Paper Logistic

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The impact of logistic performance on intra-ASEAN trade

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I. ABSTRACT

As a growing region, ASEAN has paved its way towards trade liberalization. Similar to the European Union (EU) as their role model, ASEAN has a growing trade percentage. However, ASEAN has a relatively lower intra-regional trade than the EU. The reduction of tariffs was no longer an efficient way to increase trade. Therefore, this study analyzes other factors, other than traditional tariff reduction, that have a positive impact on trade. This study found the relationship between logistics performance and bilateral export value using data from 10 ASEAN member states from 2007 to 2018 with gaps. The results showed that the majority of improvements in logistics performance, by both the private sector and government, have a positive and significant impact on export value. In addition, the different income levels of a state might have different impact magnitudes. In summary, this study emphasizes the importance of collaboration between the private sector and government to improve logistics performance and have higher export values.

ABSTRAK

Sebagai kawasan berkembang, ASEAN telah membuka jalan menuju liberalisasi perdagangan. Seperti Uni Eropa (UE) sebagai panutannya, ASEAN memiliki persentase perdagangan yang terus meningkat. Namun, ASEAN memiliki perdagangan intra-regional yang relatif lebih rendah daripada UE. Pengurangan tarif bukan lagi cara yang efisien untuk meningkatkan perdagangan. Oleh karena itu, studi ini menganalisis faktor-faktor lain, selain penurunan tarif tradisional, yang berdampak positif terhadap perdagangan. Studi ini menemukan hubungan antara kinerja logistik dan nilai ekspor bilateral menggunakan data dari 10 negara anggota ASEAN dari tahun 2007 hingga 2018 dengan kesenjangan. Hasil penelitian menunjukkan bahwa sebagian besar perbaikan kinerja logistik, baik oleh swasta maupun pemerintah, berpengaruh positif dan signifikan terhadap nilai ekspor. Selain itu, tingkat pendapatan yang berbeda dari suatu negara mungkin memiliki besaran dampak yang berbeda. Studi ini menekankan pentingnya kolaborasi antara swasta dan pemerintah untuk meningkatkan kinerja logistik dan memiliki nilai ekspor yang lebih tinggi.

Keywords: Logistics, export value, gravity model, ASEAN, trade

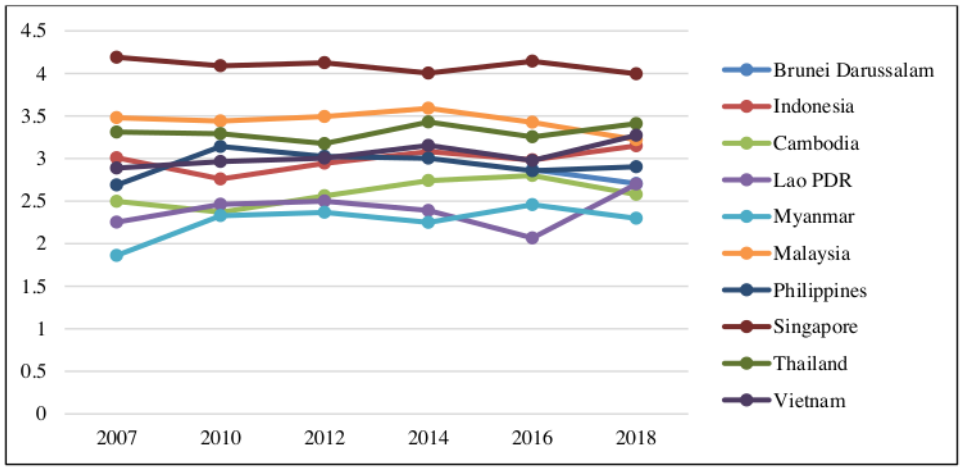
INTRODUCTION

Trade liberalization is an effective policy to achieve higher annual growth rates, investment rates, and GDP (Wacziarg & Welch, 2008). As a result, countries and regions are no longer separating themselves from the international market. For example, at a regional level, the European Union (EU)'s trade in goods accounts for 15.3 percent of world trade in 2018. At the same time, ASEAN's, another growing

and potential region, trade in goods accounts for 7.2 percent of world trade. Their growing interest in promoting trade should provide potential economic benefits in the future (ASEAN, 2019; Eurostats, 2021). However, the latest data from the EU shows that they have a relatively larger intra-regional trade compared to their extra-regional trade, which means that they trade more with other EU member states than non-EU member states. In contrast, ASEAN's intra-regional trade is relatively lower than its extra-regional trade, which means they trade more with non-ASEAN member states. Of the 10 member states, only Lao PDR has a share of intra-regional trade larger than the extra-regional trade. This issue is important to the region's connectivity.

Common Effective Preferential Tariff (CEPT), which supposedly increases their intra-regional trade, has been proven to have a relatively small impact on intra-ASEAN export (Debaere & Mostashari, 2010; Okabe & Urata, 2014). This can be explained by the existence of cost limitations, other than tariff, that are faced by exporters in the origin country. These trade cost barriers act as Non-Tariff Measures (NTMs), which are defined as other factors influencing trade (e.g., sanitary measurement, pre-shipment inspection, rules of origin). Those factors still made trade costs incredibly high, resulting in potential drawbacks to economic growth (Anderson & van Wincoop, 2004; Cadot et al., 2018; Plummer et al., 2016). Okabe & Urata (2014) suggest solutions to the situation which are improving infrastructure and developing domestic industries. This can further be simplified under the term "trade facilitation" (Cadot et al., 2018). The gains from trade facilitation are proven to be larger than those from tariff reduction (Shepherd & Wilson, 2009).

According to the World Trade Organization (WTO), trade facilitation is a simplified, modernized, and harmonized process of export and import to tackle the problem of bureaucratic delays faced by exporters and importers. Trade facilitation overall focuses on simplifying documents required for trade, modernizing customs procedures required, as well as reducing days and costs for exporting and importing goods across borders. Figure 1 shows the World Bank's Logistics Performance Index, one of the measures for trade facilitation, for ASEAN Member States. Singapore is the leading country in ASEAN with the best logistics performance. Since LPI's establishment in 2007, Singapore has already been in the top 10 performers in the world with an average nearly excellent score of 4. However, the rest of the ASEAN member states barely catch up, especially the lower middle income countries.



Note: Range "very low" (1) to "very high" (5). Source: World Bank. Author's Compilation.

Figure 1
ASEAN Member States' LPI Score (2007–2018)

Table 1 shows the export value of goods within ASEAN member states from 2007 to 2018, reaching a total of 344 billion USD in 2018. Intra ASEAN exports of goods are dominated by Singapore, Malaysia, Thailand, and Indonesia. However, as relatively underdeveloped ASEAN countries become more open to globalisation and trade, the dominance of the four countries is getting weaker (Okabe & Urata, 2014). Therefore, it is important to increase intra-ASEAN exports and to further maximize its potential as a region. This study aims to examine the impact of logistics performance on intra-ASEAN export value. The main research question is, "How can logistics performance be improved to increase ASEAN member states' export value?" The improvement in logistics performance can then be classified into two groups, which are the areas of improvement for the private sector and government related to trade and transporting goods in the ASEAN region. This study will determine which logistics performance measurement has the most impact on exports for all ASEAN member states and for ASEAN's lower to upper middle income member states. In the end, this study aims to provide recommendations to the private sector and government so that they can establish their improvement priorities at the state and regional levels. Gani (2017) and Martí et al. (2014) are two studies that this study refers to. This study will contribute to the ASEAN literature and shed light on trade-related improvement areas for the private sector and government. Moreover, this study can explain the magnitude of the impact of enhancing logistics performance and identify which factors might be prioritized.

Table 1
Intra ASEAN Exports of Goods (in million USD)

Country	2007	2010	2012	2014	2016	2018
Brunei	2,150	1,096	2,104	2,093	1,493	1,847
Cambodia	251	313	517	362	870	955
Indonesia	22,292	33,348	41,831	39,668	33,830	41,913
Lao PDR	232	1,152	905	1,391	2,725	1,776
Malaysia	45,296	50,396	60,947	65,239	55,745	71,133
Myanmar	3,428	4,194	4,388	4,360	3,511	4,202
Philippines	8,032	11,558	9,804	9,212	8,401	11,181
Singapore	95,554	107,673	133,724	130,199	99,375	121,903
Thailand	32,894	44,318	56,730	59,426	54,657	64,962
Viet Nam	7,731	10,351	17,073	18,261	17,289	24,634
TOTAL	217,859	264,398	328,024	330,209	277,896	344,507

Source: (ASEANStats, 2021)

LITERATURE REVIEW

Many studies have used gravity models to capture trad The gravity model was pioneered by Tinbergen in 1962, followed by Anderson & van Wincoop (2003), who developed the estimation method for the gravity equation. The idea of the gravity model is that bilateral trade is proportional to the economic size of two countries, which is shown by GDP and the inverse of the geographical distance between them. In its basic form, the larger the economic size of both exporter and importer countries, the more significant the impact on the increase of trade is, and vice versa. As for distance, the greater the distance between two countries, the lower their trade.

The reason why ASEAN intra-trade is lower than extra-trade can be explained by the component of the gravity model, which is their member states' economic si Two countries with similar economic sizes tend to trade more with each other. In the case of the EU, the majority of its member states are in the high income group. As for ASEAN, the similarity in terms of economic sizes within member states is low. ASEAN has a combination of high, upper, and lower middle income member states. Second, distance can be widely interpreted. For example, geographical distance between two countries as proposed in the gravity model might be the traditional or physical approach to describe distance. Meanwhile, the other proxy for distance can also mean non-physical barriers such as differences in language, borders, or colonizers. All of the variables mentioned above are then used as control variables before adding variables of interest. The purpose of control variables is to control for changes in trade due to other usual factors rather than the variable of interest (Anderson & van Wincoop, 2003; Moïsé & le Bris, 2013).

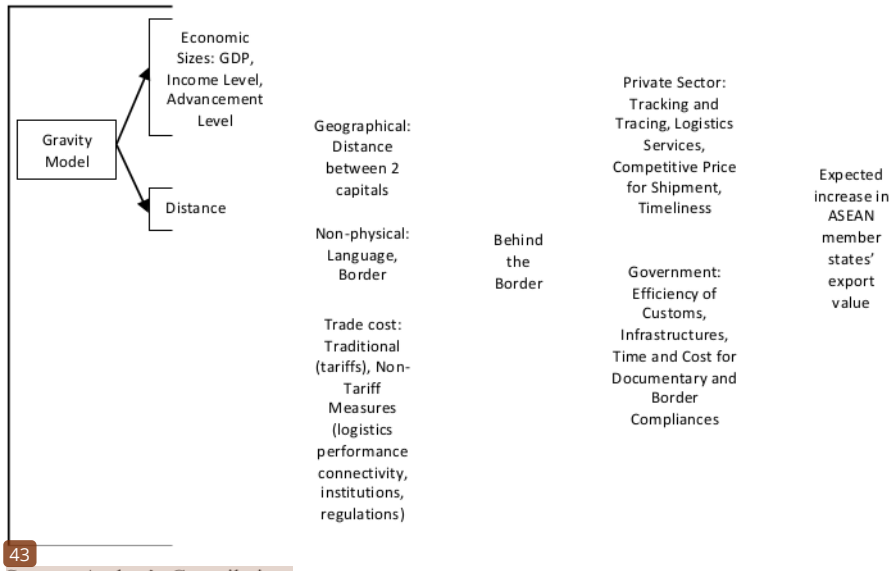
As mentioned in the previous section, another factor that might influence

trade is Non-Tariff Measures of trade cost barriers. This cost can be classified as another proxy to measure distance. However, measuring real trade costs from one country to another is hard (Anderson & van Wincoop, 2004). Therefore, Khan & Kalirajan (2011) help to conclude those costs into "behind the border costs" and "beyond the border costs." At a glance, behind the border costs are something that an exporting country can change, while beyond the border costs are something that an exporting country doesn't have the control to change. This study focuses on the former, behind the border barriers for the exporting side, which are cost factors that affect goods before they reach the border that a country can fix, such as institutional inefficiency, poor informational institutions, poor infrastructure, and bureaucratic problems. These issues are considered more important than direct policy instruments such as tariffs. As a result, improving convergency in those areas is expected to shorten the barriers of distance. The connectivity among countries can then be explained by logistics performance. In addition, efficient connectivity, improved logistics performance, or effective trade policy are expected to reduce fixed trade costs between two trading countries (Anderson & van Wincoop, 2004; Khan & Kalirajan, 2011; Lawless, 2010; Moïsé & le Bris, 2013).

METHOD

Conceptual Framework

Figure 2 helps to understand the channel of improvement in logistics performance based on the gravity model. The highlight of studies in logistics performance is that each country differs in which component is more significant, but overall improvement in any component should lead to an increase in export performance (Feenstra & Ma, 2014; Felipe & Kumar, 2012; Halaszovich & Kinra, 2020; Martí et al., 2014; Portugal-Perez & Wilson, 2012). Logistics performance has grown in importance in terms of how it affects trade over time (Martí et al., 2014). Felipe & Kumar (2012) also show that overall improvement in the Logistics Performance Index (LPI) increases Central Asian countries' trade by 44 percent and doubles their intraregional trade. Most of the operational work in logistics in a country is performed by the private sector. Meanwhile, institutional or regulatory support are mostly supporting factors and are performed by the government. The whole process is defined by supply chain connectivity, where both the private sector and government work together in moving goods across borders, starting from producers in one country until they safely arrive at the consumer in another country (Arvis et al., 2018; Gani, 2017).



Source: Author's Compilation.

Figure 1
Conceptual Framework

The government area is quite prone to change and requires excessive coordination within agencies. In addition, customs, infrastructure, and compliance are policy and stimulus sensitive. Customs is usually time-consuming, needs unnecessary paperwork, and requires coordination among several customs agencies (Gani, 2017). These problems result in long transit delays that can significantly lower exports of goods in a country (Hummels & Schaur, 2013). Typically, developing countries have higher trade costs than developed countries. However, such a huge amount is prone to corruption. Unexpected costs such as bribery or corruption are quite a problem in trade cost regulation. As a result, there is a welfare loss that can reduce trade (Gani, 2017; Hornok & Koren, 2015a). Customs is one of the cores of the government's area of logistics performance and is considered a necessity. It is more like a short-term policy where cutting down on custom procedures is considered fast relative to infrastructure. Therefore, the modernization of customs procedures starts with good governance. A modernized customs procedure makes delivering goods across borders more efficient in both cost and time. Improving efficiency of cost and time to trade can have a direct impact on exports, thus creating a more competitive business to participate in the global value chain (Shujie & Shilu, 2009).

The last but equally and usually considered the most important factor to increasing export value in the government's area of improvement is infrastructure

(Feenstra & Ma, 2014; Felipe & Kumar, 2012; Halaszovich & Kinra, 2020; Martí et al., 2014; Portugal-Perez & Wilson, 2012). Infrastructure is more of a long-term investment. It is also prone to change since it depends on the amount of budget the government in a given period is willing to spend on infrastructure. Infrastructure is a huge constraint in developing countries, but lately it is improving (Arvis et al., 2018). As a supporting role, good infrastructure should affect all components in the private sector's area of improvement, such as services, prices, and timeliness. For example, if a toll road in a country is in bad condition or even worse can't be used, exports will be delayed as a problem of connectivity. An inadequate infrastructure shows how a country is isolated from the international market (Gani, 2017). The conclusion for the government's area of improvement is that, in the short term, improving customs efficiency is easier and cheaper than improving infrastructure. While in the long term, improving infrastructure will have a greater and more significant impact on trade (Feenstra & Ma, 2014).

Although the government's role is important, the key player who actually does the operations is the private sector. Private sector areas include the ability to track and trace, logistics services, competitive prices for shipment, and timeliness. The players are shippers, forwarders, trucking companies, terminal operators, and rail companies. Hummels & Schaur (2013) show that the use of fast but expensive air cargo has risen 2.6 times faster than the use of slow but cheap ocean ships. This shows how products to be exported are time-sensitive. Any delays in transporting goods will cause a decrease in exports. In addition, the increase in export prices paid to shipping companies will lower exports. A competitive price and a wide choice of export transportation options are needed. However, it can be done if only the transportation infrastructure is in good condition (Gani, 2017; Jiang et al., 2018).

The flow of transporting goods from one country to another involves parties, be it from the private sector or government agencies. For example, the availability to track and trace goods is a combination of work between shipping companies and a country's single window in trade. Each party has their own but interdependent role, so good coordination is needed to make export easier (Sholihah et al., 2018).

Data and Estimation Strategy

This paper examines the bilateral export data from 10 ASEAN countries: Singapore, Thailand, Vietnam, Malaysia, Indonesia, Philippines, Brunei, Laos, Cambodia, and Myanmar. There are a total of 90 country pairs from the periods 2007, 2010, 2012, 2014, and 2016. Description of the variables used in this study can be seen in Table 2 and 3. Logistics performance is classified into two groups: areas for improvement for the private sector and government. The data for logistics

performance is taken from the World Bank's Logistic Performance Index, consisting of surveys on trade operators (global freight forwarders and express carriers) worldwide. They filled in the survey online and were required to rate eight countries on the six most important logistics components. Countries are chosen based on the most important export and import markets of the country where the respondents are located. As for the World Bank's Trading Across Borders, border compliance includes customs regulations and other related inspections for shipments by customs agencies. Meanwhile, documentary compliance includes documents required for government agencies in the exporter country, the importer country, and even every transit. It includes requirements from government agencies, starting from getting the document issued and stamped, completing a customs declaration or certificate of origin, waiting time for the issued certificate, showing the documents to port authorities, until submitting the customs declaration (which can be in person or electronically).

Table 2
Description of Variables: Gravity

No	Variables	Measurement	Data Sources	Years	Expected Signs
Dependent Variable					
1	Export value	In million current USD	CEPII based on UNcomtrade	2007, 2010, 2012, 2014, 2016, and 2018	
Control Variable					
2	GDP (origin, destination)	In million current USD	CEPII	2007, 2010, 2012, 2014, 2016, and 2018	(+)
3	Geographical Distance	In kilometer			(-)
4	Common language	Dummy variable 1= have common language, 0 = otherwise			(+)
5	Common borders	Dummy variable 1= have common borders, 0 = otherwise			Uncertain

Source: Author's Compilation.

Table 3
Description of Variables: Logistics Performance

No	Classification	Variables of Interest	Data Sources and Measurement	Years	Expected Signs
1	Private Sectors	Tracking and tracing	World Bank's Logistic Performance Index "very low" (1) to "very high" (5)	2007, 2012, 2014, 2016, and 2018	(+)
2		Competence of Logistics Services			(+)
3		Competitive Price of Shipment			(+)
4		Frequency on Scheduled Time			(+)

No	Classification	Variables of Interest	Data Sources and Measurement	Years	Expected Signs
5	Government	Efficiency of Customs	World Bank's Logistic Performance Index "very low" (1) to "very high" (5)	2007, 2012, 2014, 2016, and 2018	(+)
6		Quality of Infrastructures			(+)
7		Time to export: documentary compliance	World Bank's Trading Across Borders Time in hours, cost in USD	2016 and 2018	(-)
8		Time to export: border compliance			(-)
9		Cost to export: documentary compliance			(-)
10		Cost to export: border compliance			(-)

Source: Author's Compilation.

This study uses bilateral trade data of ASEAN country pairs, so it is based on a gravity model where bilateral trade is proportional to the economic size of two countries, which is shown by GDP and the inverse of the geographical distance between them.

$$Trade_{ij} = \frac{\alpha GDP_i GDP_j}{Distance_{ij}} \quad \text{..... 1}$$

Previous literature included control variables to take account of other factors that might influence trade other than GDP and distance (Halaszovich & Kinra, 2020; Luthfianto et al., 2016; Portugal-Perez & Wilson, 2012). The dependent variables in this study are export value. This study uses different models for each logistics performance measure since analyzing all of them in one equation will lead to multicollinearity since they are highly correlated. The equations are as follows:

$$LnXijt = \beta_0 + \beta_1 Ln(GDPit) + \beta_2 Ln(GDPjt) - \beta_3 Ln(DISTijt) + \beta_4 (Logistics\ Performanceit*) + \beta_A (W) + uijt \quad \text{..... 2}$$

Where Xijt is Export value, export volume from country i to j at time t; GDPit is GDP of country i at time t; GDPjt is GDP of country j at time t; DISTijt is distance from country i to j; W is dummy variables (common languages, common borders); uijt is standard error.

There are ten separate models for each logistics performance as variables of interest. In addition, this study will only use logistics performance in exporter countries. For LPI components, variables will be in levels. For time and cost for both documentary and border compliance, variables will be measured in logarithmic form. This study uses an estimation method named Poisson Pseudo Maximum Likelihood (PPML) other than Fixed Effects or OLS. The dependent variable of export will not

be in logarithmic form but in levels. This method was developed by Silva & Tenreyro (2006). They argue that the previous method of estimating trade (i.e., OLS) might be inappropriate and biased, resulting in overestimating some variables. For example, PPML estimates a 50 percent smaller effect of a trade agreement on trade than OLS estimation. This can be misleading in terms of policy making. They believe that the root cause is the presence of heteroscedasticity, which is most likely to occur in estimating trade. Any nonlinear transformation in the model with no PPML estimation can lead to inconsistent estimates. Their test results suggest that PPML shows no sign of misspecification and is robust to any pattern of heteroskedasticity.

RESULT AND DISCUSSION

As for the economic size, in 2018, ASEAN's total GDP reached the highest and tripled its value from 2007 with a total of 3 trillion USD. ASEAN's enormous value propelled it to the top ten list of the world's largest economies. This shows the region's growing economy. The constantly growing GDP is also aligned with the increase in the population, from 572 million people in 2007 to 653 million people in 2018. In 2018, the ASEAN member state with the largest GDP is Indonesia, and the ASEAN member state with the smallest GDP is Brunei Darussalam. In terms of trade, ASEAN's total export value is increasing despite a drawback in 2016. In 2018, the overall intra-ASEAN export value reached 337,854 million USD. This is way higher than a total of 212,952 million USD in 2007. As was said in the beginning, the patterns of logistics performance and the value of exports are similar.

Most ASEAN member states are also connected by land, except the Philippines. Indonesia and the Philippines are both maritime countries surrounded by sea, but only Indonesia has a common border with Malaysia. As for non-physical distance, there are only 3 country pairs in ASEAN that have a common language (i.e., Brunei-Malaysia, Malaysia-Singapore, and Philippines-Singapore). ASEAN member states are also classified into different income groups. Singapore and Brunei are the only member states in the high income group, while the rest are split up into upper and lower middle income groups.

Following previous studies (Gani, 2017; Martí et al., 2014), this study runs several correlation tests for ASEAN member states' LPI components. This study concludes the existence of a high correlation among LPI components, with values ranging from 0.865 to 0.971. Therefore, to control for the potential presence of multicollinearity, this paper follows previous studies in putting all variables of interest into different regression equations. This study uses PPML to estimate the

model. In order to be more specific, the analysis of PPML will also take account of magnitude. Magnitude is being used to see the effect due to changes in independent variables on mean export value. On average, bilateral export values between ASEAN member states reached 3,358.366 million USD per year and country.

Table 4 shows the PPML estimation results. Model (1) includes basic control variables in the gravity model, which are GDP origin, GDP destination, distance between capitals, common language, and common border. Models (2) to (5) include variables of interest from private sector areas of improvement, which are tracking and tracing; competence of logistics services; ease and competitive price of shipping; and frequency of scheduled time. Models (6) to (11) include variables of interest from government areas of improvement, which are efficiency of customs and clearance, quality of infrastructure, time and cost at the border, and time and cost for documentary compliance.

Table 4
PPML Estimation Results

Independent Variables	**Dependent Variable: Export Value (in levels)**										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
lnGDP Origin	0.821***	0.682***	0.697***	0.730***	0.668***	0.767***	0.736***	0.843***	1.032***	0.933***	0.857***
	-0.039	-0.038	-0.038	-0.04	-0.036	-0.035	-0.037	-0.045	-0.074	-0.055	-0.058
lnGDP Distance	0.731***	0.670***	0.660***	0.672***	0.679***	0.662***	0.658***	0.659***	0.722***	0.672***	0.737***
	-0.040	-0.029	-0.029	-0.028	-0.028	-0.028	-0.028	-0.043	-0.051	-0.05	-0.062
lnDistance	-1.181***	-0.903***	-0.897***	-0.972***	-0.877***	-0.891***	-0.882***	-0.824***	-1.046***	-1.057***	-1.061***
between Capitals	-0.110	-0.077	-0.077	-0.077	-0.075	-0.076	-0.075	-0.088	-0.128	-0.110	-0.159
D Common	0.476***	0.154	0.154	0.144	0.193*	0.159	0.147	0.165	0.347**	0.139	0.558***
Language	-0.128	-0.101	-0.103	-0.0973	-0.103	-0.106	-0.103	-0.103	-0.142	-0.143	-0.183
D Common Border	-0.278*	0.0495	0.0344	-0.0612	0.0444	0.0461	0.0172	0.0852	-0.0906	-0.153	-0.172
	-0.144	-0.111	-0.113	-0.113	-0.105	-0.107	-0.109	-0.143	-0.188	-0.171	-0.214
Tracking and		1.060***									
Tracing		-0.0868									
Competence of			0.925***								
Logistics Services			-0.0786								
Ease/Competitive				1.226***							
Price of Shipping				-0.0996							
Frequency on					1.207***						
Scheduled Time					-0.0928						
Efficiency of						0.827***					
Customs/Clearance						-0.0674					
Quality of							0.793***				
Infrastructures							-0.0587				
lnTime								-0.342***			
Documentary								-0.0327			
lnTime Border									-0.0837***		
									-0.0161		
lnCost										-0.501***	
Documentary										-0.102	
lnCost Border											-0.368

Independent Variables	Dependent Variable: Export Value (in levels)										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Constant	-2.386***	-5.502***	-5.059***	-6.078***	-6.553***	-5.562***	-5.136***	-3.651***	-5.795***	-2.010*	-0.227
	-0.845	-0.757	-0.757	-0.834	-0.741	-0.771	-0.75	-1.007	-1.289	-1.162	-1.951
											-1.758
Observations	514	478	478	478	478	478	478	178	178	178	178
R-squared	0.776	0.878	0.876	0.886	0.881	0.87	0.889	0.929	0.870	0.885	0.823

Robust standard errors in parentheses

*Significant at 10%; **significant at 5%; ***significant at 1%.

Source: Author's Calculation.

The theory of international trade based on gravity shows that bilateral trade is proportional to the economic size of two countries, which is shown by GDP and the inverse of the geographical distance between them. Therefore, estimation results from model (1) show that the signs for GDP and distance are as expected. GDP in both the origin and destination countries has a significant impact on export value. The positive signs, as expected, show that an increase in GDP will increase export value. Interpretation of PPML is similar to OLS, but it needs to be measured carefully*. An increase in GDP in the origin country of 1 percent will increase export value by 8,210 USD (0.0002 percent of mean export value), ceteris paribus. On the other hand, an increase in GDP in the destination country of 1 percent will increase export value by 7,310 USD (0.0002 percent of mean export value), ceteris paribus. The magnitude might seem similar, but it is noteworthy that the role of GDP in the origin country on export value is significantly larger than GDP in the destination. Here, the distance variable is also significant and has a negative sign, which shows that an increase in distance will lower the export value. An increase in distance between two countries of 1 percent will decrease export value by 11,810 USD (0.0003 percent of mean export value), ceteris paribus.

The other measures of distance can further be interpreted as trade costs. All variables used in this study that act as trade cost barriers from private sector areas that can be improved by exporting countries show significant impacts at 1 percent level on export value and the signs are as expected for the majority of independent variables. This shows any improvement in logistics performance by the private sector can increase export value. The order of importance from the most to the least is: competitive price of shipment, frequency of shipment on scheduled time, tracking and tracing, and competence of logistics services. The interpretation of these variables is different from the previous ones†. On the other hand, most of the variables used in this study to capture government areas of improvement are significant at a 1 percent level. The signs of the significant variables are as expected. This shows any improvement in logistics performance by the government, except the cost of border compliance, can increase export value.

* 1% increase of independent variable in logarithmic function leads to changes of (Coefficient/100)*1 million USD dependent variable in levels, where the number equals to (Change/mean export value) as a percentage of mean export value, *ceteris paribus*.

† 1 level increase of independent variable in levels leads to changes of Coefficient*1 million USD dependent variable in levels, where the number equals to (Change/mean export value) as a percentage of mean export value, *ceteris paribus*.

Table 5 shows the interpretation of PPML estimation results based on the coefficient provided in Table 4. The coefficients for PPML estimates might be smaller than OLS estimates for the same dataset, as argued by Silva & Tenreyro (2006). Therefore, this study can't compare the magnitude of logistics performance on export head to head with previous studies that used other estimation strategies. However, the pattern for which components might affect trade more than others is similar to previous studies mentioned in the literature review (Gani, 2017). The results can be seen to decide priorities within a sector and to estimate their impacts on export value.

Table 5
PPML Estimation Results' Interpretation and Magnitude Impact

	1 Unit/Score increase in these components will change export value by X USD (Y% of mean export value)[‡]	1 percent increase in these components will change export value by X USD (Y% of mean export value) [§]
Tracking and Tracing	1,060,000 USD (0.03% of mean export)	
Competence of Logistics Services	925,000 USD (0.02% of mean export)	
Ease/Competitive Price of Shipping	1,226,000 USD (0.04% of mean export)	
Frequency on Scheduled Time	1,207,000 USD (0.03% of mean export)	
Efficiency of Customs/Clearance	827,000 USD (0.02% of mean export)	
Quality of Infrastructures	793,000 USD (0.02% of mean export)	
lnTime Documentary		(3,420 USD) (0.0001% of mean export)
lnTime Border		(840 USD) (0.00002% of mean export)
lnCost Documentary		(5,010 USD) (0.0001% of mean export)
lnCost Border		Not Significant

Source: Author's Calculation.

In conclusion, any improvement in LPI can have a significant impact on export value, but increases in time and cost to export can lower export value. However, ASEAN hasn't fully reached convergence. There are still significant gaps in their logistics performance. ASEAN also differs in income level. Logistics performance is way more than just income level. Even being a high-income country

[‡] *Ceteris paribus.*

[§] *Ceteris paribus. All interpretation under parentheses '()' means reduced.*

doesn't guarantee Brunei Darussalam to have good logistics performance. In response to that, this paper tries to analyze whether there are significant differences if several country pairs are excluded from the estimation (i.e., Singapore and Brunei), focusing on the rest of the ASEAN member states that are in upper middle and lower middle income groups.

The order of importance slightly changes. For the private sector area of improvement in ASEAN member states with lower middle to upper middle income levels, the most important component is the frequency of delivery of goods within a scheduled time. The ability to track and trace a consignee is still the second most important. Competitive prices on international shipments are now shifting to the third place. Logistics service competence is still the least important component. For government areas of improvement, efficiency in customs is still the most important component. The coefficient is larger for this certain income group (0.943) compared to all ASEAN member states (0.827). The quality of infrastructure becomes the second most important component. The coefficient is smaller for this certain income group (0.766) compared to all ASEAN (0.793). The cost of documentary compliance is no longer significant to explain export value. In contrast, the cost of border compliance is now significant, with a larger coefficient (-1.162) for this certain income group compared to the cost of documentary compliance in all ASEAN member states (-0.501). Time for documentary compliance still has negative impact on export (-0.387) while time for border compliance has a relatively small impact (-0.052).

Table 6 shows the gap in the private sector's logistics performance among ASEAN member states to show improvements that are needed by each member state. Based on its definition, logistics services evaluate the competence of transport operators such as shipping companies, trucking companies, freight forwarders, and also customs brokers to help exporters deal with tariffs, laws, documents, and payment needed by the customs agency. In 2018, the private sector logistics performance in Indonesia, Malaysia, Singapore, Thailand, and Vietnam was above average. In contrast, Brunei, Cambodia, Lao PDR, Myanmar, and the Philippines were still below the average. This data supports recent literature where lower middle income countries tend to have lower logistics performance (Gani, 2017).

Table 6
Gaps Among ASEAN Member States Private Sector's Logistics Performance (2018)

Country	Tracking and Tracing	Gaps	Competence of Logistics Services	Gaps	Ease/ Competitive Price Shipment	Gaps	Frequency on Scheduled Time	Gaps
	2018		2018		2018		2018	
Brunei	2.747	**-0.341**	2.710	**-0.303**	2.513	**-0.515**	3.174	**-0.227**

Country	Tracking and Tracing	Gaps	Competence of Logistics Services	Gaps	Ease/ Competitive Price Shipment	Gaps	Frequency on Scheduled Time	Gaps
	2018		2018		2018		2018	
Indonesia	3.300	0.212	3.100	0.087	3.228	0.200	3.670	0.269
Cambodia	2.515	**-0.573**	2.408	**-0.605**	2.794	**-0.234**	3.155	**-0.245**
Lao PDR	2.914	**-0.174**	2.649	**-0.364**	2.716	**-0.313**	2.843	**-0.558**
Myanmar	2.202	**-0.886**	2.279	**-0.734**	2.199	**-0.829**	2.908	**-0.492**
Malaysia	3.148	0.060	3.298	0.285	3.348	0.319	3.464	0.064
Philippines	3.059	**-0.029**	2.776	**-0.237**	3.293	0.264	2.984	**-0.417**
Singapore	4.080	0.992	4.100	1.087	3.580	0.552	4.320	0.920
Thailand	3.467	0.379	3.411	0.398	3.457	0.429	3.814	0.414
Vietnam	3.450	0.362	3.399	0.386	3.155	0.127	3.672	0.272
Average	**3.088**		**3.013**		**3.028**		**3.400**	

Source: Author's Calculation based on World Bank.

ASEAN member states' shipping capacity is different. Singapore, Malaysia, and Indonesia have more competitive international shipping that is not dominated by foreign shipping, unlike the rest of the ASEAN member states (Tongzon & Lee, 2015). The competitive price of shipping should be the main priority of the private sector with the help of government regulation since a decrease in freight rate can decrease the cost of trade, resulting in an addition of participation by smaller firms to the international market (Lawless, 2010; Melitz, 2003), followed by time since it is important due to some exports being time-sensitive. Small disturbances due to delays can affect the supply chain.

An effort to create a more competitive private sector is developing at both a regional and national level. The ASEAN Freight Forwarder Association is an example of integration at the regional level by the private sector. Each member state has their own national association, although under different but similar names (e.g. Indonesian Logistics and Forwarders Association, Federation of Malaysian Freight Forwarders). Their initiatives include coordinating with government agencies to negotiate and make agreements as well as dialogue to give input and insight for policy making. They also guide private sectors to meet international standards, increasing competitiveness as well as improving the quality of services. In addition, the Singapore Logistics Association offers exclusive training and learning for the logistics workforce under The Logistics Academy, which is a private education institute.

On the other hand, government areas of improvement are more complex. It requires coordination among ministries as policy maker, customs agency, and even infrastructure rely heavily on state budget. Our estimation results and interpretation show that customs and infrastructure are almost equally important depending on whether states' focus is on short-term or long-term policy, with customs having a slightly larger impact on export than infrastructure quality, ceteris paribus. These

results support recent study from Gani (2017).

Infrastructure (e.g., ports, roads, air ports, ICT) is still a problem for lower middle income countries. As shown in Table 7, Brunei, Indonesia, Cambodia, Lao PDR, Myanmar, and the Philippines have significant gaps compared to the rest of the ASEAN member states. Myanmar is the least developed country in terms of the quality of trade-related infrastructure. Given the importance that can be seen from the magnitude impact, prioritizing building international quality infrastructure is needed, especially for Myanmar. Plummer et al. (2016) show how Myanmar actually has a potential trade-related infrastructure. Being surrounded by India, Thailand, China, and Lao PDR by borders should give Myanmar opportunities to increase its trade performance. Developing their deep sea ports for big containers and improving road infrastructure for traded goods moved by land should be Myanmar's priority. For other countries that are still lagging behind in terms of infrastructure, involving the private sector in building infrastructure is needed to reduce the large financial cost of infrastructure (Plummer et al., 2016). In addition, ICT-related infrastructure is on the list of improvements. This improvement is quite related to the next component, which is customs efficiency.

Table 7
Gaps Among ASEAN Member States Customs Efficiency and Infrastructure (2018)

Country	Efficiency of Customs/ Clearance	Gaps	Quality of Infrastructure	Gaps
	2018		2018	
Brunei	2.622	**-0.163**	2.461	**-0.341**
Indonesia	2.673	**-0.112**	2.895	0.093
Cambodia	2.370	**-0.415**	2.145	**-0.657**
Lao PDR	2.613	**-0.172**	2.441	**-0.360**
Myanmar	2.167	**-0.618**	1.995	**-0.807**
Malaysia	2.898	0.113	3.147	0.345
Philippines	2.529	**-0.256**	2.726	**-0.076**
Singapore	3.887	1.102	4.064	1.262
Thailand	3.142	0.357	3.138	0.336
Vietnam	2.950	0.165	3.005	0.204
Average	**2.785**		**2.802**	

Source: Author's Calculation based on World Bank.

In the case of Indonesia, the quality of infrastructure is slightly above average, while customs efficiency is in need of improvement. Since 2017, the Indonesian government has shown its interest in infrastructure development by allocating an enormous budget. As a result, Indonesia's trade-related infrastructure's quality is already improving. This doesn't imply that infrastructure is not necessary since the allocation of infrastructure budget in Indonesia might be targeted to achieve connectivity within the nation. Improving their customs' efficiency needs to be the

top priority as well, given the importance and magnitude of customs on export value that is slightly higher than infrastructure.

The financial cost of removing customs barriers might be low compared to improving the quality of hard infrastructure. However, the political cost of reforming customs procedures might be larger than it seems, especially in lower middle income countries. Nevertheless, the benefit of modernising customs procedures should be greater than the cost. An efficient customs procedure helps to boost firm productivity, solve tax problems, and remove corruption at the border (Cadot et al., 2018; Moïsé & le Bris, 2013).

Burdensome requirements, discrimination, lack of client orientation, minimum use of technology, and bureaucratic delays are still ASEAN's problems, especially in Myanmar (Cadot et al., 2018; Tongzon & Lee, 2016). Indonesia, for example, has more than 15 private and government agencies working on its Indonesia National Single Window (INSW), so it takes all agencies to work together on one single platform. Thus, each member state has to first improve their governance quality for such a regulation to be fully implemented. However, NTMs are not meant to be fully eliminated. Cadot et al. (2018) show that shifting towards a more improved regulatory agency is much needed. Table 8 also shows that the pattern for time and cost is more diverse than customs efficiency and infrastructure. The Lao PDR is improving in terms of time and cost, with only a small gap (128.56 USD) left in cost for documentary compliance. In addition, Indonesia (32.36 USD) and Myanmar (33.56 USD) were also below the average in terms of cost for documentary compliance. However, NTMs are not meant to be fully eliminated. Cadot et al. (2018) show that shifting towards a more improved regulatory agency is much needed.

Table 8
Gaps Among ASEAN Member States' Trading Across Borders Score (2018)

Country	Time Documentary (hours)	Gaps	Time Border (hours)	Gaps	Cost Documentary (USD)	Gaps	Cost Border (USD)	Gaps
	2018		2018		2018		2018	
Brunei	155	**-88.838**	117	**-58.43**	90	16.44	340	**-28.2**
Indonesia	61.32	4.842	62.6	**-4.03**	138.8	**-32.36**	253.7	58.1
Cambodia	132	**-65.838**	48	10.57	100	6.44	375	**-63.2**
Lao PDR	60	6.162	13	45.57	235	**-128.56**	140	171.8
Myanmar	144	**-77.838**	141.6	**-83.03**	140	**-33.56**	431.7	**-119.9**
Malaysia	10	56.162	45	13.57	35	71.44	274	37.8
Philippines	36	30.162	42.5	16.07	52.5	53.94	456	**-144.2**
Singapore	2	64.162	10	48.57	37	69.44	335	**-23.2**
Thailand	11.3	54.862	51	7.57	96.9	9.54	222.6	89.2
Vietnam	50	16.162	55	3.57	139.2	**-32.76**	290	21.8
Average	**66.162**		**58.57**		**106.44**		**311.8**	

Source: Author's Calculation based on World Bank.

In response to the gaps mentioned above, ASEAN as a region has made a good start since the early days on how to reach convergence and ease in government areas of improvement. First, ASEAN member states are required to participate in a related framework, which is the ASEAN Framework Agreement on Facilitation of Goods in Transit (AFAFGIT). AFAFGIT was initially signed in 1998. Under AFAFGIT, ASEAN established ASEAN Customs Transit Systems (ACTS) for goods that are transported by road. This ICT-based system helps exporters pay and prepare for only one customs procedure, and there won't be several customs declarations. All information and electronic data are already stored in the system. ASEAN member states have agreed on ACTS and its designated routes and customs offices in each country. The implementation depends on the level of readiness of AMS.

In addition to the transit system, ASEAN as a region is also currently working on the ASEAN Single Window (ASW). This requires its member states to fully implement their own National Single Window. ASW enables the exchange of electronic trade-related documents between customs and other government agencies, the transport sector, as well as banks and insurance agencies. This will help exporters reduce time and costs associated with exporting goods. Starting from March 2016, Indonesia and Singapore have already exchanged their electronic ASEAN Certificate of Origin, Form D. Other trade related documents such as customs declarations are also in progress as an expansion of ASW under the name ASEAN Customs Declaration Document (ACCD). In December 2020, Singapore, Cambodia, and Myanmar joined and implemented ACCD. Other ASEAN member countries are expected to join by late 2021. In addition to that, ASEAN member states' public policies are different from each other. Tongzon & Lee (2015) show how Singapore and Malaysia provided more subsidies to their maritime sectors than Indonesia and the Philippines did.

Reaching infrastructure convergence in ASEAN requires each member state to unite despite having different priorities, budgets, strategies, or other regulations for infrastructure. Recently, ASEAN has been working on the Framework for Improving ASEAN Infrastructure Productivity. The goals are to make ASEAN member states have the same understanding of the importance and priorities of infrastructure to further converge with other ASEAN member states. A well-built coordination of regulations and standards has proven to be beneficial since it increases welfare. In conclusion, convergence logistics performance can help lower trade costs, allowing domestic and least productive firms to participate in international trade (Moïsé & le Bris, 2013).

CONCLUSION

This paper examined the impact of logistics performance on intra-ASEAN export value. The findings revealed statistically significant impacts of most logistics performances on export value. This study shows that improvements made by the private sector and government have similar and significant impacts on export value. The results are consistent in that short-term customs policy (0.0246 percent) has more impact on mean export value than long-term policy of infrastructure (0.0236 percent). The private sector acts as the main actor in transporting goods across borders, with the competitive price of shipment being the most important component; every improvement in this metric increases exports by 0.04 percent.

Time and cost are areas of improvement that are important in increasing ASEAN's export value by the private sector. While giving input to the government through discussion is important, adjusting more focus on internal quality is equally important. On the other hand, government-related policies, especially customs, administrative time, and cost, play a similar significant role in export. As supported by Hornok & Koren (2015b), trade facilitation in terms of government-related logistics performance will benefit trade more if all countries are at the customs union level rather than just a free trade area. This condition is supported by the movement towards an ASEAN Economic Community that may act as a substitute for the customs union. Another issue regarding public policy is the priorities set and planned by the governments of each member state. The main goal should be the progress of connected and developed customs and infrastructure within ASEAN. Convergence with the rest of the ASEAN member states in trade policy and requirements is needed. Given its importance, infrastructure should be the main priority of ASEAN member states.

There are limitations to this study. First, since this study uses PPML other than fixed effect, all impacts on export are initially calculated by levels, not changes in percentage. Second, the data for cost and time for documentary and border compliance changed its method in 2016, so this study only uses data from 2016 and 2018. There are a few suggestions for future studies. First, future studies may consider examining the extra-ASEAN trade level since ASEAN member states trade more with other countries outside ASEAN. Second, following previous literature, this study only uses logistics performance data from the World Bank's Logistics Performance Index and Trading Across Border. This paper suggests future research to include other logistics performance measurements that are more specific (e.g.

infrastructure spending as a percentage of GDP) to show more than just the quality but also the progress.

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