

Determinant of Capital Efficiency and Its Impact on Economic Growth: Empirical Evidence in East Java

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Abstract

East Java is the engine of Indonesia's economic growth. Nevertheless, this region is still faced with the performance of industrial development, which has yet to increase consistently, thereby worsening efficiency and economic growth. As a result, this paper aims to investigate the causes and consequences of capital efficiency in the context of East Java. This paper produces three results by employing the 3SLS simultaneous equation estimation method. First, this paper demonstrates that industrial development in East Java improves efficiency. Second, improving the education level has a positive effect on capital efficiency. Lastly, an increase in capital inefficiency leads to a negative effect on economic growth in East Java. This study suggests three key policies for accelerating economic growth in East Java: providing incentives to industries that can increase capital efficiency, developing innovations to increase capital efficiency, and improving education quality to encourage increased human resource productivity.

Keywords:

capital efficiency; industrialization; economic growth

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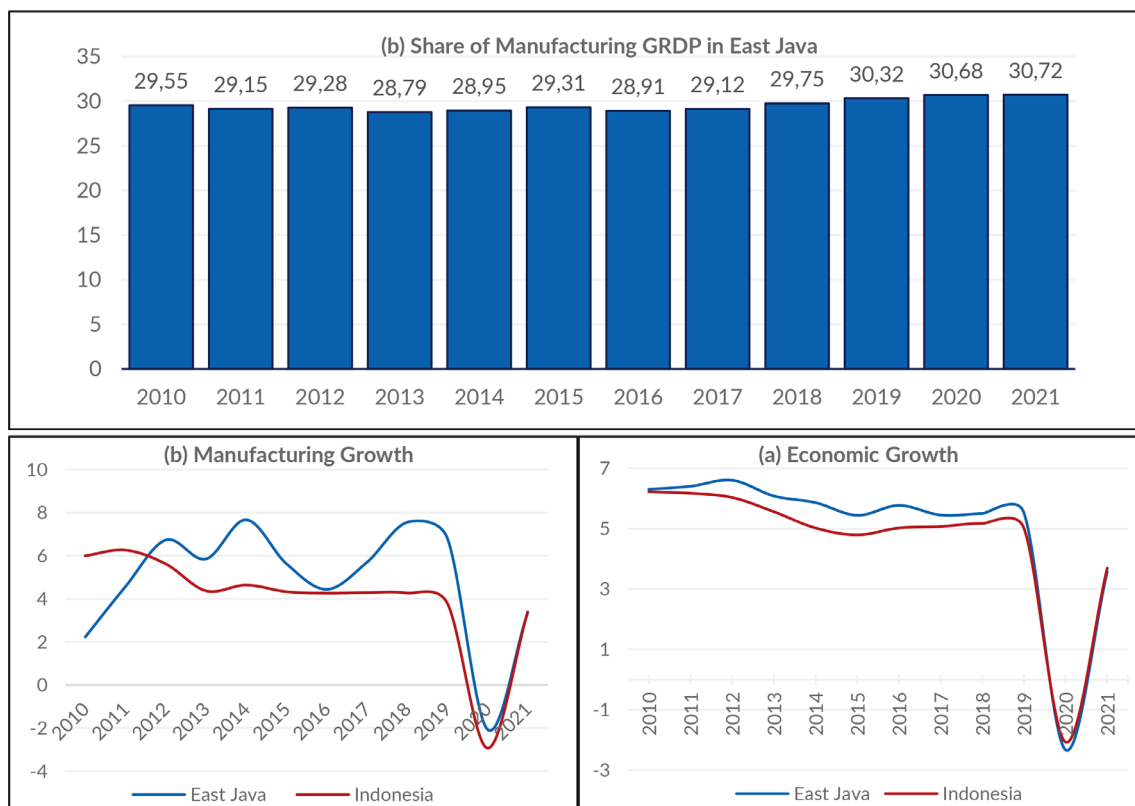
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INTRODUCTION

Capital-Output Ratio (COR) is considered an important indicator in measuring production efficiency in the economy (Billings et al., 2021; Coutiño & Zandi, 2021; Franke, 2017; Taguchi & Lowhachai, 2014). Theoretically, the lower this ratio, the more efficient the economy is in using capital to produce output. If this ratio is high, it means that the economy is less efficient in using capital to produce output, which can indicate inefficiencies in resource management and indications of other structural problems in the economy. Examining the COR can provide an overview of the level of production efficiency and identify problems that may exist in the economy so that action can be taken to address them.

The neoclassical school of thought states that industrial development can improve COR values because industry generally has a higher level of productivity than other sectors (Hallward-Driemeier & Nayyar, 2017). Industrial development can increase productivity by improving equipment, technology, and workforce quality (Doherty & Stephens, 2021; Fuchs, 2014; Rodrik, 2013; Su & Yao, 2017). It can increase efficiency and productivity in the production process, thereby increasing output per unit of invested capital. Thus, industrial development is able to improve the COR, which shows the ratio between the capital invested and the output produced.

Figure 1. Economic Growth and Industrial Development in East Java



Source: (a) Indonesian Central Bureau of Statistics (2022); (b) East Java Central Bureau of Statistics, 2022); (c) (East Java Central Bureau of Statistics, 2022a).

East Java is an industrial-based area, and industrial development should be able to improve capital efficiency while accelerating economic growth in East Java. Even though East Java's industrial growth tends to be higher than the national one, its economic growth tends to experience a faster decline than the national one. Figure 1 explains that East Java can be said to be an industrial area with a growth rate that tends to slow down. For this reason, this paper aims to identify the determinants of efficiency and estimate how significant the impact of efficiency is on economic growth in East Java.

Most of the previous studies state that the level of efficiency is considered an exogenous variable, as in the study of Ikhsan (2007), Margono et al. (2011), Kurniawan & Managi (2018), and Musyawwiri & Üngör (2019). On the contrary, the approach of this study is different, where the level of capital efficiency is considered an endogenous variable. It is one of the latest from the study of efficiency. Consequently, this study develops a simultaneous analysis model consisting of two equations: (i) equations about the factors that influence the level of inefficiency in the use of capital; and (ii) the equation regarding the impact of inefficient use of capital on economic growth. Both equations are estimated using the Three Stage Least Square (3SLS) method. This approach will be explained in more depth in the Methods section. In addition, the update from this study results is to include the impact of the Covid-19 pandemic on per capita income growth, which of course has not been done much.

METHODS

This study generally discusses capital efficiency in 38 districts/cities of East Java $\{i = 1.2.3.....38\}$ in 2019 and 2021 $\{t = 2019.2021\}$, with two main objectives: i) to analyze the factors that determine the level of efficiency in East Java and ii) to estimate the impact of the efficiency level on economic growth in East Java.

The model built to answer the first research objective can be expressed in the following equation:

$$COR_{it} = \alpha_0 + \alpha_1 IND_GRO_{it} + \alpha_2 EDU_{it} + \alpha_4 ROAD_{it} + \mu_{it} \quad (1)$$

Where: the level of capital inefficiency is measured by *COR* is an endogenous variable that is influenced by the growth of the processing industry (*IND_GRO*); the education index calculated from the average length of schooling and expected length of schooling (*EDU*); the ratio of good and very good road availability to the area (*ROAD*).

Theoretically, the growth of the manufacturing industry can improve capital inefficiency because the industrial sector can apply the most efficient technology in capital utilization compared to other sectors in economic activity (Rodrik, 2013). Development of human resources through increasing access to quality education can improve capital efficiency because most of the workforce involved in economic activity is a highly skilled workforce, so technology adoption and transfer of knowledge can be done easily (Dinerstein et al., 2022; Lentini & Gimenez, 2019; Vollrath, 2014). The provision of public goods proxied by the availability of steady roads can also increase capital efficiency.

This infrastructure can reduce transportation and logistics costs borne by the business world, both in the mobility of production factors and final demand. (Álvarez et al., 2016; Arbués et al., 2015; Deng, 2013; Laborda & Sotelsek, 2019; Melo et al., 2013). Providing stable roads is considered necessary in reducing transportation and logistics costs because most of the mobilization of goods and services in East Java still relies on land transportation modes.

The estimation results in equation 1 are then substituted in equation 2 to answer the second research objective, which is to determine the magnitude of the impact of capital inefficiency on economic growth. The equation developed is as follows:

$$G_Cap_{it} = \beta_0 + \beta_1 COR_{it} + \beta_2 COVID_{it} + e_{it} \quad (1.2)$$

Where: level of inefficiency (*COR*) expected to affect the growth of per capita income (*G_Cap*). In addition to the level of inefficiency, it is assumed that the period during which Covid-19 occurred also affected the growth rate of per capita income (*COVID*). This assumption is based on studies by Olivia et al. (2020), which state that East Java is one of the regions in Indonesia whose economic activity has been most affected by the Covid-19 pandemic, both from the demand side in the form of a decrease in people's purchasing power and the supply side in the form of production restrictions on non-essential sectors.

Furthermore, the Three-Stage Least Square (3SLS) in this study is used to estimate equations 1 and 2 models simultaneously. Compared to another similar approach, Two-Stage Least Square (2SLS), Belsley (1988) states that 3SLS produces asymptotically relatively more efficient estimates by taking into account the error relationship between the equations. Greene (2018) emphasized that 3SLS can also overcome the endogeneity bias often encountered in OLS estimation methods.

RESULT AND DISCUSSION

Before reviewing the estimation results of the 3SLS simultaneous equation, it is necessary to review the reliability of the model developed in this study. The model's reliability can be seen from the Prob>chi2 value, indicating whether all explanatory variables significantly affect the endogenous variables in the 3SLS simultaneous equation. The Prob>chi2 value in the capital inefficiency equation and the GRDP per capita growth equation are 0.0080 and 0.0000, respectively. It indicates that all explanatory variables significantly influence the endogenous variables, with a significance level of 1%. For this reason, the interpretation of the simultaneous equation estimation results can be carried out.

Table 1 shows that industrial growth and educational development tend to improve capital inefficiencies in the East Java economy, while the availability of road infrastructure is not proven to have a strong enough influence on capital inefficiencies. Table 1 also shows that capital inefficiency and the period during which the Covid pandemic occurred tended to worsen East Java's GRDP per capita growth performance.

The explanation of the statistical estimation results in this study can be divided into two parts. *First*, findings regarding the impact of industrial growth, educational development, and road infrastructure provision on East Java's capital inefficiency. Increased industrial growth coupled with efficiency improvements means that industrialization policies in East Java have encouraged the use of technology in the industrial sector that utilizes capital efficiently. Increasing access to education coupled with improving efficiency means that the policy of developing human resources through formal education in East Java has encouraged an increase in skills and transfer of knowledge of the workforce, which has triggered an increase in labor productivity. Meanwhile, the provision of road infrastructure is not proven to have an effect on improving capital efficiency, meaning that regions with access to adequate or inadequate road infrastructure do not have a significant difference in terms of capital efficiency.

Table 1. Determinants of Capital Efficiency and Its Impact on GRDP Per Capita Growth in East Java

Variable	Endogenous Variable	
	Equation 1.1	Equation 1.2
	COR	G_Cap
Industrial Growth, IND_GRO	-0.0031** (0.0015)	
Education Index, EDU	-0.1777*** (0.0648)	
The ratio of good and moderate road quality to area, ROAD	-0.0002 (0.0003)	
Capital Inefficiency, COR		-4.6754* (2.1073)
Dummy for the Covid-19 Period, COVID		-1.9352*** (0.4239)
No. Obs	76	76
Chi ²	11.81	21.06
P > Chi ²	0.0080	0.0000

The figures in parentheses indicate the standard error. *, **, *** represent significance at the level of 10%, 5% and 1%, respectively. COR and G_Cap are endogenous variables, while the rest are exogenous variables.

Source: Author's Calculation Results (2023).

Second, findings regarding the impact of capital inefficiency and the period of the Covid pandemic on the growth performance of GRDP per capita in East Java. Increased capital inefficiency can exacerbate the growth performance of GRDP per capita, meaning that with the same level of capital, wasteful use of capital provides a much lower output of economic activity. Meanwhile, the period during which the Covid occurred resulted in a lower per capita GRDP growth performance than the pre-Covid period, indicating that the Covid pandemic has indeed proven to disrupt economic activity both from the aggregate demand and aggregate supply sides.

Based on the results of previous estimates, the discussion of research findings can be divided into two main parts. The first part reviews the determinants of capital efficiency in East Java. Furthermore, the second part explains the impact of capital efficiency on East Java's GRDP per capita growth performance, including the impact of the period of the Covid-19 pandemic.

This study found that industrial development tends to be accompanied by efficiency improvements, which means that the industrialization policies implemented encourage the use of more efficient technologies. The use of more efficient technology in East Java is due to the dominant industrial structure in East Java being the agricultural product-based industrial sector (agro-industry). East Java Central Bureau of Statistics (2022a) noted that more than 80% of East Java's industrial sector is agro-industry. Agro-industry encourages the use of more efficient technology because the growing industrial sector can utilize intermediate inputs originating from the agricultural sector, which incidentally corresponds to the potential of East Java's local resources. In other words, agro-industry that is efficient in capital utilization, on the one hand, increases economic growth and can also increase the added value of the agricultural sector.

This study's results align with research conducted by Otsuka (2021) in the case of Indonesia and Santoso (2015) in the case of East Java, particularly in forest plant commodities. Agro-industry is most likely to be developed as a basis for economic development in developing countries because the agro-industry does not require complex technology compared to other industrial sub-sectors. Hence, adjustments to technology adoption in this sector are easier to make. Simple technology in agro-industry is necessary considering that the workforce that moves to this sector is a workforce that comes from the agricultural sector.

In addition to industrial development, this research finds that human resource development in improving access to formal education tends to be accompanied by increased capital efficiency. These results indicate that improving access to formal education in East Java is followed by increases in labor productivity. A recent study by OECD & Asian Development Bank (2020) confirmed that East Java's education development policy is one of the best practices in Indonesia in developing education that is in line with labor productivity. One example of the most progressive education development policy in East Java is the implementation of a double-track system at Senior High Schools (*Sekolah Menengah Atas/SMA*) and Vocational High Schools (*Sekolah Menengah Kejuruan/SMK*). One of the main objectives of this program is to provide skills to high school/vocational school students so that if they graduate and are forced not to have the opportunity to continue studying at tertiary institutions, these students will have the provision to become independent entrepreneurs or work in their area according to the skills acquired.

In contrast to industrial development and human resources, the provision of road infrastructure has not proven to have an effect on capital efficiency. These results indicate that regions with access to adequate or inadequate road infrastructure do not have significant differences in capital efficiency. The findings of this study are different from the

research conducted by Álvarez et al. (2016), Arbués et al. (2015), Deng (2013), Laborda & Sotelsek (2019), Melo et al. (2013). One plausible explanation is that increasing the availability of steady access roads (good and medium quality) does not necessarily reduce transportation and logistics costs in the movement of goods. An efficient transportation and logistics system requires good coordination between different types of modes, such as road, sea, and air (Agamez-Arias & Moyano-Fuentes, 2017; Li et al., 2023), as well as a warehouse management system and distribution of quality goods (Karagiannis et al., 2022).

Furthermore, this study finds that capital inefficiency tends to exacerbate per capita GRDP growth performance. This result is quite reasonable considering that capital inefficiency means more capital is needed than in the previous period to achieve the same level of economic growth. (Billings et al., 2021; Coutiño & Zandi, 2021; Franke, 2017; Taguchi & Lowhachai, 2014). The need for more capital than before makes the investment cost per unit more expensive. More expensive investment costs will further inhibit investment and, in the end, lower the growth performance of GRDP per capita.

In addition to capital inefficiency, the period of the Covid pandemic also tended to worsen per capita GRDP growth performance. The period where Covid occurred resulted in a lower GDP per capita growth than the pre-Covid period, indicating that the Covid pandemic has indeed proven to disrupt economic activity due to policies restricting social mobility. Olivia et al. (2020) found that East Java's economic activity was disrupted both on the demand and aggregate supply sides. On the demand side, social restrictions due to the pandemic have reduced people's purchasing power as household income has contracted. On the supply side, social restrictions have hampered production expansion, especially in the non-essential sector.

Based on data released by the Indonesian Central Bureau of Statistics (2023), after the Covid-19 pandemic, East Java's economic growth required a high level of resilience. Considering that during the pandemic, the rate of economic contraction in East Java was relatively higher than the national average. Therefore, efforts to increase efficiency in the use of capital are critical in accelerating East Java's economic recovery after the Covid-19 pandemic through three development policy strategies. First, providing incentives to industries that are efficient in the use of capital. Referring to the research results of Otsuka (2021) and Santoso (2015), the agro-industry is an industry that can use capital efficiently. Thus, developing agro-industry in East Java is strategic for strengthening post-pandemic economic resilience. In addition, the accelerated growth of the agro-industry in East Java can provide benefits by increasing the value-added agricultural sector, which still has a prominent role at the national level.

Second, encouraging the growth of innovations that can increase the level of efficiency in the use of capital. Concerning agro-industry development, East Java has a fairly strong agricultural base. The innovations emphasized are innovations in the agricultural sector, especially in the use of agricultural tools and machinery, as well as digitalization. Thus, innovations that occur in the agricultural sector can increase

production efficiency in the agro-industrial sector. Third, strengthening education that can encourage increased productivity. East Java has developed better vocational schools (OECD & Asian Development Bank, 2020). However, this effort needs to be continuously increased, considering that the young population in East Java has considerable potential.

CONCLUSION

This study shows that the efficiency of the use of capital can be increased along with industrialization while increasing the level of education can also increase efficiency. In addition, accelerated growth in per capita income in East Java can be achieved through efforts to increase the efficiency of the use of capital. In this case, the government's success in increasing the efficiency of the use of capital will significantly affect the acceleration of economic resilience in East Java during the post-Covid pandemic period.

Three main policies can be implemented to accelerate per capita income growth in East Java in the post-Covid era. First, providing incentives to industries that are capable of increasing efficiency in the use of capital. Second, encouraging the growth of innovation to increase efficiency in the use of capital. Third, improving the quality of education to encourage increased productivity of human resources.

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