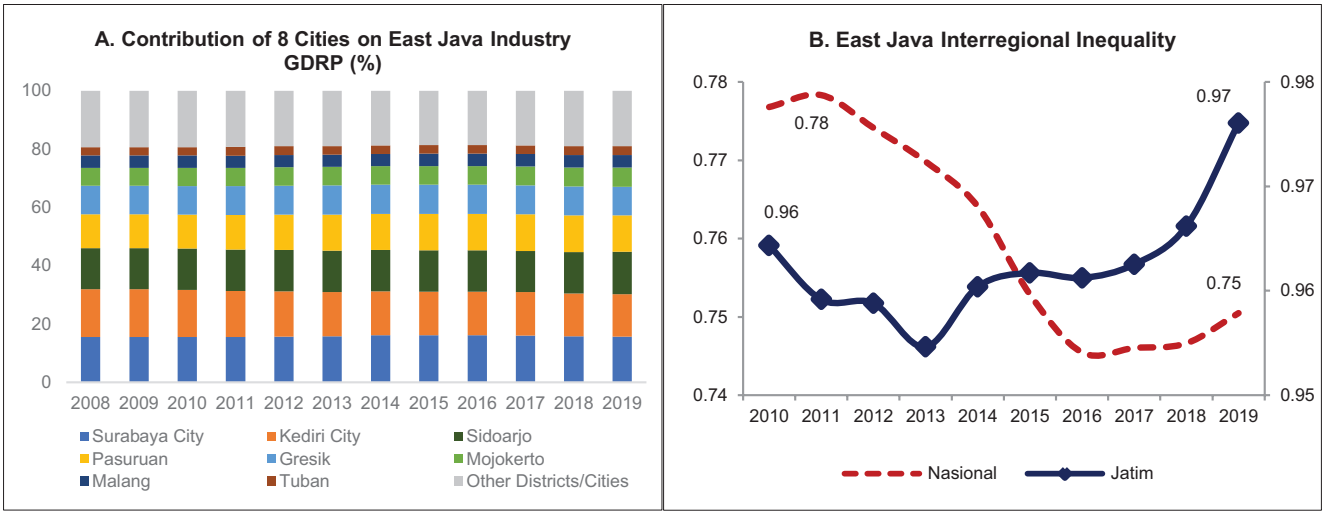

Figure 2: Agglomeration and Interregional Inequality in East Java

Source: Indonesian Statistics (2019).

in dealing with the impact of industrial agglomeration on economic growth in East Java.

2. Research Method

Conceptually, there are two potential impacts of industrial agglomeration. First, the imbalance of development between regions is caused by geographic concentration in which industrial areas tend to grow faster leaving non-industrial areas. Second, the acceleration of economic growth is due to economies of scale, where economic activity is centered on the base sector, resulting in greater returns.

Apart from industrial agglomeration, two policy mixes can affect the characteristics of economic growth. First, the development of soft infrastructures such as improving access to education and health; and the provision of hard infrastructures such as road construction, electricity, and clean water that is evenly distributed can reduce the effects of regional inequalities from the choice of industrial agglomeration strategy. Second, growth in each sector (agriculture, industry, and services) marked by the achievement of economies of scale can increase productivity and increase overall economic growth.

This study uses a quantitative approach using panel data covering 38 districts/cities in East Java during the 2011–2019 period. The use of panel data allows researchers to control individual heterogeneity, or in this study, refers to the heterogeneity of districts/cities in East Java. The absence of control over the unobserved individual heterogeneity effects can produce biased estimates. In line with this thought, all models in this study are estimated using a fixed-effect which assumes that error is a parameter that is estimated to be fixed (fixed parameters) (Baltagi, 2010). In this study, we use a convergence model developed by Barro and Sala-i-Martin (2004). The model estimates the level of convergence, namely the catching-up process of poorer regions to richer regions. The model specifications are as follows:

$$G_{i,t}^{\text{cap}} = \beta_0 + \beta_1 \ln y_{i,t_0} + \varepsilon_{i,t} \quad (1)$$

The left-hand side of equation (1) reflects the per capita growth of area (i) over (t) years. Meanwhile, the right side of equation (1) shows the relationship between regional (i) economic growth and its per capita income in the base year ($\ln y_{i,t_0}$). A negative value of β_1 indicates convergence, in which the regions with higher per capita income will have lower economic growth. On the other hand, a positive β_1 shows divergence. The value of β_1 is referred to as absolute beta convergence, which can also be interpreted as the large economic development inequality between regions, assuming other factors are not considered. In short, the value of β_1 indicates the magnitude of the value of development inequality between regions had the government not changed economic development policies such as in 2010–2019. Furthermore, if equation (1) is developed into the following equation:

$$G_{i,t}^{\text{cap}} = \beta_0 + \beta_1 \ln y_{i,t_0} + \beta_2 \text{IG}_{i,t} + \varepsilon_{i,t} \quad (2)$$

Where IG where (ig) is the industrial agglomeration index, a measure of the high level of industrial concentration

or intensity in an area (Gardiner et al., 2011). If the value of β_1 in equation (1) is significantly different from β_1 in equation (2), it can be interpreted as the magnitude of the influence of industrial agglomeration. Apart from industrial agglomeration, two policies can affect the convergence rate, namely sectoral growth ($G^s_{i,t}$) and infrastructure development ($\text{INFR}_{i,t}$). The impact of sectoral growth policies on the convergence rate can be formulated in the equation (3) in accordance with (2011) framework of Rodrik (2011), as follows:

$$G^{\text{cap}}_{i,t} = \beta_0 + \beta_1 \ln y_{i,t_0} + \beta_2 \text{IG}_{i,t} + \sum\nolimits_1^i \gamma_i \ln G^s_{i,t} + \varepsilon_{i,t} \quad (3)$$

Where ($G^s_{i,t}$) is *S* sector growth (consists of agriculture, industry, and services) of region *i* on *t* year. While the impact of soft infrastructure development policy (Barro & Sala-i-Martin, 2004) or hard infrastructure (Amalia et al., 2018) can be shown in equation (4)

$$G^{\text{cap}}_{i,t} = \beta_0 + \beta_1 \ln y_{i,t_0} + \beta_2 \text{IG}_{i,t} + \sum\nolimits_1^i \Psi_i \ln \text{INFR}_{i,t} + \varepsilon_{i,t} \quad (4)$$

Finally, if the policies for sectoral growth, human resource development, and infrastructure are considered in the model, equations (1)–(4) are developed into the following equation:

$$\begin{aligned} G^{\text{cap}}_{i,t} &= \beta_0 + \beta_1 \ln y_{i,t_0} + \beta_2 \text{IG}_{i,t} + \sum\nolimits_1^i \gamma_i \ln G^s_{i,t} \\ &\quad + \sum\nolimits_1^i \Psi_i \ln \text{INFR}_{i,t} + \varepsilon_{i,t} \end{aligned} \quad (5)$$

Furthermore, this study seeks to empirically prove whether there is a systematic difference between equation (1) as a baseline and equations (2), (3), (4), and (5), especially about the length of time (period) of convergence denoted by the coefficient β_1. Using the Hausman Test, the proposed null hypothesis is that the coefficient difference between the two equations is not systematic. If the Hausman Test yields a significant result, it can be concluded that the level of convergence during periods of economic development, such as 2010–2019, differs from the rate of convergence when other policies, such as industrial agglomeration, sectoral growth policies, and infrastructure development, are implemented.

3. Results and Discussion

3.1. Statistical Results

Table 1 shows the statistical results of the five models consisting of the coefficient of determination (R^2) and the impact of variables on economic growth. Model 1 has an R^2 value of 0.0137, which means that the model's initial ability to explain the variance of the per capita income growth variable is around 1.37%. Model 2 has an R^2 value of 0.0151 which is not much different from model 1. This means that the per capita income growth variance is explained by initial per capita income and industrial agglomeration of 1.51%.

Furthermore, Model 2 is modified into Models 3, 4, and 5. Model 3 incorporates the sectoral growth policy variables; Model 4 incorporates soft and hard infrastructure development, while Model 5 incorporates both sectoral growth policies and infrastructure development. In these models, the coefficient of determination is relatively the same, ranging from 0.0043 to 0.0135. The initial assumption regarding this result is that the characteristics of panel data tend to have a low coefficient of determination (Baltagi, 2010). In addition, the *F* test on the three models is relatively significant at the 10% level so that further interpretation of the magnitude of the influence of the independent variables on the growth of per capita income in the three models can be carried out.

All models other than Model 3 show the negative impact of initial per capita income on economic growth to varying degrees of significance. It can be interpreted that regions with low initial per capita income tend to have high per capita income growth, or economic development reaches convergence. All models also show that industrial agglomeration harms economic growth at a significant level of 10%. Conversely, all sectoral growth policies tend to have a positive effect on economic growth. Infrastructure development policies do not influence per capita income growth in East Java. Although the health access variable, for example, tends to increase per capita income growth, the relationship is relatively not robust as evidenced by inconsistent significance across all models.

After obtaining the estimation results, we tested the difference in convergence and per capita income growth using the Hausman specification test to ascertain a systematic difference in coefficients in the two-equation models. This study first compares the convergence rate during economic development policies such as 2010–2019 (Model 1) with the convergence rate when industrial agglomeration is applied (Model 2). Using the Hausman Test, we obtain a systematic convergence rate difference between Model 1 and Model 2 at the 1% level. Second, a comparison of the level of convergence in industrial agglomeration policies (Model 2) and combined models of industrial agglomeration and sectoral growth policies is carried out (Model 3). As a result, the convergence difference between Model 2 and Model 3 is not systematic. Third, model 2 and model 4 are compared and systematically show the difference in the convergence rate at the 1% level. Finally, model 2 is compared to model 5, which combines industrial agglomeration policies, sectoral growth policies, and infrastructure development policies.

Table 1: Convergence Estimation Results and Growth Determinants

Independent Var.	Dependent Var.: Income Per Capita Growth (ln(G))				
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Income per capita **(Ln (y))**	–0.0175*** (0.0058)	–0.0167*** (0.0058)	0.0115*** (0.0032)	–0.0302* (0.0172)	–2.5500** (1.1514)
Agglomeration Index, **(Ln (ig))**	–	–0.0426* (0.0261)	–0.0353*** (0.0115)	–0.0414 (0.0264)	–2.8120 (1.8574)
Industry Growth, **(Ln (ind))**	–	–	0.0781*** (0.0253)	–	0.4156* (0.2357)
Agriculture Growth, **(Ln (agr))**	–	–	0.1057*** (0.0210)	–	0.1497* (0.0798)
Other Sector Growth, **(Ln (others))**	–	–	0.6495*** (0.0179)	–	2.8294*** (0.1431)
Health Index, **(Ln (health))**	–	–	–	0.0240 (0.2023)	24.1770* (13.4535)
Education Index, **(Ln (edu))**	–	–	–	0.0223 (0.0456)	0.9185 (2.9890)
Road Availability, **(Ln (road))**	–	–	–	–0.0001 (0.0017)	–0.0631 (0.1579)
Electricity Availability, **(Ln (elec))**	–	–	–	0.0041 (0.0128)	1.2806 (0.8476)
Clean Water Availability, **(Ln (water))**	–	–	–	0.0029 (0.0019)	0.1362 (0.1270)
Cons.	0.1053*** (0.0186)	0.0765*** (0.0256)	–0.0574*** (0.0125)	0.0873 (0.1170)	2.8220 (7.8432)
Prob > *F*	0.0029***	0.0032***	0.0000***	0.0453**	0.0000***
R^2	0.0137	0.0151	0.0083	0.0135	0.0043

Note: (i). The panel data model used is Fixed-Effect;
(ii). ***, Significant at the 1% level, **, 5%, *, 10%;
(iii). The numbers in parentheses are the standard error.

Table 2: Model Specification Test Results

Model Comparision	Hausman Test	
	Prob > χ^2	**Explanation**
Model 1 with Model 2	0.0001***	The difference in coefficients between the two models is systematic
Model 2 with Model 3	0.7074	The difference in coefficients between the two models is not systematic
Model 2 with Model 4	0.0000***	The difference in coefficients between the two models is systematic
Model 2 with Model 5	0.0045***	The difference in coefficients between the two models is systematic

Note: (i) all models compared are Fixed-Effect model;
(ii) ***Sign. 1%, ** Sign. 5%, *Sign. 10%.

As a result, the two models also have different levels of convergence systematically at the 1% level (Table 2).

After examining the difference in convergence, we can identify the characteristics of economic growth in East Java which consist of an estimate of the convergence rate and the growth in per capita income (see Table 3). There are three conclusions from the five policy simulations mentioned above. **First**, suppose East Java focuses on the agenda of accelerating equitable regional development or creating convergence. In that case, economic development

Table 3: Estimation Result of Convergence Rate and Per Capita Income Growth

Model	Policy Simulation	Estimated Time of Convergence (Years)	Estimated Income per Capita Growth (%)
1	Without changes in economic policy, as in 2010–2019	39.81	5.22
2	With industrial agglomeration	41.62	1.75
3	With a mix of agglomeration and sectoral growth policies	Divergence	5.51
4	With a mix of agglomeration and infrastructure development policies	23.22	0.40
5	With industrial agglomeration, sectoral growth policies, and infrastructure development	27.53	6.07

policies with a mix of infrastructure policies are an ideal policy scenario. Second, if East Java focuses its primary economic development objective on accelerating economic growth, sectoral growth policy is an ideal policy scenario. Third, if East Java chooses to accelerate regional inequality reduction without sacrificing economic growth, then the mix of industrial agglomeration policies, sectoral growth, and infrastructure development is appropriate.

3.2. Discussion

There are five essential findings in this study. First, if the economic development policy remains like 2010–2019, it will result in a per capita income growth of around 5.22% with a convergence time of approximately 39.81 years. Although the growth is relatively high, it will take a long time to fix regional inequalities. This finding is reasonable given that the existing condition of regional inequality in East Java is quite high. The level of regional development inequality in East Java as measured by the Williamson Index ranges from 0.95 to 0.97 and has increased since 2013. The value is even far above the national level, which has consistently decreased.

Second, economic development with industrial agglomeration resulted in per capita income growth of around 1.75%, with a convergence time of around 41.62 years. Apart from generating relatively low growth, this policy can slow down the improvement of regional inequality. This finding indicates that the spill-over benefits of the Industrial Development Center (IDC or PPI/Pusat Pembangunan Industri) are limited to industrial-based areas. About 80% of East Java's industry originates only from eight districts/cities with relatively constant figures. With the composition of industrial areas that do not change much, the economic benefits automatically cannot reach geographically far from the PPI.

These results also indicate that industrial areas do not consistently achieve high economic growth. Not only in East Java, but Rodríguez-Pose (2018) also found a similar phenomenon in Detroit, St. Louis, and Youngstown in the United States; Guyuan, Yichun, or Lanzhou in China; and Dnipropetrovsk in Ukraine. The cities above were previously the center of the country's economic growth but turned stagnant and were unable to boost their economic growth. Borrowing the explanation from Rodríguez-Pose (2018), Gerbangkertasusila Region (Gresik, Bangkalan, Mojokerto, Surabaya, & Sidoarjo), which Surabaya drives, has relatively slow industrial development. Santosa and McMichael (2004) found that industrial development in East Java was relatively left behind compared to several other cities in ASEAN, even the Greater Jakarta area (Jakarta, Bogor, Tangerang, Bekasi). East Java could not capitalize on international relations in the deregulation period of the 1990s and has not recovered rapidly in the post-Asian financial crisis period.

Third, economic development with a sectoral growth policy resulted in a per capita income growth of around 5.51%. Even though it produced the highest economic growth, this policy created divergences. This finding is not surprising given that East Java's economic resources are quite high with the economic structure of each region being relatively constant during the observation period. In line with the study by Rodrik (2018), this divergence occurs because many developing countries or regions still rely on the agricultural sector as the basis of the economy. Even if developing countries or regions have transformed into the industrial sector, they still rely on the low-tech, small-medium scale, and informal industrial sectors.

On the other hand, sectoral growth can increase the overall economic growth of East Java. GRDP growth in other sectors has a relatively more significant impact on the growth in per capita income and the convergence rate than GRDP growth in the industrial and agricultural sectors. This result is not surprising considering that the GRDP of other sectors dominates around 55.6–60.3% of all economic activities in East Java. The workforce in other sectors also dominates around 34.4–44.6% of the total workforce, compared to the industrial and agricultural sectors.

Fourth, economic development policies accompanied by infrastructure development resulted in a per capita income growth of around 0.40 with a convergence time of around 23.22 years. These findings indicate that infrastructure development has been evenly distributed in both poor and wealthy areas. Furthermore, soft infrastructure improving regional inequality is in line with the studies conducted by Cunha et al. (2006), Barro and Sala-i-Martin (1995), and Todaro and Smith (2011). Access to adequate education allows poor areas to improve the skills needed in economic activities (Barro & Sala-i-Martin, 1995). Meanwhile, access to health, such as the provision of health services and early childhood interventions, allows the economic participation of the workforce in poor areas to increase in the future (Cunha et al., 2006).

Meanwhile, hard infrastructure can accelerate the improvement of regional inequality, as the findings of the studies by Banerjee et al. (2020), Crescenzi and Rodríguez-Pose (2012), Olsson (2013), and Bröcker and Rietveld (2009). Infrastructure, especially transportation, enables poor regions to increase their market reach and reduce transaction costs (non-production costs) by improving connectivity to centers of economic growth. Infrastructure may attract the creation of new economic activities in poor areas. Moreover, infrastructure also helps reduce the population density due to urbanization (Haryanto et.al, 2021), thus spreading the economic activity. Such findings also stated by Yuliadi & Raharja (2020), that states the main triggers for an individual to migrate is economics factor.

Infrastructure development policies do not affect per capita income growth in East Java, because infrastructure investment generally takes a relatively long time to impact increasing regional productivity. The study by Lee and Mason (2010), in a powerful way, estimates that investment in education and health will not be felt in the same year. Still, it will take a generation to create a productive workforce expected to accelerate per capita growth. The same case also occurred in providing public infrastructures such as roads, electricity, and clean water, which took a relatively long time. Alam et al. (2005) divided the time lag from investment in infrastructure over three periods: short, medium, and long-term. In the short and mid-term, returns from infrastructure investment can be enjoyed in 3–6 years. Meanwhile, in the long term, returns can be enjoyed within 15 years.

Fifth, economic development with a mix of industrial agglomeration policies, sectoral growth policies, and infrastructure development resulted in per capita income growth of around 6.07% with a convergence time of around 27.53 years. This policy scenario yields relatively the best outcomes for both correcting regional imbalances and accelerating economic growth. The findings in this study are not surprising because although industrial development is centered on eight districts/cities in East Java, sectoral growth, soft and hard infrastructure development can compensate for the growth in per capita income in non-industrial-based regions. At least, sectoral growth policies, soft infrastructure development, and infrastructure can increase the potential of non-industrial-based regions.

The findings of this study are in line with the research of Amalia et al. (2018) in East Java. They found that infrastructure policies such as the availability of good roads and the availability of electricity will accelerate convergence. Meanwhile, soft infrastructure development policies such as improving the workforce quality and labor productivity can make poor regions catch up with rich regions. The model used in the study of Amalia et al. (2018) found that convergence can occur in the next 11.20 years.

Our research findings are also in line with the study of Rodríguez and Santos (2018) in the European Union on a broader scale. Developed countries maintain their existing conditions so that their economic activities continue to grow. On the other hand, massive human and infrastructure investment has enabled developing countries to catch up with developed countries. The study suggests that human investment and infrastructure policies should be maintained and coordinated more intensely with EU members. Thus, the cohesion policy that includes investment in people and infrastructure effectively achieves equitable development between countries in the European Union.

4. Conclusion

This study examines what strategies are best for minimizing the adverse effects of agglomeration of these industries. Based on the analysis, we find that East Java's economic growth characteristics are convergent but relatively long. Therefore, the East Java economic development policy during 2010–2019 should be reviewed due to the relatively long convergence period. Furthermore, this study also found that industrial agglomeration slows down the convergence and economic growth of East Java. In the future, the deployment of Industrial Development Centers (PPI) outside the existing eight districts/cities is needed to accelerate the spread of economic activity in East Java.

Despite accelerating economic growth, sectoral growth policies tend not to support the convergence of East Java. In addition, infrastructure development policies accelerated convergence but slowed economic growth in East Java. Suppose East Java maintains its existing Industrial Development Center (IDC) and sectoral growth policies, in that case, this strategy needs to be accompanied by soft (access to education and health) and hard (access to roads, electricity, and clean water) infrastructure outside the IDC.

Finally, the main finding in this study is that the combination of policies for accelerating sectoral growth,

development of soft and hard infrastructure, and industrial agglomeration provides the best policy outcome, both in terms of improving regional inequality and accelerating economic growth in East Java. This policy combination requires a convergence of around 27.53 years and predicts annual growth of around 5.11%. Thus, the combination of policies for accelerating sectoral growth, infrastructure development, and industrial agglomeration in East Java needs to be maintained to realize the plan for improving regional inequality and increasing per capita income growth.

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