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Revisiting the Nexus of Trade Openness and Economic Growth: A Focus on the Moderating Role of Port Infrastructure*

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Abstract

Purpose – Multiple stakeholders—including politicians, investors, and the wider public—have questioned the value of investing in port infrastructure improvements and the contributions they can make to economic performance.

Design/methodology – This paper presents an empirical study of 56 countries with seaports from the year 2006 to 2019 to determine how the quality of port infrastructure affects its contribution in terms of trade openness and economic growth. To this end, this study applies hierarchical multiple regression analysis with panel data to empirically examine the economic impact of port infrastructure quality on the relationship between trade openness and economic growth. After the 56 selected countries were categorized as developed or developing, a multi-group panel data analysis was conducted.

Findings – The results of this study show that trade openness has a significant positive effect on the national economy. The findings also indicate that, although developing countries should expect greater economic growth after investing in port infrastructure, this relationship weakens as developing countries become richer.

Originality/value – The findings of this study not only elucidate the relationship between trade openness and national economic growth, but they also emphasize the importance of trade openness and port infrastructure in national economic growth, particularly among developing countries.

Keywords: Economic Growth, Port Infrastructure, Trade Openness
JEL Classifications: F40, F41, F43

1. Introduction

The central role of international trade in promoting wealth has been recognized since at least the late 18th century, when economist Adam Smith wrote *The Wealth of Nations* (Smith, 1776). Recent statistical data released by UNCTAD (2015) confirms a continued strong association between the two. For example, data collected in 2014 showed that a 2.3% growth in global trade volume mirrored a 2.5% rise in global gross domestic product (GDP). Nonetheless, each generation since Adam Smith's analysis of market specialization has had its own critics of international trade openness. For instance, David Ricardo criticized the *British Corn Laws* in 1815. Hence, there has never been a consensus about the value of free trade. Proponents of trade openness argue that it ensures that resources are efficiently

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allocated, helps disseminate knowledge and technological progress, and fosters competition in both domestic and international markets (Chang, Kaltani and Loayza, 2009). According to standard trade theory, openness pushes an industry to pursue the most innovative and economical production possible. Not only does it promote higher incomes at individual level, but recent research such as the endogenous models of Young (1991), Grossman and Helpman (1991), Eicher (1993), and Lee Jong-Wha (1993) shows that there can be long-run growth when the areas of specialization fostered by the growing trade leverage return to scale.

History has shown that urban areas tend to experience the fastest and greatest development in terms of technology, trade, and other areas of human endeavor (Shan Jun, Yu Ming-Zhu and Lee Chung-Yee, 2014). It is therefore unsurprising that urban seaports carry over 80% of the world's trade (Stopford, 2009; UNCTAD, 2015). Moreover, the recent trend toward globalization—in this case, in terms of sophisticated industrial production processes in particular—has only increased the relative importance of maritime cities in the global supply chain (Munim and Schramm, 2018). Port activity today extends well beyond the mere handling of cargo; seaports now have a central function of providing a range of logistics services to international stakeholders (Wang Teng-Fei and Cullinane, 2006). Hence, to ensure that logistics performance can meet the needs of an expanded range of clients and functions, there has been an increased focus on logistics costs and the reliability of supply chains. As Arvis et al. (2007) observed, a country's competitive advantage can be either undermined or boosted by its ability to facilitate complex logistical operations.

Under the prevailing model of just-in-time production processes, reliability and predictability are as important as the time and cost involved in shipment deliveries (Munim and Schramm, 2018). When the relevant logistics services lack reliability and predictability, a firm's hedging costs can increase considerably as a result of an increased inventory maintenance burden (Arvis et al., 2010). Each country has its own trade-off between direct freight costs and reliability that depends on its commodity trade and logistics performance. Hence, developing countries may be restricted in the extent to which they can move from time-insensitive commodities to value-added goods (Arvis et al., 2010). Although the importance of port infrastructure quality on trade and wider economic well-being has been recognized, it has been neglected in the relevant literature (Munim and Schramm, 2018).

Investors and other stakeholders seeking to justify the economic contributions of large infrastructure facility developments generally conduct economic impact studies. When such developments are controversial, such a study is often carried out "prospectively to justify public subsidy or extraordinary planning permission" (Hall, 2004, 354). Port impact studies, as a subgroup of economic impact studies, have the specific purpose of informing the wider public about the economic contributions made by ports. It is not always easy to communicate these contributions, as some expected economic gains from improving port infrastructure are not immediately visible, such as socio-economic benefits and gains in external economies (Chang Se-Moon, 1978). Hence, although consent is typically required when port infrastructure is built or developed, it must be sought in the context of continuing doubt as to whether ports do, in fact, contribute to national or regional economic well-being (Munim and Schramm, 2018). No consensus has yet been reached among researchers concerning whether and to what extent ports stimulate national or regional economic growth. The debate about the direct economic contributions made by ports has been affected by the ongoing decline in the number of people employed in ports due to automation and containerization (Munim and Schramm, 2018).

In the wake of the successes achieved in cities such as Singapore, Shenzhen, Hong Kong, and Dubai, among others, several countries have planned the construction of regional hub ports. The aim of such developments is to boost economic growth through the provision of new service markets, potentially with the addition of transshipment facilities and efficient onward transport networks. However, any such plans must consider the changing nature of the port–city relationship, as the intensity and spatial distribution of maritime transport networks no longer rely principally on the existence of the quality of urban structures (Ducruet, Cuyala and Hosni, 2016). According to Slack and Gouvernal (2015), much of the port literature overestimates the extent to which developing hub ports can stimulate economic development. Due to the uncertainty caused by structural changes in the global maritime industry, estimations of the potential throughput and wider economic contributions of such ports are often too optimistic (Hesse, 2006). Moreover, the ability to estimate with certainty was undermined by the destruction of the shipping conference system in 2008, and the global financial crisis of 2009 also had a serious negative impact on the shipping sector (Munim and Schramm, 2017). As observed by Grossmann (2008), since these adverse events, "economic growth has shifted to newer economic sectors which require investments into different locational factors, a high quality of life and an attractive, well-functioning city-core." In this context, stakeholders considering multi-million-dollar investments in the construction or expansion of port infrastructure must examine how such investments will affect the relevant national or regional economy (Munim and Schramm, 2018).

There has been a noticeable decrease in studies on port–region relationships over the past three decades. Ng (2013) stated that the research focus has shifted to the day-to-day operations of ports, including performance, competition, management, governance, and supply chains. The current study therefore seeks to re-examine how port infrastructure quality impacts the relationship between trade openness and economic growth by investigating whether:

(RQ1) trade openness has any significant impact, whether positive or negative, on national economy;

(RQ2) port infrastructure quality has any significant impact, whether positive or negative, on the causal relationship between trade openness and economic growth; and

(RQ3) port infrastructure quality impacts the relationship differently in developed and developing economies.

The impact of trade openness on the national economy (RQ1) is investigated by using hierarchical multiple regression analysis to determine whether port infrastructure has a moderating effect in the trade openness–economic growth relationship, and a multi-group hierarchical multiple regression analysis is applied to developed and developing economies to determine the potential differential impact of port infrastructure on the two groups.

The rest of this paper is structured as follows. The trade and port economic impact literature is reviewed with reference to the conceptual framework laid out above in Section 2. Section 3 presents the data collection, analysis methods, and chosen methodology, and the results of the empirical analysis are discussed in Section 4. Finally, policy implications and recommendations for future research are presented in Section 5.

2. Literature Review and Conceptual Framework

2.1. Effect of Trade Openness on Economic Growth

Several endogenous growth theories which consider the implications of trade openness on economic growth have recently been developed. For example, Rivera-Batiz and Romer (1991) and Grossman and Helpman (1991) have developed a robust theoretical framework to explore the relationships between trade policy and economic growth, therein positing that trade openness opens four potential avenues (communication, duplication, integration, and allocation effect) for economic growth.

Multiple empirical studies have examined the openness–growth nexus, particularly after the development of endogenous growth frameworks offered new analytical tools at the same time as liberalization programs had been implemented in developing countries in the 1980s. Such studies tended to agree with previous cross-country studies regarding the positive correlation between trade openness and economic growth (Sghaier and Abida, 2019). Barro and Sala-i-Martin (1997) identified two ways that trade openness may promote economic growth in the long term: First, the import of high-tech items supports the dissemination of technical knowledge. Second, foreign direct investment has spillover effects such as financial openness (Almeida and Fernandes, 2008). Hence, trade openness and collaboration with innovation sources led to growth in markets due to returns to scale and economies of specialization (Bond, Jones, and Wang Ping, 2005). For Rajan and Zingales (2003), one of the advantages of trade openness is that governments faced with international competition are forced to implement reforms. Redding (1999) found that trade openness can, in fact, have a negative impact on long-term growth for national economies which specialize in sectors characterized by dynamic comparative disadvantages. However, Young (1991) concluded that countries with such economies can implement selective protection policies to promote technological development, thus leading to economic growth.

Rassekh (2007) applied Frankel and Romer's (1999) empirical model to 150 selected countries to determine how trade openness affected income levels as well as the rate of income growth. The author found that developing (i.e., low-income) countries benefited more than developed countries from trade openness. Economidou and Murshid (2008) investigated how trade affected manufacturing productivity in 12 OECD countries and concluded that, although the relationship is tenuous, trade positively impacts such productivity. In another work, Chang, Kaltani, and Loayza (2009) studied economic growth data from 82 countries and found a positive relationship with trade openness. Moreover, the authors determined that this positive effect could be magnified by programs of financial and public infrastructure development and governance reform, particularly in developing countries. Dufrenot, Mignon, and Tsangarides (2010) observed that the benefits of trade openness were greater in developing countries than developed countries.

A study by Kim Dong-Hyeon, Lin Shu-Chin, and Suen Yu-Bo (2012) revealed that, while there is a positive relationship between trade openness and economic growth in countries characterized by high incomes, low inflation, and little reliance on agriculture, the corresponding relationship is negative in countries with low incomes, high inflation, and a strong agricultural basis. Huang Liang-Chou and Chang Shu-Hwa (2014) studied data from 46 countries and found that those with higher stock market development were more likely to benefit from trade openness in terms of economic growth, while trade openness promoted

growth to a far lower degree in those with lower stock market development. Sakyi, Villaverde, and Maza (2015) found that the long-term relationship in 115 developing countries between trade openness and income levels was both positive and bi-directional, indicating that such openness is both a cause and a consequence of income levels. A recent study by Zahonogo (2016) applied a dynamic growth model to examine the effect of trade openness on economic growth in 42 sub-Saharan Africa (SSA) nations. The authors found that the long-term impact was generally positive and significant, but that the effect was not linear: after a certain threshold was reached, the effect diminished.

2.2. Role of Port Infrastructure in Economic Growth

There has recently been significant debate regarding the role of transport infrastructure in economic growth. Compared to the long-term effects of soft development expenditures (education, healthcare, etc.), the effects of investing in infrastructure are not only tangible and visible, but they are felt in a much shorter period of time. Indeed, many political economists hold that developing the logistics sector can transform an economy within mere years. Hence, there is widespread consensus that developing logistics boosts economic progress by facilitating access to markets. Currently, both internal and external trade are largely determined by their logistical underpinnings, which is among the main reasons that this emerging sector has recently been developed in many countries.

According to linkage theory, expanding the logistics sector will lead to significant spillover effects, particularly in less developed economies. For example, statistical data indicates that, whereas the deterioration of infrastructure absorbs 4–6% of GDP annually (Ruiz-Nuñez and Wei Zi-Chao, 2015), the greater purchasing power brought by growth leads to a demand for development of the integrated logistics sector. Underdeveloped countries frequently find that poor logistics infrastructure is a major obstacle to the timely transport of perishable agricultural goods to market, with the knock-on effects of waste, increased transport costs, and, hence, rising cost of living or even risk to food security. Clearly, ensuring that transportation infrastructure is both dynamic and sustainable will facilitate economic growth (Jiang Bin, 2001).

Improvements to transportation infrastructure are among the multiple growth indicators that have been put forth by growth theorists as those that can bear fruit within a relatively short period (Mody and Wang Fang-Yi, 1997). Turkey and China serve as case studies to demonstrate how development can be achieved by improving transport infrastructure (Saatcioglu and Karaca, 2013). Turkey has been able to access African markets (Siyakiya, 2019), while China has embarked on the one belt one road (OBOR) initiative. If the full potential of transportation technology is to be realized, a proactive infrastructure development policy is needed to ensure that the long-run aggregate supply curve expands (Demurger, 2001). When the necessary logistics infrastructure to integrate multiple regions is in place, the costs of doing business drop substantially. This drop not only motivates private capital providers (Cohen and Paul, 2004), it also boosts public service delivery, thus enabling local communities to access public services such as education, healthcare, and local government offices (Agénor and Moreno-Dodson, 2006) while ensuring that resources are shared (Sheffi, 2013). However, if investment in infrastructure remains low, then rather than expanding the logistics network, it could simply be absorbed in the maintenance of the existing one, in which case any positive effects are dissipated; Kayode, Onakoya, and Abiodu's (2013) work consi-

dering Nigeria offers a case study of this possibility.

Many researchers have shown that investing in transport facilities promotes national or regional economic growth. However, the literature on maritime economic impact has largely focused on specific ports or regions, meaning that the benefits of maritime trade to the global economy are still unclear (Munim and Schramm, 2018). Kinsey's (1981) study of the English port of Liverpool found a relatively reduced impact on the local economy: fewer jobs were directly related to port activities, British ports were no longer important providers of employment, and the inter-related industrial complex of the previous age disappeared (Gripaios and Gripaios, 1995). Recent studies of South Korea (Jung Bong-Min, 2011) and China (Deng Ping, Lu Shiqing and Xiao Hanbin, 2013) have similarly found that ports are having declining effects on local economies. For example, Jung Bong-Min (2011) found an 87.5% decrease per billion Korean won in employment directly linked to port activities between 1990 and 2008 in South Korea. Although Deng Ping, Lu Shiqing, and Xiao Hanbin's (2013) study of Chinese ports found that seaborne trade had no significant impact on economic growth, their work uncovered a significant positive association between value-added activity and economic development at the regional level. However, this finding may be due to the fact that the value-added activity construct used included total volume of imports and exports, which falls within the seaborne trade construct by Deng Ping, Lu Shiqing, and Xiao Hanbin (2013).

Investment in transport infrastructure can also have benefits by reducing time spent traveling (Banister and Berechman, 2001). For example, a study by Lakshmanan (2011) concluded that improved freight services lead to growth in trade, a more reliable labor supply, and diffusion of technology, and port impact studies from the U.S. (Yochum and Agarwal, 1987), Europe (Bottasso et al., 2013/2014; Ferrari, Percoco and Tedeschi, 2010), China (Shan Jun, Yu Ming-Zhu and Lee Chung-Yee, 2014), and South Africa (Chang Young-Tae, Shin Sung-Ho and Lee Tae-Woo, 2014) have also found evidence that port activity significantly affects regional/national economies. Yochum and Agarwal's (1987) case study of firms in Hampton, USA, concluded that a shortage of ports would have serious economic damage on certain parties. Bottasso et al. (2013) analyzed the relationship between ports and local employment in 560 regions across 10 countries in western Europe and found that 400–600 local jobs depend on every million tons of net port throughput, while a 10% increase in port throughput can lead to an increase of 6–20% in regional GDP along with an increase of 5–18% in the GDP of neighboring regions due to the spillover effect (Bottasso et al., 2014). Shan Jun, Yu Ming-Zhu, and Lee Chung-Yee's (2014) study of a Chinese port found a 7.6% increase in GDP per capita growth per 1% increase in port cargo, as well as a similar spillover effect on neighboring economies due to port throughput. Chang Young-Tae, Shin Sung-Ho, and Lee Tae-Woo (2014) even estimated that a single unit shortage in port activity could inflict a 17% loss on the economy of South Africa.

Since the 1980s, most port impact studies have applied an input–output or regression analysis and been restricted to specific ports or regions (Munim and Schramm, 2018). Moreover, such studies have focused exclusively on port throughput and have not investigated port infrastructure quality or trade. The present study thus analyzes national-level data from 56 countries (see Appendix Table A) to determine whether port infrastructure quality leads to broader economic benefits in the causal relationship between trade openness and economic growth.

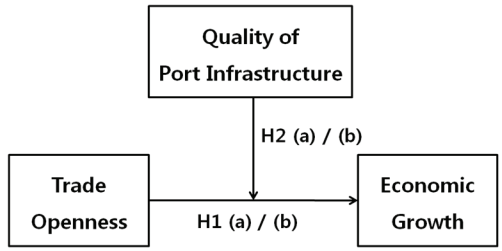
2.3. Conceptual Framework and Hypothesis Development

Based on the literature review above, Fig. 1 presents the conceptual framework of this study. Specifically, following the results of the study Chang, Kaltani, and Loayza (2009) as well as Dufrenot, Mignon, and Tsangarides (2010), two hypotheses were formed:

H1a: Trade openness has a positive effect on economic growth.

H1b: Trade openness has a greater positive effect on economic growth in developing countries than developed countries.

Fig. 1. Conceptual Framework



3. Data and Analysis Method

3.1. Variables and Data Collection

This study was conducted using panel data on the economic growth rate, openness, investment, initial capital, and port infrastructure of 56 countries. Except for Quality of Port Infrastructure (QPI), the data on all observed variables of latent constructs in this empirical analysis were collected on an annual basis per country from the World Bank database, and related data were extracted from the economic activity panel data of 56 countries from 2006 to 2019; the selected items are listed in Table 1.

Table 1. Element Selection

Factor	Element
Dependent Variable	GDP, Growth
Independent Variable	Trade Openness
Control Variable	Initial GDP, Edu, Life
Moderating Variable	Port, Interaction
Period and Sample	2006 – 2019, 56

3.1.1. Trade Openness

Although various methods have been used to measured trade openness, most research findings have indicated that trade openness is positively associated with economic growth. In

general, there are two types of methods of measuring trade openness: utilizing the indices of trade policies or the trade volume of each country. Each type has its own pros and cons.

The first type, which is based on the trade policy orientation of each country, allows researchers to focus on accessing the net effect of global policy. However, this method has two flaws. Through this measure, each country can only roughly be classified into closed or open economies. This implies that the outward-oriented degree of each country cannot be specifically measured. In addition, it is quite difficult to gather the necessary data to develop these indices from multiple countries, particularly when trying to obtain panel data.

In the case of the second type of measurement, which is based on the trade volume of each country, collecting most data requires the calculation of trade openness, which is simpler and includes panel data by using trade policy indices. However, there is also a shortcoming in this method. This measure is fundamentally based on outcomes, but the outcomes are generally affected by a number of factors. As a result, identifying the exact effect of trade openness is difficult when using this type of measurement. Another shortcoming of this type of measurement is that researchers need to consider how to cope with the potential endogeneity between trade openness and economic growth in the regressions. According to Anderson and Babula (2008), it is still unclear if the increase in trade volume contributes to economic growth or otherwise, or if the causal link is bi-directional. Due to this endogeneity, considerable biases can occur in estimations.

There are three major types of measurement of trade openness utilizing trade volume: The first measure, the so-called 'trade share' (TS), is the sum of exports and imports divided by the GDP of each country. The second and third are total imports and exports by GDP, respectively. TS has been the one most often used to measure trade openness (Squalli and Wilson, 2011). In addition to these three major measures, several adjusted TS measures have been applied to deal with outliers (Li et al., 2004; Alcalá and Ciccone, 2004). Regardless of the employed measure, each one offers a means of assessing and comparing the degree of each country's trade openness. However, these proxy indicators for trade openness cannot be utilized together in one model because there are certain positive correlations between them (Hye, 2011).

The main method used to measure trade openness has changed over time. In the 1990s, trade openness was mainly measured using data relevant to the trade policies of each country. However, since 2000, research using trade volume to examine the effect of trade openness on economic growth has markedly increased. Following this trend, the present study uses trade volume to measure trade openness.

3.1.2. Quality of Port Infrastructure (QPI)

QPI is one of the factors of the Global Competitiveness Index released annually by the World Economic Forum (WEF). It shows an assessment of each country's quality of port facilities based on data from the WEF Executive Opinion Survey, a long-lasting and broad survey collected from over 14,000 business leaders in 144 countries. QPI is measured using a single question. The respondents answer on a scale from 1 (underdeveloped) to 7 (extensive and efficient by international standards), regarding the operation of their country's port facilities and inland waterways. For countries not located near a coast, respondents are asked to answer regarding access to port facilities and inland waterways on a scale from 1 (impossible) to 7 (easy). A country score is then calculated by aggregating and averaging the individual responses.

3.1.3. Control Variables

The growth potential of each country and the accumulation of physical capital were measured by utilizing proxies. The utilization of proxies is inspired by the work of Barro and Lee (1994). Based on their research, the initial level of investment in human capital was utilized for assessing the growth potential. Accordingly, the life expectancy at birth and the standard of education are used as a proxy for the human capital investment. In terms of the measurement of the accumulation of physical capital, gross investment was used as a proxy for physical capital growth. The gross investment can be measured by using the gross savings (de Boyrie and Johns, 2013). The data on all variables was gathered from the World Development Indicators produced by the World Bank.

3.2. Research Model

Regression analysis is a statistical technique that explains and predicts the value of a specific variable (dependent variable) from one or more other variables (independent variables) by identifying the relationship between two or more variables. In general, a regression model including two or more variables is called a multiple regression model. If the relationship between the dependent variable Y measured from the fixed values of the n independent variables X is assumed to be linear, then it is assumed that the following relational expression holds.

$$Y = \beta 0 + \beta 1i*C1i \quad (1)\text{ Basic model}$$

$$Y = \beta 0 + \beta 1i*C1i + \beta 2i*X1i + \beta 3i*X2i \quad (2)\text{ Trade Openness input regression formula}$$

In this study, after panel regression analysis was performed by classifying countries into developed countries and developing countries, the initial GDP levels for each country were classified into two groups and compared to understand the differences; the classification criteria for initial GDP are presented in Table 2.

Table 2. Criteria for Country Classification

Classification	Initial GDP
Developed Country	Initial GDP over 10.0
Developing Country	Initial GDP less than 10.0

3.3. Analysis

This study analyzed port infrastructure using the R Studio program based on elements selected from the panel data in order to elucidate the causal relationship between the degree of openness to the outside and economic growth. Panel data is a type of multi-level data with a two-level structure; it is composed of observations within both the lower level and the upper level. In panel data, the upper level is the subject and the lower level is the time at which the object was observed. For this reason, panel data can be said to be a combination of cross-sectional data and time series data. It allows us to see the characteristics of the individual in the cross-sectional data while also allowing us to capture the change over time of the object shown by the time series data. The advantage of an analysis using such panel data is that it is possible to control the heterogeneity of individuals so that more efficient estimates can be

obtained. The number of samples of panel data is calculated as the product of the upper level and the lower level. That is, with the total number of panel data N (total number of samples), T (time: 2006 to 2019), and the number of individuals (56 countries), N = n × T is calculated.

4. Analysis Results and Discussion

4.1. Correlation Analysis Result between Variables

To estimate the coefficients of the linear regression model, this study required an assumption that there should not be a perfect linear relationship between the explanatory variables including the constant. If the linear relationship between the variables is high, then multicollinearity is suspected.

Table 3. Correlation Analysis Result between Variables

Constructs	GDP	Growth	Open	Invest	Initial GDP	Edu	Life	Port	Interaction
GDP	1								
Growth	.102*	1							
Open	.388**	.098*	1						
Invest	.164**	.305**	.097*	1					
Initial GDP	.168**	.270**	.287**	.110	1				
Edu	.126**	.181**	.176**	.092*	.779**	1			
Life	.130**	.129**	.241**	.360**	.710**	.706**	1		
Port	.175**	.156**	.277**	.114**	.643**	.313**	.493**	1	
Interaction	.150**	.093**	.639**	.160**	.616**	.295**	.482**	.710**	1

Note: *p<0.05, **p<0.001.

4.2. Hypothesis Testing

4.1.1. H1a Verification

In this study, a regression analysis was conducted to verify the previously established 'H1a. Openness to the outside world will have a significant effect on the economic growth of the country.' In the regression analysis result, the significance probability p value was analyzed as .000 with F = 4.390, indicating that the regression equation was meaningful, and it was verified that openness to the outside world (β = .307, p < .001) had a significant effect on the economic growth of the country.

Table 4. Effect of Openness on the Economy

DV	IV	B	S.E.	Β	t Value	p Value	Tolerance	VIF
GDP	Constant	1.823	.169		6.784	.000		
	Trade Openness	.129	.016	.307	4.095	.000***	.301	1.985

Notes: 1. Model Summary: Modified R^2=.192, F-Value=11.390. 2. ***p<0.001.

Hierarchical multiple regression analysis was also conducted by selecting capital (Initial GDP), higher education enrollment rate (Edu), and life expectancy (Life) as control variables to analyze the effect of openness on national economic growth. As a result, [Model 1] has an F value of 17.28 and a significance probability of p=0.000 while [Model 2] has an F value of 43.78 and a significance probability of p=0.000, meaning that [Model 1] and [Model 2] were both verified to be suitable. As a result of inputting capital (Initial GDP), higher education enrollment rate (Edu), and life expectancy (Life) as control variables, only capital (Initial GDP) was verified to be effective. The hierarchical regression analysis ($\beta = .307$, $p < .001$) result showed a significant effect, thus verifying 'H1a: Openness to the outside world will have an impact on national economic growth', and the change in influence after input of the control variable was verified as well. In other words, it was found to be .307 before the input of the control variable, while the influence was found to decrease to .213 after the input. It was verified that the influence of external openness on national economic growth differs depending on whether or not the control variable is input.

Fig. 2. Regression Standardized Residual of Economic Growth

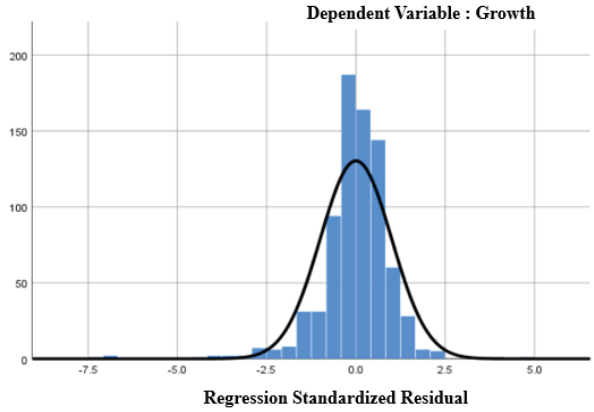


Fig. 3. Regression Standardized Predicted Values

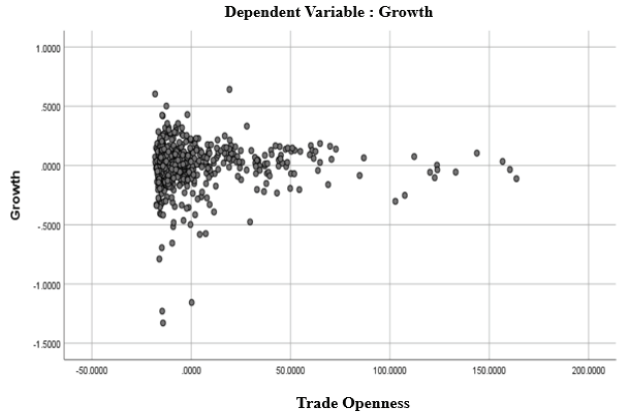


Table 5. Effect of Openness on an Economy under the Control of Initial GDP, Edu, and Life

IV		Model－1				Model－2			
		B	S.E.	B	t Value (p)	B	S.E.	B	t Value (p)
Constant		1.823	.169		6.784***	2.709	.225		11.597***
Trade Openness		.189	.016	.307	4.095***	.242	.021	.213	3137**
Control Variable	Initial GDP					.113	.024	.198	2.035*
	Edu					.021	.012	.061	1.773
	Life					.062	.005	.125	1.428
F-Value=17.28 (p=.000), Adjusted R^2=.192						F-Value=43.78 (p=.000), Adjusted R^2=.192			

Note: *p<0.1, **p<0.05, ***p<0.001.

4.1.2. H1b Verification

The relationship between the independent variable and the dependent variable may appear differently depending on the value or level of the third variable. In this way, a third variable whose value or level of a specific variable affects the relationship between the independent variable and the dependent variable is called a moderating variable. To test a statistical model in which the relationship between the independent variable (X) and the dependent variable (Y) varies depending on the level of the moderating variable (R), the independent variable, the moderating variable, and the dependent variable, an interaction term, which is the product of a variable and a moderating variable, is introduced, and the model can be expressed as follows.

$$Y = \alpha + \beta 1*X + \beta 2*R + \beta 3*X\#R + \varepsilon \quad \text{(3) Controlled Regression}$$

This study is based on a model by Baron and Kenny (1986) to verify 'H1b. The port infrastructure will have a moderating effect on the causal relationship between external openness and national economic growth'. Controlled regression analysis was thus performed. The results of this analysis are listed in Table 6 below.

In this study, since the control variable was first considered, the results were derived after inputting only the control variable in Model 1. In total, four steps of hierarchical regression analysis were conducted by performing three steps of controlled regression analysis (Model 2~Model 3). The hierarchical regression analysis of Model 2 is identical to the previous regression analysis because only trade openness was input as an independent variable. Here, the moderating effect refers to the effect on national economic growth through the interaction with trade openness and port interaction. According to the analysis results, R^2 continuously increased at each stage, and the change in F was statistically significant at 0.042 (p<.05) in the fourth stage. The Durbin-Watson value of 1.891 is close to the reference value of 2.0, so it is verified that there is no problem.

Table 6. Moderating Effect of Port Infrastructure on the Relationship between Trade Openness and Economic Growth

DV	IV	B	S.E.	β	t Value	P Value	Tolerance	VIF
GNP	Constant	3.464	1.560		11.102	.000		
	Initial GDP	.867	.258	.456	7.246	.000 ***	.342	2.982
	Edu	.489	.289	.106	1.694	.091	.346	2.887
	Life	.165	.019	.125	1.725	.085	.436	2.292
	Constant	1.823	.169		6.784	.000		
	Trade Openness	.189	.016	.307	4.095	.000 ***	.301	1.985
	Constant	2.709	.225		11.597	.000		
	Trade Openness	.142	.021	.213	3.137	.008 **	.175	3.359
	Initial GDP	.113	.024	.198	2.035	.042 *	.075	8.741
	Edu	.021	.012	.061	1.773	.121	.056	6.412
	Life	.062	.005	.125	1.428	.144	1.000	1.000
	Constant	4.321	.198		8.808	.000		
	Trade Openness	.129	.016	.307	2.095	.037 *	.129	1.891
	Initial GDP	.109	.034	.145	1.985*	.048 *	.300	.2.114
	Edu	.021	.012	.061	1.741	.082	.788	1.421
	Life	.059	.007	.044	1.189	.235	.606	1.009
	Port Interaction	.588	.103	.645	8.238	.000 ***	.384	2.241
	Moderating Effect	.054	.015	1.610	3.321	.000 ***	.470	1.891

Note: *p<0.1, **p<0.05, ***p<0.001.

4.1.3. H2 Verification

Considering that this panel data is data that has changed over 14 years for a total of 56 countries, in order to understand the difference between the upper and lower groups of the panel, dummy processing was performed based on Initial GDP. Countries scored as less than 10.0 were classified as developing and given a value of 1. After classification by country, the influence of trade openness on national economic growth and the moderating effect of port infrastructure on the causal relationship between external openness and national economic growth were verified. The results showed that there is a significant difference in the effect of openness to the outside world on national economic growth between developed and developing countries. As a result of the regression analysis of developed countries, it was found that openness to the outside did not have a significant effect on national economic growth (p>.05). On the other hand, in the case of developing countries, openness to the outside world (β=.244, p<.001) was found to have a significant effect on the economic growth of households. Through these results, it was verified that openness to the outside world had a direct effect on economic growth in developing countries but not in developed countries. The analysis results are presented in Table 7 and Table 8.

Table 7. Effect of Openness on the Economy (Developed)

DV	IV	B	S.E.	β	t Value	p Value	Tolerance	VIF
GNP	Constant	2.336	.269		4.971	.000		
	Trade Openness	.009	.005	.090	1.805	.072	1.000	1.439

Note: Model Summary: Modified R^2=.090, F-Value=3.260 (p=.000).

Table 8. Effect of Openness on the Economy (Developing)

DV	IV	B	S.E.	β	t Value	p Value		Tolerance	VIF
GNP	Constant	2.447	.310		1.153	.000			
	Trade Openness	.109	.002	.244	4.068	.000	***	1.000	2.064

Note: Model Summary: Modified R^2=.244, F-Value=16.547 (p=.000).

In addition, it was verified whether port infrastructure had a moderating effect on the causal relationship between openness to the outside world and national economic growth by country. At this time, to analyze the impact on national economic growth according to the openness of developed countries to the outside world, a four-step hierarchical multiple regression analysis was performed by selecting capital (Initial GDP), higher education enrollment rate (Edu), and life expectancy (Life) as control variables. As a result, R^2 was found to increase in each stage, and the change in F was found to be statistically significant at 0.019 (p<.05) in Stage 4, indicating that the impact on national economic growth by interacting with trade openness and port infrastructure is proven to have a significant effect. A Durbin-Watson value of 1.914 was found to be satisfactory because it was close to the baseline value of 2.0.

To analyze the impact on the economic growth of developing countries according to openness to the outside world, a four-step hierarchical multiple regression analysis was performed by selecting capital (Initial GDP), higher education enrollment rate (Edu), and life expectancy (Life) as control variables. As a result, R^2 continued to increase in each stage, but the change in F did not show a statistically significant difference in Stage 4 (p>.05), so the effect of trade openness and interaction with port infrastructure on national economic growth proved to be incomplete.

Table 9. Moderating Effect of Port Infrastructure on the Causal Relationship between External Openness and National Economic Growth (Developed)

DV	IV	B	S.E.	β	t Value	p Value		Tolerance	VIF
	Constant	2.966	.562		5.279	.000			
	Initial GDP	.085	.023	.280	3.607	.000	***	.399	2.505
	Edu	.020	.021	.085	.941	.347		.297	3.366
	Life	.200	.128	.098	1.565	.118		.615	1.627
	Constant	2.336	.269		4.971	.000			
	Trade Openness	.009	.005	.090	1.805	.072		1.000	1.439
	Constant	3.079	.560		5.502	.000			
	Initial GDP	.093	.023	.307	3.950	.000	***	0.392	2.552
	Edu	.018	.021	.076	.850	.396		0.297	3.370
	Life	.179	.127	.087	1.405	.161		0.612	1.634
	Trade Openness	.001	.000	.133	2.593	.010	*	0.907	1.102
	Constant	3.071	.597		5.143	.000			
	Initial GDP	-.092	.027	-.306	-3.368	.001	**	.289	3.460
	Edu	.017	.024	.074	.707	.480		.218	4.586
	Life	.180	.134	.088	1.349	.178		.556	1.800
	Trade Openness	.001	.000	.133	2.536	.012	*	.864	1.158
	Port Interaction	.007	.001	.304	6.463	.000	***	.661	1.513
	Moderating Effect	.158	.071	.215	3.399	.005	**	.470	1.914

Note: *p<0.1, **p<0.05, ***p<0.001.

Table 10. Moderating Effect of Port Infrastructure on the Causal Relationship between External Openness and National Economic Growth (Developing)

DV	IV	B	S.E.	β	t Value	p Value		Tolerance	VIF
	Constant	5.974	2.431		2.458	.015			
	Initial GDP	.001	.044	.002	.032	.974		.810	1.235
	Edu	.069	.030	.148	-2.284	.023	*	.894	1.118
	Life	.609	.581	.071	-1.049	.295		.825	1.212
	Constant	2.447	.310		1.153	.000			
	Trade Openness	.109	.002	.244	4.068	.000	***	1.000	2.064
	Constant	6.278	2.389		2.628	.009			
	Initial GDP	.023	.044	.036	.536	.593		.785	1.274
	Edu	.093	.041	.133	.2153	.032	*	.479	2.087
	Life	.717	.571	.083	-1.255	.211		.822	1.217
	Trade Openness	.000	.000	.274	3.256	.001	**	.510	1.959
	Constant	6.310	2.404		2.625	.009			
	Initial GDP	.026	.047	.040	.550	.583		.683	1.464
	Edu	.019	.043	.041	2.043	.042	*	.433	2.307
	Life	.719	.573	.084	-1.256	.210		.821	1.217
	Trade Openness	.000	.000	.269	2.912	.004	**	.426	2.346
	Port Interaction	.002	.014	.011	.143	.886		.665	1.503
	Moderating Effect	.019	.001	.084	1.259	.209		.794	1.220

Note: *p<0.1, **p<0.05, ***p<0.001.

5. Conclusion

The purpose of this study was to analyze factors affecting economic growth using panel data from 56 countries. To this end, data were analyzed using the R studio program and SPSS program, and the results are as follows.

First, as a result of analyzing the effect of external openness on national economic growth, it was found that external openness (β=.307, p<.001) had a positive effect on national economic growth; the higher the value, the higher the national economic growth. At this time, to verify the control effect of Initial GD, Edu, and Life, the results of [Model 1] before and after the inputting of the control variable [Model 2] were compared. The results showed that there was a significant change in both models. That is, the value before the input of the control variable was .307, while after input, the influence decreased to .213, indicating that the influence of openness to the outside world on national economic growth differs depending on whether the control variable is input.

Second, as a result of examining what moderating effect it has on the causal relationship between openness to the outside and national economic growth, R^2 continuously increased at each stage of the conditioning regression analysis; the change in F was .042 (p<.05) in Stage 4, which was statistically significant. At this time, it is confirmed that there was no problem because the Durbin-Watson value of 1.891 was close to the reference value of 2.0. Therefore, it was verified that trade opening interacts with port infrastructure and has a moderating effect on national economic growth.

Third, considering that this panel data is data that has changed over a 14-year period for a total of 56 countries, it is classified by country in an attempt to understand the differences

between the upper and lower groups of the panel. It was verified whether influence and port infrastructure had a moderating effect on the causal relationship between external openness and national economic growth. As a result, it was verified that there is a significant difference in the effect of openness to the outside world on national economic growth between developed and developing countries. In developed countries, it was found that openness to the outside did not have a significant effect on economic growth. This shows that openness to the outside world has a direct effect on economic growth in developing countries but not in developed countries.

It was also verified whether port infrastructure had a moderating effect on the causal relationship between openness to the outside and national economic growth by country. The results verified that developed countries have an impact on national economic growth by interacting with trade openness and port infrastructure. However, in developing countries, the effect of trade openness and interaction with port infrastructure on national economic growth was verified to be insignificant.

In summary, this study examined the causal relationship between trade openness and national economic growth with the moderating role of port infrastructure. Overall, the results show that trade openness has a significant positive effect on national economy, which is similar to the results outlined by Barro and Sala-i-Martin (1997) and Chang, Kaltani, and Loayza (2009), who showed that trade openness has positive effects on the economy. In addition, a significant moderating role of improvement in the quality of port infrastructure in the benefits to the economy of a country by trade openness was demonstrated. Further, the extension to multi-group analysis reveals important findings, particularly for developing economies. The effect of trade openness on economic growth is more enhanced in developing countries than in developed countries, which confirms the results of Dufrenot, Mignon, and Tsangarides (2010). Moreover, this study found for the first time that the moderating effect of port infrastructure on the relationship between trade openness and economic growth was more enhanced in developing countries.

In terms of the contributions of this study, while most of recent studies focused on the specific operations of ports, this study adopts more holistic approach by verifying how the relationship between trade openness and economic growth of country is influenced by port infrastructure quality. Moreover, this study extends the theoretical model of economic development by examining the moderating effect.

The findings of this study emphasize the importance of trade openness and port infrastructure for national economic growth, particularly for developing countries. Lastly, in terms of future directions for studies on the nexus between economic growth and trade openness, the effect of airport infrastructure also needs to be demonstrated. Further, a mere 56 countries comprise the sample of this study, so future studies should add more countries to improve the generalizability of the findings.

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Appendix

Table A. List of Countries

Albania	Egypt	Kazakhstan	Poland
Argentina	Finland	Lithuania	Portugal
Armenia	France	Malaysia	Romania
Azerbaijan	Georgia	Malta	Russia
Bangladesh	Greece	Mexico	South Korea
Belgium	Hong Kong	Mongolia	Spain
Botswana	Hungary	Morocco	Sweden
Bulgaria	Iceland	Namibia	Switzerland
Cambodia	India	Netherlands	Thailand
China	Ireland	Norway	Uganda
Croatia	Israel	Pakistan	United Kingdom
Cyprus	Italy	Panama	Ukraine
Czech Republic	Jamaica	Peru	United States
Denmark	Jordan	Philippines	Vietnam