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Seaport Status, Access, and Regional Development in Indonesia

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Seaport Status, Access, and Regional Development in Indonesia[1]

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Abstract

As the biggest archipelago nation, Indonesia considers port infrastructure one of the most important infrastructures in bolstering the regional economic development. In this paper, we study the impacts of access to the existing port infrastructure on regional development, i.e. income per capita, productivity, and poverty at district level in Indonesia. While other similar studies use the size of seaport, we argue that the access may be much more important. Additionally, using access variable accommodates spillover effect of the seaport for landlocked district. We define access to the nearest port as the shortest distance of the respective district to the nearest port. Our estimation results show that proximity to the main ports provides positive effect on GDP per capita, labor productivity, poverty rate, and poverty rate. We also find the importance of ports may vary between Java and non-Java regions.

Keywords: seaport status, distance, regional economic development, seaport access, Indonesia

1. Introduction

As one of the maritime transport infrastructures, seaport is considered a gateway, linking across regions and countries. In the context of Indonesia, the seaport infrastructure plays one of the most fundamental roles in shaping the national economy. As an archipelago country, Indonesia has heavily relied on the reliability of its ports in supporting national inter-island trade, as well as mobility factors. In 2012, the Ministry of Transportation, Government of Indonesia (GoI) passed the Master Plan of National Port in order to build a maritime infrastructure system which is efficient, effective, and responsive to support domestic and international seaborne trade and further promote regional development. The master plan is then more supported as the newly-elected president, Joko Widodo, has mandated maritime sector as one of the main focuses of bolstering national economic development. Therefore, evaluating the impact of existing port infrastructure on Indonesian regional development is essential to examine to what extent the access to nearest port influences the regional outcome. In this paper, we study the effect of the proximity to current seaport, measured by the distance to nearest port, on the regional outcome in Indonesia.

Economic literature has often emphasized that transport infrastructure expansion is one of the critical factors for regional economic development (OECD, 2012). Better transportation infrastructure enables the economy to access wider market, benefits from trade, promotes inter-regional integration, and improves

[1] This is a much earlier version of a paper currently under consideration in Maritime Economics and Logistics.

factor markets (Lakshmanan, 2011). Banerjee *et al* (2012) add that good transportation infrastructure also promotes better opportunities for investment in human capital as well as other intangible benefits. Depending on the types, physical infrastructure projects potentially generate 12-29 percent economic rate of return (World Bank, 1994). Physical infrastructure also plays significant role in affecting regional convergence (Sloboda and Yao, 2008), poverty (Fan & Chan-Kang, 2008), or even exporter behavior (Fabling *et al*, 2013). Recent body of literature argues that the presence of a seaport in a region would give positive impact on its economic development[2]. Given its sufficient size, quality of road access and cargo capacity, the presence of port will improve economic activities (i.e. trade sector), which in turn accelerates the Gross Domestic Product (GDP) growth and regional development. The impact will be bigger when the port can facilitate the delivery of goods and transporting people not only in one country but also from one country to another.

Recent empirical studies show significant impacts of seaport infrastructure and investment on various economic activities, i.e. GDP growth per capita (Shan *et al*, 2014; Song and van Geenhuizen, 2014), local employment (Bottasso *et al*, 2013), and other related port-related activities, such as river tourism (van Balen *et al*, 2014). In Indonesian context, Maryaningsih *et al* (2014) investigate the impact of physical infrastructures, such as electricity, road length, and port throughput on provincial GDP per capita[3]. Their finding shows that there is a positive relationship between provincial throughputs and the GDP per capita, but the effect is relatively small.

Furthermore, the presence of ports has not only significant impacts on region they belong to, but also puts effects on the adjacent regions. The presence of seaport provides more access for landlocked regions to be involved in regional and international export-import activities. Shan *et al* (2014) show that the competing ports in the neighboring cities provide even stronger positive effect than the local port city in China. Bottasso *et al* (2014) find that 10 percent increase in the troughput tends to potentially generate 0.16 percent GDP in European neighbouring regions. Cohen and Monaco (2009) also find a positive impact of port infrastructure (measured in depreciated cumulative investments in port infrastructure) in the county and in neighboring counties on production in the retail sector. Using similar approach and measurement on port infrastructure, Cohen and Monaco (2008) suggest that it tends to reduce production costs of manufacture sector, not only within a state, but neighboring states as well.

Aside from positive impact of large-scale transport infrastructures such as seaport, there is also a literature which argues that large-scale infrastructures may create adverse effects, in form of traffic externalities and noise, among others, and tend to outweigh, which in turn reduce, the attractiveness of port neighboring areas (Ferrari *et al*, 2006). Yet, Bottasso *et al* (2014) believes that negative role of seaport may not work for less-developed countries and to emerging countries, which are under early stage of industrialization process.

In this paper, rather than examining the effects of port size or throughput, we consider the effects of districts' distance toward the nearest port. To our best knowledge, this is a pioneering study, which measures the impacts of port access and status on regional development. We combine Indonesia distance data from GIS software and list of ports available, which both are at district level, to generate the distance variables. While other similar papers only emphasize the size of seaport, we argue that the access

[2] Woo, Pettit, Kwak, & Beresford (2011) provide a comprehensive summary seaport research.

[3] Similar study was done by (Vidyattama, 2010) who inquired Indonesia's regional growth determinants. Yet, this study only includes road length as the proxy of physical infrastructure quality.

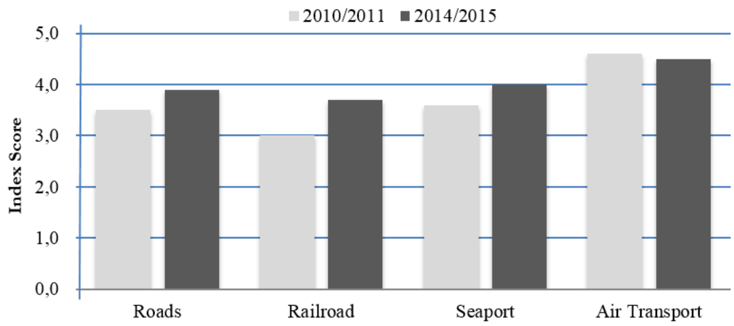

Figure 1: Indonesia's Infrastructure Quality
Source: The World Economic Forum 2010 and 2014

may be much more important. In addition, using the access variable accommodates spillover effect of the seaport for landlocked district. We measure the access to port as the shortest distance of the respective district to the nearest port. The most similar paper, which incorporates the distance to the port, is by Bottasso *et al* (2014). They use panel spatial econometric to estimate the impact of port activities, in form of weighted ports total throughput, on local development. Nevertheless, this approach assumes that all ports may contribute to each region, which is a weak assumption. In contrast, we hypothesize that all regions will directly benefit from the nearest port, not only those that own port, but other districts as well. However the benefit attenuates with the distance. Our approach is similar to the recent body of literature which discusses the access effects of transport infrastructure on economic activities, such as on GDP per capita and income distribution (Banerjee *et al*, 2012), location decision (Deichmann *et al*, 2005), urbanization process (Garcia-Lpez, 2012; Faber, 2014), and trade integration (Donaldson, 2010; Faber, 2014).

Our estimation results show that there is statistically significant relationship between the regional outcome and access to the nearest port. We find that GDRP per capita, productivity, and poverty are associated with closer distance to the port. Nevertheless, the impacts differ across regions. Access to the main port provides more benefit on regions in Java. In contrast, regions outside Java benefit more from the presence of collector port.

The remainder of this chapter is organized as follows. Section 2 overviews the recent regional port development in Indonesia. The data and estimation strategy are presented in the Section 3. We provide results and analysis in Section 4 and conclusion in Section 5.

1.1. *Overview of seaport development in Indonesia*

As an archipelago nation with total sea area of about 3 million square kilometers and 17,508 islands, Indonesia finds seaport infrastructure crucial for its national development. Improving the capacity, combined with better provision of road and air transport, will accelerate inter-island and international trade, and in turn economic growth, particularly in the eastern part of Indonesia (Standard Chartered, 2011). Figure 1 presents infrastructure index for Indonesia during 2010-2015, including road and air transports. In general, Indonesia has experienced with improving infrastructure quality, except for air transport. For seaport, the index hikes 11.1 percent from 3.6 in 2010/2011 to 4.0 in 2014/2015. However, this improvement is relatively lower than road and railroad infrastructure.

Table 1: Number of districts which has ports in 2011

Standard	Number of districts	% to total districts
Number of districts which has		
Main port	40	8.2
Feeder port		
Regional	118	24.2
Local	158	32.4
Collector port	181	37.1
At least one port	274	56.1
No port	214	43.9
Number of districts	488	100.0

Source: Indonesian Ministry of Transportation, National Port Master Plan (2013)

Improvement in the quality of seaport infrastructure during 2011 - 2014 is partly because the government interest in expanding seaport infrastructure network. In 2011, the GoI has launched National Ports Master Plan in order to develop a responsive, competitive, and efficient seaport system, which supports international and domestic trade, economic growth, and regional development (Indonesian Ministry of Transportation, 2013). One of important action plans is to expand the capacity and status of the existing ports to accommodate the increasing trend in Indonesian seaborne trade. As a comparison, by 2009, the containerized trade volume reached 88.2 million tons and the number is predicted to double by 2020. Similarly, trade volume for dry and liquid bulk is predicted to increase by 50 percent.

To simplify the planning process, the masterplan classifies all existing ports into the following categories. First category is main port, which centrally facilitates international seaborne trade and national bulk trade. Second category is collector port, which particularly serves national intermediate-volume seaborne trade. The feeder port has two subcategories, regional and local collector ports. The last category is collector port, of which main task is to serve national small-volume inter-island trade as well as to function as a feeder for main and collector port. Table 1 presents the number of districts having ports. This table signifies that more than half of total districts in Indonesia have at least one port (56.1 percent) and the majority has feeder port (37.1 percent). In contrast, only 8.2 percent of total districts owning main port. By 2030, it is expected that there are additional 11 and 81 main and collector ports, respectively, to serve Indonesian seaborne trade, particularly in eastern Indonesia.

To give more understanding on how Indonesian seaports are distributed, Figure 2 illustrates the distribution of main and collector ports in Indonesia. We focus on both types of ports as they serve international seaborne trade (main port) and large-scale domestic trade. While collector ports are relatively evenly-distributed, most main ports are located in west part of Indonesia, particularly in Java Island. As many as 57 and 17 percent of total main and collector ports are in the western part of Indonesia and Java Island, respectively.

The distribution of main and collector ports across the country closely relates with the pattern of international trade of containerized cargo (see Figure 3 and 4). While domestic trades are served by island-based cluster, both containerized and conventional cargo network utilize main ports in Java for inter-island and international trade activities, particularly Tanjung Priok and Tanjung Perak ports. Hence,

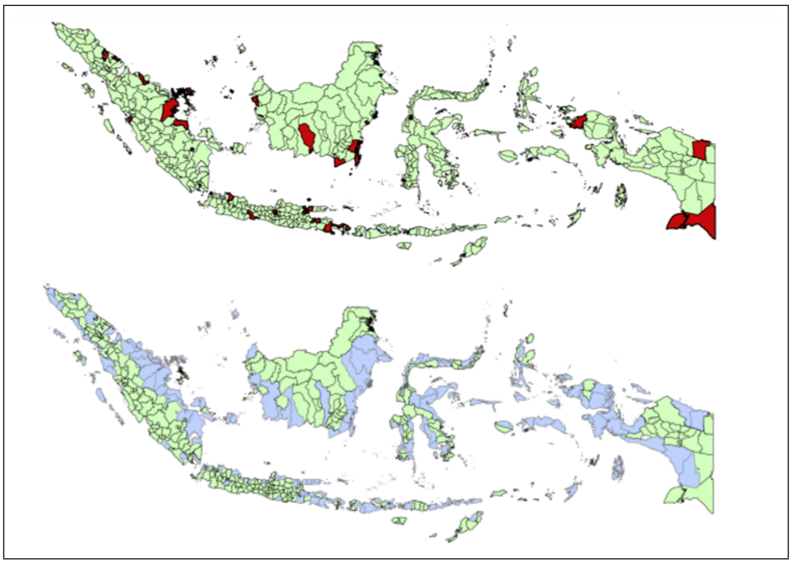

Figure 2: Districts With Main and Collector Ports
Source: Authors's illustration from National Port Master Plan (2013)

Note: Districts in red and blue are for those which have main and collector port, respectively.

most of international trade activities are heavily served by main seaports within west region of Indonesia. As a consequence, the establishment of local hub ports in Eastern Indonesia to open more new shipping routes to this region should be more prioritized. By doing this, it is expected that the hub port will be able to help balancing the trade expansion between the east and west regions. The containerized cargo does not need to enter Singapore/Malaysia and Java regions before reaching Kalimantan, Sulawesi and Maluku-Papua. At the end, this will reduce additional shipping cost significantly.

2. Data and estimation strategy

2.1. Estimation strategy

We consider a simple production problem faced by each district as the underlying model. The model is adapted from (Banerjee, et al., 2012), yet we add the port as one of the production inputs. Let assume that each region produces one tradable product and has production function $Y = (1+\theta d)AK^{\alpha}L^{1-\alpha}T^{\beta}$, where K, L and T are capital, labor, and port input, respectively. Capital and labor inputs are available in each region, but port input is located in some regions. Nevertheless, the port can also be utilized by the adjacent regions which do not own the port. Furthermore, the presence is assumed to be source of production's increasing return to scale. Since seaport is not available in every region, let assume that cost of port input is proportional to distance d. The presence of seaport, however, also generates an adverse effect. The OECD (OECD; International Transport Forum, 2008) argues that social costs of seaports include not only road congestion, but also local and global pollutions, which in turn reduce production. In our model, such effect is represented by term $(1+\theta d)$, where $\theta > 0$. The effect that attenuates as the distance to seaport is further.

Maximizing profit with respect to capital, labor, and port input yields

$$r = (1+\theta d)\alpha A \left(\frac{K}{L}\right)^{\alpha-1} T^{\beta}$$

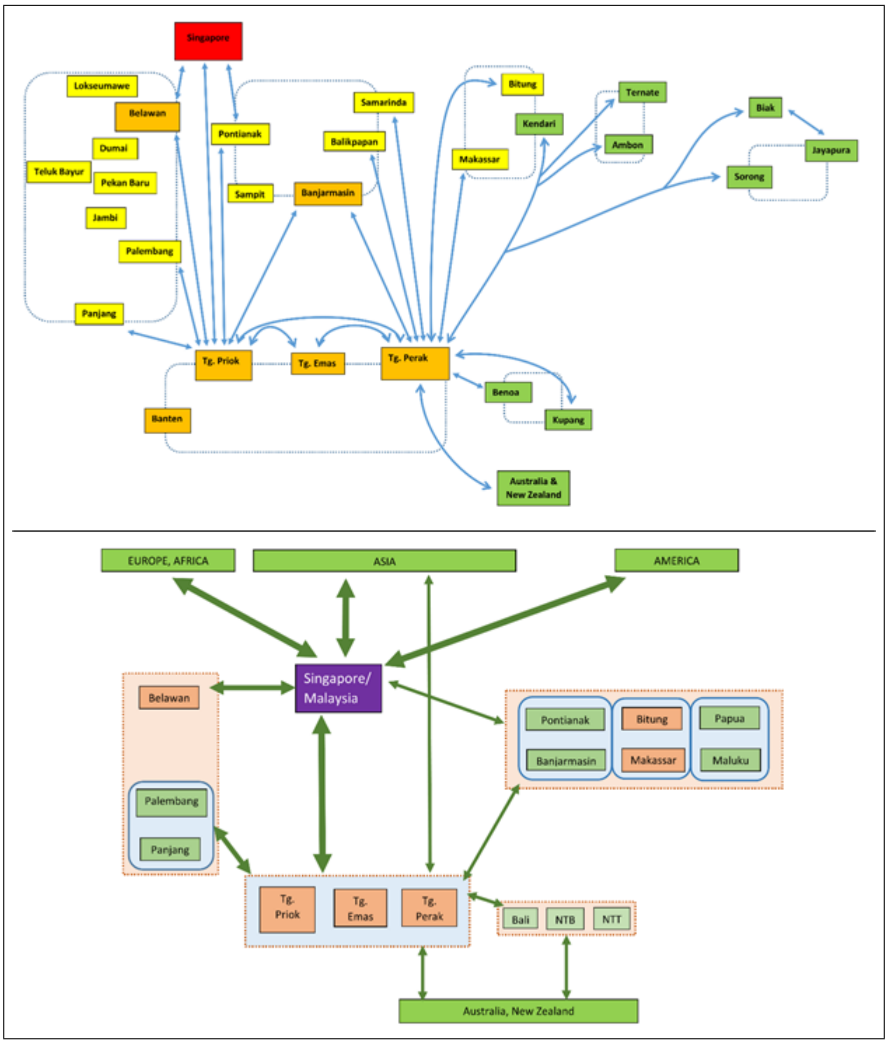

Figure 3: Existing Pattern for International Trade of Containerized Cargo in Indonesia
Source: Authors's illustration from UNESCAP (2014)

$$w = (1+\theta d)(1-\alpha)A\left(\frac{K}{L}\right)^{\alpha} T^{\beta}$$

$$t = \frac{(1+\theta d)}{d}\beta A K^{\alpha} L^{1-\alpha} T^{\beta-1}$$

Next, consider outputs per worker/capita,

$$y = (1+\theta d)A\left(\frac{K}{L}\right)^{\alpha} T^{\beta}$$

By manipulating the seaport demand condition, the outputs per worker/capita function can be written as

$$y = (1+\theta d)A\left(\frac{K}{L}\right)^{\alpha}\left[\frac{(1+\theta d)}{td}\beta A K^{\alpha} L^{1-\alpha}\right]^{\frac{\beta}{1-\beta}} \tag{1}$$

Taking first order condition with respect to d, and setting less than zero, we have

$$(1+\theta-\beta t)d < 0 \tag{2}$$

Equation (2) tells us that output per capita is decreasing in d as long as (2) holds. Intuitively, a particular region will always experience with lower output per capita as d increases

Table 2: Number of ports in 2011

	Java	Outside Java			Total
		Sumatera	Kalimantan	Other	
Number of					
Main port	10	12	6	12	40
Collector port	26	51	21	83	181
Total	36	63	27	95	221

Source: Indonesian Ministry of Transportation, National Port Master Plan (2013)

if the negative externality is sufficiently small, relative to the importance of port for the economy. To quantify the impact of access to port, we consider a linear form of Equation (1) and rely on the pooled district panel as follows:

$$y_{it} = \beta_0 + \sum_{j=1}^{4} \gamma_j \ln\left(\bar{d}_i^j\right) + \sum_{l=1}^{L} \delta_l X_{it}^l + \sum_{l=1}^{L} \delta_l Z_i^l + u_j + \rho_t + \omega_{kt} + v_{it} \quad (3)$$

i denotes th We also include province fixed effects, u_j, year fixed effects, ρ_t, and island-year interaction fixed effects, ω_{kt}. The latter captures island trend effect that reflects other infrastructure progress during the period. $v_i t$ represents a random term disturbance. We further anticipate the presence of heterogeneity in Indonesia by running Equation (1) into two-subsamples: Java and Non-Java. As the economic structure of Java is more advanced than of Non-Java, we expect that the roles of port differ between two areas. As an illustration, Table 2 provides the distribution of ports in Indonesia based on the National Port Master Plan. One-fourth and almost one-fifth of total main ports and total collector ports of Indonesia, respectively are located in Java, while as a comparison, the size of Java is about 6.6 percent of total national. In term of capacity, seven main ports in Java Island can manage almost 65 percent of containers for export and import activities by 2013. It indicates that regional economic activities in Java Island are higher among the others in average.

This paper uses data from multiple sources. The sample is based on 488 districts of Indonesia, observed in 2008-2012. We use this time period to assume that during this period there is no significant change in port capacity as well as port status since the data for port status provided by the Master Plan of National Port of Indonesia is only for 2011. The basic dataset on district level is obtained from the Indonesia Database for Policy and Economic Research (INDO-DAPOER) of the World Bank. The database provides us with GDRP per capita, land size, and other economic variables at district level.

$$H(y) = \begin{cases} r_i, & \exists \text{ port}^* \\ \min\left(d_{im}^j\right) + r_m, i \neq m, & \nexists \text{ port}^* \end{cases} \quad (4)$$

*: port type j in district i

where m indicates all districts that have port type - j. Equation (2) assigns r_i, i.e. the radius of the district i, for districts owning port type - j. Meanwhile, when the district i does not have port type - j, we assign the shortest distance with the nearest district owning port type - j, i.e. district m, plus its radius r_m.

Table 3 presents the descriptive analysis of variables we use in the model. For the sake of brevity, we focus on the infrastructure and economic variables. Except for geographical vari-

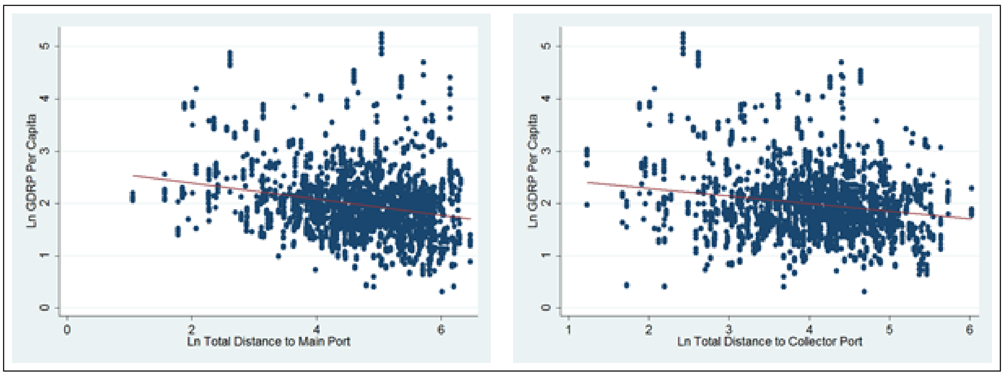

Figure 4: Relationship between Distance to Port and GDRP Per Capita
Source: Authors's calculation

Table 3: Descriptive analysis of variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Distance to Collector Port (km)	2440	32	37.9	0	221.1
Distance to Main Port (km)	2440	136.7	134.5	0	677.8
GDRP per Capita (million IDR)	2373	8.6	12.5	0.3	187.2
Population Density (people per km-sq)	2378	1095.9	2581.1	0.7	18585.3
Share Primary Sector to GDRP (percent)	2390	38.3	21.4	0.1	95.9
Share Secondary Sector to GDRP (percent)	2390	12.3	14.5	0	91.8
Poverty Rate (percent)	2364	15.3	9.3	1.3	51.9
Poverty Gap (index)	2304	2.8	2.5	.06	22.6
Labor Productivity					
Total (IDR million)	2348	20	32.2	0.6	644.5
Primary Sector (IDR million)	2347	16.4	32.9	0	456.7
Secondary Sector (IDR million)	2246	66	351.2	0	7937.3
Tertiary Sector (IDR million)	2342	24.6	83.5	0	3424.4

Source: Author's calculation

ables, we find some missing data for each variable, which reduce the number of observations. On the port-distance variables, the average distance to the collector port is 32 kilometers; meanwhile it is 136.7 kilometers on average to reach main port. The average population density is 1095.9 people per kilometer square and shows significant variation. As comparison, the densest district is Central Jakarta, of which density reaches 17.9 thousand people per kilometer square. Per capita GDRP is 8.6 million rupiah under 2000 constant price. We also find a wide variation of the population density, which ranges from 0.7 to 18.6 thousand people per kilometer square.

We start with examining the relationship between distance variable and economic outcome by using simple scatter plot. Figure 4 shows the relationship between the natural log of GDRP per capita and the distance to main and collector port, respectively. As shown in the figure, the negative correlation is apparent in the raw data.

Similarly, the link between the structure of GDRP and distance to port suggests a negative relationship. If distance to nearest port (main

Table 4: The Effects of Distance to the Nearest Port on GDRP per capita

	Dependent variable: ln per capita GDRP					
	(1)	(2)	(3)	(4)	(5)	(6)
Ln distance to main port	-0.0851*	-0.0500*	-0.0491*	-0.0119	-0.00569	-0.082***
	(-6.03)	(-3.63)	(-3.38)	(-0.85)	(-0.41)	(-1.76)
Ln distance to collector port	-0.0435*	-0.0266***	-0.0260***	-0.0306**	-0.0604*	0.0410
	(-2.70)	(-1.75)	(-1.71)	(-2.04)	(-3.92)	(1.18)
Dummy region status	0.240*	0.408*	0.402*	0.361*	0.623*	-0.0520
	(7.94)	(9.51)	(8.29)	(7.53)	(10.97)	(-1.01)
Primary/GDRP		0.00716*	0.00727*	0.00761*	0.0120*	0.00144
		(6.03)	(5.79)	(6.08)	(8.80)	(0.61)
Secondary/GDRP		0.0192*	0.0192*	0.0196*	0.0216*	0.0151*
		(16.68)	(16.67)	(16.46)	(15.24)	(7.91)
Ln population density			0.00427	-0.0150	-0.0785*	0.229*
			(0.29)	(-0.99)	(-5.15)	(6.54)
Ln distance to capital city				-0.0726*	-0.100*	-0.034***
				(-7.54)	(-10.85)	(-1.68)
Observations	2373	2373	2373	2373	1786	587
Adjusted R-squared	0.485	0.586	0.586	0.599	0.613	0.718

Note: *t* statistics are in parentheses. ***, **, * are statistically significant at 10, 5, and 1 percent, respectively. All regressions control for year, province, and year*island fixed effects. These estimates use a strongly balanced district-year level panel. GDRP data are from *Indonesia Database for Policy and Economic Research, World Bank.* All geographic variables are computed by the authors.

port or collector) increases, a region tends to have lower share of manufacturing sector, in terms of GDRP. The data show that, for the regions which are situated approximately 29-67 kilometres from nearest main port, the manufacturing sector contribute 16,7% - 18,5% to its GDRP on average. While for the regions with distance to nearest main port over 150 kilometres, its manufacturing sector only contributes 5.9%-7.1% to GDRP.

We also find there is a negative correlation between poverty rate and distance to port. A region which is located around 29-67 kilometres from nearest main port, is correlated with low poverty rate (10.3-12.2 percent in average). It is less 10 percent than poverty rate in other regions located more than 200 kilometres from nearest main port.

3. Results and analysis

3.1. The Effects on GDRP Per capita

Table 4 presents the estimates of Equation (1), which consists of six specifications. The first four results regress the distance variables with GDRP per capita in natural log and include both distance variables using all samples. Different set of control variables are introduced to obtain robust estimates. Both portions of primary and secondary sectors represent the district's economic structure (Vidyattama, 2010). Population density variable controls the presence of urbanization economies (Rosenthal & Strange, 2004). Distance to the nearest capital city controls spillover effects of capital city's economic activities. The fifth and last estimates divide the sample into two subsamples, i.e. Java and non-Java island, respectively, to capture the heterogeneity as the economic activities in Java island are relatively more advanced than those outside Java.

For the first three results, the estimates show a negative and quite robust relationship between distance to the nearest seaport and the log of GDRP per capita. Our estimation results show that the elasticity for the main port lies between 0.05-0.09; one percent reduction in the distance is associated with 0.05-0.09 percent increase in GDRP per capita. It is statistically significant at the 5 percent level. Meanwhile, the elasticity for the collector port is within 0.03 -0.04); one percent closer to the nearest collector port will potentially increase 0.03-0.04 percent GDRP per capita. However, once the control variable of distance to capital city is introduced, the proximity to main port becomes statistically insignificant, indicating a certain level of confounding relationship between the proximity of main port and capital city of province. This can be true since some of main ports are located in/near the capital city of province.

We further check the robustness results by separately estimating the model for subsamples Java and outside Java districts. Column (5) and (6) provides information on how the proximity variable provides different impact on the GDP per capita between districts in Java and outside Java. We find that districts in Java benefit from the presence of main ports. In contrast, districts located outside Java benefit more from the collector ports. There are two possible explanations. First, districts in Java produce more exported goods than districts outside Java, thereby much relying on main ports. Second, main hubs for export-import activities of Indonesia are Tanjung Priok, Tanjung Mas, and Tanjung Perak, which are situated in Java Island. By 2013, both ports serve 46.08 percent of Indonesian seaborne trade import. As a result, districts located near those ports can benefit from bigger port-related economic activities.

The estimation results also indicate that there is a difference in the importance between both types of ports. We find that the elasticity of main port is higher, almost twice, than that of collector port. Yet, as the average mean of main port proximity is about five times than of collector port proximity, the effect of one kilometer away from the main port is lower than that of the collector port. This result can be explained by market area hypothesis. Since the main ports serve wider role and are more equipped by supporting infrastructure, they cover more districts than the collector ports do. As a consequence, the proximity benefit of main ports attenuates more slowly than that of collector ports.

Results for the control variables are also consistent with the recent body of literature. While the share of primary sector less likely affects the GDRP per capita, higher portion of secondary sector significantly increases the GDRP per capita, indicating the secondary sector as one engine of regional growth in Indonesia. Population density provides different impact between districts in Java and outside Java. The variable has negative relationship with the GDRP per capita for districts outside Java, indicating that the density rather generates negative externalities to the economy. Meanwhile, the density in Java generates agglomeration benefit for the GDRP per capita.

We further argue that the effect of port access may have different magnitudes toward GDRP per capita in each sector. GDRP per capita is then divided into three categories, i.e. primary, secondary, and tertiary. The proximity arguably affects more on tradable goods than that on non-tradable goods since the latter serves more on the local economy than the earlier does. Hence, we expect that at least, the secondary sector has significant relationship with the distance variables since it contains tradable goods produced by respective districts. Table 5 reports the regression results for this specification. Among those significant

Table 5: The Effects of Distance to the Nearest Port on GDRP per capita by Sector

	Dependent variable: ln per capita GDRP		
	Primary	Secondary	Tertiary
A. Full sample			
Ln distance to main port	-0.0187***	-0.0133***	-0.0221**
	(-1.67)	(-1.66)	(-2.01)
Ln distance to collector port	-0.0262**	-0.0259*	-0.0252**
	(-2.44)	(-3.22)	(-2.14)
Observations	2373	2373	2373
Adjusted R^2	0.762	0.895	0.708
B. Non-Java			
Ln distance to main port	-0.0239**	-0.00199	-0.0161
	(-1.96)	(-0.30)	(-1.55)
Ln distance to collector port	-0.0433*	-0.0316*	-0.0434*
	(-3.41)	(-4.86)	(-3.71)
Observations	1786	1786	1786
Adjusted R^2	0.731	0.915	0.695
C. Java			
Ln distance to main port	-0.0102	-0.0908**	-0.0767***
	(-0.58)	(-2.31)	(-1.82)
Ln distance to collector port	0.0209	-0.0128	0.0152
	(1.19)	(-0.46)	(0.49)
Observations	587	587	587
Adjusted R^2	0.788	0.868	0.795

Note: t statistics are in parentheses. ***, **, * are statistically significant at 10, 5, and 1 percent, respectively. All estimates are using control variables introduced in the baseline model in the column (6) of Table 5.

Table 6: Effects of Distance to the Nearest Port on Productivity

	Dependent variable: ln productivity			
	Total	Primary	Secondary	Tertiary
A. Full sample				
Ln distance to main port	-0.0114	**-0.0427****	-0.0339	-0.0231
	(-0.74)	(-2.00)	(-1.28)	(-1.45)
Ln distance to collector port	**-0.0346****	-0.0335	0.00104	**0.0569***
	(-2.01)	(-1.57)	(0.04)	(3.15)
Observations	2346	2340	2239	2335
Adjusted R^2	0.585	0.418	0.649	0.437
B. Non-Java				
Ln distance to main port	-0.00336	-0.0223	-0.0267	-0.0109
	(-0.21)	(-1.02)	(-0.93)	(-0.65)
Ln distance to collector port	**-0.0621***	**-0.0386*****	0.0209	**0.0614***
	(-3.43)	(-1.67)	(0.72)	(3.00)
Observations	1759	1759	1653	1748
Adjusted R^2	0.589	0.494	0.658	0.384
C. Java				
Ln distance to main port	**-0.0928*****	**-0.138****	-0.0165	**-0.0956****
	(-1.92)	(-2.48)	(-0.25)	(-2.49)
Ln distance to collector port	0.0228	-0.0726	**-0.156****	0.0219
	(0.62)	(-1.62)	(-2.48)	(0.68)
Observations	587	581	586	587
Adjusted R^2	0.728	0.125	0.681	0.691

Note: t statistics are in parentheses. ***, **, * are statistically significant at 10, 5, and 1 percent, respectively. All estimates are using control variables introduced in the baseline model in the column (6) of Table 5.

Table 7: The Effects of Distance to the Nearest Port on Poverty

	Dependent Variable: Poverty Rate			Dependent Variable: Ln Poverty Gap		
	Total	Non Java	Java	Total	Non Java	Java
Ln distance to main port	0.440**	0.484**	0.0566	0.0294*	0.0292*	0.0158
	(2.42)	(2.48)	(0.12)	(2.84)	(2.64)	(0.58)
Ln distance to collector port	0.0687	0.543*	-1.473*	-0.0118	0.00870	-0.0782*
	(0.40)	(2.74)	(-5.54)	(-1.21)	(0.76)	(-4.72)
Observations	2357	1771	586	2291	1708	583
Adjusted R^2	0.709	0.730	0.644	0.692	0.709	0.666

Note: t statistics are in parentheses. ***, **, * are statistically significant at 10, 5, and 1 percent, respectively. All estimates are using control variables introduced in the baseline model in the column (6) of Table 5.

coefficients, we obtain similar pattern with that in Table 4; the relationship is negative and the impacts differ between Java and non-Java. Higher sectoral GDRP per capita in Java is associated with better proximity to the main port. In contrast, higher GDRP per capita in outside Java is more driven by collector port.

Now we turn to the results on each sector. In general, we obtain no significant difference of the impact among sectors. Both port proximity variables are statistically negative and significant. One percent closer to main port potentially leads to 0.019, 0.013, and 0.022 percent increase in GDRP per capita in primary, secondary and tertiary sector, respectively. The elasticity for collector port proximity is now higher than that for min port proximity, indicating much lower impact of the earlier relative to the latter.

3.2. The Impacts on Productivity

Aside from the impact on GDRP per capita, we further inquire the impact of port access to labor productivity. The potential channel is that better transportation access provides firms with better labor skills variety, and thus letting them to be more productive (Arbus et al, 2015). Technology diffusion also tends to cultivate in big markets and/or are located on principal sea routes (Chowdury and Erdenebileg, 2006).

Table 6 reports the estimation results on the labor productivity, including for both Java and non-Java subsamples. We find less robust estimate, relative to what we have in the GDRP per capita estimates, that closer proximity to the main can affect the labor productivity. Furthermore, the estimate shows positive relationship between the distance to the collector port and the labor productivity in tertiary sector. The presence of collector port rather brings the negative externality on the productivity of tertiary sector. The heterogeneity in estimation results remains persistent for the subsamples. Labor productivity in Java benefits from the main port proximity, while the productivity in outside Java is more affected by the collector port proximity. This result strengthens our previous heterogeneous findings in the GDRP per capita between Java and non-Java.

3.3. The Impacts on Poverty

We further argue that access to the nearest port infrastructure also has a direct impact on the local poverty rate. Recent studies suggest that the access to particular infrastructures may significantly reduce poverty rate. Sawada (2015) surveys recent studies of infrastructure impacts in development, including the poverty alleviation, to conclude that development of infrastructure is one of the indispensable components of poverty reduction. Being closer to the port means lower transport cost for production, which in turn attracts more economic activity, particularly from exporting firms, resulting in better opportunities in landing jobs and alleviating poverty.

Table 7 reports our estimation results on poverty. Two poverty measurements are used, i.e. poverty rate and poverty gap. The estimates show that both poverty indicators are significantly affected by the access to main port. At the total sample, one percent reduction in the distance to main port is associated with 0.440 and 0.029 percent in poverty rate and poverty gap, respectively. In contrast, the proximity to collector port is found to be insignificant to reduce the poverty.

The result for the subsamples, however, gives different magnitude from the findings of the GDRP per capita and the labor productivity. The proximities are statistically significant in reducing poverty rate and poverty gap in non-Java districts. Channel for the proximity of collector port can be explained through the fact that such proximity is associated with higher GDRP per capita and labor productivity. Meanwhile, the channel for the main port may arise from the proximity effect to GDRP per capita at primary sector as presented in Table 5. Since most population outside Java are living in rural areas, this finding is in line with the study by (Suryahadi *et al*, 2012), which suggests that rural poverty can be reduced by agricultural sector growth.

A contrasting result arises for the Java districts as the proximity is not able to statistically reduce the poverty. Furthermore, the proximity of collector port potentially increases both poverty rate and poverty gap and the elasticity is much higher than main port's. One possible explanation is that the proximity of collector port is associated with poor fishermen who reside in coastal areas (Measey, 2010; Hasanuddin *et al*, 2013) and tend to utilize more collector port.

3.4. Endogeneity Problem

Estimating Equation (1) using OLS, however, may create an endogeneity problem and hence the instrumental variable (IV) model is needed. The distance to main port can be endogenous for at least two reasons. First, we cannot rule out the possibility that a port in a district is built because its region is lagging relative to other regions. This is true, particularly for eastern part of Indonesia. Alternatively, to accommodate this issue, the first instrument lags provincial GDP in 1976. Due to data limitation, the provincial GDP in 1976 is the oldest and official data published by the Statistics of Indonesia.

Second, main ports may be built in particular districts since they are cheaper and easier if built in old infrastructures (Duranton and Turner, 2012). In the literature which attempts to relate the recent transportation network and regional outcomes, this issue is tackled by using historical network as potential instruments (Duranton and Turner, 2012; Garcia-Lpez, 2012; Garcia-Lopez et al, 2015). In our case, the potential instrument is the shortest distance to the capital city of ancient kingdoms, as Indonesia was dominated by monarchy system in 17th-18th centuries. Additionally, the archipelagic form of Indonesia may lead the ancient kingdoms to locate their capital city near ancient port cities . We further argue that ancient port cities tend to have main port and therefore being closer to the capital city of ancient kingdoms may lead to being closer to the main port. The distance to the capital city of a kingdom can be strongly exogenous as the decision of the kingdom's capital city is planned to address the respective kingdom's economic outcomes in 17th and 18th centuries without considering current Indonesia's regional economic challenges. The data on capital city of ancient kingdoms are drawn

Table 8: 2SLS Panel Estimates

	GDP per capita	Labor Productivity	Poverty rate	Poverty gap
Dist. to Main Port	-0.396*	-0.385**	3.612*	0.237*
	(-2.79)	(-2.57)	(3.00)	(2.84)
Dist. to Collector Port	-0.0167	-0.0198	-0.0538	-0.0203***
	(-0.87)	(-0.94)	(-0.29)	(-1.77)
Observations	2299.7	2346	2357	2291
R-sq overall	0.45	0.477	0.661	0.626
Chi-sq	2634.08	2696.46	7865.4	5478.47
First Stage. Dependent variable is ln distance to main port				
ln (Distance to ancient kingdom)	0.0636*	0.0652*	0.0651*	0.0562*
	(3.54)	(3.65)	(3.65)	(3.10)
ln (GDRP at Province level 1976)	-0.141*	-0.142*		-0.147*
	(-5.25)	(-5.29)		(-5.36)
F-statistics	70.45	68.83	69.93	68.16
Endogenity test (chi2)	8.328*	6.693*	7.795*	8.263*
First stage statistics	21.402*	21.871*	22.217*	18.215*

Note: t statistics are in parentheses. ***, **, * are statistically significant at 10, 5, and 1 percent, respectively. All estimates are using control variables introduced in the baseline model in the column (6) of Table 5.

from Poesponegoro and Notosusanto (1993a) and Poesponegoro and Notosusanto (1993b).

We focus on treating the proximity of main port as potentially creating endogeneity problem, yet keeping assuming that the proximity of collector port is more exogenous. As presented in Figure 2, almost all coastal districts have collector port.

Table 8 presents the result on 2SLS panel estimates. We focus on the estimates for full sample only and include both instruments. Bottom part of the table reports tests for the instruments. Wu Chi-sq statistics indicate that the proximity of main port is potentially endogenous. The first-stage statistics is higher than Stock and Yogo's (2005) rule of thumb, which avoids the model from weak instruments problem. Our first stage estimates also show that the instruments are statistically able to explain the distance variable.

The IV estimates are largely in line with or, if anything, somewhat larger than the corresponding OLS estimates. The effect of distance of main port on all economic outcomes remains statistically significant, while the collector port effect is statistically not different from zero. Therefore, although we prefer interpreting the more conservative pooled OLS estimates as preferred results, the IV estimates support the robustness of our OLS findings.

4. Conclusion

This paper investigates the effects of being closer to the nearest seaport to the regional development in Indonesia. Using 2008 - 2012 panel dataset at district level, we find that districts closer to the two types of seaport, i.e. main and collector ports produce higher levels of GDRP per capita, particularly for tradable goods. In addition, we also find that being closer to the main port is more beneficial than to the collector port since the earlier accommodates the international trade activity as well as endows with larger capacity. Similarly, we also find that being closer to port infrastructure is beneficial for labor productivity and poverty alleviation. It is evident that those regions which are closer to the main port are associated with higher labor productivity and lower poverty rate.

Our results also provide empirical facts on the heterogeneous effects of the port distance. Districts in Java Island are more likely to benefit from proximity of main ports as economic activities in Java are more export-oriented, while districts in outside Java Island are better off with collector ports. Hence, it is natural to see the increasing trend in inequality between Java and non-Java (Yusuf and Rum, 2013).

These heterogeneous results, however, should not discourage those who believe that future the Indonesian maritime policy must be less Java-oriented. Rather, they show that existing performances of main ports in outside Java are somewhat limited. Thus, formulating policy packages to optimize the presence of current main ports in that area will be relevant to be immediately addressed by the central government.

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Appendix A: Detailed Microfoundation

We provide detailed derivation of Equation (2). Profit maximization takes form as

$$\text{Max}_{K,L,T}\ p\left[(1+\theta d)AK^{\alpha}L^{1-\alpha}T^{\beta}\right] - [rK + wL + tfT] \tag{.1}$$

Taking the first order necessary conditions on T gives us

$$T^{1-\beta} = \frac{\beta p(1+\theta d)AK^{\alpha}L^{1-\alpha}}{td} \tag{.2}$$

Our production function, thus, can be written as

$$y = [(1+\theta d)A]^{\frac{1}{1-\beta}} \left(\frac{K}{L}\right)^{\frac{\alpha}{1-\beta}} \left[\frac{\beta pL}{td}\right]^{\frac{\beta}{1-\beta}} \tag{.3}$$

Taking partial derivative with respect to distance d,

$$\frac{\delta y}{\delta d} = \left[\left(\frac{1}{1-\beta}\right)\left(\frac{1+\theta d}{td}\right)^{\frac{\beta}{1-\beta}} - \left(\frac{\beta}{1-\beta}\right)\left(\frac{1+\theta d}{td}\right)^{\frac{1}{1-\beta}}\right]\omega \tag{.4}$$

where $\omega = [A]^{\frac{1}{1-\beta}} \left(\frac{K}{L}\right)^{\frac{\alpha}{1-\beta}} [\beta pL]^{\frac{\beta}{1-\beta}}$. Since ω will always be greater than zero, the sign of $\frac{\delta y}{\delta d}$ is determined entirely by the big bracket.