Better transport connectivity in ASEAN: Impacts on commodity trade

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Introduction

Background

In order to grow the economy and to improve welfare for the citizens, developing countries need to enhance domestic production and facilitate markets for the produce, while making employment opportunities available through facilitating business investment. Export markets provide incentives to domestic production, and it may be beneficial for a country to import goods and services that a country hasn't got comparative advantage in producing. To facilitate international trade and business investment, a country needs to take measures to minimise trade costs.

Trade costs comprise financial costs as well as time delays. These trade costs could significantly be reduced by two main ways. By improving logistics performance in each mode of transport and by transitioning from unimodal to multimodal (or combined) transport services. There are practical examples of significant savings in financial costs and delivery times by creating and improving multimodal connectivity.

'Multi-modal transport planning' refers to planning that considers various modes of transport and connections among modes (Litman, 2017). Research in the area of multimodal transportation planning has accelerated during the last decade (Steadie Seifi, 2014). The increasing interest in multimodal transport planning demonstrates the increasing focus on multimodal connectivity.

The 'ARISE (ASEAN Regional Integration Support from the European Union) Plus' project supports the implementation of the 'ASEAN Framework Agreement on Multimodal Transport' (AFAMT). As a part of the ARISE Plus project, the Centre for Supply Chain and Logistics (CSSL) was commissioned to benchmark the existing logistics performance in the ASEAN region.

Scope

This study will examine the following:

- What is the current situation in relation to multimodal connectivity in freight transport in the ASEAN region?

- What are the barriers to improving multimodal connectivity in freight transport in the ASEAN region?
- What are the potential economic impacts of increasing multimodal connectivity on the economies of the ASEAN region, in terms of economic growth, trade and investment flows and regional economic integration?
- What are the data available to support the analysis?
- What are possible policy actions to address the barriers identified?

Multimodal connectivity

The main limitation of this study is the problem of measurement of multimodal connectivity. Multimodal transport connectivity is a complex concept, involving the quality and quantity of infrastructure and the private sector's ability to coordinate complex inter-modal linkages. These three dimensions are captured in this study, by including information on land, air and sea transport in addition to logistics competence, as a proxy for an economy's ability to manage inter-modal connections along the supply chain.

A disadvantage in using this approach to measurement is that any network effects, such as the importance of an economy being connected to other economies that are themselves well connected, are not captured. Data for capturing these network effects are scarce and methodologies to exploit them are not developed yet.

Definition of terms

'Multimodal transport' of freight in this study is defined as carriage of goods by at least two different modes of transport, on the basis of a multimodal contract from a place in one country at which the goods are taken in charge by a 'multimodal transport operator', to a place designated for delivery located in a different country.

A 'multimodal transport operator' is defined as a person who, on his own behalf or through another person acting on his behalf, concludes a 'multimodal transport contract' and who acts as a principal, not as an agent of or on behalf of the consignor or of the carriers participating in the multimodal transport operations, and who assumes responsibility for the performance of the contract.

A 'multimodal transport contract' is a single contract with the sender of the goods, for door-to-door delivery of the goods from one point in a place in one country to a point in a place in another country. In this case, the sender does not need to be liaising with more than one transport contractor as with unimodal transport services.

'Multimodal connectivity' means how effective and efficient that the multimodal transport, as defined above, practically operates in an economy. In other words, multimodal connectivity means the performance of multimodal transport in an economy.

A prerequisite for improving multimodal connectivity in an economy is the effective transition from unimodal to multimodal freight transport contracts. This type of a transition needs implementing necessary regulatory changes, capability building, accreditation and registration

of multimodal transport operators, improving efficiency and reducing time delays in transporting, trans-loading and customs clearance, and improving infrastructure in relation to transport routes and hubs such as airports and sea ports.

Other studies on multimodal connectivity

Connectivity has been studied between trading economies within a single mode (for example, Arvis and Shepherd, 2013) as well as between modes within a single economy (for example, Shepherd, et al, 2010).

Multimodal connectivity assessments have mainly been conducted, in relation to passenger transport (Litman, 2017; OECD, 2016; Krul, et al, 2010). Similar studies in relation to freight transport are not so common.

The Asia-Pacific Economic Cooperation (APEC) has completed a detailed study on the economic impact of multimodal connectivity in the APEC region (APEC, 2010). For each of the 19 APEC countries analysed, the changes from 2005 to 2010, the relative position with regard to maritime, air and land transport, logistic competence and an aggregated multimodal transport indicator are presented. The correlation between exports and multimodal transport performance has been estimated using the Gravity Model of bilateral trade (see Shepherd, et al, 2011).

The US congress has brokered a long-term agreement to address the nation's infrastructure challenges, through the passage of a new five-year, $305 billion surface transportation bill—Fixing America's Surface Transportation (FAST) Act, 2015. Passing this act has begun to sketch out a new multimodal freight policy, strategic plan, and network (Kane and Tomer, 2015).

Butta and Abegaz (2016) have studied the challenges, including connectivity issues, in the operation of the multimodal transport system in Ethiopia after being introduced in 2012.

Direct and indirect benefits

Multimodal connectivity includes individual modes of transport, such as air, sea, road and rail, as well as the inter-modal linkages. It is based on a network of nodes (such as sea ports and airports) and links (such as roadways, railways and air and sea routes).

Improvements in the efficiency and performance of any freight transport mode individually or linkages between modes, would directly benefit the users of these modes of transport. The businesses that use freight transport services would take the advantage of these improvements by adjusting their logistics processes and supply chains. Over time, the businesses would end up making input substitutions and reconfiguring production processes, thereby improving service and reducing costs.

The economy-wide impact of transportation system improvements capture the spill-over effects and other multiplier effects. Improvements in multimodal connectivity could lead to an

expansion of a transportation network, thereby opening-up access to previously un-reachable areas and linking key economic centres in a region to central national markets.

Trade and foreign direct investments could expand due to improvements in transportation and logistics. Export and import volumes could grow with reduction in freight costs and time delays. Access to interior areas of a country due to improvements in transport links, would provide opportunities for local producers to access cheaper land and labour in the country's interior. Overseas investors could also become aware of the formation of these complementary business clusters in inland, prompting foreign direct investment.

Growth in trade and business investment could also enhance growth in other industrial sectors, such as tourism, manufacturing and retail. This would in turn result in growth in employment in positively affected industry sectors.

Improving transportation and logistics would also support stronger regional integration. Trade with neighbours become important due to scale economies in production and transport.

Development and poverty reduction in a country would be supported by improvements in transportation. It would enable quicker and cheaper movement of basic foodstuff, agricultural inputs and medicines, which are important in human and rural development aims.

Environmental benefits could be achieved as a result of improvements in transportation. Reduced congestion could potentially reduce air pollution and energy wastage, while better environmental safety and standards could reduce the risk of environmental hazards.

Even improving inter-modal connectivity at transport hubs could benefit the growth and the environmental sustainability of tourism in a country or a region within a country (OECD, 2016).

Barriers to multimodal connectivity

From the point of view of the freight transport customers, accessibility and efficiency are major considerations in making decisions to use two or more modes of transport. Reliability of the service and the transit time could be affected by the level of connectivity between the modes. Multimodal transportation being a continuous flow of goods from one geographical point to another, even a single bottleneck through the process can make transit times longer. A bottleneck could be any impediment that slows or halts the flow of traffic.

Causes for bottlenecks through a supply chain could be classified as infrastructure bottlenecks, regulatory bottlenecks and supply chain dis-functions (Prentice, 2003). Infrastructure problems could be either chronic or temporary in nature. Chronic infrastructure problems may include climatic barriers, physical barriers and under-investment. Temporary infrastructure problems include weather disruptions, spikes in demand for goods and dis-investment (when parts of existing infrastructure are not used or maintained properly). Regulatory bottlenecks include direct effects such as un-intended consequences of some other policy objectives, or indirect effects such as cabotage restrictions. Another source of bottlenecks could be when various

participants of the supply chain fail to act in common interest. There may be instances where particular parties benefit from bottlenecks and may not want them removed.

Goh, et al (2008) suggests a classification into regulatory and non-regulatory barriers to the integration of multimodal transport networks. Regulatory includes custom-related barriers and cabotage. Non-regulatory may include lack of infrastructure by country or by mode, as well as lack of inter-modal connectivity.

Barriers to inter-modal transportation have been mapped and the potential for using digital technologies to mitigate some of their impacts, have been suggested by Eriksson and Yaruta (2018).

Transport infrastructure planning should ideally be aligned with trade policy, adopting a supply chain approach. Not practising a strategic approach to infrastructure planning and development could lead to bottlenecks and inefficiencies in the freight transport system.

Sometimes, critical transport projects may not be or slower to be implemented due to the lack of clear understanding and proper mechanism to share risks, costs and benefits among the stakeholders or affected parties.

Particular regulatory frameworks that govern various transport sectors may become a barrier to achieving multimodal connectivity. A level playing field between modes of transport should be ensured, so that modal choices and utilisation are not distorted.

Improving and maintaining the quality of service throughout the supply chain, is extremely important for multimodal connectivity. Especially for the economies transitioning from mainly unimodal to multimodal transport contracts, absence of required regulatory framework enacted and enforced, absence of an accreditation system for multimodal transport operators (MTO), and shortage of required skills could delay the transition.

Current status of multimodal connectivity in the ASEAN region

An optimal combination of a modal mix is necessary for achieving efficiencies in transporting goods traded. The choice of the modal mix would be based on the availability and the quality of various transport modes, routes and infrastructure, as well as considerations of time, costs and risks involved.

In order to reap the benefits of improving multimodal connectivity, an economy needs to have a mix of modes of freight transport with good quality, well maintained infrastructure and efficient services and systems, and good quality and efficient inter-modal facilities. In this context, the performance of the available freight transport modes and inter-modal facilities within a framework of the supply chain, using both quantitative and qualitative measures, are first presented for each of the economies within the ASEAN region.

The 10 economies of the ASEN region and the abbreviation used for each of them in this report, are as follows:

- Brunei (BRN)
- Cambodia (CAM)
- Indonesia (INS)
- Lao PDR (LAO)
- Malaysia (MAS)
- Myanmar (MYN)
- Philippines (PHL)
- Singapore (SIN)
- Thailand (THA)
- Viet Nam (VNM)

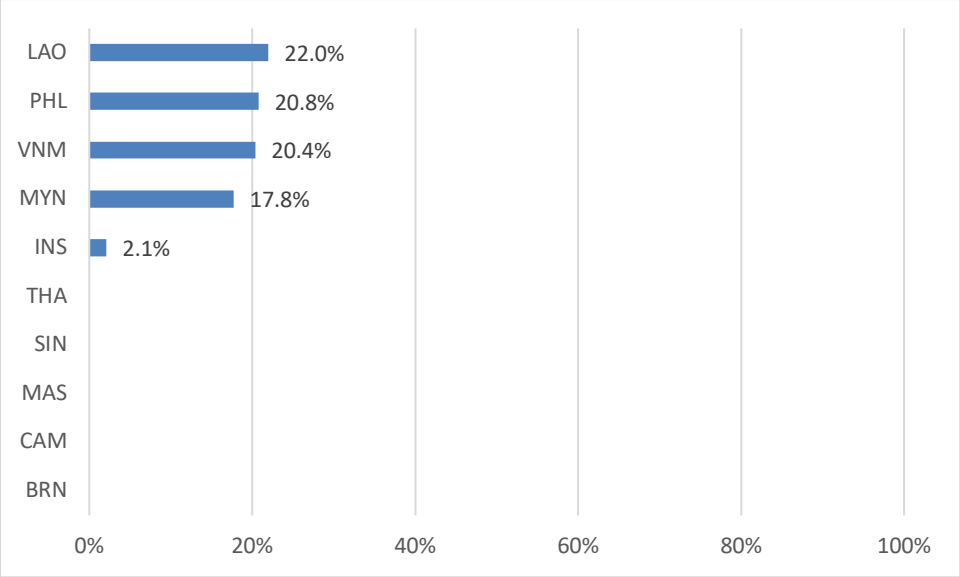
Transport performance in the ASEAN region

The 'Logistics Performance Survey', conducted by the World Bank since 2007, is based on the private sector perceptions of supply chain performance and bottlenecks. The survey responses given by logistics professionals around the world, along six core dimensions, are aggregated into a single, comprehensive index Logistics Performance Index (LPI). The six core dimensions are as follows:

- Efficiency of customs clearance process
- Quality of trade and transport related infrastructure
- Ease of arranging competitively priced international shipments
- Competence and quality of logistics services
- Ability to track and trace consignments
- Frequency with which shipments reach the consignee within the scheduled time

According to the latest survey by the World Bank (Arvis, et al, 2018), the infrastructure core dimension has improved since 2007 in five of the 10 ASEAN economies (Figure 1). The declines in the infrastructure dimension of the LPI score over the years were evident in Brunei (down 11% since 2016, when Brunei entered the survey), Cambodia (down 7%), Malaysia and Singapore (both, down 5%) and Thailand (down 1%).

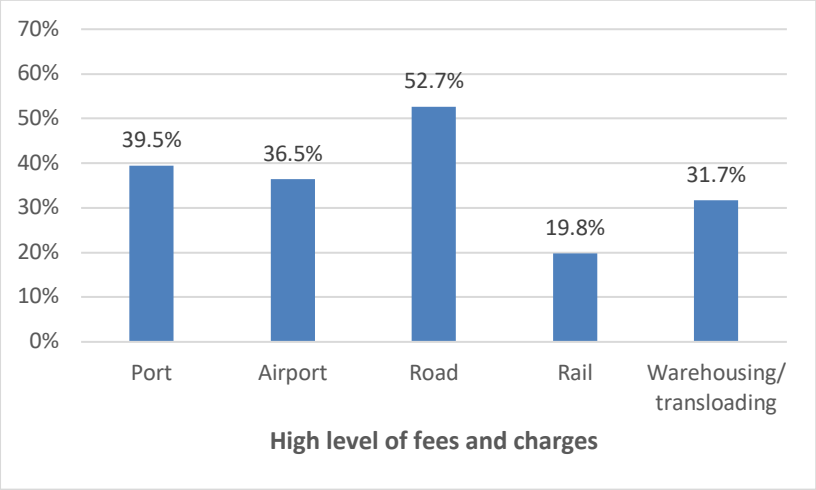
Figure 1: Logistics infrastructure improved since 2007, in 5 ASEAN economies



Source: Calculations, based on Arvis, et al (2007) and Arvis, et al (2018).

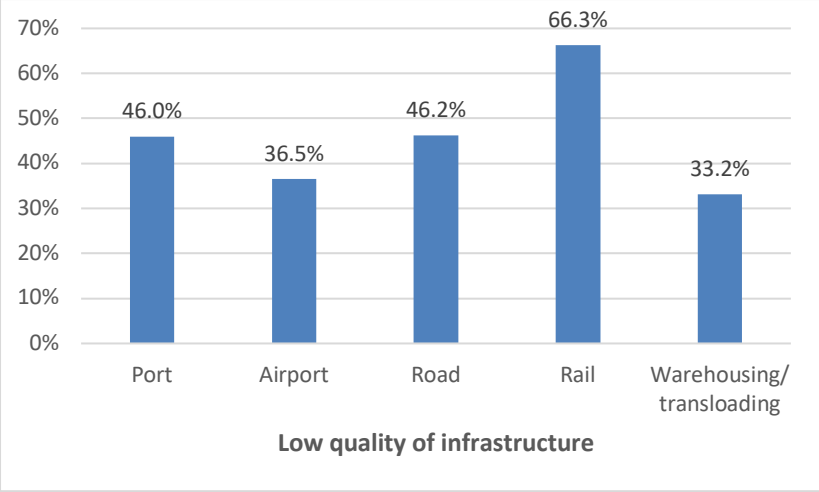
Available qualitative data on each mode of transport and inter-modal connections (World Bank, 2018a) are summarised and presented as simple averages across the ASEAN economies for which the data are available (Figure 2, Figure 3 and Figure 4). The data for 2018 are available for the ASEAN economies except Brunei, Cambodia, Lao PDR and Thailand. Road transport has the highest level of dis-satisfaction with respect to fees and charges while rail transport has the highest level of dis-satisfaction in terms of quality of infrastructure. Rail transport has also got the highest level of dis-satisfaction in relation to the competence and quality of service.

Figure 2: Percentage of respondents answering that "Fees and charges are high/very high"



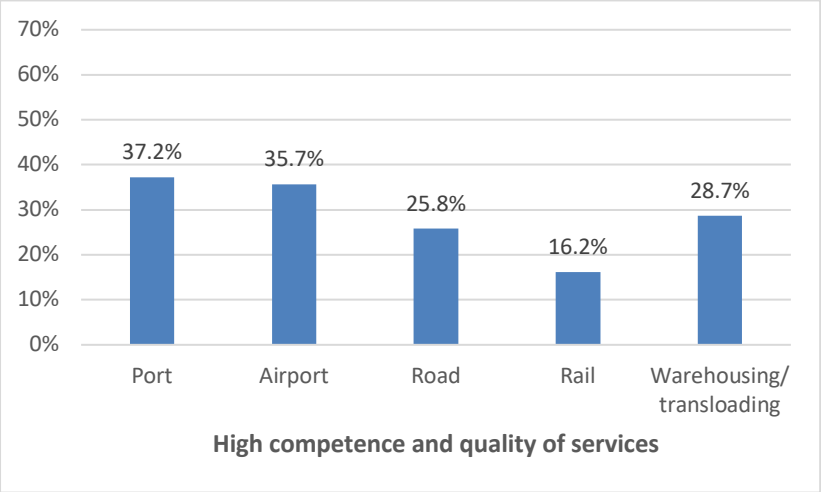
Source: World Bank (2018a).

Figure 3: Percentage of respondents answering that "Quality of infrastructure is low/very low"



Source: World Bank (2018a).

Figure 4: Percentage of respondents answering that "Competence and quality of services is high/very high"



Source: World Bank (2018a).

Maritime transport

How well an economy is connected to global shipping networks is attempted to be captured in the Linear Shipping Connectivity Index (LSCI) developed by the United Nations Conference on Trade and Development (UNCTAD). The higher the index value, the easier it is for the economy to access a high capacity and high frequency global maritime freight transport system (UNCTAD, 2018).

As of 2017, Singapore, Malaysia and Viet Nam are among the top three across the ASEAN, followed by Thailand and Indonesia being equal in shipping connectivity (Table 1). The LSCI has improved since 2004 in all nine economies for which data are available, while there has been a slight decline from 2016 to 2017 in all the economies except Indonesia and Myanmar.

Table 1: Linear Shipping Connectivity Index (LSCI) in ASEAN economies, 2004 to 2017

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Brunei	4	3	3	4	4	4	5	5	4	5	4	5	9	7
Cambodia	4	3	3	3	3	5	5	5	3	5	6	7	9	8
Indonesia	26	29	26	26	25	26	26	26	26	27	28	27	30	41
Lao PDR [a]	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Malaysia	63	65	69	82	78	81	88	91	100	98	104	111	102	98
Myanmar	3	2	3	3	4	4	4	3	4	6	6	6	9	14
Philippines	15	16	16	18	30	16	15	19	17	18	20	18	28	25
Singapore	82	84	86	88	94	99	104	105	113	107	113	117	120	115
Thailand	31	32	34	35	36	37	44	37	38	38	45	44	47	41
Viet Nam	13	14	15	18	19	26	31	50	49	43	46	46	62	60

Note: Index (Maximum for an economy in 2004=100).

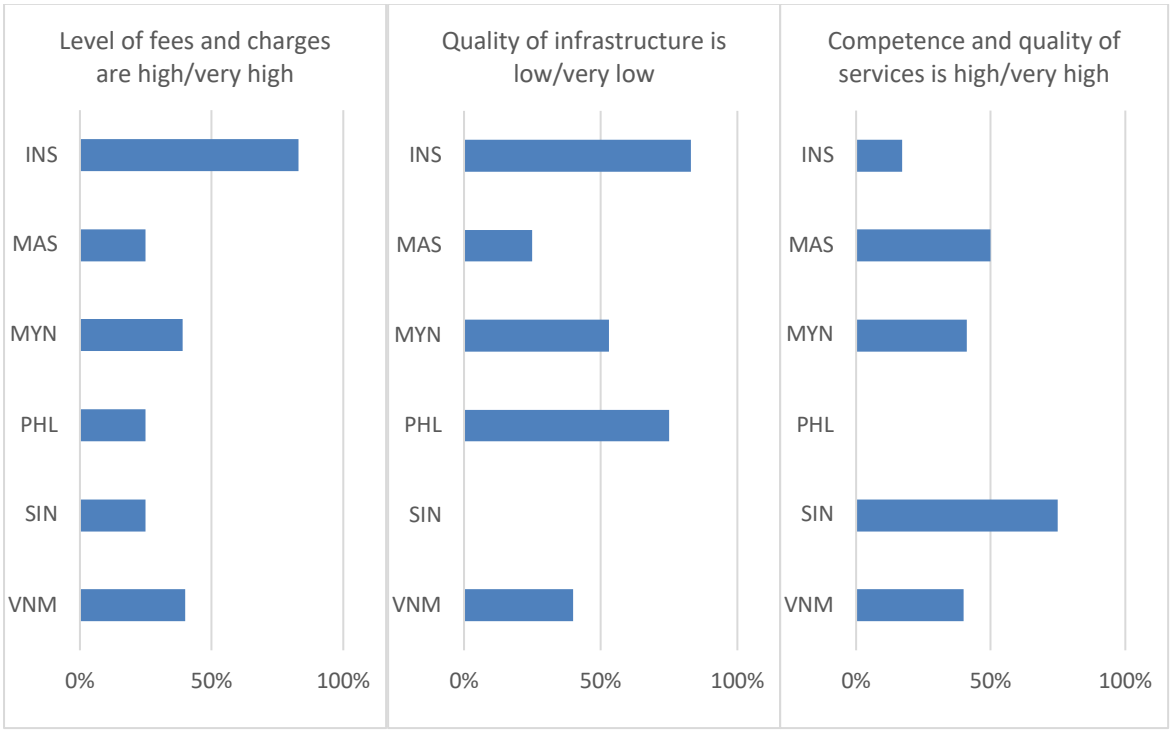
[a] Data, not available.

Source: UNCTAD (2018).

One should take care, not to confuse the connectivity within a single mode of transport, such as the LSCI measure, with the term 'multimodal connectivity' (as explained before, under the section "Introduction"). Furthermore, Fugazza and Hoffmann (2017) have extended UNCTAD's LSCI further, into a truly bilateral linear shipping connectivity index between pairs of economies.

Based on the 2018 survey of logistics professionals in each of the six ASEAN economies surveyed, port charges are considered to be high by the highest proportion of respondents in Indonesia while Singapore, Malaysia and Philippines had the lowest proportion (Figure 5). The quality of port infrastructure is considered low by the highest proportion in Indonesia, followed by Philippines. The highest proportion of respondents in Singapore perceives the competence and quality of maritime transport services to be high, followed by Malaysia.

Figure 5: Maritime transport (percentage of respondents answering that)



Source: World Bank (2018a).

Inland water transport

Recent data on inland waterways in ASEAN economies is not readily available from a common, comparable source. The CIA World Factbook (CIA, 2017), which provides internationally comparable data, shows that Viet Nam has the largest network of inland waterways, followed by Indonesia and Myanmar (Table 2). Any qualitative data that is comparable between ASEAN economies, are not available on inland water transport.

Table 2: Inland waterway statistics for ASEAN economies

	Year of data	Total length (km)
Brunei	2012	209
Cambodia	2012	3,700
Indonesia	2011	21,579
Lao PDR	2012	4,600
Malaysia	2011	7,200
Myanmar	2011	12,800
Philippines	2011	3,219
Singapore		
Thailand	2011	4,000
Viet Nam	2011	47,130

Source: The CIA World Factbook 2017.

Air transport

According to CIA (2017), there is a total of 1,311 airports across the ASEAN region. Indonesia has the largest number of airports, followed by Philippines, Malaysia and Thailand. When Brunei that has got only one airport is excluded, Singapore has got all the airports with paved runways, followed by Viet Nam and Thailand having the next largest proportion with paved runways. Singapore tops in the proportion of airports as primary airports, followed by Viet Nam and Myanmar.

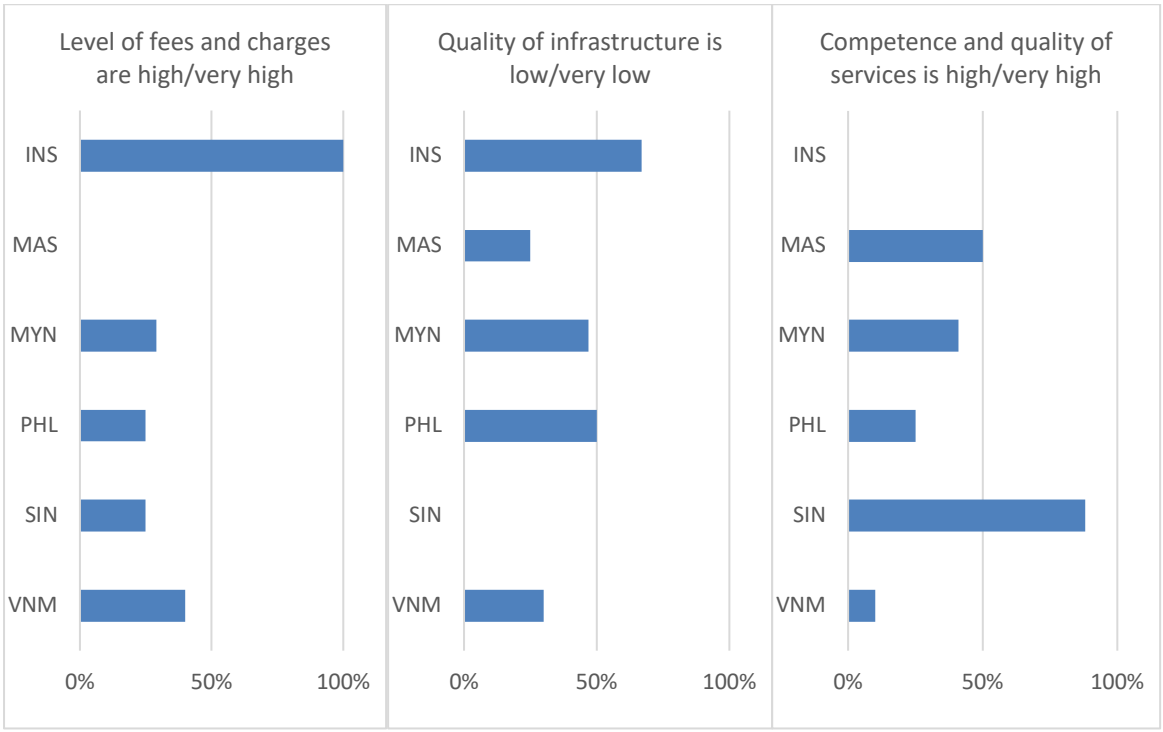
Table 3: Air transport infrastructure in ASEAN economies

	Total number of airports	Airports with paved runways	Primary airports	Secondary airports
Brunei	1	1	1	
Cambodia	16	6	3	2
Indonesia	673	186	26	51
Lao PDR	41	8	3	4
Malaysia	114	39	16	7
Myanmar	64	36	23	12
Philippines	247	89	12	33
Singapore	9	9	4	3
Thailand	101	63	20	23
Viet Nam	45	38	16	13

Source: The CIA World Factbook 2017.

Based on the survey of domestic logistics professionals from the ASEAN economies, airport fees and charges are perceived to be high by all of the respondents in Indonesia (Figure 5). Meanwhile, Indonesia also tops the proportion of respondents dis-satisfied with the quality of air transport infrastructure, followed by Philippines and Myanmar. The perceived satisfaction with the competence and the quality of air transport services is highest in Singapore, followed by Malaysia and Myanmar.

Figure 6: Air transport (percentage of respondents answering that)



Source: World Bank (2018a).

Road transport

Most of the ASEAN economies, except Philippines and Singapore, are connected with another country by land, allowing alternative modes of freight transport. Economies that share borders are (CIA, 2018) as follows:

- Brunei – 266 km with Malaysia
- Cambodia – 2,530 km with Lao PDR, Thailand and Viet Nam
- Indonesia – 2,958 km with Malaysia, Papua New Guinea and Timor-Leste
- Lao PDR – 5,274 km with Cambodia, China, Myanmar, Thailand and Viet Nam
- Malaysia – 2,742 km with Brunei, Indonesia and Thailand
- Myanmar – 6,522 km with Bangladesh, China, India, Lao PDR and Thailand
- Philippines – No border countries
- Singapore – No border countries
- Thailand – 5,673 km with Cambodia, Lao PDR, Malaysia and Myanmar
- Viet Nam – 4,616 km with Cambodia, China and Lao PDR

However, Singapore and Malaysia are connected by a causeway, paving way for alternative modes of freight transport.

The key characteristics of the road network in ASEAN economies are shown in Table 4. Indonesia has the largest road network across ASEAN, followed by Philippines, Viet Nam, Thailand and Malaysia. Singapore has got all its roads paved and Brunei, Malaysia and Viet Nam

follows in the proportion of the road network paved. Singapore possesses the lowest length of road network per 1,000 people, but the highest per 1,000 sq km of land.

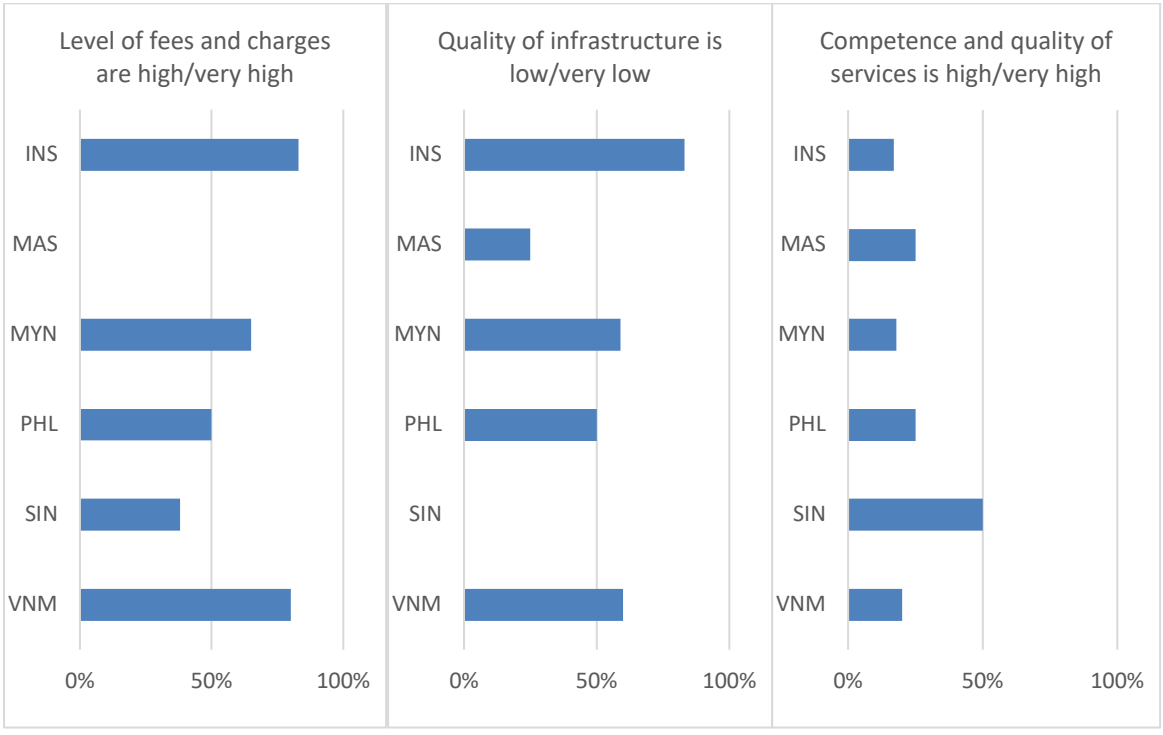
Table 4: Road statistics for ASEAN economies

	Year of data	Total roadways (km)	Percentage of road paved	Road service (km of road per 1,000 people)	Road density (km of road per 1,000 sq km of land)
Brunei	2010	3,029	80%	7.07	574.76
Cambodia	2010	44,709	8%	2.79	253.28
Indonesia	2011	496,607	57%	1.88	274.13
Lao PDR	2009	39,586	14%	5.77	171.52
Malaysia	2010	144,403	80%	4.57	439.52
Myanmar	2010	34,377		0.64	52.64
Philippines	2014	216,387	28%	2.06	725.72
Singapore	2012	3,425	100%	0.61	4,830.75
Thailand	2006	180,053		2.61	352.43
Viet Nam	2013	195,468	76%	2.05	630.40

Source: The CIA World Factbook 2017 and own calculations.

According to the survey of domestic logistics professionals, more than half of the respondents in Indonesia, Viet Nam and Myanmar perceive the road transport charges to be high, as well as the quality of road infrastructure to be low (Figure 6). Only a very low proportion of the respondents in all ASEAN economies except Singapore, perceive the competence and quality of road transport services to be high.

Figure 7: Road transport (percentage of respondents answering that)



Source: World Bank (2018a).

Rail transport

Indonesia has the longest rail network among the ASEAN economies, followed by Myanmar, Thailand, Viet Nam and Malaysia (Table 5).

Table 5: Rail line statistics for ASEAN economies

	Year of data	Total railways (km)
Brunei		
Cambodia	2014	642
Indonesia	2014	8,159
Lao PDR		
Malaysia	2014	1,851
Myanmar	2008	5,031
Philippines	2015	995
Singapore		
Thailand	2017	4,127
Viet Nam	2014	2,600

Source: The CIA World Factbook 2017.

Although eight of the 10 ASEAN economies share borders with another economy, international rail flows are greatly constrained by the different track gauge systems adopted by adjoining countries, when constructing rail systems (Table 6).

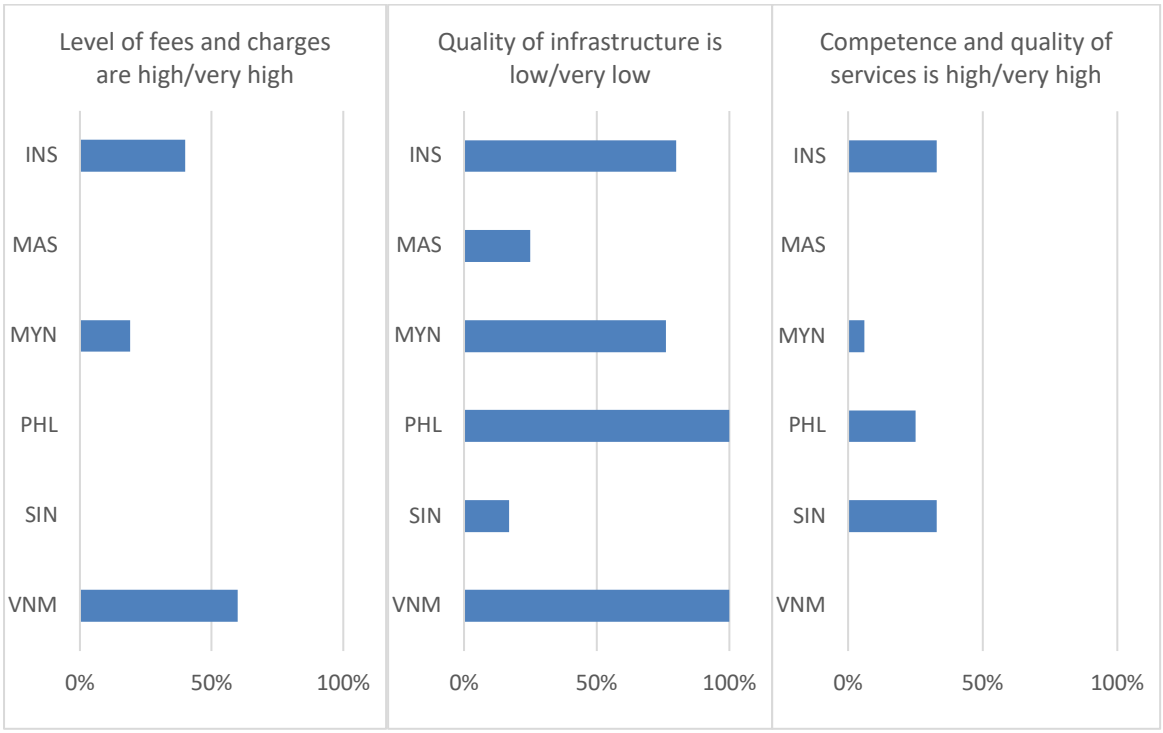
Table 6: Rail gauges in ASEAN economies

	Railways broad gauge (km)	Railways standard gauge (km)	Railways narrow gauge (km)
Brunei			
Cambodia			642 km 1.000-m gauge
Indonesia			8,159 km 1.067-m gauge (565 km electrified)
Lao PDR			
Malaysia		59 km 1.435-m gauge (59 km electrified)	1,792 km 1.000-m gauge (339 km electrified)
Myanmar			5,031 km 1.000-m gauge
Philippines			995 km 1.067-m gauge (484 km are in operation)
Singapore			
Thailand		84 km 1.435-m gauge (84 km electrified)	4,043 km 1.000-m gauge
Viet Nam		178 km 1.435-m gauge; 253 km mixed gauge	2,169 km 1.000-m gauge

Source: The CIA World Factbook 2017.

According to the survey of domestic logistics professionals, more than half of the respondents in Viet Nam perceive rail transport charges to be high (Figure 7). All the respondents in Viet Nam and Philippines and more than half in Indonesia and Myanmar perceive the rail infrastructure to be of low quality. The majority in each economy didn't feel satisfied with the competence and quality of rail transport services.

Figure 8: Rail transport (percentage of respondents answering that)



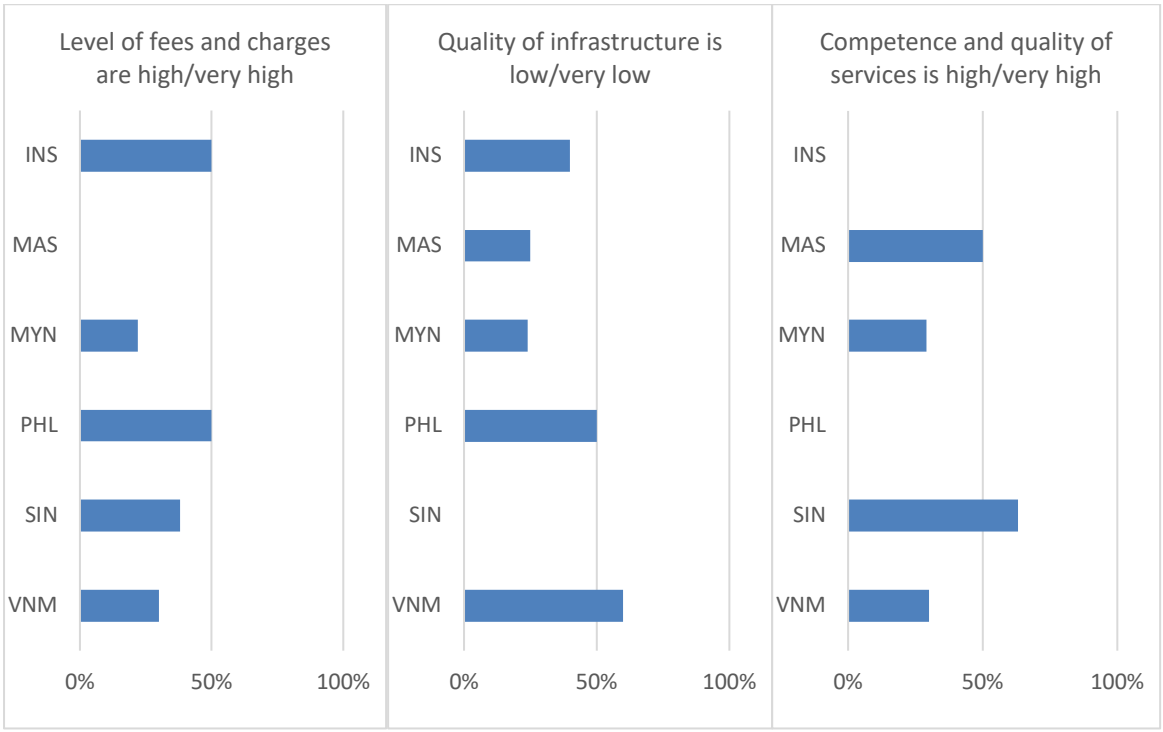
Source: World Bank (2018a).

Inter-modal facilities

Efficient transport of goods traded using more than a single mode of transport, needs efficient warehousing and transloading activities. Warehousing/transloading charges are considered to be high, by half of the domestic logistics professionals surveyed in Indonesia and Philippines (Figure 8). The quality of warehousing/transloading infrastructure is perceived to be low, by more than half of the respondents in Viet Nam and a half of them in Philippines. The competence and quality of warehousing/transloading services is considered high, by more than half of the respondents in Singapore and a half of them in Malaysia.

According to the same survey, delays due to compulsory warehousing/transloading are experienced by 50% of the respondents in Philippines, 40% in Indonesia, 22% in Viet Nam, 20% in Myanmar and 13% in Singapore.

Figure 9: Warehousing/Transloading (percentage of respondents answering that)



Source: World Bank (2018a).

Logistics environment

The overall logistics environment plays a major role, in the ability of the private sector to plan and organise complex logistics activities and to make the individual transport modes work together effectively. The World Bank's Logistics Performance Index (LPI) summarises the most important aspects of the logistics environment under six core dimensions, as explained before.

The LPI is based on a five-point scale for assessing performance. The ASEAN region in 2018, has an average score of 3.02 which is in the middle of the scale (Table 8), with Singapore having the highest LPI score of 4.0 followed by Thailand (3.41), Viet Nam (3.27), Malaysia (3.22) and Indonesia (3.15). Being a survey-based index which could be subject to sampling error, the focus should be on statistically significant changes based on non-overlapping low and high ranges, when making comparisons between economies and through time. Only when there is no overlap between ranges that it is possible to conclude a statistically significant difference between scores (for more details, see Appendix 5 of Arvis, et al, 2018).

Based on the above criterion in comparing the LPI scores between 2007 and 2018, it can be concluded that only three of the ASEAN economies, Viet Nam, Myanmar and Lao PDR, have improved their logistics performance from 2007 to 2018.

Table 7: Logistics performance in ASEAN economies

	2007			2018			
	Lower bound	LPI score	Upper bound	Lower bound	LPI score	Upper bound	Statistically significant change?
Brunei [a]	-	-	-	2.51	**2.71**	2.91	No change
Cambodia	2.38	**2.5**	2.62	2.38	**2.58**	2.78	No change
Indonesia	2.88	**3.01**	3.14	2.85	**3.15**	3.45	No change
Lao PDR	2.01	**2.25**	2.46	2.47	**2.70**	2.93	Improved
Malaysia	3.41	**3.48**	3.55	3.00	**3.22**	3.44	No change
Myanmar	1.69	**1.86**	2.07	2.10	**2.30**	2.50	Improved
Philippines	2.54	**2.69**	2.84	2.73	**2.90**	3.07	No change
Singapore	4.14	**4.19**	4.24	3.86	**4.00**	4.13	No change
Thailand	3.21	**3.31**	3.41	3.29	**3.41**	3.53	No change
Viet Nam	2.71	**2.89**	3.07	3.11	**3.27**	3.44	Improved
ASEAN average		**2.91**			**3.02**		

Source: Arvis, et al (2007) and Arvis, et al (2018).

Methodology for measuring multimodal connectivity

The ideal method to measure multimodal connectivity in economies that are in transition from unimodal to a multimodal transport system, is to evaluate the progress in implementing required changes. Since the transition has only commenced in most of the ASEAN economies, necessary data are yet to become available.

Therefore, this study focuses on using any data that are readily available from international sources, which could be used as a proxy for an economy's ability to manage inter-modal connections along the supply chain. Performance indicators for maritime, air and land transport as well as for logistics competence, were chosen from the previous section.

These performance indicators are presented for each ASEAN economy, as standardised relative scores across the economies. This method of presenting the relative scores results in two advantages. Firstly, the focus would be attracted to regional best practice cases. Secondly, the data for all modes are standardised into the same scale, facilitating comparisons across the indicators.

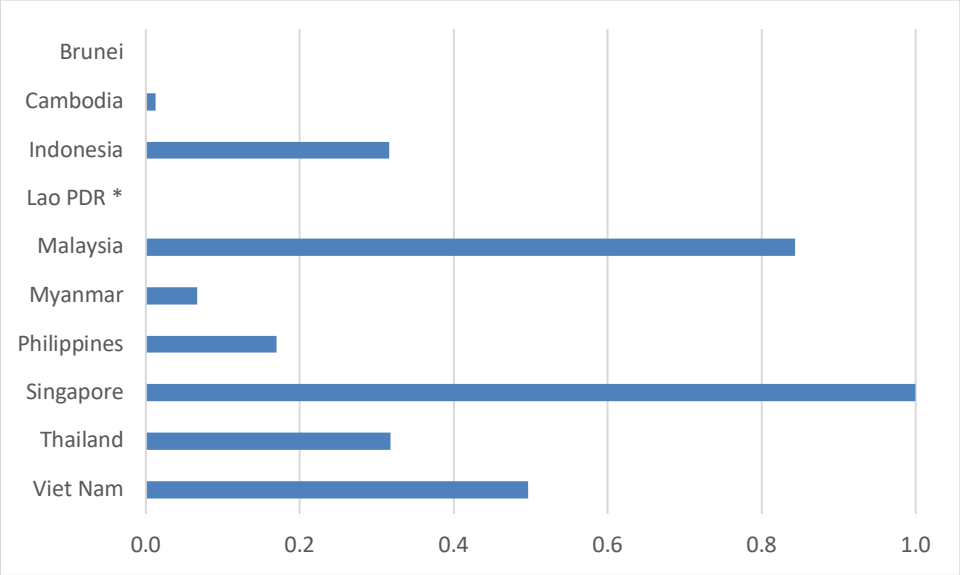
Multimodal connectivity in the ASEAN region

Performance indicators are first presented for maritime, air and land transport, and for logistics competence. These indicators are presented as scores between 0.0 and 1.0, relative to the top and bottom scores across the economies of the region. Then, an aggregated multimodal transport indicator is developed using the four indicators above.

For maritime transport, the Linear Shipping Connectivity Index (LSCI) developed by the UNCTAD is a useful indicator (Figure 10). A variety of linear shipping indicators are combined into a single, broad-based index using a statistical technique named 'Principal Component Analysis'

(PCA). The LSCI takes five factors into account, namely, the number of ships, their container carrying capacity, maximum vessel size, number of services, and number of companies deploying container ships to and from an economy's ports (UNCTAD, 2018). These factors include measures that could be considered as quantitative as well as qualitative.

Figure 10: Maritime transport indicator, as a relative score across ASEAN region

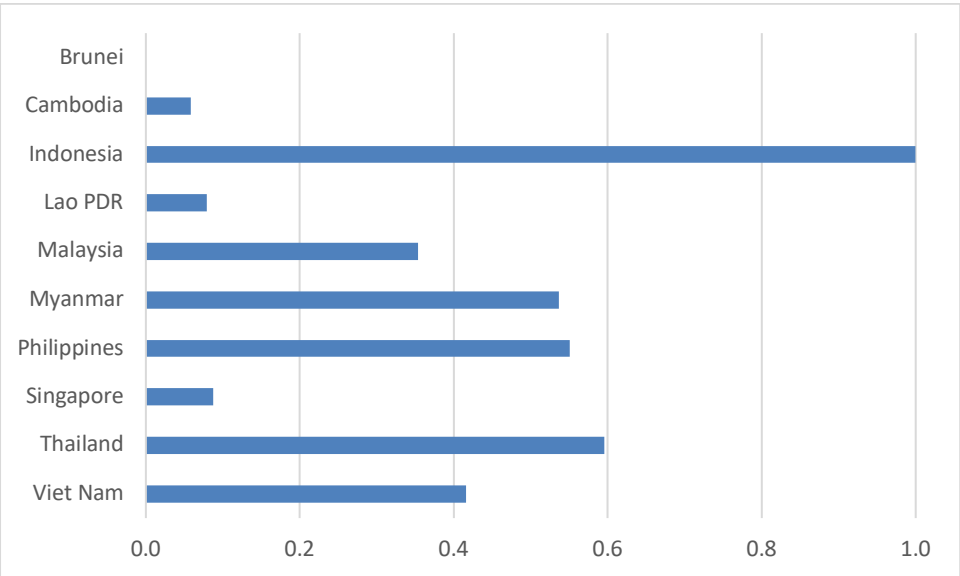


Source: UNCTAD (2018).

** Data are not available for Lao PDR.*

There is no indicator for air transport, which is equivalent to the LSCI. A similar indicator was constructed by combining two underlying data series (Figure 11). The number of primary airports and the number of secondary airports in each ASEAN economy, sourced from the CIA World Factbook, were combined as a weighted average. The statistical technique PCA, which was used by the UNCTAD, was applied to determine the weights.

Figure 11: Air transport indicator, as a as a relative score across ASEAN region



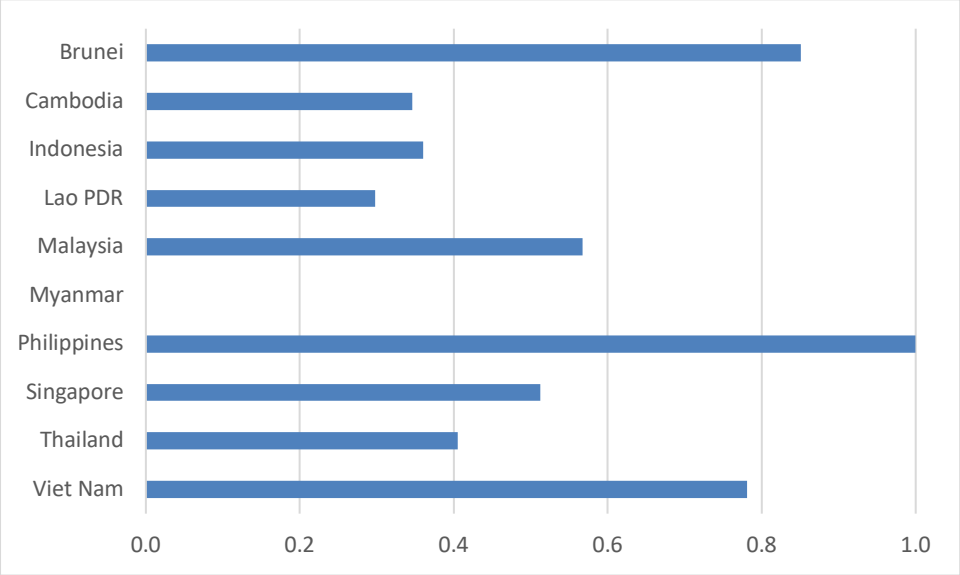
Source: Calculated from CIA, 2017.

Transport of produced goods between factory, warehouse and port requires land transport within an economy. International trade are often impossible to complete without having a strong land transport environment. Therefore, land transport is an important aspect of multimodal connectivity.

The 'road network density' and the 'rail network density' have been combined as a weighted average, to arrive at a road transport indicator (Figure 12). Each density was calculated as "km of road/rail per 1,000 sq km of land", by dividing the total length of the road/rail network in an economy (sourced from the road and rail statistics from the CIA World Factbook) by the land area of that economy (World Bank, 2018b). The statistical technique PCA was applied to determine the weights, in calculating the combined land transport indicator.

Using the density of road and rail networks rather than the total length in an economy, removes the bias towards economies that are geographically large. This adjustment is important because some economies that are geographically small (for example, Singapore) have very well developed road and/or rail links.

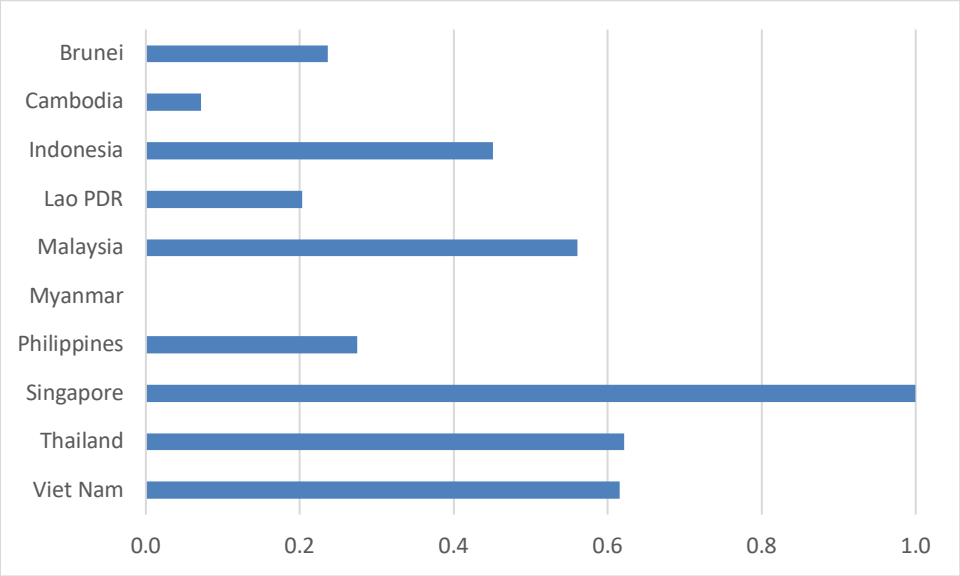
Figure 12: Land transport indicator, as a relative score across ASEAN region



Source: Calculated from CIA, 2017.

Logistics environment is the final major dimension of multimodal transport connectivity. Operators in logistics are responsible for coordinating complex cross-border transactions and a variety of transport modes, as well as necessary interchanges and trans-shipments. The most comprehensive dataset to measure the performance of an economy's logistics is the World Bank's Logistics Performance Index (LPI), which is described in previous sections. Out of the six dimensions of logistics performance of an economy that are captured in the LPI, the 'competence and quality of logistics services' dimension is used to measure an economy's ability to coordinate complex multimodal transactions (Figure 13).

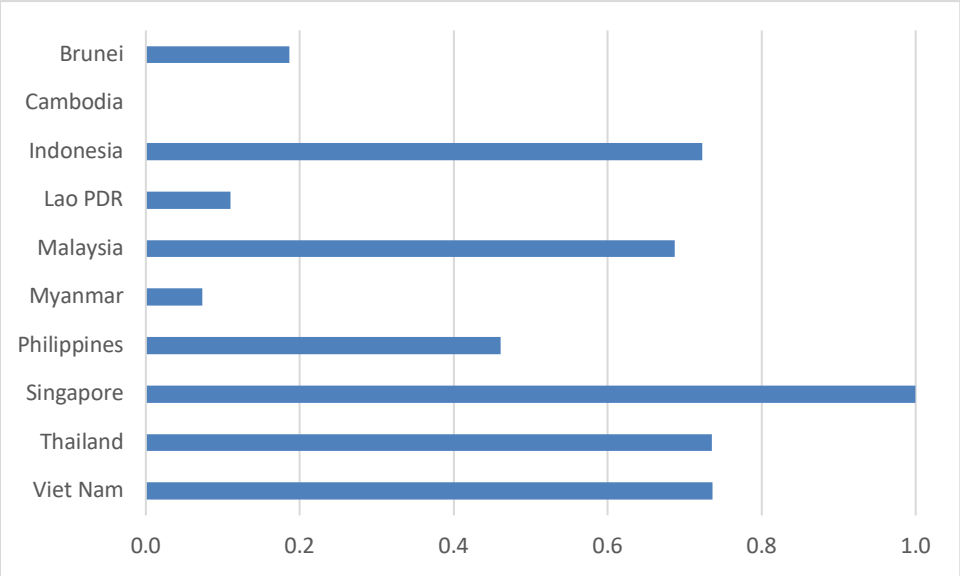
Figure 13: Logistics competence indicator, as a relative score across ASEAN region



Source: World Bank (2018a).

It is apparent that Singapore leads in two of the four performance indicators above, maritime and logistics. This has resulted in Singapore becoming the top performer across ASEAN region in terms of the overall multimodal transport indicator (Figure 14). This summary indicator was created by combining the four performance indicators, to obtain an overall measure of multimodal transport connectivity across the region. The PCA technique was used to determine the weights used in calculating the weighted average of the indicators for maritime, air, land transport and logistics competence.

Figure 14: Multimodal transport indicator, as a relative score across ASEAN region



Source: Author's calculations.

These measures of multimodal connectivity are based on performance outcomes, such as infrastructure quantity and quality. It is important to note that policy plays a major role in boosting connectivity. In addition to supporting the construction and maintenance of

infrastructure, appropriate regulatory environments should be created for the service providers to be able to perform efficiently. Policy makers have an important role in all modes of transport to help build private sector capacity and create a trade-friendly environment.

Impact of improving multimodal connectivity on trade

Some of the ASEAN economies, such as Singapore, Malaysia and Thailand, offer multimodal operators an environment that can support the development of this sector, while most other countries are lagging behind (Dullaert, et al, 2012). It is evident that there is enormous scope for improving multimodal transport connectivity in most of the economies in the ASEAN region.

Bizoi and Sipos (2014) have proven the positive relationship between the GDP per capita and the logistics performance across the developed and under-developed economies of the European Union.

Impact of improving transport performance on the Gross Domestic Product (GDP) could be measured using Computable General Equilibrium (CGE) modelling. In order to measure the impact on trade, specific trade models, such as the Gravity Model, could be used.

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Arvis, J-F., Ojala, L., Wiederer, C., Shepherd, B., Raj, A., Dairabayeva, K. and Kiiski, T., 2018. Connecting to Compete 2018: Trade Logistics in the Global Economy. World Bank, Washington, DC.

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https://datacatalog.worldbank.org/dataset/world-development-indicators

Appendix

Logistics Performance Index (LPI) data for individual economies of the ASEAN

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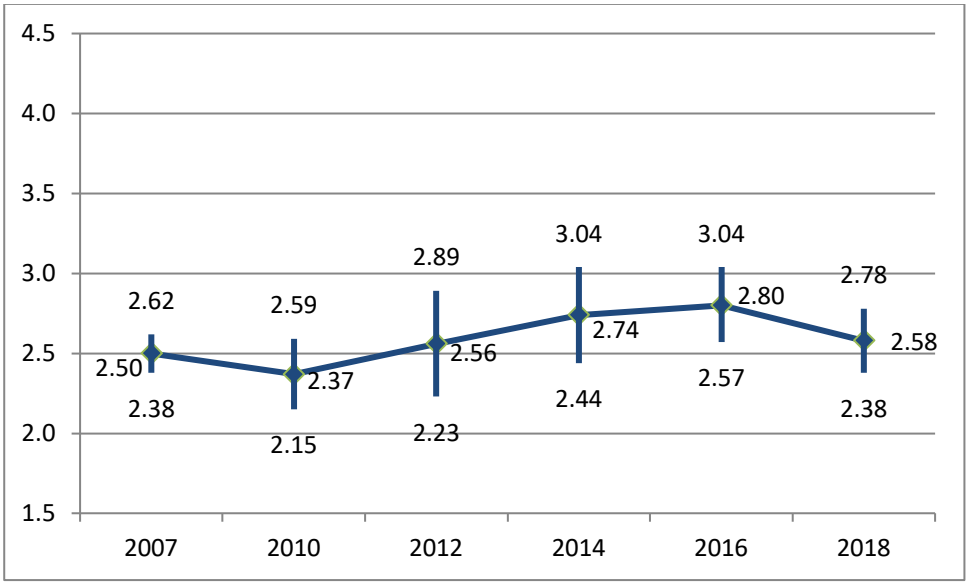

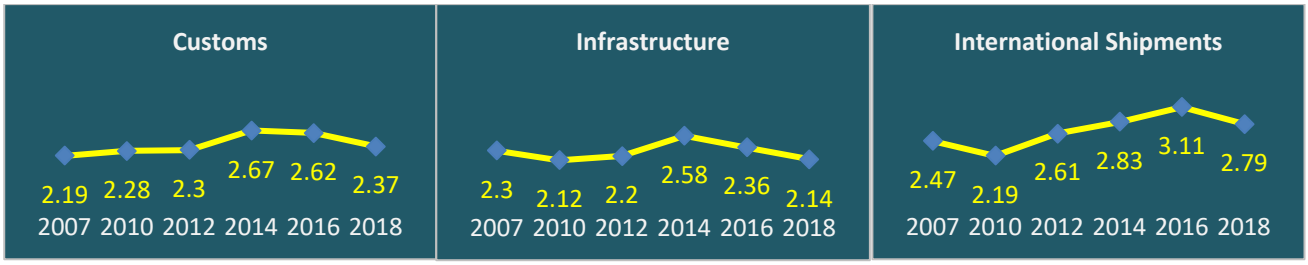

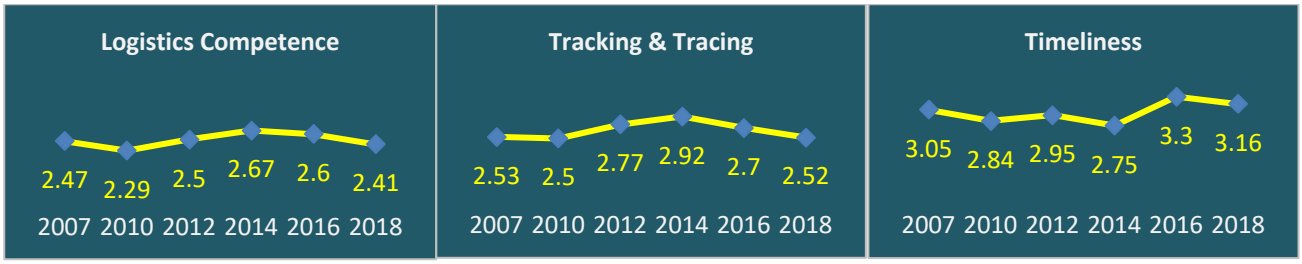

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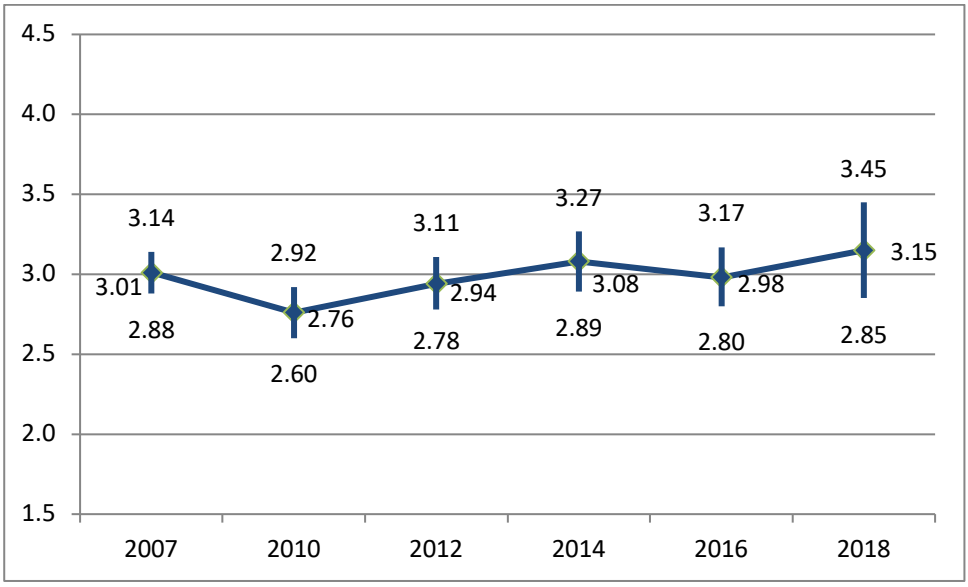
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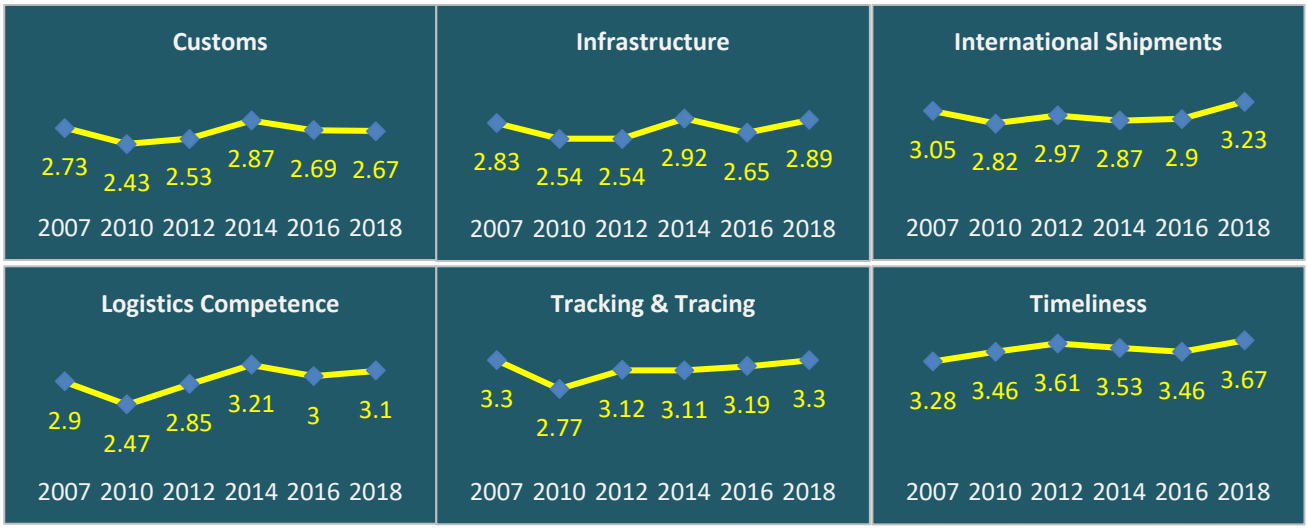
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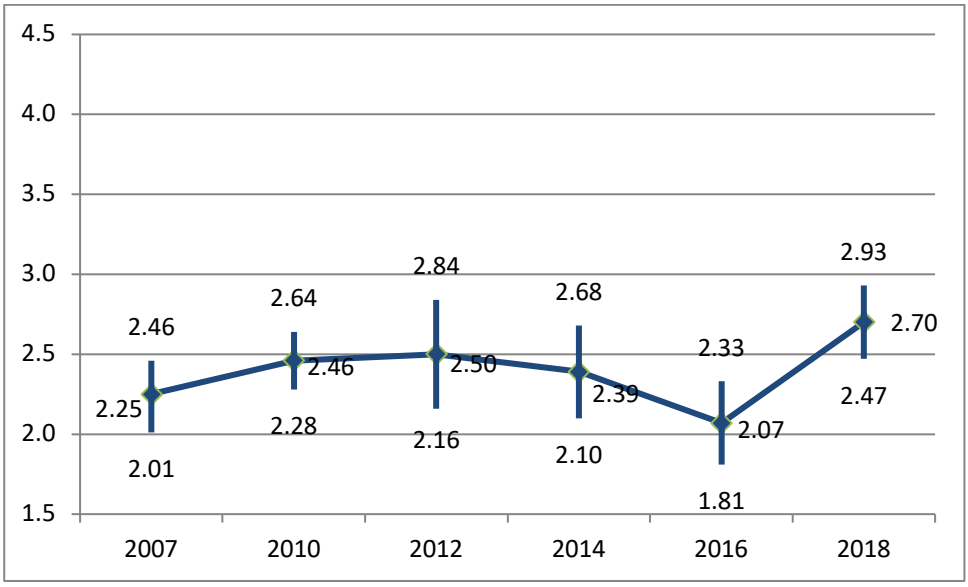
Lao PDR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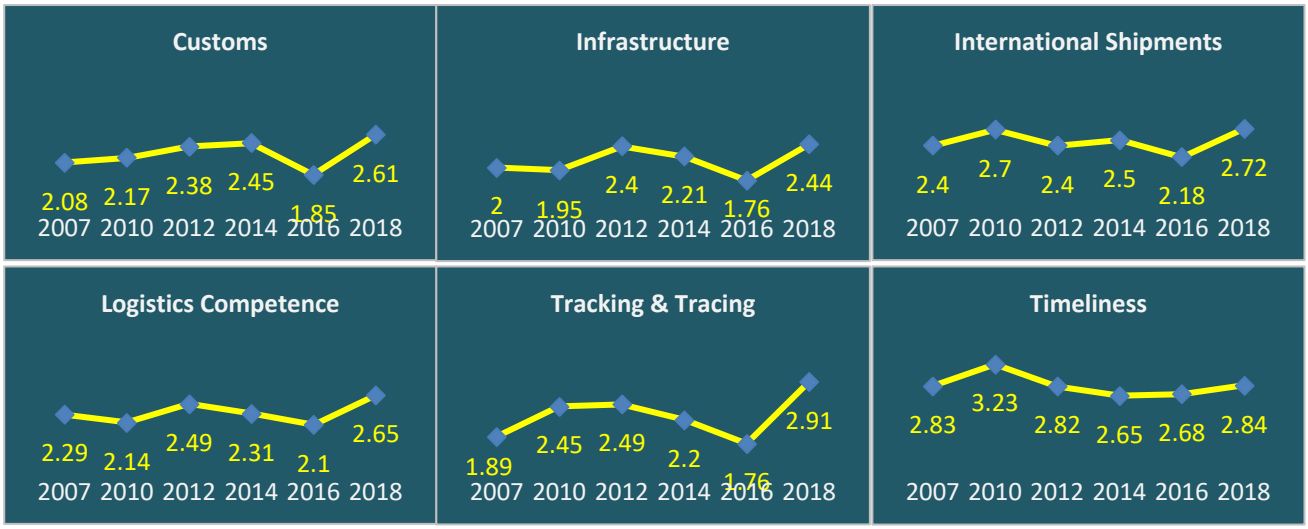
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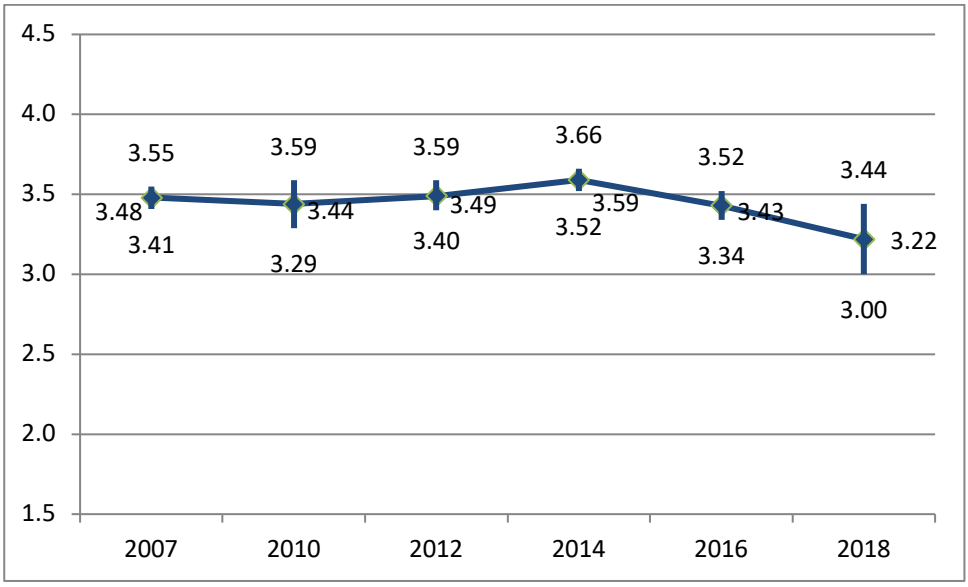
Malaysia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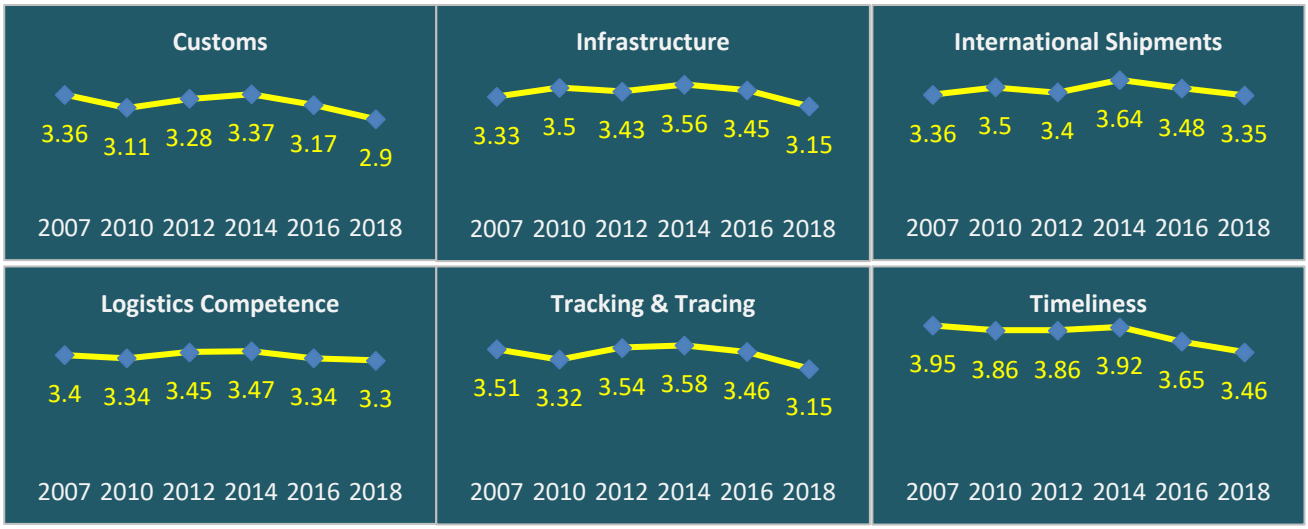
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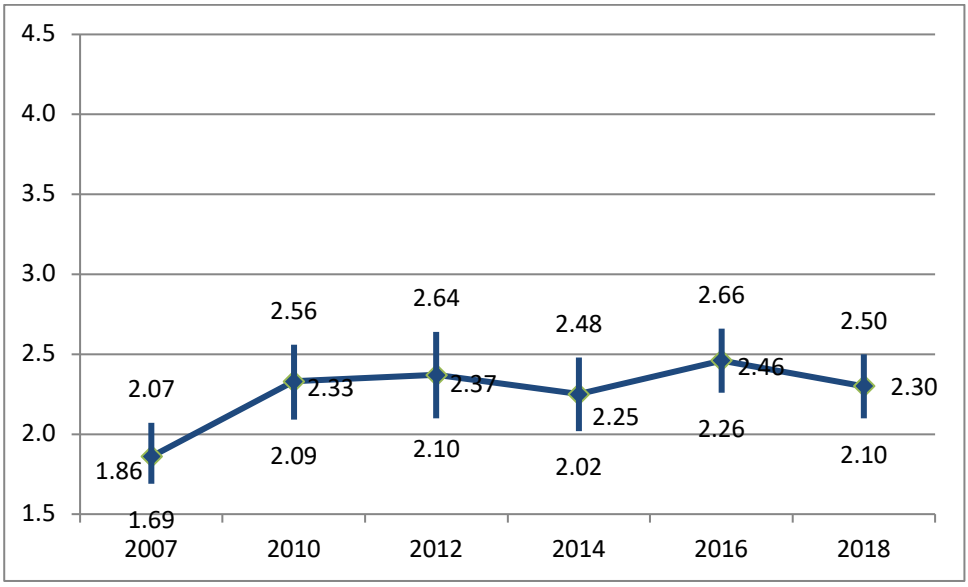
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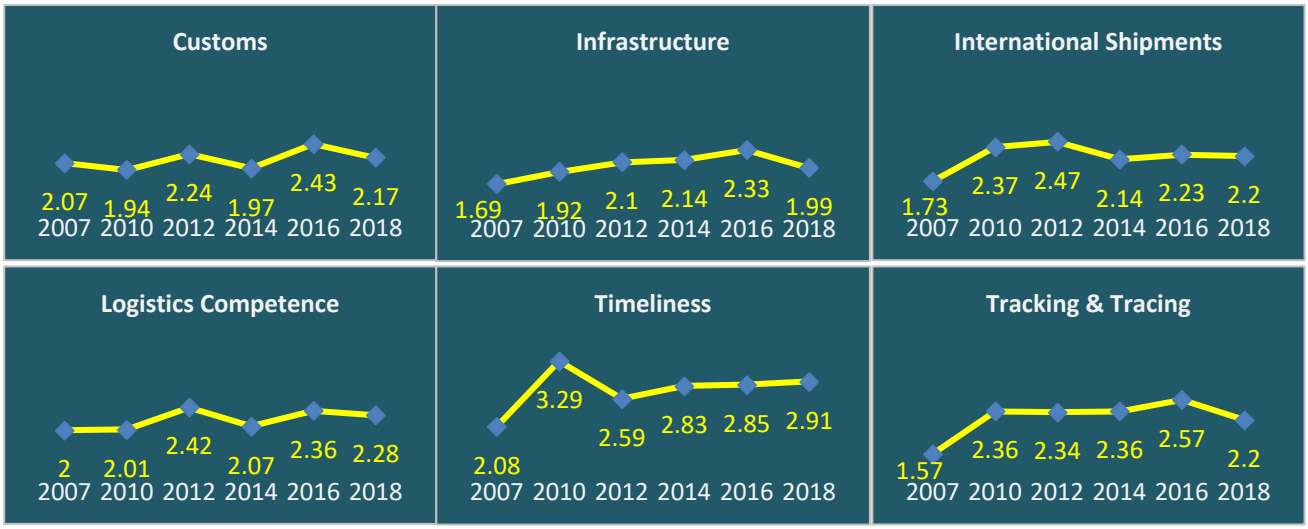
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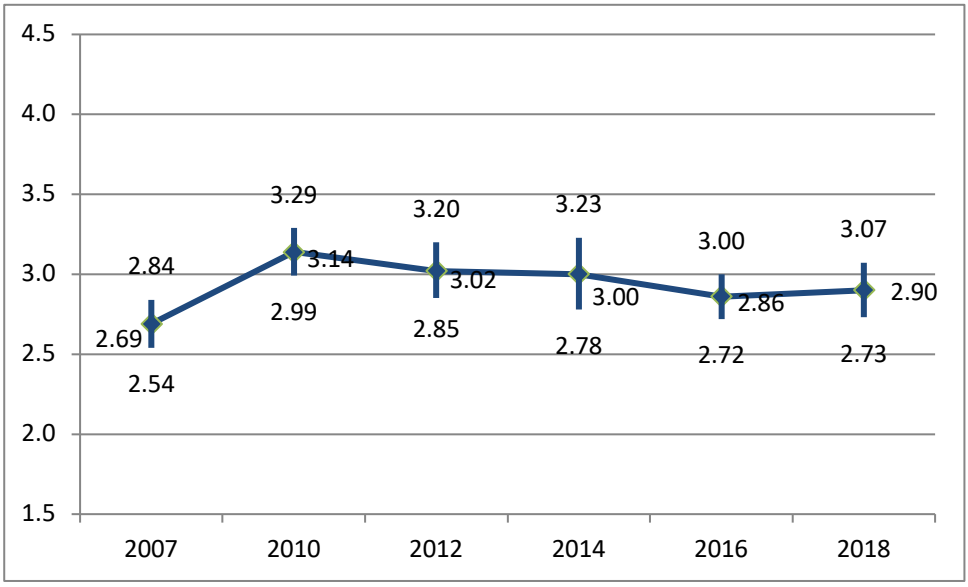

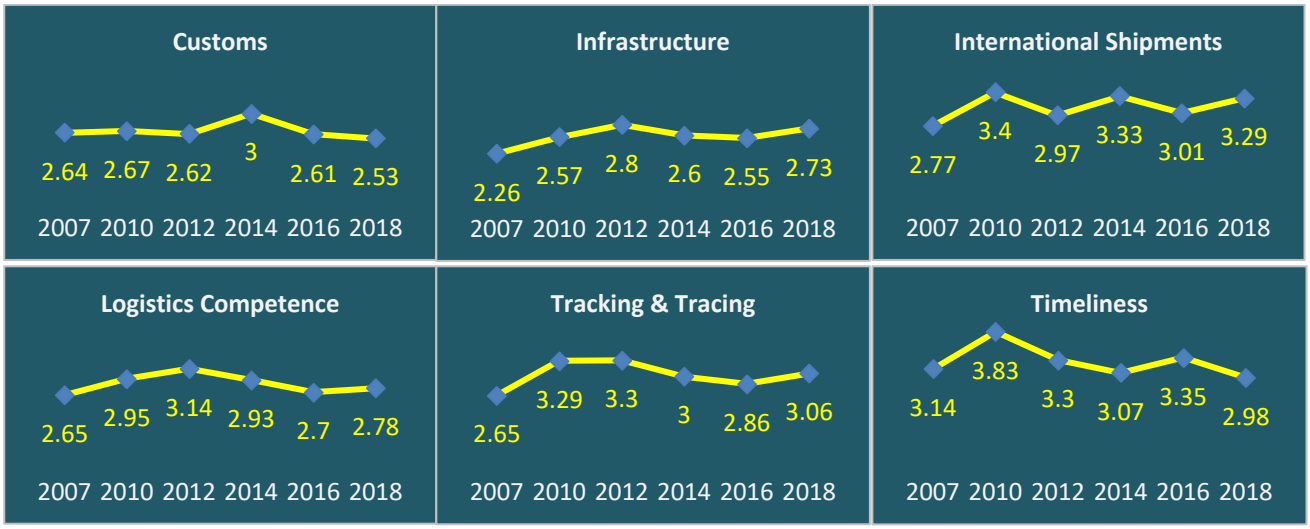

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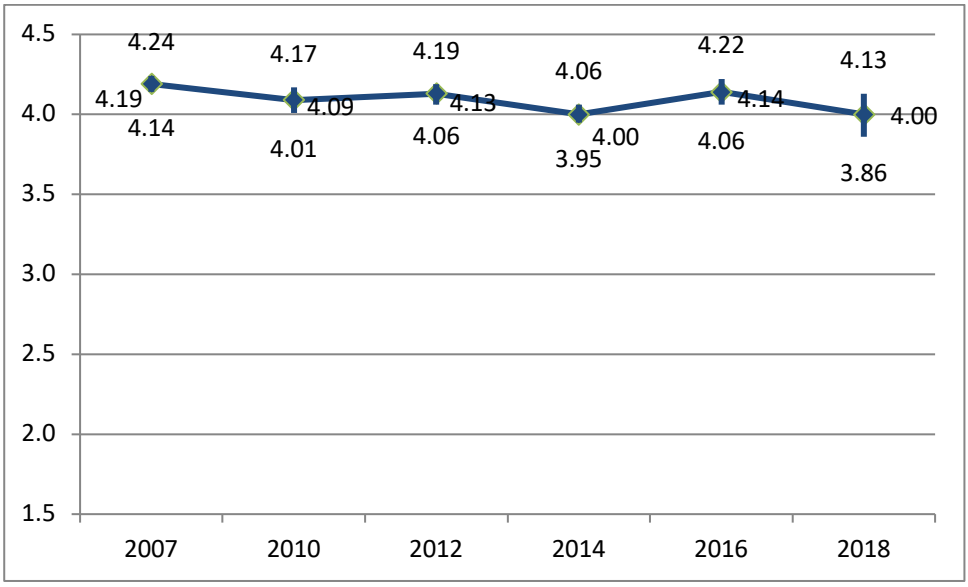
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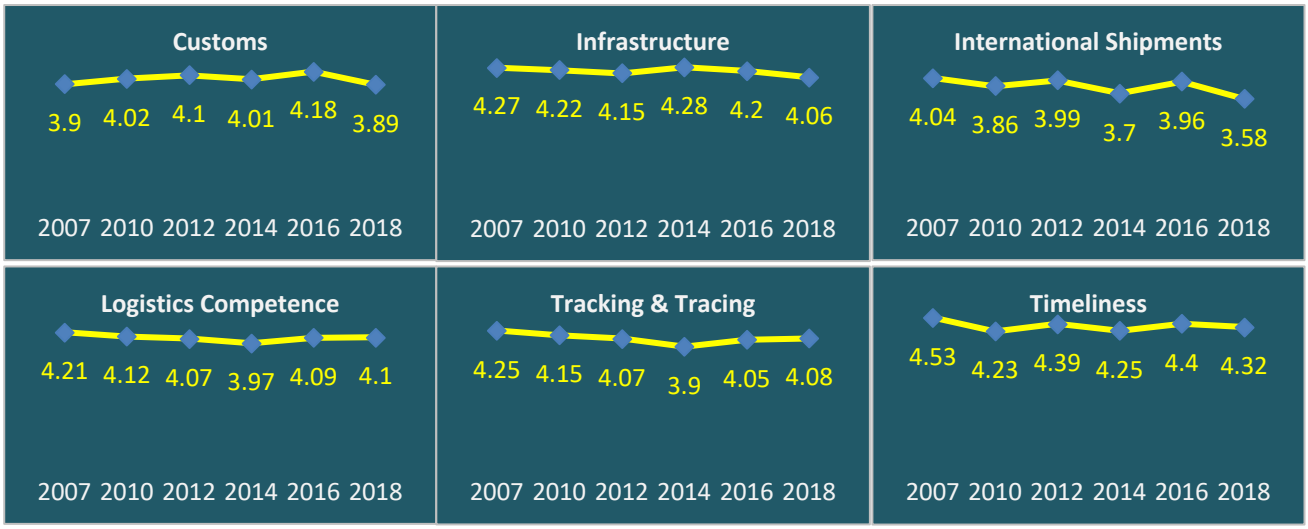
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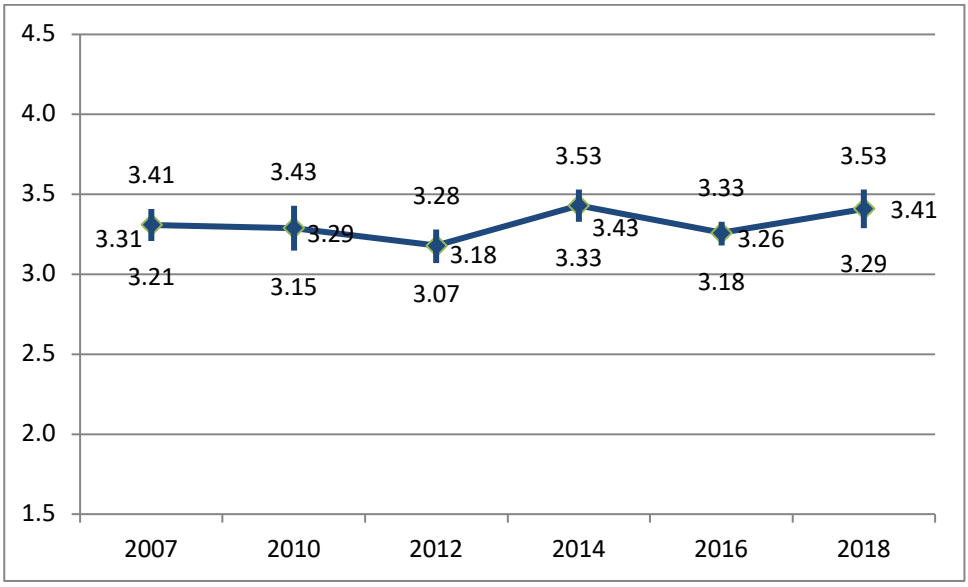
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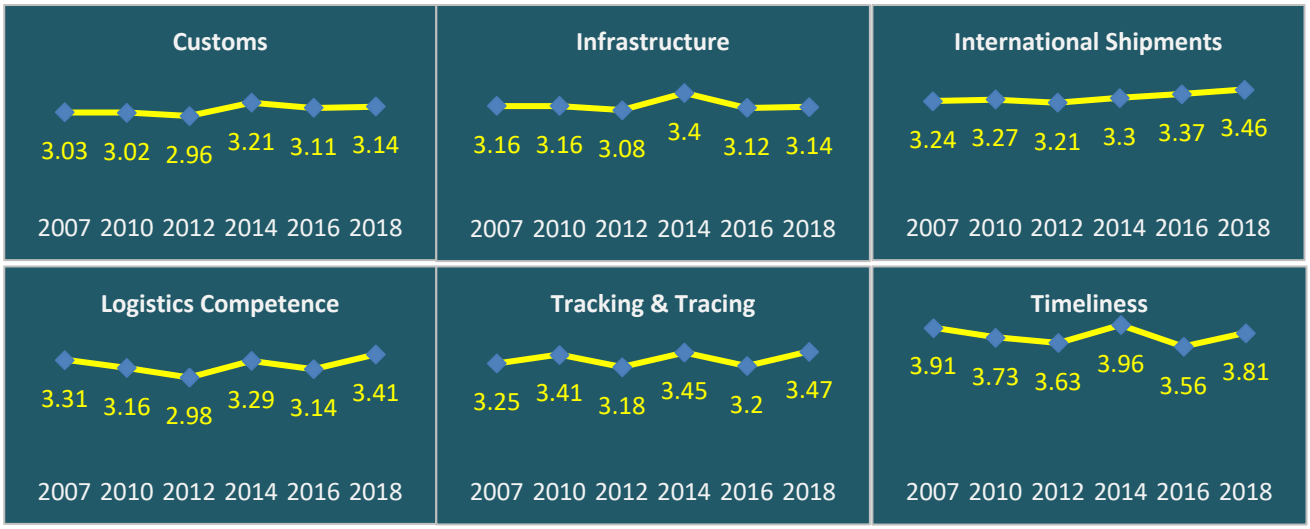
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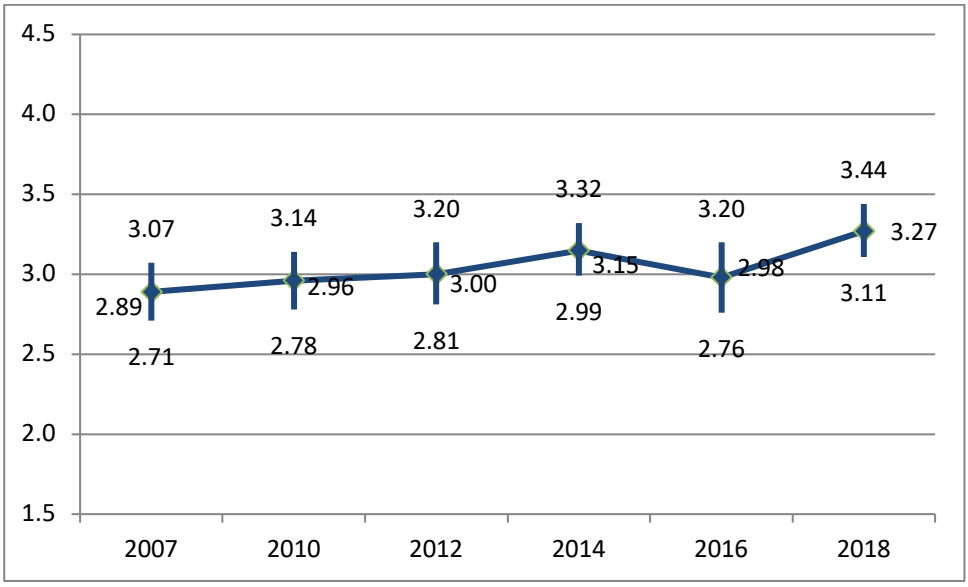
Vietnam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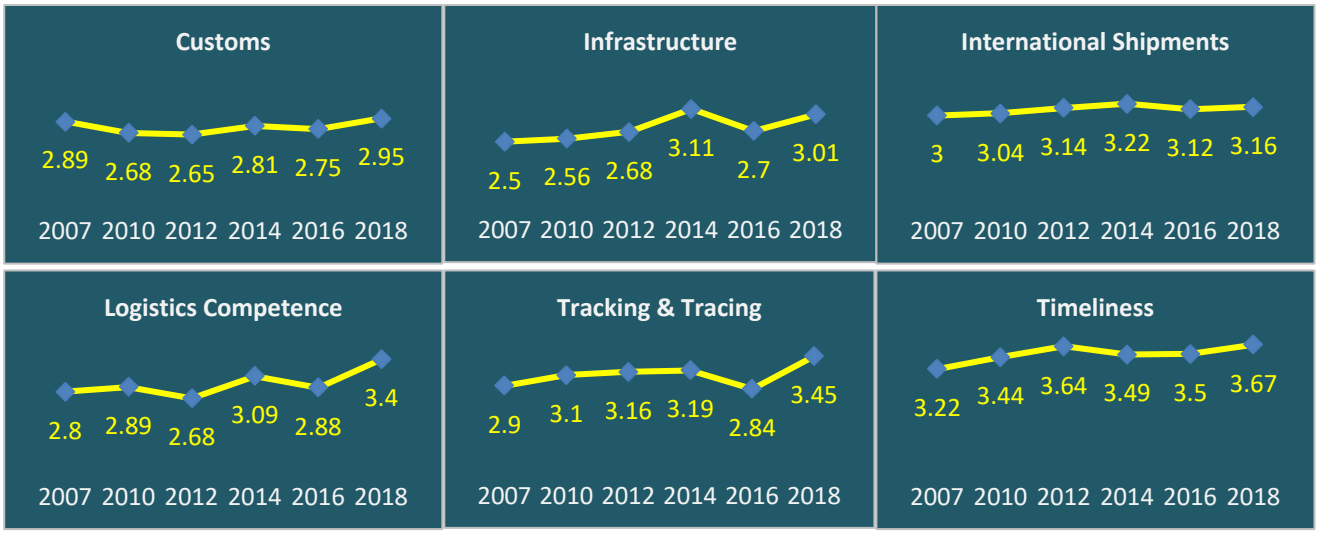
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