Analysis of The Effect of Cities on Economic Growth Through Ports: A Case Study of Indonesian Port

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ABSTRACT

Port is an area where there are economic and trade activities and is also a transportation hub between land and sea modes (interface). Port development aims to increase port productivity in anticipating an increase in the volume of service demand stimulated by economic and trade developments. Development is carried out through investment activities in developing port infrastructure in increasing terminal capacity and equipment and other resources. Port is expected to contribute to the growth of cities as key regional development centers, driving economic expansion. This study examines the effect of ports on economic growth and assesses its role in mediating the effect of cities on economic development in Indonesia, the largest archipelagic country in the world. The study employed a quantitative approach, collecting panel data from 50 cities and ports involved in loading and unloading activities in Indonesia, and analyzing the data using Structural Equation Modeling. The research findings demonstrate that ports have a positive and significant effect on economic growth, and mediates the effect of cities on economic development in Indonesia. These results provide empirical support for enhancing policies and developing more effective economic strategies for archipelagic countries, based on the interconnected variables. Investments in appropriate infrastructure and collaborative stakeholder strategies can deliver substantial and sustainable port development and economic benefits.

Keywords: *Archipelagic country, Cities and ports, Economic growth Ports, Transportation system.*

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1. INTRODUCTION

Cities and ports are generally spatial and economic and administrative entities located on the coastline which in their relationship must support each other's development and growth. This is very important and strategic because the movement (transportation) of goods through ports (sea) takes a very significant portion, which is around 80% of the total world's goods transportation and seaports are strategic economic contributors and the main catalysts for the globalization process[1].

The success of managing city and port resources can have a significant impact on economic growth. In the context of Indonesia as an archipelagic country, large cities that have strategic ports are highly dependent on the efficiency of managing these resources to support industry, trade, and logistics and facilitate the growth of other economic sectors. The description of the growth relationship from aspects that support Indonesia's economic growth is as seen in Figure 1.
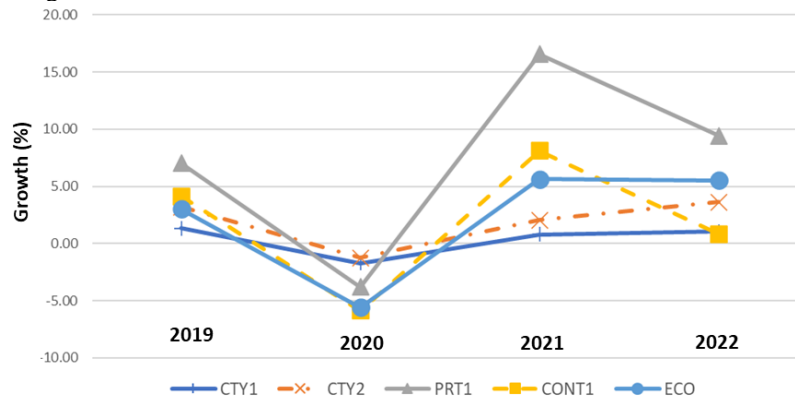

Figure 1. Growth of City Port Indicators in the period 2018-2022.

Indonesia as an archipelagic country with a gap in city and port conditions requires a different management strategy. One ficture of the disparity in ports can be seen from the intensity of container cargo traffic as in Figure 2.
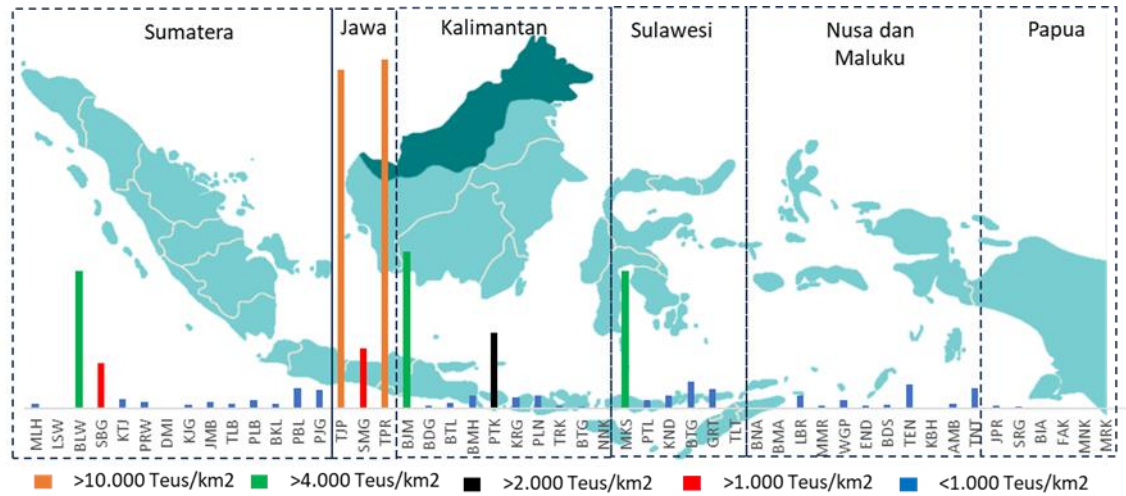

Figure 2. Container traffic intensity in 2022 (Teus/km2).

Several previous studies have stated that containerization has an effect on port development where the port is part of the urban area, between the city and the port there is a relationship that affects each other so further research on the effect of cities and ports on economic growth provides valuable insights for the development of more effective policies.

1.1 The relationship between the city and the port

Cities and ports are positively interdependent based on the assumption that increasing urban activities, e.g. growth of transportation infrastructure or industrial activities, will affect the growth of cargo flows[2]. Furthermore, a model based on four relationships between port and city development, namely: (1) Ports have a positive effect on cities. (2) Cities have a positive effect on ports, (3) Ports have a negative effect on cities, (4) Cities have a negative effect on ports[2].

The relationship between port cities and their hinterlands is effect by many factors such as economic development, industrial specialization, trade relations, expansion, social migration, family networks, and cultural exchanges. New factors such as containers, intermodal integration, shipping networks, logistics patterns, information technology, environmental sustainability, land use, and policies have effect the importance of ports and their hinterlands in this relationship[3].

Although the general process of city and port relationships can be identified in the literature, its variations are still not well understood when dealing with the involvement of port cities in the global transportation chain. For the analysis of this relationship from a world sample, it is proposed to use simple characteristics such as geographical position, urban population, logistics activities, port infrastructure, maritime traffic, and transport connections[4].

1.2 The effect of cities and ports on economic growth

According to Figure 2.10 [5] explains the effect of ports on urban economic growth through direct, indirect, and induced effects as a funnel for economic development.
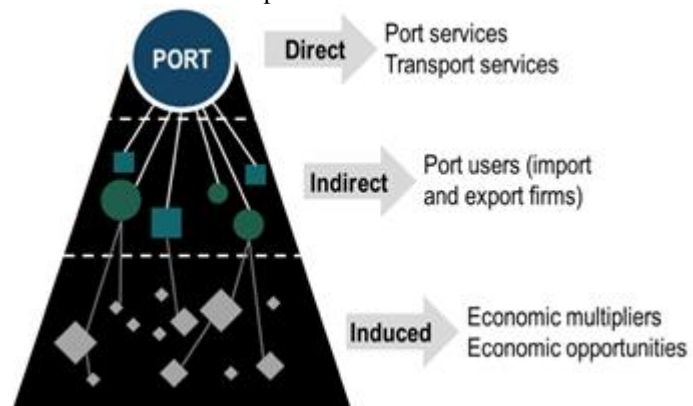

Figure 3. Ports as a funnel for economic development

The effect of transportation as one of the city's resources is very significant for the economy. Explains that urban dynamics are greatly effected by investment in transportation development[6]. The population in districts/cities near container ports grows about twice as fast as in other coastal port districts because of containers [7].

Ports have a direct effect by creating jobs and income from port services and transportation[5]. In addition, ports also have an indirect effect through employment and the economic effects caused by port service users, as well as the induction effect related to broader economic opportunities in the surrounding area, this is in line with the results of research conducted in Tanzania stating that there is a direct effect between port infrastructure and the economy and also the effect of port infrastructure on international trade [8].

Several ports in Poland show that maritime networks have a growing effect on ports and port-city relations. On the one hand, the growth of maritime logistics services has a positive effect on the labor market and transport infrastructure[9].

1.3 Previous Research on the effect of City Port on economic growth

Several previous studies in the last ten years related to the relationship between variables in several countries using several analysis methods have produced findings that show a positive and significant influence as in Table 1., and from several kinds of literatures, it can be concluded that City resources are described as area, population, workforce, and city infrastructure[10],[11], [12][13],[14],[15],[16]. Port indicators include port facilities and port traffic[17],[18],[19]. Economic growth is an increase in output per capita from the main business fields (primary, secondary, and tertiary)[20]and [21].

Table 1. Summary of studies the effect of City Port on economic growth.

| Author (Year)	Country	Var./Indicator	Method	Findings
Deng at. al (2013)	China	AV, Port demand, regional economic	SEM	Added Value of Port activity has a positive and significant effect on the development of the regional economy
Essoh, N.P.S. (2013)	Korea	Traffic, GDP	Solow Model	Port activity and activity generated have contributed and can accelerate the economic growth
Goncalves (2016)	Brazil	AV, Port demand, regional economic	SEM	Value added port activity effects the regional economy, playing a mediating role between the demands of the port and the regional economy
Prakoso,A, et.al (2017)	Indonesia	GDRP, Teus, Road	Dynamic Approach	Tj.Priok Port Development has a positive effect on economic growth in Jakarta
Munim and Schramm (2018)	World	Infrastructure, LPI, Sea Borne Trade, Economic Growth	SEM	Port infrastructure and logistics performance affect economic growth and mediating by seaborne trade
Mudronza at.al (2020)	Europian Union	GDP, Population, HC, un employ, Population	Method of moments	The operation of seaports has a positive effect on the economic growth
Fratila at. al (2021)	Europian Union	GDP, Investment, Traffic, unemployment, GINI, NOx, SO2	Panel Regression	Reducing the impact of the intensity of maritime economic activities through green investments in port infrastructure and ship ecology..
Sun and R. Kauzen (2023)	Tanzania	Port infra, International trade, economic growth	SEM	International trade has a significant effect on economic growth in Tanzania.
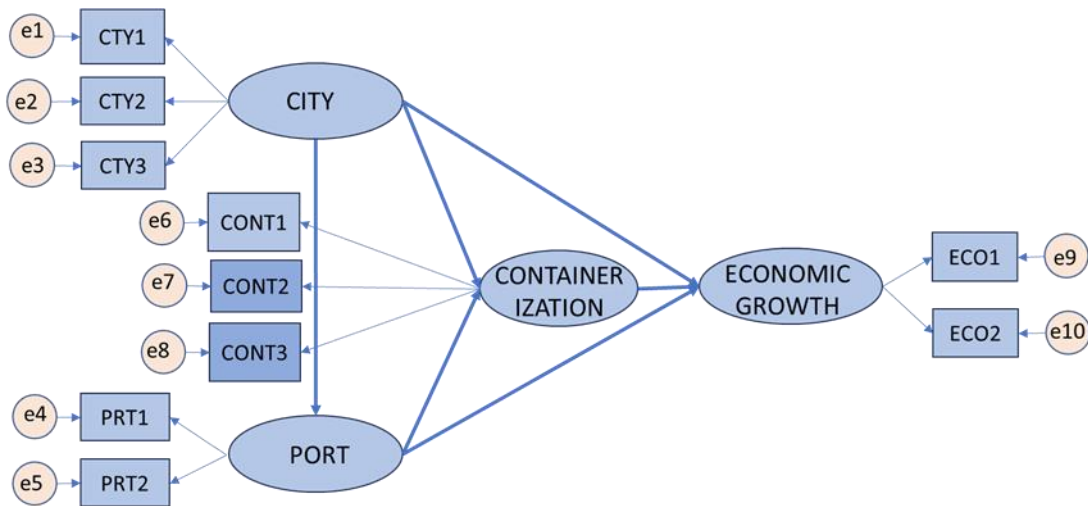
Figure 4. Structural model

Table 2. Variables and description.

Construct	Indicator	Abrev.	Description	Source	Units
City(CTY)	Population	CTY1	Number of city port population	IBS	People
	Employment	CTY2	Number of city port employment	IBS	Person
	Roads Length	CTY3	Total roads length in city port	IBS	Km
Port (PRT)	Berth Lenght	PRT1	Total berth length at port	Pelindo	M
	Cargo Troughput	PRT2	Total number of cargo handled at port	IBS	Tons
Containerization (CONT)	CT Traffic	CONT1	Total number of container loaded/unloaded in terminal	Pelindo	TEUs
	CT Performance	CONT2	Average number of container handled per ship per hour	Pelindo	Box/Ship/Hrs
	CT Berth Lenght	CONT3	Total berth length at terminal	Pelindo	M
Economic Growth (ECO)	GDP Industry	ECO1	GDP from industry and manfactr sector at CMP	IBS	IDR Bi
	GDP Transportation	ECO2	GDP from transportation and warehouse sector at CMP	IBS	IDR Bi

Notes: CMP= Indonesia Beareu of Statistic, Pelindo=Indonesian Port Corp., CMP=cosntant market price

2. RESEARCH METHODOLOGY

The study uses quantitative descriptive. The research method used is survey research, namely research whose data is collected from a sample of the population to represent the entire population. The type of research used is explanatory research the sampling technique used was purposive sampling with a homogeneous sample category (homogenous sampling), namely a sampling technique based on certain considerations according to the research objectives and the sample has characteristics that are by the characteristics of the population[22].

Data analysis uses secondary data from sample size with quantitative techniques determined using the Slovin formula[23] sample of 50 cities and ports that serve containers managed by PT Pelabuhan Indonesia. The following Figure 13. is a map of the location of the city and container port which is the sample analysis.

The data collected is secondary data in the form of statistical data obtained from Indonesia Beareu of Statistic publications, Ministry of Transportation dan Indonesian Port Corp. Data is panel data, combining time series and cross-section data in 50 districts/cities and ports. The data analysis technique is analysis to obtain an overview of the characteristics of the sample. Data analysis and processing using SmartPLS 4.0 software. Table 3. below shows the descriptive statistics data for variables.

3. RESEARCH RESULTS
3.1. Validity and Reliability Model

Based on the validity of outer loading, it is stated that all items or indicators are valid using convergent validity (Table 4.), another method for assessing validity is discriminant validity. The AVE value (Table 5.) above 0.5 means that all latent variables used in this study are valid because they have met the recommended AVE value indicating that the constructs used in the model have good convergent validity and can explain most of the variance of the related indicators. Another method in assessing Discriminant Validity.

Based on the Fornell-Larcker Criterion Table 6., all the roots of the AVE of each construct are greater than its correlation with other variables, the latent construct is truly different from other constructs, so the discriminant validity requirements in this model have been met.

Table 4. Convergent validity

Variable	Containerization (CONT)	City (CTY)	Port (PRT)	Economic Growth (ECO)
CTY2			0,946	
CONT3	0,843			
PRT1			0,949	
ECO1				0,990
ECO3		0,896		
CTY2	0,696			
CONT1	0,920			
CTY2		0,979		
CTY1		0,983		
ECO2				0,991

Table 5. Discriminant validity

Variable	AVE
CONT	0.680
ECO	0.981
CTY	0.909
PRT	0.897

Table 6. Fornell-Larcker Criterion, the roots of AVE

	CONT	CTY	PRT	ECO
CONT	0,825			
CTY	0,912	0,953		
PRT	0,910	0,919	0,947	
ECO	0,914	0,963	0,919	0,990

Internal Consistency Reliability measures how well an indicator can measure its latent construct. (Memon et al., 2017). Based on Table 7, it can be seen that all constructs have Cronbach's Alpha values> 0.6, so it can be said that all these constructs are reliable.

Table 7. Result of Reliability Analysis

	Cronbach's Alpha	rho_A	Composite Reliability	AVE
CONT	0,763	0,836	0,863	0,680
CTY	0,949	0,963	0,968	0,909

PRT	0,886	0,886	0,946	0,897
ECO	0,980	0,981	0,990	0,891

3.2 Model Fit Measurement

Model Fit indicates how well the model fits the data obtained. The results of the model fit test, some of the model fit measures used are as in the following Table 8:

Tabel 8. Result of Model Fit

Result	Saturated Model	Estimated Model
SRMR	0,076	0,076
d_ULS	0,316	0,316
d_G	1,321	1,321
Chi-Square	1169,454	1169,454
NFI	0,756	0,756
rms Theta	0,364	

In the model results, the SRMR value of 0.076, which is below the threshold of 0.08, indicates that this model has a good fit with the existing data. Containerization mediates the effect of cities on economic growth but is complementary [24], with or without containerization the effect of cities on economic growth remains significant and positive as shown in Table 9.

Table 9. Mediation Effect

Indirect Effect	Original Sample	t Statistic	P Values	Mediation Type
CTY (a) -> ECO (b)	0,688	13,971	0,000	*Complementary,*
CTY (a) -> PRT (c) -> ECO (b)	0,142	2,943	0,003	*partial mediation*

3.3 Statistical hypothesis test

Direct effect of CTY on ECO with a coefficient of 0.487 and a p value of 0.000 where <0.05 so accept H1 meaning there is a significant and positive effect of CTY on ECO, $ECO=0.668 \cdot CTY + \epsilon 1$ and so Direct effect of CONT on ECO with a p value of 0.001 where <0.05 so accept H1 meaning there is a significant and positive effect of CONT on ECO, with the equation $ECO=0.145 \cdot CONT + \epsilon 5$. Indirect effect of the CTY on ECO through PRT with a coefficient of 0.142 and a p-value of 0.003, thus accepting H2, meaning that there is a significant and positive effect of the CTY on ECO through PRT and CONT, with the equation: $CTY \rightarrow PRT \rightarrow ECO$: $\beta CTY \rightarrow PRT \rightarrow ECO=0.142$, t=2.943, p=0.003, the details of which are explained in Table 10.

Table 10. Hypotesis Test Result

Hypotesis	Original Sample	Sample Mean	Standar Deviation	t Statistik	P Values	Decision
H1	0,688	0,688	0,049	13,971	0,000	Accepted (Significant)
H2	0,142	0,132	0,048	2,943	0,003	Accepted (Significant)

t table = 1,65 (df =246, α=0,05, one tail

Discussion

City resources directly have a significant and positive effect on ports, indicating that increasing city resources will increase port efficiency and capacity. Area, population, workforce, and infrastructure are city resources that can spur production and increase the volume of needs for goods for materials and finished goods that can increase goods traffic through the Port so that production efficiency from the economy of scale and optimization of the use of Port facilities.

The population, workforce, and road data of Port cities with cargo volume in 50 Port cities in Indonesia in 2018-2022 shows unidirectional growth (Figure 4.9). The population growth of 50 port cities is 0.38% smaller than Indonesia's population growth of 1.08%, this shows that population growth is dominated by births (fertility factor), while research on port cities in the United States conducted [25] which states that the population in cities near container ports grows about twice as fast as other coastal cities because the development of container ports attracts activities of the surrounding population (migration factor due to urbanization).

Today, ports are no longer large direct users of labor and are no longer interconnected industrial complexes as before due to limited areas, ports serve industries in other areas even though they can increase transportation costs[26] this is in line with data from port cities in Indonesia which shows that the average growth of port city labor in the 2018-2022 period was 1.7% smaller than the average cargo growth in ports in the 2018-2022 period of 7.33%.

Roads play an important role as a supporter in economic activities in production and consumption activities in one region or between regions, roads are also facilities to support the smoothness and speed of distribution. The better the road infrastructure, the faster and more efficient the distribution of goods and services. Roads open access to various regions, making it easier for people and businesses to obtain raw materials, and labor, and sell their products to a wider market. Distribution between regions is greatly affected by accessibility between cities and ports. In addition to road quality, distance also determines transportation time. From data from 50 port cities, it is clear that integrated port cities contribute 82.39% of Indonesia's container traffic, cities and ports with a distance of 1 to 20 km contribute 4.5% and distances> 20 km contribute 13.1%. City and port accessibility has a significant effect on traffic volume and port development[27].

Industrial and Transportation Business Fields 50 Indonesian port cities contribute an average of 27.05% to the GRDP of Indonesia's industrial and transportation sectors, much larger than the percentage of population of 14.16% and area (5.22%). This shows that the industrial and transportation sectors are very closely related to cities and ports and the process of added value from urban activities, ports, and containerization to sector income. City resources directly have a significant and positive effect on economic growth, indicating that investment in city infrastructure (especially roads) will directly improve the economy, city infrastructure has a direct effect on industrial and manufacturing business fields, namely the smooth supply of materials and distribution of production results as well as transportation and warehousing business fields for smooth logistics and storage of production and consumption goods. This is also shown in the comparative data on growth between population and worker indicators against GDP (Figure 1.) showing a movement in the same direction from year to year.

Cities indirectly have a significant effect on economic growth through ports, indicating that ports are an important mediator between city resources and economic growth. Port mediation in the relationship between city resources and economic growth can be seen as the role of ports in strengthening or connecting city resources with increased economic activity. Several researchers[12],[28], [29], [30] have noted that ports stimulate the economic growth of a country or region.

CONCLUSION

The study concluded that cities and ports have a significant and positive effect on economic growth indicating that population and workforce support economic growth and investment in city infrastructure will directly boost the Indonesian economy and cities have a significant effect on economic growth through ports, emphasizing the importance of cities in driving efficiency in port process with investment in the right infrastructure and collaborative stakeholder strategies can generate significant and sustainable economic benefits. Ports as a mediating variable play an important role in strengthening the relationship between urban resources and economic growth for island nations and port environmental management will build the foundation for sustainable development.

Further research to complement these findings is needed, namely the addition of other dynamic indicators and measuring the level of competition between ports to improve the effectiveness of the Indonesian port system.

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