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The Impact of Seaport Activities on Growth: Evidence from Indonesia

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Abstract

The research aims to analyse the impact of seaport activity on economic development in Indonesia. The time series of data has ranged between 2008 – 2018. This cross-section of data covers 33 provinces in Indonesia. The research uses secondary sources, such as the Central Statistics Agency, CEIC, and Ministries, and employs panel data analysis, which chooses the fixed effect as the best model. The results show that : (i) capital expenditure to gross investment in the economy (PMTB) positively affects boosting economic growth, (ii) the university workforce has a positive impact on per capita income growth (iii) the depreciation appears to erode gross regional domestic product per capita, and (iv) the variables associated with port activity in the model have no significance at a p-value of 1 % or 10 %. Furthermore, the variable with a lag of one year significantly affected growth. It meant that the investment activities impacted the economy in the following year. The policy implications include: (i) Increased government capital expenditure is needed, (ii) Providing the broadest possible access to higher education is one of the policies that can be taken to improve the quality of workers; (iii) improve access to and from the seaport to facilitate the flow of goods both for unloading and loading and unloading at the seaport.

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INTRODUCTION

Being an archipelago nation, Indonesia is surrounded by the Pacific and Indian Oceans, which positions it as a crucial anchor in maritime affairs. The global trade routes that pass through Indonesia offer a significant advantage, enhancing Indonesia's geo-economic position in the eyes of the world. The potential of the resources is immense, given an area of sea surface covering approximately 6.4 million km² and boasting the world's 4th longest coastline, stretching 108,000 km. With such extensive coverage of international shipping lanes, there are vast opportunities for economic development.

Geographically, Indonesian Archipelago is located at the equator and is renowned as the Coral Triangle. This designation highlights Indonesia as the epicentre of global marine biodiversity. Additionally, the Trajectory of the Indonesian Archipelago Sea (ALKI), based on the Law of the Sea 1982, comprises three main components: ALKI I (encompassing the South China Sea, Karimata Strait, DKI, and Sunda Strait Sea), ALKI II (covering the Sulawesi Sea, Makassar Strait, Flores Sea, and Lombok Strait), and ALKI III (spanning the Pacific Ocean, Maluku Strait, Seram Sea, and Banda Sea).

Indonesia's sea waters hold tremendous potential for fisheries, boasting approximately 12.54 million tons of fisheries products. Moreover, ten marine service sectors can potentially be the driving force behind maritime economic development in the country. These sectors encompass energy, sea transportation, marine biotechnology, marine industry, marine construction, marine tourism, energy and human resources, small island resources, and mangrove forests. It is estimated that these sectors combined could yield a potential value of more than US$ 1.2 trillion annually.

Maritime has importance as a new source of economic growth regarding the urgency of Indonesia's structural transformation. The primary sector of marine commodities has little added value if sea products are limited to further process. The structural change in industrialization boosted the value-added of the sea product. Additionally, the economic transformation encouraged the tertiary sectors with enormous potential. The sector includes shipbuilding industry services, marine cable industry, floating harsh industry, and jarring factory.

However, amid the tremendous maritime economic potential, maritime utilisation is still not optimal, represented by the contribution of marine gross domestic product (GDP) to the national GDP. The contribution of maritime GDP was around 7 % between 2017 and 2021. During the first three years, the growth of the maritime sector increased significantly from 0,63 % (2017) to 2,13 % (2019). In 2020, when Covid-19 happened, the growth of maritime GDP fell to minus 3,93 %. Also, maritime GDP's contribution to the economy reached the lowest level during the period, 7,38%.

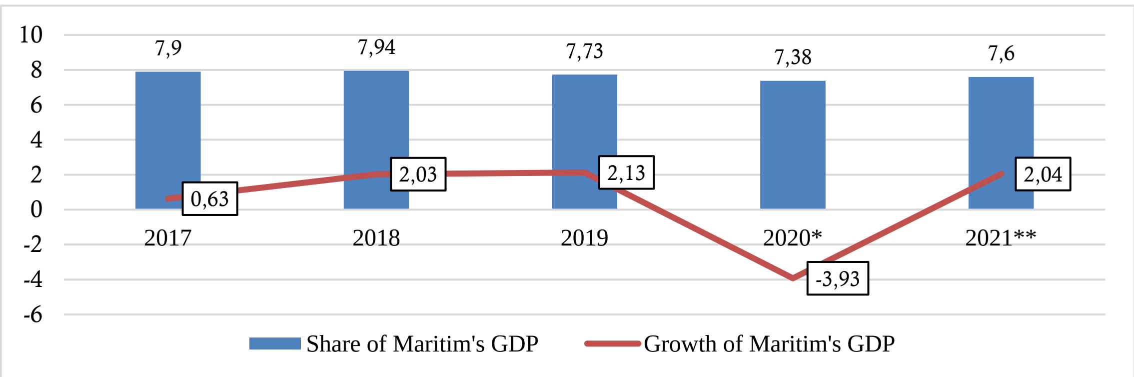

Figure 1. The Contribution of Maritim GDP and Its Growth, 2017-2021
Source: Ministry of Coordinator on Maritim and Investment – Statistic of Indonesia, 2022

Furthermore, when viewed based on its subsector, the utilisation of the maritime sector in the economy is still low among the abundant maritime resources in Indonesia, of which two-thirds of Indonesia's territory is the sea. In detail, the primary industries are still dominant in the maritime economy. In 2021, almost 55% of maritime GDP was dominated by fisheries, maritime culture, and maritime energy resources sector, 29.11 and 24.98 %, respectively. The marine sector has a strategic role in national economic activities. Optimal and sustainable utilisation of marine potential in transportation can be a national development capital.

Table 1. Maritime Gross Domestic Product (2021)

No	Sectors	2021**		
		Nominal GDP (Trillion Rupiah)	Share to total GDP	Share to Maritime GDP
1	Fisheries and Maritime Culture	375.6	2.21	29.11
2	Maritime Energy Resources	322.3	1.90	24.98
3	Maritime Mineral Resources	63.0	0.37	4.88
4	Maritime Processing-Based Industry	53.3	0.31	4.13
5	Ship Industry	9.6	0.06	0.74
6	Other Maritime Industry	101.9	0.60	7.90
7	Maritime Renewable Energy	0.0		
8	Maritime Construction	16.2	0.10	1.26
9	Maritime Trade	101.0	0.60	7.83
10	Maritime Transportation	126.2	0.74	9.78
11	Maritime Tourism	51.6	0.30	4.00
12	Maritime Services	53.7	0.32	4.16
Maritime GDP		1,290.2		
Total GDP		16,970.8		

Source: Ministry of Coordinator on Maritim and Investment – Statistic of Indonesia, 2022

The utilisation of maritime potential in Indonesia does not support by marine logistic efficiency. As a result, transporting goods from Jakarta to cities in Indonesia is more expensive than transportation abroad, even though the distance is farther. As an archipelago nation, Indonesia relies heavily on connectivity between islands. Furthermore, Indonesia's logistic performance is still lagging behind Singapore (third ranking), Thailand (ranked 20th), Vietnam (ranked 12th), and Malaysia (ranked 54th). Indonesia itself ranked 546th in 2021.

The Liner Shipping Connectivity Index (LSCI) also shows the inefficiency of maritime connectivity in Indonesia. The LSCI demonstrates the level of integration of existing ship delivery networks by calculating ship shipping connectivity. It is then associated with the port utility via Container Port Traffic. The indicator measures the flow of containers from the land-to-sea mode of transportation and vice versa. Figure 2 shows Indonesia's port connectivity is still significantly left behind from China, Thailand, and Vietnam.

Transportation is one of the critical sectors of economic activity. This sector is a connector. The production of goods/services from producers can reach consumers' hands, domestic and cross-border consumers. Besides, the transportation sector can also encourage regional development and economic growth. The provision of transportation infrastructure services positively encourages regional development in several ways: (1) increase productivity; (2) lower production costs; (3) better specialisation; (4) trade growth; (5) expansion of related markets; (6) exploitation of economies of scale; (7) improve territorial cohesion; (8) reduce economic inequality; and (9) increased division of labour. The transportation sector is a substantial factor in economic development and regional balance and greatly (Aschauer, 1989; J. P. Cohen, 2010; Crescenzi & Rodríguez-Pose, 2012; Park & Seo, 2016b; van de Vooren, 2004).

According to (Nazemzadeh 2016), economic development determinants could come from transportation infrastructure mainly through two lines. Firstly, -the direct effect - activates the transport sector's contribution to GDP by providing easier access to inputs and reductions in transportation costs. Secondly, - the indirect effect - works through additional inputs to other sectors. The transportation networks provide faster, cheaper, and more reliable and flexible transportation services that create higher productivity in manufacturing and production. Besides, contributes to production concentration, creating economies of scale and access to unique inputs. It also has a complementary solid with human and physical capital.

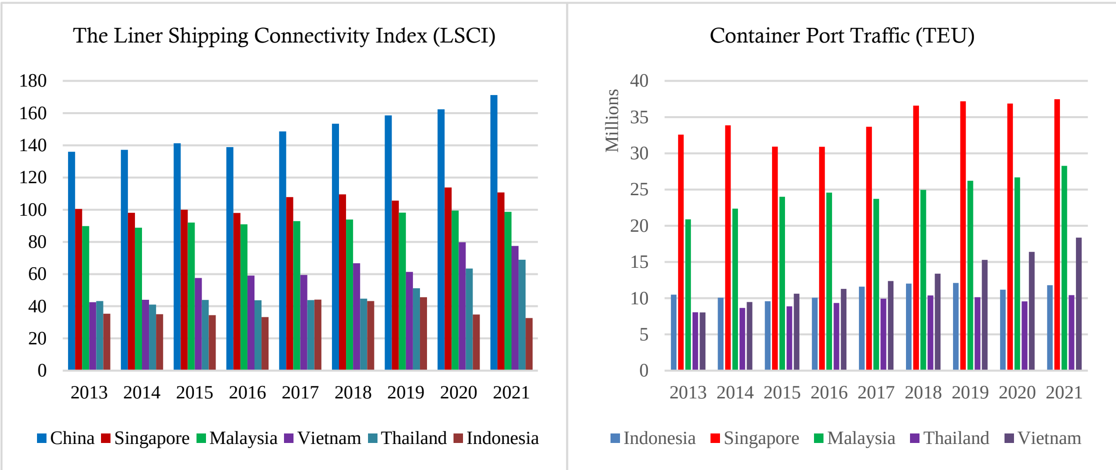

Figure 2. Overview of Connectivity Based on The Liner Shipping Connectivity Index (LSCI) and Container Port Traffic between Countries 2013-2021

One transportation facility that has an essential impact on the region's economic growth is the port. A port is a location on a beach or beach that contains one or more ports where ships can dock and move people or cargo to or from the virgin. The port is one of the main components of the public transport sector. It is currently associated with the world economy's growth due to the global economic system (Dwarakish & Salim, 2015). The port is the main gateway to the flow of goods, both export and import and cargo transfer between transportation modes (Karunia, 2013). Also, it can create jobs and encourage more significant economic activity. Port development lead more excellent trading activity, increased supply, significant foreign exchange reserves, and lower overall commodity prices (Dwarakish & Salim, 2015).

The study conducted by (Park & Seo 2016a) reveals that cargo ports that do not have enough lanes hinder local economic growth. In contrast, cargo ports contribute to regional economic growth only if they have adequate results. Furthermore, the results showed that container port activities positively affected regional economic growth. In contrast, port investment indirectly led to economic growth. Research conducted by (2013) shows that ports play an essential role in developing cities in Indonesia, following port cities in Asia's growth patterns. Besides, there is a difference in the growth of port cities and cities that do not have ports judging by the proportion of manufacturing labour, population density, and the average education level. Jouili & Allouche (2016) concluded that public investment in port infrastructure positively influenced Tunisia's economic growth. The study also revealed that the service sector is the biggest beneficiary of the port's investment infrastructure.

Studies conducted by Yudhistira & Sofiyandi (2018) show that proximity to major ports positively impacts per capita GDP, labour productivity, poverty rates, and poverty inequality. For areas far from the nearest main port above 150 Km, the manufacturing sector only contributes 5.9–7.1 % to GDP. The area located 29–67 Km from the nearest main port has a relatively low poverty rate (average 10.3–12.2%).

Munim & Schramm (2018) studied port infrastructure's influence on economic growth in 91 countries with ports. Using the Structural Equation Model (SEM) shows that developing countries must improve port infrastructure quality continuously. It contributes to better logistical performance, leading to higher cross-sea trade and higher economic growth. On the other side, it becomes a constraint for developing countries to reach higher economic growth due to its constraint on infrastructure development. Empirical studies conducted by Caglak et al., (2011) on the impact of port investment on regional economy and development in Turkey show that seaport has a vital role in both trade and economy. Port investment has increased business and employment opportunities (direct and indirect), GNP and land prices resulting in population and migration.

Various studies regarding the influence of ports on economic growth show a positive relationship. However, there are also some negative impacts of increased high port activity, such as the port cities sometimes bear the external costs of port construction like congestion, noise, air pollution, and the loss of sizeable coastal space for the public (J. Cohen & Monaco, 2008; Grobar, 2008; Musso et al., 2000; Park & Seo, 2016a).

The data of LSCI show the importance of the seaport capacity. The bigger the seaport capacity, the more goods could be included in the trade, national or international. As a result, the economy will get the beneficiary. This research aims to analyse the impact of seaport activity on economic development in Indonesia. The research covers the other factor related to the port activity regarding accelerating economic activities.

RESEARCH METHODS

This section involved this paper's model, method, and data. The growth model in this paper utilises the neo-classical economic growth model. The model of economic growth is defined as (Y), the function of capital (K) and labour (L).

$$Y_t = F(K_t, L_t) \quad \text{...} (1)$$

Where, t is the time index.
The amount of labour divides the per capita output:

$$y_t = f(k_t) \quad \text{...} (2)$$

From equation 2, y represents the level of production or output per worker (Y/L). k is the amount of capital per worker (K/L). Furthermore, it can be said that output per worker (y) relies on the amount of capital available to each worker (k). On the other hand, k is the only determinant of y.

Furthermore, depreciation makes the capital stock per worker (k) could change over time. It is caused by external factors that exhaust the stock. The Solow model (Solow, 1956) states that the increment of k is a piece of the saving money on the yield and investment then diminishes by depreciation. It can likewise be weakened by expanding the populace and propelling innovation since they increment work.

Assume the saving rate is s, capital deteriorates at a rate d, the populace develops at a rate n, and the innovation propels at a rate g, the adjustment of capital stock per labour is:

$$k_{t+1} - k_t = s(k_t) - (\delta + n + g) + k_t \quad \text{........} (3)$$

If capital stock per labourer unites to a specific level, i.e., arrives at steady-state capital stock (k^*) where $k_{t+1} - k_t = 0$, the degree of yield was resolved exclusively by the remaining variables. All in all, at a consistent express, the above condition becomes:

$$0 = sf(k^*) - (\delta + n + g)k^* \quad \text{......................} (4)$$

Reorganise equation (4) regarding defining a function of output per worker, Φ :

$\Phi(k^*) = \frac{f(k^*)}{k^*} = \frac{\delta+n+g}{s}$ ....(5)

At that point, k* is acquired as the answer for the condition (5).

$k^* = \Phi^{-1}\left(\frac{\delta+n+g}{s}\right)$ ....(6)

Now, it can be observed that s,δ,n,and g decided k*. It also determines y*, steady-state output per worker, since y*= f(k*).

Mankiw et al. (1992) introduced the augmented Solow model by adding human resources (H) to beat the course book Solow models' deficiencies. The Cobb–Douglas creation work unequivocally incorporates the degree of innovation (A), which was justifiable for F (condition 1).

$Y_t = f(K_t, L_t, A_t, H_t) = K_t^{\alpha} H_t^{\beta}(A_t L_t)^{1-\alpha-\beta}$ ...(7)

Where K is presently characterised as physical capital, note that α > 0, β > 0, and α + β < 1 are ordinarily accepted. At that point, it tends to be shown that each sort of capital per successful work advances correspondingly to the above mentioned.

$k'_{t+1} - k'_t = s_k f(k'_t) - (\delta + n + g)k'_t$ ....(8)

$h'_{t+1} - h'_t = s_k f(h'_t) - (\delta + n + g)h'_t$ ....(9)

Where k' =A/L and h'=H/AL are amounts of each sort of capital per viable work unit. S_k and S_h are the negligible portions of pay that individually put resources into physical and human resources. Since the creation work is entirely determined, the valuable types of Φ and Φ^{-1} can be found.

Accordingly, a steady-state state k* and h* can be resulted:

$k^* = \left(\frac{s_k^{1-\beta} s_k^{\beta}}{\delta+n+g}\right)^{\frac{1}{1-\alpha-\beta}}$ ....(10)

$h^* = \left(\frac{s_k^{1-\alpha} s_k^{\alpha}}{\delta+n+g}\right)^{\frac{1}{1-\alpha-\beta}}$ ....(11)

At last, subbing these into the production function yields, a condition for each yield per capita.

$ln y_t = \ln A_0 + gt + \frac{-(\alpha+\beta)}{1-\alpha-\beta} + \ln(\delta + n + g) + \frac{\alpha}{1-\alpha-\beta} ln(s_k) + \frac{\beta}{1-\alpha-\beta} ln(s_h)$ ....(12)

Economic growth relies upon the underlying degree of innovation and its headway. Additionally, it is influenced by the portion of pay put resources into human resources (s_h) and in actual capital (s_k) and how quickly the two capitals devalue (d + n + g). A testable experimental model can be inferred if this relationship is fixed at some random time and let time be 0 for straight forwardness.

$\ln y = \beta_0 + \beta_1 \ln(\delta + n + g) + \beta_0 + \beta_2 \ln(s_k) + \beta_3 \ln(s_h) + \mu$ ....(13)

where β_0, β_1, β_2 and β_3 are the coefficients, and u is the province-specific error term. This is the observational benchmark model dependent on the expanded Solow model. Since α and β are positive numbers, and their total is under 1, it is expected that $\beta_1 < 0$, $\beta_2 > 0$, and $\beta_3 > 0$. Economic growth is relied upon to increment as more human or actual capital is accessible in the economy, diminishing if capital deteriorates quicker. It is essential to add factors (x's) that address port exercises to the above benchmark model to test what fundamentally the port industry means for financial development.

$\ln y = \beta_0 + \beta_1 \ln(\delta + n + g) + \beta_2 \ln(s_k) + \beta_3 \ln(s_h) + \beta' x + \mu$ ....(14)

Where β is a coefficient for each variable of port activity (x).

The model would now be assessed on the information utilising fitting intermediary factors. There is a definition of the variable that is utilised in this research.

Gross regional domestic product per capita (*GDP per capita*). As the dependent variable, the data is a proxy of economic growth and represents the province's economic activity. The data unit is in thousands of rupiah a year.

Depreciation (n'). The level of capital depreciation follows Mankiw et al. (1992). The depreciation is calculated by adding the population growth rate to 0.05.

Share of capital (s_k). In this paper, the share of capital uses the measurement of capital-government spending as a multiplication share of capital expenditure to total investment in GRDP. The unit is in the billion rupiahs.

Human capital (s_h). The share of income invested in human capital (sh) is addressed by a negligible part of college graduates over the quantity of capital employed or effectively looking for work. The data unit is in %.

Port activities. There are three data. The port activities employ the number of loading cargo activities divided by the total cargo. Secondly, depart cargo activities are divided by total cargo, and lag $_{t-1}$ on loading cargo activities is divided by total cargo. The data unit is in a tonne.

$$\ln y = \beta_0 + \beta_1 \ln(\delta + n + g) + \beta_2 \ln(s_k) + \beta_3 \ln(s_h) + \beta_4 \text{lnloadingcargototoal} + \beta_5 \text{departcargotototal} + \beta_6 \text{laglnloadingcargototal} + \mu \quad \text{.........(15)}$$

The study used the data panel econometric analysis method. The cross-section data is the province of Indonesia with time series 2008-2018. The choice of a period is to lay on the reason for Covid-19 and the availability of the data. The 2020 data was dropped due to the COVID-19 outbreak. Additionally, attempts were made to expand the data until 2019, but there were constraints as not all variables met the time range of 2008-2019. Specifically for North Kalimantan and East Kalimantan data, a merger was carried out regarding the period above 2012, and North Kalimantan Province is still part of East Kalimantan Province. The data was gathered from the Central Statistics Agency and CEIC (each province's total port loading and unloading data).

The use of panel data in modelling has advantages and disadvantages. There are the benefits of using panel data, among others (Baltagi, 2005; Hsiao, 2003): Control specific heterogeneity. Data panels can treat individuals, companies, and countries heterogeneously. It was also added by Greene (2002), who mentioned that the number of cross-section units is significant in some panel data. However, the observation period is small, so the time series method is no longer suitable. This data condition was better analyzed with cross-section variation or heterogeneity techniques. Besides, the panel data is also able to analyse variables that do not change over time (time-invariant/ time constant variable).

Panel data is more informative and varied, colinearity between variables is small, and degrees free is greater and more efficient. More informative data can result in more reliable parameter estimation. Furthermore, panel data is suitable for analysing dynamic phenomena, one of which is poverty and income dynamics, Panel data helps identify and measure effects that cannot be detected in cross-section data or time series.

The model above aims to see the elasticity of independent variables changes to dependent variables. The estimation method was conducted with panel data using a common effect, random effect, or fixed effect approach, depending on which model was best.

Common Effect. The Common effect regression model is the most straightforward technique to estimate panel data by combining cross-section and time-series data without seeing the difference between time and individual. The ordinary least square (OLS) method can estimate the model.

Fixed Effect. The fixed effect regression model assumes that the interception differs between individuals while the slope remains the same between individuals. To estimate the fixed effect model, use a dummy variable technique method to explain the interception difference. This estimation model is often called the Least Square Dummy Variables (LSDV) technique.

Random Effect. Including dummy variables in the fixed effect model represents ignorance about the actual model. However, this also brings the consequences of reduced degrees of freedom (degree of freedom), ultimately reducing parameters' efficiency. The problem can be solved using a nod variable (error terms) known as the random effect method.

The construction of the hypothesis on this model follows the economic growth function when the independent variable positively affects economic growth.

Table 2. The Research Hypothesis

Variables	Expected Result
GDRP per capita	+
Depreciation (n')	-
Share of Capita (s_k)	+
Human Capital (s_h)	+
Port Activities	+

Source: Data Processed, 2023

RESULTS AND DISCUSSION

This study consists of 363 observations in the form of panel data. There are 33 provinces and an 11-year series. The panel data is strongly balanced. Table 1 informs a summary of statistics data consisting of GRDP data per capita (in thousands a year), multiplication between local government and total investment in GRDP (in the billion rupiahs), univ_total is the percentage of the working-age population who completed higher education both diploma and university (unit in %), depreciation, and the amount of cargo loaded and unloaded (unit in a tonne).

Table 3. Descriptive Statistics

Variable	Obs	Mean	Std.Dev.	Min	Max
gdprr	363	249000	349000	13084.48	1740000
bmskreal	363	18110.4	31809.67	944.313	285000
univ_tot	363	3.03	3.825	.29	16.68
dep	363	1.523	1.119	.314	18.974
muat	363	2.44e+07	6.39e+07	0	4.24e+08
load	363	1.95e+07	3.55e+07	0	2.43e+08
muattotkargo	361	.404	.237	0	.977
loadtototk~o	361	.598	.234	.06	1

Source: Data Processed, 2023

Statistical tests were conducted regarding the BLUE requirement of the model. The best model for model estimation was determined. The first step is to do a Hausman test that reveals that the fixed effect model is the most efficient in this model regarding the value Prov>Chi2=60.29 > 0.000. (Appendix i). Furthermore, the model tested multicollinearity, autocorrelation, and heteroskedasticity. The multicollinearity test employs the variance inflation factor (VIF), which measures the correlation and strength of correlation between the explanatory variables in a regression model. The results showed that VIF < 10's mean value means no strong relationship between variables. (Appendix ii).

In this study, the heteroskedasticity test utilises a Wald test that conducts a command xttest3 (Baum, 2000). This command calculates a modified Wald statistic for group-wise heteroskedasticity in a fixed effect regression model's residuals. Wald's test results show Prov>Chi2= > 0.000 (Appendix iii). The result shows that the hypothesis rejects the null hypothesis. There is significant evidence that there is heteroskedasticity in the model.

Furthermore, the Wooldridge test employs the serial correlation test (Drukker, 2003). The estimation shows a p-value of <0.05, which indicates serial correlation (Appendix iv). The research runs the model with the robust option regarding heteroskedasticity and serial correlation. The table below shows the estimation result, whereas column 4 lists the robust estimation result.

Table 4. Estimation Result

lngdprr	FE	RE	FE Robust
1	2	3	4
lnbmskreal	0.469***	0.544***	0.469***
	(16.09)	(19.56)	(7.26)
lnuniv_tot	0.233***	0.362***	0.233***
	(4.50)	(8.80)	(3.65)
lndep	-0.316***	-0.240***	-0.316
	(-7.94)	(-6.12)	(1.53)
lnmuattotkargo	0.009	-0.003	0.009
	(0.45)	(-0.17)	(0.52)
lnloadtototkargo	0.020	0.002	0.020
	(0.84)	(0.10)	(0.66)
laglnloadtototkargo	0.033*	0.035*	0.033*
	(1.77)	(1.77)	(1.75)
Constant	7.495***	6.689***	7.495***
	(28.2)	(26.53)	(11.75)
N	319	319	319
R-Squared	0.696	0.686	0.696

Note: *** p<0.01, ** p<0.05, * p<0.1
*) See the appendix for the whole estimation result.
Source: Data Processed, 2023

The ratio of capital expenditure to gross investment in the economy (PMTB) positively affects boosting economic growth at a p-value of 1 %. The coefficient of capital expenditure is 0.469. The number explains the increasing capital expenditure ratio to real investment by 1 %, then gross regional domestic income per capita rises by 0.46 %, cateris paribus. The coefficient of capital expenditure is more remarkable than other variables in the model.

The result shows that government spending holds an essential role in the economy. This finding is in line with the findings from Putri (2014), which stated that government spending positively impacts a Java island with a p-value of 5%. The same study results related to the influence of capital expenditure on economic growth were at least also delivered by Andita Astria, 2014; Mirza, 2011; Rizki Amalia A, 2013; Rizky et al., with a difference of significance.

Moreover, the result aligns with a government policy that massively develops an infrastructure around Indonesia the Jokowi's presidential term since 2014. There was the type of infrastructures such as road, seaport, airport, and dam railroad that were built by the government.

The importance of capital expenditure in improving the regional economy is faced with the fiscal capacity disparity between Java and non-Java and local governments in provinces and city districts with low fiscal capacity. Based on the Regulation of the Minister of Finance of the Republic Indonesia Number 120/PMK.07/2020 concerning Regional Fiscal Capacity, as many as four provinces in Java Island, namely DKI Jakarta, West Java, East Java, and Central Java, have a very high fiscal capacity index. Provinces outside Java with high fiscal capacity status are Papua Province, East Kalimantan Province, South Sumatra Province, Riau Province, and North Sumatra Province. Apart from the province is medium and low status. At the district/city level is not much different.

The workforce is positively related to per capita income growth with a p-value rate of 1 %. The coefficient figure of 0.23 statistically informs that for every one % increase in university graduates, the gross regional domestic income per capita rises by 0.23 %, according to Paribus.

This study is in line with the results of research conducted by Sari (2018). Also, the same result was revealed by Eigbiremolen & Anaduaka (2014); L. I & A (Mrs) (2014), Norlita (2016), and M. Sari et al. (2016) found that labour has a significant influence on economic growth. The research finds that the quantity and high quality of labour are positive driving factors in spurring economic growth in Java.

Kampus Merdeka's program, which allows students to get more flexible internships in broader sectors outside the university, could boost the skill acquisition by the students. It is essential to secure that the labour supply from higher education is fulfilled by skilled labour.

The finding aligns with the economic growth theory in this research, which explains that labour is one growth factor. The increase in labor quantity and quality (high education) added to production, increasing output and income even further. Furthermore, this study is in line with the theory put forward by Adam Smith. He argues that human beings are the main production factors determining a country's prosperity. Natural wealth is meaningless if there are no human resources to manage it to benefit.

Depreciation erodes gross regional domestic product per capita. The model shows that the direction of depreciation relationship with per capita GDRP is negative at a p-value of 1 %. The coefficient of 0.316 indicated that every one % of economic depreciation eroded per GDRP, reaching 0.316 %. This model's result aligns with those delivered by Mankiw et al. (1992), which stated that depreciation erodes economic growth.

All variables associated with port activity in the model have no significance at a p-value of 1 % or 10 %. Nevertheless, the relationship direction of the variables associated with port activity showed a positive direction: increased port activity drove the rate per capita of GDRP. However, regressing the cargo loading variable with a lag of 1 year resulted in significant results at the p-value level of 10 %. Statistically, these results indicated that cargo unloading activity in this year drove GDRP growth per capita at a significance of 10 %. The coefficient of lag loading cargo was 0.033. This number suggested that one % growth in lag year cargo loading accelerated 0.033 % per capita GDRP growth in the following year, ceteris paribus.

The significance of the unloading variable with a lag of 1 year indicates several things. Firstly, investment activities impacted the economy in the following year. Investment activities required imported goods, which constituted a part of the total cargo unloaded. Secondly, expanding the first reason, the infrastructure that connects the port and the industrial centre is not optimal. The situation leads to the utilisation of goods entering through the port not maximising in the same year.

Increased cargo activity shows many things related to the port, such as port capacity, the area's economic activity around the port, and port support infrastructures such as toll roads and industrial estates. Research conducted by Mudronja et al. (2020) using data from EU countries shows that seaports' operation positively impacts the economic growth of their regions. The paper conducted by Yudhistira & Sofiyandi (2018) shows that proximity to the main ports positively affects GDP per capita.

Research conducted by Park & Seo (2016b) shows that more specific activities at the port have a different impact on Korea's economy. The econometrics investigation shows that the payload ports without adequate throughput deter local financial development. In contrast, load ports add to provincial financial development just when they have adequate throughput. Besides, the outcome demonstrates that holder port exercises decidedly influence provincial monetary development. In contrast, in a roundabout way, port ventures prompt economic growth. This research should be able to look more specifically at port activities such as the research above. However, due to data limitations, the variable used is only the total cargo loading and unloading of ports per province.

Talking about port activities, one of which is seen from the loading and unloading cargo activities, the relationship between supporting infrastructure availability becomes essential.

Supporting infrastructure includes connecting roads, industrial estates, water, and energy availability. These infrastructures can be provided through capital expenditure. The allocation of capital expenditures intended for capacity building that supports port activities added port leverage to the economy.

CONCLUSION

The research finds that seaport activity is related to economic growth. Export activities have a positive relationship with economic growth with insignificance statistics. Furthermore, the import activities at the seaport pushed economic growth one year ahead. It indicated that loading activities, which disembarked many goods at the seaport, positively affected the economy in the following year.

Besides, the research has three policy implications. Firstly, increasing government capital expenditure is needed, especially amid Java's low fiscal capacity and fiscal independence inequality. Human resource investment is essential in driving economic improvement. Providing the broadest possible access to higher education is one of the policies that can be taken to improve the quality of workers. Furthermore, improve access to the port to facilitate the flow of goods for export and import. In line with that, a policy that encourages accelerating the utilisation of goods arriving at the port is needed. The impact of unloading at the port can be felt immediately by the economy and easing policy on investment. Further research may cover more issues: a) the extension of port type from the small port to the main port and b) the road variable that connected the port with the outer area.

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APPENDIX

Appendix 1. Hausman (1978) specification test

	Coef.
Chi-square test value	60.291
P-value	0

Source: Data Processed, 2023

Appendix 2. Variance Inflation Factor (VIF).

Variable	VIF	1/VIF
lnbmskreal |	15.56	0.06427
lnloadtoto~o |	8.74	0.114472
laglnloadt~o |	6.52	0.153408
lnmuattotk~o |	5.95	0.168203
lnuniv_tot |	2.11	0.473094
lndep |	2.1	0.475196
Mean VIF |		6.83

Source: Data Processed, 2023

Appendix 3. Wald test.

Modified Wald test for groupwise heteroskedasticity in fixed effect regression model H0: sigma(i)^2 = sigma^2 for all i
chi2 (32) = 212.79 Prob>chi2 = 0.0000

Source: Data Processed, 2023

Appendix 4. Wooldridge test for autocorrelation in panel data

D.lngdprr	Coef.	Std.Err.	t	P>t	[95%Conf.	Interval]
lnbmskreal						
D1.	0.129	0.024	5.490	0.000	0.081	0.178
lnuniv_tot						
D1.	0.046	0.017	2.640	0.013	0.010	0.081
lndep						
D1.	-0.044	0.039	-1.130	0.268	-0.125	0.036
lnmuattotkargo						
D1.	-0.000	0.005	-0.060	0.950	-0.011	0.010
lnloadtototkargo						
D1.	-0.004	0.009	-0.490	0.628	-0.022	0.013
laglnloadtototkargo						
D1.	-0.000	0.005	-0.110	0.916	-0.010	0.009

Note: *** p<0.01, ** p<0.05, * p<0.1

Source: Data Processed, 2023

Appendix 5. FE Regression Result

lngdprr	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
lnbmskreal	0.469	0.029	16.09	0.000	0.411	0.526	***
lnuniv_tot	0.233	0.052	4.50	0.000	0.131	0.335	***
lndep	-0.316	0.040	-7.94	0.000	-0.394	-0.238	***
lnmuattotkargo	0.009	0.019	0.45	0.655	-0.029	0.046	
lnloadtototkargo	0.020	0.024	0.84	0.400	-0.027	0.068	
laglnloadtototkargo	0.033	0.019	1.77	0.078	-0.004	0.070	*
Constant	7.495	0.266	28.20	0.000	6.972	8.018	***

Mean dependent var	11.744	SD dependent var	1.191
R-squared	0.696	Number of obs	319.000
F-test	107.419	Prob > F	0.000
Akaike crit. (AIC)	-604.627	Bayesian crit. (BIC)	-578.270

Note: *** p<0.01, ** p<0.05, * p<0.1

Source: Data Processed, 2023

Appendix 6. RE Regression Result

lngdprr	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
lnbmskreal	0.544	0.028	19.56	0.000	0.489	0.598	***
lnuniv_tot	0.362	0.041	8.80	0.000	0.281	0.443	***
lndep	-0.240	0.039	-6.12	0.000	-0.317	-0.163	***
lnmuattotkargo	-0.003	0.020	-0.17	0.865	-0.042	0.035	
lnloadtototkargo	0.002	0.025	0.10	0.921	-0.047	0.052	
laglnloadtototkargo	0.035	0.020	1.77	0.076	-0.004	0.074	*
Constant	6.689	0.252	26.53	0.000	6.194	7.183	***

Mean dependent var	11.744	SD dependent var	1.191
Overall r-squared	0.940	Number of obs	319.000
Chi-square	1158.777	Prob > chi2	0.000
R-squared within	0.686	R-squared between	0.947

Note: *** p<0.01, ** p<0.05, * p<0.1

Source: Data Processed, 2023

Appendix 7. FE Robust Regression results

lngdprr	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
lnbmskreal	0.469	0.065	7.26	0.000	0.337	0.600	***
lnuniv_tot	0.233	0.064	3.65	0.001	0.103	0.363	***
lndep	-0.316	0.207	-1.53	0.137	-0.737	0.106	
lnmuattotkargo	0.009	0.017	0.52	0.609	-0.025	0.042	
lnloadtototkargo	0.020	0.031	0.66	0.514	-0.042	0.083	
laglnloadtototkargo	0.033	0.019	1.75	0.089	-0.005	0.072	*
Constant	7.495	0.638	11.75	0.000	6.194	8.795	***
Mean dependent var		11.744	SD dependent var			1.191	
R-squared		0.696	Number of obs			319.000	
F-test		45.075	Prob > F			0.000	
Akaike crit. (AIC)		-606.627	Bayesian crit. (BIC)			-584.035	

Note: *** p<0.01, ** p<0.05, * p<0.1

Source: Data Processed, 2023