

## Competitiveness and Logistics Performance Index: How does the infrastructure pillar perform in ASEAN countries?

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### Abstract

This paper examines the impact of strategic sub-components of the Global Competitiveness Index (GCI) on the Logistics Performance Index (LPI), positing a correlation between the LPI and selected GCI factors, specifically within the infrastructure domain—namely, the indicators of road quality, rail service efficiency, port efficiency, air transport efficiency, and electrification. The objective is to identify which indicators within the infrastructure sector most significantly affect the Logistics Performance Index. In this study, the LPI is the dependent variable, while the five previously mentioned competitiveness indicators act as independent variables. A panel data regression analysis was employed to evaluate how these independent variables influence the dependent variable. The data for this study were derived from the World Bank, specifically the LPI of the World Bank and the World Economic Forum, covering countries in the ASEAN region from 2012 to 2020. The findings indicate that, among the five indicators, port efficiency significantly impacts the Logistics Performance Index in the ASEAN region. Furthermore, air transportation efficiency and electrification significantly influence the Logistics Performance Index. Conversely, road quality and rail service efficiency do not significantly affect the Logistics Performance Index in the ASEAN region.

**Keywords:** *Competitiveness, Economic growth, Logistic*

**JEL Classification:** O18, F13, F63

### INTRODUCTION

Economic globalization, characterized by its increasingly free and unbounded nature, invariably leads to competition. Such competition is essential for every nation striving to seize opportunities for prosperity. Without competition, countries would lack the impetus to enhance productivity to foster national well-being. Competition embodies a process that leverages a nation's capacity to seek and sustain superiority (Magretta, 2014), thereby illuminating the contours of global competitiveness.

In a world where globalization intensifies, regions lacking efficient supply logistics, including robust infrastructure networks, are at a significant disadvantage, potentially compromising economic development. Infrastructure, considered in terms of physical space, requires thoughtful planning and design to foster an attractive and harmonious environment that integrates living and working spaces. Nevertheless, the significance of physical space extends beyond merely enhancing infrastructure networks; while necessary, infrastructure alone does not suffice to foster competitiveness. The advent of globalization has broadened the understanding of competitiveness, highlighting its impact on territories. These territories, viewed as operational systems, generate conditions conducive to economic and social advancement, bolster local enterprises, and entice new entrepreneurs (Sergi et al., 2021).

Logistics emerges as a critical element underpinning the success of the industrial and trade sectors. A nation's efficient management of its logistics not only enhances its competitiveness (Subekti & Jayawati, 2017) but also plays a crucial role in national economic trade activities. The focus on national logistics performance underscores its importance, given its role in effectively addressing transportation, storage, and packaging challenges, enhancing business competitiveness, and benefiting the country (Martí et al., 2014). Nations with subpar logistics capabilities face detrimental effects on economic activities within industry and trade, including exports and imports, thereby impeding international trade and national competitiveness.

The Logistic Performance Index (LPI), developed by the World Bank biennially, is a gauge for assessing a country's logistics sector performance. This indicator, derived from surveys of logistics professionals worldwide, reflects their perceptions of logistics efficiency based on several dimensions: efficiency of customs and border management (Custom), quality of trade and transportation infrastructure (Infrastructure), ease of arranging competitive shipments (International Shipping), competence and quality of logistics services (Logistics Competence), ability to track and trace shipments (Tracking and Tracing), and the frequency of on-time delivery (Timeliness) (Arvis et al., 2016). The LPI is calculated as an average of these six components, scaled from 1 to 5, where a higher score indicates superior logistics performance. The following section presents the LPI values and their rankings within the ASEAN region for 2020.

Based on Table 1, which outlines the LPI for the 10 ASEAN member countries, Singapore stands out for its exceptional logistics performance, boasting an index score of 4.00 and ranking 7th among 160 countries. This high ranking is attributed to Singapore's robust trade and transportation infrastructure, the competence and quality of its logistics, trucking, forwarding, and customs brokerage services, and its reliability in delivering goods within the expected timeframe. Following Singapore, Thailand secured the 32nd position with an index score of 3.41, while Vietnam and Malaysia recorded scores of 3.27 and 3.22, respectively, placing them 39th and 41st out of 160 countries. These rankings represent an improvement from the previous year.

In 2018, Indonesia ranked 46th out of 160 countries with a logistics performance index score 3.15. As a developing nation categorized within the Upper-Middle Income Countries, with a per capita income of IDR 62.2 million annually, Indonesia's logistics performance is considered satisfactory by the World Bank's assessment. However, there remains room for improvement, particularly in customs efficiency and border management permits, to facilitate smoother and more efficient trade activities.

With an index score of 2.90, the Philippines ranks 60th out of 160 countries. Meanwhile, Brunei Darussalam, Cambodia, and Myanmar have index scores of 2.71, 2.58, and 2.30, respectively, positioning them at 80th, 98th, and 137th out of 160 countries. Enhancing logistics efficiency in countries with lower LPI scores necessitates focusing on key components such as Customs, Infrastructure, International Shipments, Logistics Quality and Competence, Tracking and Tracing, and Timeliness. Insufficient logistics capabilities adversely affect economic activities within industry and trade, including exports and imports, potentially hindering international trade and national competitiveness.

**Table 1.** Logistics Performance Index in ASEAN

Country	Score	Ranking
Brunei Darussalam	2.71	80
Cambodia	2.58	98
Indonesia	3.15	46
Laos	2.70	82
Malaysia	3.22	41
Myanmar	2.30	137
Philippines	2.90	60
Singapore	4.00	7
Thailand	3.41	32
Vietnam	3.27	39

Source: *LPI Report, 2021*

Wilson et al. (2005) highlight three principal challenges encountered in empirical research on trade facilitation: defining and measuring trade facilitation, selecting an appropriate modeling methodology to estimate trade facilitation's significance for trade flows, and devising a scenario to quantify the impact of enhanced trade facilitation on trade flows. Drawing upon the reviewed literature, this study adopts the LPI as a pertinent proxy for trade facilitation. This choice is informed by the comprehensive nature of the LPI and its subcomponents in encapsulating various facets of trade facilitation (Felipe & Kumar, 2012). Developed by the World Bank, the LPI gauges the trade facilitation scores of over 150 countries globally, rating them based on logistics performance, which includes critical factors such as customs procedures, timeliness, logistics quality and competence, and the quality of infrastructure essential for overland and maritime transport (Arvis et al., 2016). Gani (2017) asserts that transport and logistics services facilitate international trade and are crucial for a country's growth and development, underscoring logistics performance's pivotal role in supporting international trade.

Competitiveness within a country is vital for overcoming challenges and barriers to national prosperity. This competitiveness is fostered through the fortification of key sectors, including the economy, politics, and culture, contributing to a nation's superiority in the global arena (Kemenkeu, 2014). According to the Ministry of Finance report (2014), high competitiveness sustains economic growth and promotes an orderly societal structure, prompting many nations to strive towards maintaining their competitiveness.

Furthermore, economic cooperation among countries is widespread, with nations engaging in various forms of collaboration to bolster their economies. Such cooperative

endeavours often involve trade agreements and other economic arrangements, leveraging comparative and competitive advantages. Regional economic cooperation, exemplified by the collaboration among Southeast Asian nations within the ASEAN framework, serves as a key model. Indonesia, as one of ASEAN's five founding members, seeks to enhance active and effective cooperation in areas such as economy, science, administration, social affairs, culture, and engineering, illustrating the significance of collective efforts in regional development.

The quality of a country's logistics network, crucial for success in global trade, hinges on the services, investments, and policies developed by the government. At the macro level, governments provide transportation infrastructure and implement standardized regulations to enhance logistics activities, which, in turn, fosters economic growth and boosts the country's competitiveness. Consequently, the performance and competitiveness of state enterprises in logistics are closely interconnected (Arvis et al., 2016; Ekici et al., 2016). The efficiency of a country's logistics network, essential for its global trade, depends on the governmental provisions in terms of services, investments, and policies. In this context, the government is pivotal in constructing infrastructure and formulating and enforcing efficient transport regulations and customs procedures.

Therefore, this study examines the impact of infrastructure competitiveness on a country's logistics performance. Previous research, such as that conducted by D'Aleo & Sergi (2016), has explored the relationships between the global competitiveness index's sub-components and the logistics performance index, specifically focusing on infrastructure competitiveness and LPI in European countries. These studies reveal significant disparities among central, eastern, and southern European countries, attributing the negative impact of the quality of infrastructure to inadequate investment in the upgrade and maintenance of the transport network. Since the 1990s, public investment in transport infrastructure has plateaued, leading to road and rail infrastructure deterioration across the continent due to insufficient funding and a backlog of pending road maintenance. Maintenance budgets have not kept pace with the growing length of the infrastructure and the ageing of key links, often facing severe cuts that detrimentally affect the condition of many states' roads.

Uca et al. (2015) employed multiple linear regressions to demonstrate the significant role of logistics as a mediator in amplifying the influence of Global Competitiveness Index (GCI) pillars on the economic growth of European countries, suggesting that the expansion of freight transport and improvements in the logistics sector could enhance Europe's competitiveness. However, their analysis did not extend to examining the causal relationship between GCI and LPI pillars. D'Aleo & Sergi (2017) focused on three GCI clusters—infrastructure, institutions, and human factors—and identified human factors as particularly crucial for enhancing the LPI. Önsel Ekici et al. (2016) discovered a strong link between global competitiveness and a country's logistics efficiency, highlighting the significance of fixed broadband Internet access as a pivotal factor influencing logistics performance. Conversely, Mohan (2013) explored how the logistics sector in India contributes to the country's global competitiveness.

The existing literature reveals a scarcity of studies examining the relationship between the GCI pillars and the LPI indicators. Önsel Ekici et al. (2019) explored the unidirectional interaction between competitiveness and logistics performance, employing the GCI and LPI indicators. Although their research shares the same

objective as this study, prior investigations have solely focused on unidirectional relationships without considering the bidirectional interactions and correlations among the sub-components of the GCI pillars. These studies have perceived competitiveness as influencing logistics without acknowledging the potential reciprocal causal relationship between the GCI pillars and LPI. The notion of bidirectional interaction between logistics and economic growth and competitiveness is supported by additional literature (Kabak et al., 2020; Kálmán & Tóth, 2021; Nguyen & Tongzon, 2010). While enhancements in various competitiveness indicators significantly benefit a country's logistics performance, logistics improvements are anticipated to foster economic growth. Efficient logistics infrastructure is expected to decrease travel time and facilitate producers' access to distant markets. Furthermore, logistics enhancements will likely boost local production and attract foreign direct investment, thereby contributing to economic growth (Hooi Lean et al., 2014). Consequently, it is vital to investigate the significance of this inverse relationship.

Although research has been conducted on the relationship between global competitiveness and logistics performance, a detailed examination of how the infrastructure pillar in the GCI affects the LPI in ASEAN countries remains significantly limited. In contrast to other regions worldwide, such as Asia, Latin America, and Africa, addressing the need for infrastructure to bolster economic growth presents a substantial future challenge (gap). This need is critical for ensuring the connectivity of the ASEAN Economic Community (AEC), which achieves uniformly developed regions and integrates the region into the global economy effectively. Therefore, this study explores the influence of competitiveness within the infrastructure pillar on the LPI across ASEAN countries.

## **METHODS**

This study analyses the impact of national competitiveness on logistics performance, as measured by the LPI, in the ASEAN region, encompassing Singapore, Brunei Darussalam, Malaysia, Thailand, Cambodia, Indonesia, Laos, Myanmar, the Philippines, and Vietnam. The research period spans from 2012 to 2020, employing panel data. The data observed, collected, and analyzed in this study include national competitiveness (GCI) and logistics performance (LPI) across these 10 ASEAN countries, sourced from the annual reports of the World Economic Forum for the GCI and the World Bank for the LPI report.

The methodological approach of this study is quantitative, employing econometric analysis for model estimation through panel data regression equations. It utilizes three analytical approaches: the Common Effect Model, the Fixed Effect Model, and the Random Effect Model. Panel data, as defined by Baltagi (2008), refers to data resulting from observations across multiple individuals (cross-sectional units), each observed over several consecutive periods (time units). This study employs three tests to determine the most suitable model output from multiple linear regression using panel data: the Chow Test for deciding between the Common Effect or Fixed Effect models, the Hausman Test for choosing between the Fixed Effect or Random Effect models, and the Lagrange Multiplier (LM) test, for selecting between the Common Effect or Random Effect models.

The objective is to elucidate the relationship between the LPI and the selected

factors within GCI. Prior research, such as that by Sergi et al. (2021), identified three significant cluster groups in the GCI affecting LPI, Human Factors, and Institutions. They highlighted the crucial role of institutions in fostering competitiveness through national policies focusing on border flow management procedures, infrastructure policies, and land transportation regulations. However, our hypothesis posits that the infrastructure pillar within competitiveness plays a pivotal role in the logistics sector. This is due to the macro factors in the LPI, such as "international shipments," "domestic logistics competence," "national logistics costs," and "timeliness," exerting a significant influence (D'Aleo and Sergi, 2016). The research model is thus conceptualized with Competitiveness in the Infrastructure Pillar as the primary focus, examining the indicators of this pillar as follows:

$$LPI_{it} = \beta_0 + \beta_1 (QR_{it}) + \beta_2 (ETS_{it}) + \beta_3 (ESS_{it}) + \beta_4 (EATS_{it}) + \beta_5 (EL_{it}) + e_{it} \dots\dots\dots (1)$$

Where  $LPI_{it}$  denotes the logistics performance index (ranging from 0 to 5),  $QR_{it}$  is the quality of roads (ratio 0-7, with higher values indicating greater competitiveness),  $ETS_{it}$  represents the efficiency of train services (ratio 0-7, with higher values indicating greater competitiveness),  $ESS_{it}$  is the efficiency of seaport services (ratio 0-7, with higher values indicating greater competitiveness),  $EATS_{it}$  denotes the efficiency of air transport services (ratio 0-7, with higher values indicating greater competitiveness), and  $EL_{it}$  is electrification (ratio 0-7, with higher values indicating greater competitiveness), serving as an indicator of the infrastructure pillars in global competitiveness.  $\beta_0$  is the constant,  $\beta_1$  to  $\beta_5$  are the variable coefficients,  $e_{it}$  is the residual value outside the model,  $i$  represents the cross-section (10 regions), and  $t$  denotes the time series (2012-2020).

## RESULTS AND DISCUSSION

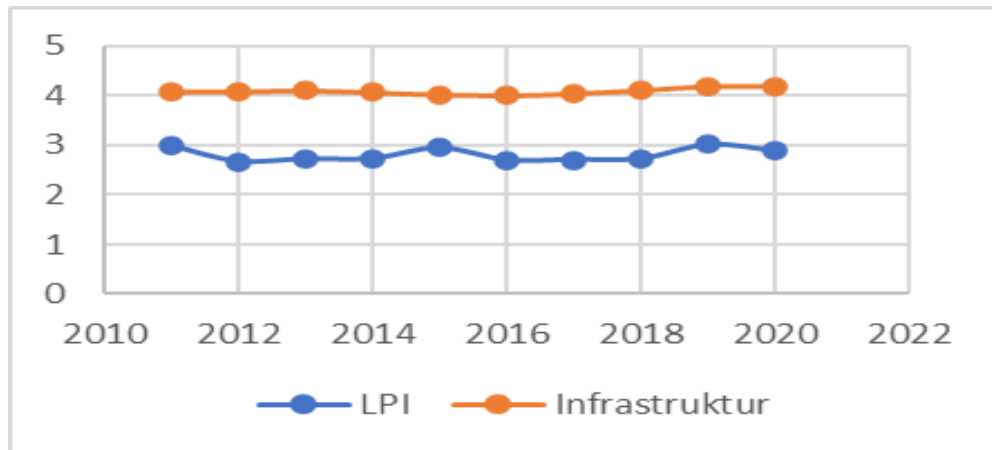
### Development of infrastructure competitiveness and Logistics Performance Index in the ASEAN Region

Infrastructure is recognized as a crucial pillar that impacts logistics performance. This assertion is consistent with the findings presented in the Global Competitiveness Report (Schwab, 2017), which underscores the importance of efficient infrastructure for the smooth operation of an economy. The availability of high-quality transportation methods, such as roads, railways, ports, and air transport, is vital for enabling business professionals to move goods and services to the market securely and on time.

These observations agree with Kvint's (2004) predictions that Asia will prioritize infrastructure development. This focus is partly driven by the anticipation that 350 million births over the next few years will create a significant demand for transportation and communication infrastructure, including roads, bridges, power plants, and networks. The development of physical and digital infrastructure is foundational for stimulating economic activities in Asia, facilitating the efficient and effective production and distribution of goods locally and globally in trade activities.

The analysis, supported by Figure 1, highlights the relationship between infrastructure competitiveness and logistics performance. Infrastructure competitiveness is rated on a scale of 1 to 7, with values closer to 7 indicating higher competitiveness. Similarly, logistics performance is measured on a scale of 1 to 5, with values closer to 5 reflecting better performance. The data reveal that between 2011 and 2015, the

competitiveness of infrastructure and logistics performance exhibited fluctuations, with notable improvements in 2015 — logistics performance increased by 5% from 2014, and infrastructure competitiveness rose by 2% from the previous year. This correlation suggests that a country's infrastructure competitiveness enhancements can positively affect its logistics performance, which is critical for facilitating trade in goods, including exports and imports, within the ASEAN region.



**Figure 1.** Infrastructure pillar on competitiveness and LPI in ASEAN

Trade in goods can significantly benefit from advancements in regional and long-distance link terminals, such as developing and modernizing ports and airports, expanding road access for logistics, and strategically located logistics platforms and distribution centers. These improvements aim to optimize supply, demand, and intermodal transport locations, thereby reducing costs and enhancing a country's logistics performance.

A robust infrastructure reduces transportation costs and supports the fluid movement of goods, people, and information. This is especially important for developing countries, where enhancing connectivity infrastructure is a high priority for sustainable development. The 2018 Logistics Performance Report (Arvis et al., 2018) indicates that infrastructure concerns are prevalent across all LPI performance categories except for the highest-performing groups. The report also notes that the quality of information and communication technology (ICT) is consistently rated above that of physical transportation infrastructure. In their research, Bensassi et al. (2015) utilize an expanded gravity trading model that considers logistics and infrastructure indicators in transportation as explanatory variables. Their analysis, based on bilateral exports from Spain, demonstrates the significant role of logistics in understanding the flow of traded goods.

To enhance sector competitiveness through infrastructure and logistics performance pillars, we will examine the data on these variables as presented in the article, specifically through the descriptive statistics in Table 1. The data shows the mean values: LPI at 2.978, QR at 4.146, ETS at 3.091, ESS at 4.053, EATS at 4.494, and ELC at 4.680. These averages serve as a representation of the observed data. Additionally, the standard deviation, represented as "s," indicates the average deviation of the data from its mean. The standard deviations are as follows: LPI (0.510), QR (1.149), ETS (1.323), ESS (1.215), EATS (1.178), and ELC (1.195). The fact that the

standard deviations are lower than the means suggests no extreme outliers within these variables exist.

**Table 1.** Descriptive statistics

	LPI	QR	ETS	ESS	EATS	ELC
Mean	2.978	4.146	3.091	4.053	4.494	4.680
Median	2.975	3.900	2.500	3.900	4.300	4.600
Maximum	4.140	6.500	5.900	6.800	6.900	6.900
Minimum	2.067	2.300	1.600	2.000	2.200	2.700
Std. Dev.	0.510	1.149	1.323	1.215	1.178	1.195
Skewness	0.647	0.435	0.927	0.716	0.271	0.207
Jarque-Bera	6.983	5.100	15.768	8.543	1.529	3.642
Probability	0.030	0.078	0.000	0.014	0.466	0.162
Observations	100	100	100	100	100	100

Source: Data processed, 2022

\*Note: LPI is logistics performance index, QR is Road Quality, ETS is Railway Service Efficiency, ESS is Port Service Efficiency, EATS is Air Transport Service Efficiency, ELC is Electrification

Regarding LPI, the highest value recorded is 4.14, observed in Singapore, whereas the lowest is found in Laos. For competitiveness through road quality (QR), Singapore also scores the highest at 6.5, with Myanmar having the lowest road quality score of 2.3 out of 7.0. Singapore leads in the efficiency of train services within the ASEAN Region with a 5.9 out of 7.0 score, while Cambodia has the lowest score of 1.6. The highest efficiency of seaport services is also in Singapore, scoring 6.8 out of 7.0, with Laos having the lowest score of 2.0. Regarding the efficiency of air transport services, Singapore again ranks highest with a score of 6.9 out of 7.0, and the lowest score, 2.2, is observed in Myanmar. Electrification competitiveness scores highest in Malaysia and Singapore, at 6.9 out of 7.0, with the lowest score being 2.7 in Myanmar.

These findings indicate that Singapore stands out in terms of infrastructure pillars and logistics performance, whereas countries like Myanmar and Laos exhibit lower competitiveness within the ASEAN region. This highlights a significant regional disparity in the Logistics Performance Index (LPI) and competitiveness scores, affecting trade levels and reliance on a few countries for trade flow. For the ASEAN Economic Community (AEC), this presents a substantial challenge in addressing infrastructure gaps that could hinder regional interaction and cooperation, ultimately limiting potential growth within the ASEAN Region.

### Econometric result

The results of panel data estimation were employed to analyze infrastructure pillars, focusing specifically on indicators within them, such as road quality, rail service efficiency, port service efficiency, air transportation service efficiency, and electrification, and their impact on logistics performance in the ASEAN region. The analytical models selected for examination were the Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM). A comparison of these models is presented in Table 2.

Analysis of Table 2 reveals that the CEM statistically outperforms the other models. This is because almost all variables, including QR, ESS, EATS, and ELC, display probability values lower than the significance level. However, the ETSS variable exhibits a probability value higher than the significance level at 0.1815. For the



FEM, there are two variables, QR (0.6944) and ETSS (0.0986), which do not exhibit significance values below five percent. Conversely, the variables ESS, EATS, and ELC all show probability values lower than the five percent significance level. In the REM approach, only two variables, ETSS and ESS, have probability values below 5 percent, indicating their significant impact on logistics performance in the ASEAN region. The QR, EATS, and ELC variables, displaying probability values above the significance level in the REM, do not significantly affect logistics performance within this context.

**Table 2.** Panel data regression output results on LPI

Variable	CEM		FEM		REM	
	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.
C	1.340961	0.0000	3.136850	0.0000	1.929063	0.0000
QR	-0.423271	0.0000	0.032816	0.6944	-0.057070	0.4426
ETSS	0.039777	0.1815	0.099564	0.0986	0.119351	0.0072
ESS	0.396129	0.0000	0.206849	0.0093	0.267574	0.0001
EATS	0.177489	0.0058	-0.191993	0.0227	-0.035550	0.6157
ELC	0.184943	0.0013	-0.123609	0.0337	-0.001788	0.9703

Source: Processed data, 2022

\*Note: LPI is logistics performance index, QR is Road Quality, ETS is Railway Service Efficiency, ESS is Port Service Efficiency, EATS is Air Transport Service Efficiency, ELC is Electrification

Furthermore, three diagnostic tests were conducted to identify the most suitable model for analyzing the impact of infrastructure competitiveness on the Logistics Performance Index in the ASEAN region: the Chow test, the Hausman test, and the Lagrange Multiplier (LM) test. The outcomes of these model tests are summarized in Table 3.

**Table 3.** Best model testing

Best model testing	Infrastructure	
	Statistic	Prob.
Chow test	18.233	0.0000
Hausman test	29.642	0.0000
LM test	51.080	0.0000

Initially, the Chow test was used to compare the Pooled Least Squares (PLS) method with the Fixed Effect Model (FEM), aiming to evaluate the suitability of applying FEM. The results, indicating a probability value of 0.0000, suggested that the FEM is preferable due to its statistically significant difference from PLS, as evidenced by a probability value below the 5% significance level. Subsequently, the Hausman test was employed to decide between the FEM and the Random Effect Model (REM). With a Chi-Square probability value of 0.0000, the FEM was again identified as the superior choice. These tests, leading to the same conclusion, rendered the Lagrange Multiplier test unnecessary. Therefore, it was concluded that the FEM is the most appropriate approach for analyzing the influence of Global Competitiveness Infrastructure Pillars on the Logistics Performance Index.

The estimation results using the Fixed Effect Model approach are detailed in Table 4. Further stages of analysis involved statistical tests, including the F test, t-test, and the coefficient of determination. The results from the F statistic test indicated that the statistical F probability value is less than the 5% significance level ( $0.0000 < 0.05$ ).

This suggests that all estimation variables in the fixed effect approach significantly impact the Logistics Performance Index in the ASEAN region.

**Table 4.** Panel data regression output using Fixed Effect Model approach

Variable	Coefficient	t-Statistic	Prob.
C	3.13685	9.922829	0.0000
QR	0.032816	0.394199	0.6944
ETS	0.099564	1.66981	0.0986
ESS	0.206849	2.663231	0.0093
EAT	-0.191993	-2.32023	0.0227
ELC	-0.123609	-2.15878	0.0337
R-squared	0.951698		
Adjusted R-squared	0.943743		
F-statistic	119.6265		
Prob(F-statistic)	0.000000		

Source: Data processed, 2022

\*Note: LPI is logistics performance index, QR is Road Quality, ETS is Railway Service Efficiency, ESS is Port Service Efficiency, EATS is Air Transport Service Efficiency, ELC is Electrification

The t-test results for each variable revealed that road quality (QR) and train service efficiency (ETS) have values above the 5% significance level, suggesting that these variables do not significantly affect logistics performance in the ASEAN region individually. Conversely, the variables of port service efficiency (ESS), air transport service efficiency (EAT), and electrification (ELC) are found to significantly influence logistics performance in the ASEAN region, as indicated by t-values greater than the t-table values and probability values less than the 5% significance level.

The coefficient of determination, which measures the ability of the independent variables to explain the variation in the dependent variable, is noted to be 0.9437. This implies that the variables of road quality, efficiency of rail services, efficiency of port services, efficiency of air transportation services, and electrification collectively explain 94% of the variance in logistics performance.

The constant term = 3.136 suggests that if the values for road quality, railway service efficiency, port service efficiency, air transportation service efficiency, and electrification are all held constant or set to zero, the LPI would be 3.136 percent. This implies that, in the absence of these infrastructure elements, the LPI stands at 3.13 percent.

The coefficient for road quality (QR) = 0.0328163023374 indicates a positive relationship with the LPI. Specifically, a 1% improvement in road quality is associated with a 0.03281 percent increase in the LPI.

The coefficient for railway service efficiency (ETS) = 0.0995640474459 also shows a positive effect on the LPI. A 1% increase in railway service efficiency could elevate the LPI by approximately 0.0995640 percent. Similarly, the coefficient for port service efficiency (ESS) = 0.206849199791 demonstrates a positive impact, where a 1% enhancement in port service efficiency would result in a 0.206849% increase in the LPI.

On the other hand, the coefficient for air transportation service efficiency (EAT) = -0.191993398094 indicates a negative effect on the LPI. Thus, a 1% rise in air transportation service efficiency would decrease the LPI by 0.191993 percent.

Lastly, the coefficient for electrification (ELC) = -0.123609357694 suggests that

electrification negatively affects logistics performance. A 1% increase in electrification levels would lead to a 0.12360 percent reduction in the LPI.

These findings underscore the pivotal role of infrastructure in enhancing the competitiveness and efficiency of logistics operations. The positive influence of road quality, railway service efficiency, and port service efficiency aligns with the expectation that effective transportation infrastructure is crucial for the smooth functioning of the economy, enabling businesses to move goods and services to the market efficiently. Conversely, the negative impact of air transportation service efficiency and electrification on the LPI calls for a deeper investigation into the underlying reasons, potentially including operational inefficiencies or misalignments with current logistics needs.

This analysis resonates with the insights from the Global Competitiveness Report (Schwab, 2017), which emphasizes the importance of efficient infrastructure in fostering economic activity. High-quality transportation modes such as roads, railways, ports, and air services are fundamental for entrepreneurs and businesses to access markets effectively and on time. The strong correlation observed between infrastructure competitiveness and logistics performance in the ASEAN region highlights the critical role of infrastructure development in achieving higher levels of logistics efficiency and competitiveness on a global scale.

Table 5 illustrates that each infrastructure indicator exhibits a robust correlation (0.7-0.8). Specifically, the quality of port services is associated with a correlation of 0.88, the efficiency of air transportation with 0.84, and the efficiency of rail services with 0.81. This underscores a strong correlation between port services and logistics performance. The significance of ports in economic development has grown with their increasing relevance in logistics activities, particularly in intermodal or multimodal transportation. Furthermore, ports often serve as foundational locations for cities or civilizations, housing numerous cultural heritage and colonial buildings in urban areas. A pivotal and strategic role of a port lies in its substantial contribution to the growth of industry, economy, and trade, marking it as a vital sector in national economic development. Moreover, transportation services play a crucial role in ensuring the smooth operation of the national economy, particularly through ports. Their importance is reflected in facilitating distribution to enhance the flow of goods.

**Table 5.** Infrastructure competitiveness correlation coefficient

Correlation	LPI
Quality Roads (QR)	0.75983
Efficiency of Train Services (ETS)	0.81851
Efficiency of Seaport Services (ESS)	0.88756
Efficiency of Air Transportation (EATS)	0.84902
Electrification (ELC)	0.72374

*Source: Processed data, 2022*

The quality of roads is essential for facilitating the flow of goods; however, the correlation between road quality and logistics performance is relatively low compared to other infrastructure types. This discrepancy stems from the varying road quality across ASEAN member countries. For instance, Singapore and Malaysia exhibited competitive road quality ratings of 6.5 and 5.3 in 2020, nearing excellence. In contrast, developing countries such as Myanmar and Vietnam reported significantly

lower ratings of 2.3 and 3.4 in 2020, respectively, highlighting a stark disparity in road quality. Adequate road and rail services are pivotal for distributing goods to trading venues, encompassing domestic and international trade. The multiple linear regression analysis further indicates that road quality and rail service efficiency do not significantly impact Logistics Performance.

The analysis reveals that road infrastructure is poorly developed and uneven in the ASEAN region, particularly in countries with medium and low per capita income levels (below 60 million rupiah), such as Indonesia, the Philippines, Vietnam, Laos, Cambodia, and Myanmar. This is largely due to inadequate investment in upgrading and maintaining transport networks. Road and rail infrastructure are deteriorating across the continent due to insufficient funding and a maintenance backlog. Maintenance budgets have not kept pace with the expansion of infrastructure and its aging, often facing significant reductions and adversely affecting roads in many countries. Additionally, adapting infrastructure to new mobility patterns and the need for clean, alternative fuel infrastructure introduces further challenges, necessitating new investments and a shift in the approach to designing transport networks and business models. This aligns with the study's findings, which indicate no significant effect of road quality on logistics performance in trade, as evidenced by a probability value exceeding the 5% significance level.

Addressing the infrastructure disparity among ASEAN countries, where the level of development and provision of infrastructure varies significantly, necessitates ASEAN integration through enhanced connectivity. In recent years, ASEAN leaders have agreed on the Master Plan for ASEAN Connectivity (MPAC), a testament to their commitment to bridging this gap. MPAC aims to foster a well-connected ASEAN by 2015, which is expected to bolster the region's resilience and competitiveness, facilitating closer interaction among people, goods, services, and capital. Furthermore, by advancing ASEAN connectivity, it is envisioned that the production and distribution networks within the ASEAN region will become more extensive, deeper, and more integrated with the economies of East Asia and the world at large. The strategy outlined in MPAC encompasses the development of physical infrastructure, establishing effective institutional mechanisms and processes, and empowering communities to enhance connectivity among ASEAN residents.

Road infrastructure and rail services are pivotal for a country's development, ensuring the distribution of essential goods such as food and clothing. In the ASEAN region, particularly in developing and poorer countries like Indonesia, Laos, Thailand, and Vietnam, road and rail infrastructure quality falls short of that found in more developed member states such as Singapore and Malaysia. The challenge is compounded by high funding requirements and maintenance costs, which have not scaled in proportion to the growing length and aging of the infrastructure. This study corroborates these challenges, indicating no significant impact of these infrastructural elements on logistical performance, as the probability values of these variables exceed the 5% significance level.

Another critical facet of infrastructure impacting global competitiveness is the efficiency of port services. Ports facilitate economic transactions through exports and imports, significantly influencing logistics performance. This study reveals that in the ASEAN region, the efficiency of port services markedly affects a country's logistics

performance. An increase in port service efficiency is associated with improved logistics performance, while a decline in efficiency adversely affects it. This aligns with findings from several studies, including those by Hausman et al. (2013), which suggest a significant correlation between port infrastructure quality and a country's logistics performance and the influence of logistics performance on maritime trade. While some research emphasizes ports' immediate job creation potential, others, like Helling & Poister (2000), argue that ports focusing solely on direct employment opportunities may become less competitive over time, resulting in fewer long-term employment opportunities. Economic development, they suggest, is more closely linked to a port's long-term ability to attract customers, thereby creating and sustaining jobs and income. Since maritime transportation necessitates inputs from a broad network of interconnected transportation and logistics industries, neglecting continuous improvements in port infrastructure quality could have significant negative implications for a country's economy.

## **CONCLUSION AND RECOMMENDATIONS**

### **Conclusion**

The development of transport network infrastructure necessitates appropriate investment, particularly in new road and railroad infrastructure. To enhance infrastructure, repairing and modernizing existing networks and increasing coordination among ASEAN member countries is vital. High-quality infrastructure supports the efficient distribution of goods for import and export, significantly impacting a country's logistics performance as indicated by various performance metrics. In infrastructure competitiveness, land, sea, and air transport access is essential for improving a country's logistics performance. This study's analysis underscores the critical role of competitiveness indicators within the Infrastructure Pillar in enhancing national logistics performance..

### **Recommendations**

The government is advised to establish a Sustainable Development Commission to conduct thorough analyses on developing sustainable infrastructure for the movement of goods. Sustainable and eco-friendly infrastructure development strategies should include adopting green construction practices, investing in renewable energy for transportation, and implementing policies to minimize the carbon footprint in logistics activities.

Additionally, the government should invest in infrastructure that encourages the establishment of logistics parks. Investment reform and infrastructure development should be grounded in solid economic analysis to foster growth. This involves creating a joint funding mechanism for infrastructure projects in partnership with the Asian Development Bank (ADB), specifically through the ASEAN Infrastructure Fund (AIF). The AIF aligns with ASEAN's strategic commitment under the Master Plan on ASEAN Connectivity (MPAC) and the ASEAN Economic Community (AEC), which aims to reduce infrastructure disparities among countries and advance broader ASEAN connectivity objectives.

Beyond physical infrastructure, the potential of digital infrastructure to boost logistics performance cannot be overlooked. Investments should be channelled into

digital platforms for logistics management, enhancing ICT infrastructure for improved communication and coordination, and adopting technologies like the Internet of Things (IoT) and blockchain for supply chain transparency.

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