Liner Shipping Connectivity and International Trade in Maritime Southeast Asian Countries

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Abstract

Liner connectivity plays an important role as a determinant in how a country is able to gain access to world markets. Liner shipping as the medium of seaborne transport for import and export of manufactured and semi-manufactured goods plays a significant part in international trade, which in turn potentially contribute towards the prosperity of a country and its surrounding region. Liner Shipping Connectivity Index (LSCI) is one of the most common benchmark to see how well connected a country in global trade, where it consists of five components, namely the number of ships, carrying capacity, ship size, services provided, and the number of companies that deploy container ships calling a country’s ports. This paper aims to tally from the most to the least which LSCI component contributes in improving the shipping connectivity with the most impact, in six Maritime South-East Asian countries, i.e., Indonesia, Malaysia, Philippines, Singapore, Thailand, and Vietnam. By descriptive statistics, correlation analysis, and panel data, this paper finds that the country port’s capacity to accept larger ship size provides the most significant impact towards the improvement of the connectivity in the region. To attract companies to deploy largest ship, the improvement needs to be complemented with the capacity that can meet the expected volume, offering a variety of service, and good turnaround speed at the country’s port. The paper is expected to present not only indicative recommendations on which logistics connectivity initiative needs to be invested first, but also necessary proposals to develop a programme for building the region’s overall logistics industry.

Key Words: International Trade, Liner Shipping Connectivity, ASEAN

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1. Introduction

International trade is playing an important part towards the region’s economy, where its development would support the development of maritime logistics sector. With this linkage, logistics would grow accordingly with the economic development, and reversibly the economic development would also potentially influence the logistics industry. It is generally accepted that more than 90% of world trade is carried by sea. No matter what estimates that is used, take into account door-to-door transport or just a shipment segment until the border, or whether the count units uses tons or ton-miles; the share percentage still stay around the same (D. L. Hummels & Schaur, 2013). A country’s access to world markets depends on its seaborne transport connectivity, especially with regards to the metrics of liner shipping services for the import and export of manufactured goods (Hoffmann, 2012).

Throughout the last century, the shipping industry has consistently seen a general trend of increases in total international trade volume (IMO, 2012). Container ports play a major, if not an indispensable part in global shipping networks (Wilmsmeier, Hoffmann, & Sanchez, 2006). The importance of containerization transported over the sea has been even further placed its importance. Which containers travelling via shipping lines, goods are to be packed once from the origin, moved over very long distances, and would be transported by variety of transport nodes, crossing straits, canals, seas, and oceans (Levinson, 2008).

This paper will look into five components of LSCI, introduced by The United Nations Conference on Trade and Development (UNCTAD) in 2004, to identify which among the connectivity components contributes the most impact towards the improvement of international trade, specifically Association of Southeast Asian Nations (ASEAN) countries and more specifically for Maritime Southeast Asian (SEA) countries, namely: Indonesia, Malaysia, Philippines, Singapore, Thailand, Vietnam. While Logistics Performance Index (LPI), are a result of a perception survey of logistics operators on the ground (global freight forwarders and express carriers), by means of providing feedback on the countries they do business with, LSCI aims at capturing and benchmarking a country’s level of integration into global liner shipping networks.

This paper will try to answer the main research question on which indicator can provide the most significant impact, on already-existing LSCI indicators, towards the improvement towards its economic growth and trade volume in a form or container traffic in ASEAN countries. In addition, this paper will try to present a more indicative

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1) Considering the majority of ASEAN economy mostly played by six of those Maritime ASEAN countries, this paper hereinafter, when Author mentions ASEAN, it will only cover those countries.
recommendation to policy makers prioritize on which logistics connectivity initiatives needs to be invested first; will suggest insights to develop a programme for building the region’s logistics industry; and base on the research output, present some recommendations for further research.

This study is covered into four main sections. First is a comprehensive literature review of journal articles in dealing with logistics indexes, international trade, and the ASEAN’s logistics and geopolitical landscape. Second part will delve into more detail on descriptive statistics on LSCI components, along with LSCI’s benchmark with other already-available logistics indexes. Third is a quantitative analysis using correlation and panel data to determine the relationship between the LSCI components and international trade along with the required statistical tests. Finally, the fourth will be conclusion and recommendation for future research.

2. Literature Review

2.1. Liner Connectivity and International Trade

Liner shipping is a ship carrying cargo and passengers which operates on a fixed schedule. As a research scope, this paper only covers liner shipping carrying cargoes inside containers. With containers travelling via global liner shipping network, even small importers and exporters from far away countries can trade with each-other, which was before would not have been possible as their individual trade transaction would not economically justify chartering a ship to transport a small amount of goods travelling from origin to destination. The advantage of liner shipping is its harmonized coordination with various ports. In a healthy market situation, liner ships will still run its voyage even if the cargo is far from full as the revenue optimization of shippers and port operators was done at the planning stage, where schedule adapts according to cargo traffic trend and optimal carrying capacity throughout the overall shipping line.

LSCI captures how well countries are connected to global liner shipping networks. Most overseas trade in semi-finished and manufactured goods is moved in containerized shipping services, in which case the LSCI provides an annual update on a country’s connection to global networks of such services (UNCTAD, 2014). The LSCI assesses a country’s position within such global networks, both with regards to changes over time, and in comparison to other countries. It is calculated as the weighted average of five core components: (1) number of vessels assigned to liner services, (2) combined container
carrying capacity of those vessels, (3) number of services offered by companies, (4) number of companies that provide liner shipping services calling the country's ports, and (5) the largest vessel size. The data are derived from Containerisation International Online\(^2\) and Lloyds List Intelligence.

The component can be further explained, as follows:

1) The total number of ships that are deployed from/to country’s ports. This component could directly indicate a high frequency of services or plenty of berth available at ports. The more ships passes through a country would imply a better connectivity.

2) The total container carrying capacity of the ships that provide services from/to country’s ports, measured in Twenty-foot Equivalent Units (TEU). The count will be the full capacity of the ship itself. Therefore, it does not necessarily make full use of this capacity, a larger total TEU capacity is likely to imply more available space, and an opportunity value to do more trade shipping more cargo-filled containers, or schedule at a lowest rate possible when ships has ample available capacity, attractive businesses to ship at the best price.

3) The number of companies that provide services from/to a country’s ports. The count of companies does not necessarily owned by the respective country. In most instances, a country’s trade is mostly moved by foreign companies, and all major liner shipping carriers do business by transporting other countries’ imports and exports. The more carriers compete for trade in a country, the more choices exporters/importers have and the less freight rates will be charged.

4) The number of liner services that connect a country’s ports. This component is an indicator of how efficient containers travel via liner shipping. More specifically, of how those containers can travel with the least connection possible, so that it can arrive to destination possibly even without the need for trans shipments.

5) The largest ship that is deployed from/to a country’s port, measured in total TEU. This component is used as an indicator of economies of scale and infrastructure. In order to attract largest ship to dock, ports need to provide adequate equipment, such as cranes, and dredge their access channels.

A country’s index is generated, for each of the five components; of which then, country's value is divided by the maximum value of that component in 2004. The index generated the value 100 for the country with the highest average index of the five

\(^2\) As of 2013, Containerisation International Online is part of the Lloyd’s List Intelligence
components in 2004. Then for each country, the average of the five components is calculated. For years thereafter, those averages is subsequently divided by the maximum average for 2004 and multiplied by 100.

UNCTAD (2014) finds that high-frequency and predictable liner service determines the connectivity to overseas markets. With this, country’s product is known and leads to competitiveness in global markets. Not only liner shipping is important to shipping lines, it contributes to the constellation of liner shipping networks and ports within the network. Port location, attractiveness, and its variety of services become indicators of competitiveness of trade (Ojala & Hoffmann, 2010). Development of containerized transport through shipping network goes hand-in-hand to the development of its overall shipping networks.

As one of the vehicle of maritime industry, IMO (2012) further found that liner shipping covers 16% of the total world trade. With this liner shipping, ever larger vessel sizes, and the level of competition on a given trade route, have also been found to be closely related to lower transport costs (D. Hummels, 2007). It was further found that not only these maritime power increased their trade volume by lowering transactions costs, instituting preferential trade arrangements, forming customs union, and establishing trade policies significantly promotes trade within their network (Mitchener & Weidenmier, 2008).

Towards a more recent finding in maritime logistics; the economic crises that mainly occurred in 2008 and 2009 has significantly affected the maritime industry, UNCTAD in its annual flagship, Review of Maritime Transport, report further reported that total trade volume dropped from 8.2 billion tonnes in 2008 to 7.8 billion in 2009. As an international and capital intensive business, the liner shipping industry was greatly affected (Song & Panayides, 2012). The problems could include oversupply of weight capacity, sudden drop in demand, and lack of ability of companies to recover from disruption causes the declining freight volumes (Lee, Chew, Zhen, Gan, & Shao, 2011). Docherty and MacKinnon (2014) also argued that transport and economic development is a two-way symbiosis where each influences the other; where the economic development will create demand for improved transport which will, at one point, support further economic growth. The role of international trade to the overall economy needs to be interpreted carefully, where it needs to be understood more broadly in the wider economic perspective, social and environmental impacts of transport.

UNCTAD Maritime Transport further finds that shipping services is derived from the performance of maritime transportation and seaborne trade, where it is largely dependent on the developments of the world’s economy and overall international trade (UNCTAD, 2014). This derivation however, has yet shown the in what way, and what formula this
demand is derived. Over the years, starting in about 1997 the world’s merchandise trade has grown about twice as fast as the world’s Gross Domestic Product (GDP). This is quite possibly as a result of the multiplier effect, from among others, globalization, technology that improves port efficiency and service speed, transshipment activities, and increased trade in intermediate goods. The report also found that trade elasticity in exports, since 1971 to 2010 is about 2.5 times the size of GDP (UNCTAD, 2014).

GDP was found not the best indicator because its composition changes over time. Previous research proposed an alternative approach. The main causes of this are the globalization of the world economy, decoupling freight and trade routes, and the ever changing business behavior due to short-term/time-based competition (Jong, Vierth, Tavasszy, & Ben-Akiva, 2013). Those three main causes however, have yet to be specifically proven. They instead, have only shown that GDP is not detailed enough to be a dependent variable of economic activity.

Van de Voorde and Meersman (2013) argued that GDP is not precise enough in the long run to be used as an indicator of growth in relation to freight transport. On one side, it is because the changes of composition of GDP; e.g. investment heavy, consumption heavy, or positive/negative trade balance. On the other side, the type of the economic development presented in GDP changed over time, e.g. investment to boost certain sectors of industry, social programmes for the country’s citizens, or programmes to stimulate employment. The domain of their research only covers OECD countries, where significant part of the freight transport traffic goes via land (i.e. road, rail, and pipeline). It will be interesting to see if the model can be propagated to include the rest of the world and intercontinental transport, or for a specific region.

Based on these findings, when the panel data analysis is presented, the approach in improving maritime industry will potentially be different from developed countries (a complementarity value) and developing countries (a necessary requirement) (Banister & Berechman, 2001). Further case study for ASEAN will further analyze whether the region’s maritime logistics infrastructure investment has an impact towards economic development, divided further into economic groups or logistics development level.

2.2. ASEAN’s Maritime and Geopolitical Situation

Generalizing about a group of countries as diverse background of Southeast Asia is interesting but difficult at best. A region that is almost synonymous with economic failure almost two decades ago and in some cases: was then experienced turbulent political turmoil is now considered to be the most stable and one of the few bright spots in global economic
arena (Beeson, 2015). While some countries and economic regions still face series of mini-crisis post 2008 that has yet to be resolved decisively, ASEAN countries addressed them pretty quickly. Ever since ASEAN’s inception in 1967, it has frequently faced by economic and political forces, of which it has little control of them. Its inception was mainly political. Therefore, it could be quite a challenge to say anything conclusive about the future prospects of the region considering its history.

In almost every aspect ASEAN is highly heterogeneous. Politically, from fully-fledged democracies in Indonesia and the Philippines, semi-democracies in Malaysia, Singapore and Thailand, and the only non-founding ASEAN member covered in this paper, the communist regime in Vietnam. Alongside this political diversity, each and every ASEAN country has vastly different level of economic development. Ranging from Singapore, which is among the top GDP per capita in the world, middle-income countries like Malaysia and Thailand, to Indonesia, Philippines and Vietnam, still considered to be positioned inside the middle-income-trap (C. Lee & Narjoko, 2015). Both political and economic aspects combined, ironically the fully-fledged democracies of Indonesia and Philippines, are still placed at the lower-tier of the per capita GDP, where democracy seems to have made harder to implement domestic policy and to get up to speed with the growth rate of other ASEAN countries.

The relative strength and resilience of the economies in the region was considered to play an effective role in stimulating ASEAN’s domestic economies, especially in facing potentially another external downturn. ASEAN is now economically crises resistant, with much healthier reserves and less reliance on releasing government bonds for sale to strong economic and political powers. In comparison their trade counterparts out west, ASEAN governments plays a greater role in stimulating their own economies.

2.3. Logistics Situation in ASEAN

The image of the region is an important influence on investment decisions, a number of surveys attempt to measure the trading partners logistics perception towards a country. ASEAN countries received a high variance score in logistics services which somewhat indicates the inherent limits of trying to generalize about the region as a whole. According to World Bank’s Logistics Performance Index (LPI), out of the 160 countries surveyed, Singapore is among the best in the world, while other ASEAN countries fare quite far from it, where they are ranked from 25th (Malaysia) to 57th (Philippines). If one can synthesize, the main problem that deters business investment is the endemic and seemingly inescapable corruption (Widjaja, 2012).
Table 1.
ASEAN's latest LPI and LSCI scores and its world rank, 2014 and 2015, respectively

| Country   | LPI | LPI (worldrank) | LSCI | LSCI (worldrank) |
|-----------|-----|-----------------|------|------------------|
| Singapore | 4.004 | 4              | 117.13 | 3               |
| Malaysia  | 3.590 | 25             | 110.58 | 5               |
| Thailand  | 3.430 | 35             | 46.36  | 31              |
| Vietnam   | 3.155 | 48             | 44.43  | 29              |
| Indonesia | 3.082 | 53             | 26.98  | 46              |
| Philippines | 3.004 | 57            | 18.27  | 63              |

Ports in ASEAN are able fulfill their role of a regional transport hub. As a consequence, not only taking the advantage of transport geography of Southeast Asia, it is also contributed by a good level of economic development where it has brought about an environment that facilitates business activities, including transport. In this case, World Bank’s LPI reveals that ASEAN offers good conditions for maritime transport than other regional countries and economic groups. By global comparison of the LPI, which operates on a scale from 1 to 5; looking at the score alone, ASEAN countries belong to the first and middle tier. The 2015 LSCI and 2014 LPI for ASEAN countries are shown in Table 1, while the geographical map of ASEAN along with its latest LSCI index is displayed in Figure 1.

Tongzon and Ganesalingam (1994) performed an analysis by comparing overseas ports similar to ASEAN ports then compared them the ASEAN ports in terms of performance and efficiency. ASEAN ports were found to have higher levels of efficiency in the functioning and utilization of advanced port facilities such as: cranes, berths and storage areas; where Singapore is placed as the top performer. On another perspective however, they have identified lack of efficiency in terms of human resource related and soft skills performance, such as: timeliness, labor and tugboat utilization. Port charges in ASEAN ports are also observed to be relatively more expensive than other major economic regions.
Tongzon and Cheong (2013) further proposed measures to improve ASEAN’s competitiveness in logistics industries and identified underlying factors that either supports or hinder their implementation. From their qualitative survey using questionnaires and interviews with logistics firms and government agencies in the region, it was found that the implementation has been low caused by perception gap between the respective governments and private sector logistics firms. They further proposed that these gaps need to be addressed by embarking on a dialog; otherwise it would hinder the competitiveness of the ASEAN country’s logistics industry.

Furthermore, UNESCAP (2013) conducted an empirical study on trade costs where it used LSCI as one of the indicators. It concluded that 25% of changes in non-tariff policy-related or non-government-imposed trade costs can be explained by LSCI. As quite expected, the ESCAP study further found that the exporting country’s LSCI had a higher correlation with the trade costs than the importing country’s LSCI.
3. Descriptive Statistics

In ASEAN, Singapore leads the connectivity index, where Malaysia is placed almost immediately under it. Both those upper-tier countries are placed with a considerable gap to the rest of ASEAN countries with index score reaching more than 100, starting in 2014. Presumably, countries that are actively involved in trade, especially in transshipment of finished and semi-finished goods have the highest index values. Both Malaysia and Singapore are export-oriented economies, placed as a gateway for passing-through as a hinge-joint from the Pacific to Indian Ocean. In addition, these countries are also a sweet spot for transshipment activities.

When building up the LSCI component numbers from the dataset, China always ranks number one for every component item every year since its inception. Except for the liner companies component, where before 2010, it was led by European Union (EU) countries. In 2004, liner companies was led by the United Kingdom, 2005 to 2009 was led by the Netherlands, and Belgium took the lead in 2010.

Looking at the overall LSCI index data graph in figure 2, the evolution of rankings of ASEAN, tends to stay the same since 2011. From top to bottom: Singapore, Malaysia, Vietnam, Thailand, Indonesia, and the Philippines. Over the years since 2004, Vietnam showed a significant growth from 2008 to 2011. Thailand showed growth albeit small, while the scores for Indonesia and the Philippines tend to stay stagnant.

Figure 2 further depicts the development of the LSCI ASEAN countries. Singapore continues to lead in overall LSCI index, and almost without experiencing any impact from the economic crisis, where it caused a short downturn in most export oriented economies. Malaysia is the best performer in terms of improvement, entering the world’s top ten in 2006, and reached the fifth place in 2014. It consistently continues to lead the LSCI ranking in ASEAN as a major shipping player, followed closely by Malaysia. If a straight line is drawn between 2015 counting down to 2004; Singapore, Malaysia and Vietnam countries increased their LSCI scores, Thailand showed a slow increase, while Philippines and Indonesia tended to stay stagnant or even declined with very low gradient.
Transport connectivity is one of the main determinants for countries to access the world market, where it can have access to liner shipping services to import and export goods. Based on this overall index, one can interpret that liner companies are considered to relatively less likely to set sail and provide services to and from seaports in Indonesia, Philippines, and Thailand, as their national trade volume is relatively lower and low levels of development make it less attractive for transshipment and transit cargo. Those four countries, despite potentially attractive geographic location and growing economies, their trade would need to be improved to attract more frequent shipping routes.
Figure 3.
Comparison on LSCI Trend between the World and ASEAN
Source: Lloyd’s List and UNCTAD
From the LSCI index in comparison between the whole world and ASEAN, this region shows resilience and continues to show growth in economy overall, and more specifically, in trade connectivity. As an international and capital intensive business, the world’s liner shipping industry was greatly affected by the economic downturn in 2008 (Song & Panayides, 2012). The problems include oversupply of weight capacity, sudden drop in demand, thus causes the declining freight volumes (Lee et al., 2011). The falling global demand that impacted the global GDP in 2008 did not quite significantly impact ASEAN countries, and growth is still sustained since then to the present.

A comparison of the World’s trend in LSCI index in comparison to ASEAN is available in Figure 3. The figure depicts the development of the 5 components of the LSCI. On average (i.e. the statistical mean of the 159 countries covered by the LSCI), the ship size component has increased by 124% between 2004 and 2015. While for ASEAN countries, it increased 115%. Although the largest new ships built since 2014 were not bigger than those built in 2015 (e.g. Maersk's Triple E class), the ships are certified and reported to carry more TEU than the ships in the previous years. The chart also illustrates the impact of the economic crisis of 2009, when many ships were idle and thus shows a decline in the number of ships component. Another trend that can be observed is the continued process of concentration. The average number of services per country has decreased by 17% between 2004 and 2015. While for ASEAN countries, in contrast, it increased slightly by 12%.

Overall, similar to the economic conditions explained in the previous chapter, from the LSCI index, this region shows resilience and continues to show growth in economy as reflected in trade connectivity. The falling global demand that impacted the global GDP in 2008 did not significantly and fundamentally impact ASEAN countries, and growth is still sustained since then to the present. It can be seen that particular to ASEAN countries, the growth of trade in terms of shipping capacity surpasses the number of maximum size of ships, number of ships and services tend to stay stagnant instead of declining, while number of companies tends to decline slowly.

3.1. Number of Ships

Unlike other subsequent LSCI indicators in the next sub sections, only this number-of-ships component indicated a decline of ship number in 2008, quite possibly as a result of the economic crises. This especially can be seen vividly in both Malaysia and Singapore. As shown in figure 4, this component also shows a flat line (gradient=0) characteristic in overall trend; which does not support the overall growth trend of the LSCI across all ASEAN countries; where the actual growth are supported by other indicators
which will be analyzed hereinafter, like the liner carrying capacity and the maximum ship size, where it has more dynamics.

![Number of Ships](image)

**Figure 4.**
Number of Ships

Source: Author’s Compilation, Data Source: Lloyd’s List

### 3.2. Liner Shipping Capacity

Higher carrying capacity can cater the growing global trade, improves economies of scale, and better value for money to help to reduce costs. With new ship technology, larger and heavier ship does not however, in linear reduce the speed of transport. As shown in figure 5, Singapore and Malaysia leaves other ASEAN countries behind, placing them with the most significant gap relative to other countries.

Both countries have carrying capacity in millions of TEU in magnitude, while the rest of the countries are in hundreds of thousands. The carrying capacity of Malaysia and Singapore, not only as a result of being able to accommodate large containers, but also the multiplier effect of the ship frequency docking their ports. Overall, as shown in both figure 3 (LSCI Trend) and figure 5 (liner shipping capacity), this liner shipping capacity component is the main growth driver of ASEAN country’s LSCI index.
3.3. Number of Liner Companies

Looking at overall components, ship carrying capacity and ship size calling to a country’s port tend to increase; while the number of ships and number of services remain stagnant. Since the reporting of 2004 until the recent numbers in 2015, major carriers have now covered practically all regions, thus consolidation among them leads to a reduction of overall number of companies per country. There is declining tendency of this component for both the whole world and ASEAN. As shown in figure 3, for the whole world, it declines dramatically: 29%; while for ASEAN, it declines 23%. The number of liner companies component index, shown in figure 6, depicted a declining tendency. This might be caused by a couple of reasons.

First, is the nature of scoring of the LSCI itself. The index is built based on the reference highest LSCI score, in this case is China. As mentioned in the beginning of the section, China leads for every component except for the liner companies, where it was predominantly lead EU countries. The declining tendency on China’s score in number of liner companies component also reflects the ASEAN components. The competitiveness between countries to improve connectivity tends to compete in volume of trade/traffic,
while this liner companies component tend to show a declining trend.

Second, the decrease might be caused by the nature of the service amongst the companies provide that is somewhat homogenous; where consequently their competitive options are restricted. In relation to maximum ship size component, larger ships require larger companies, which often mean that smaller players are pressured out of the market, which in turn may lead to less competition. In actuality, when leading or dominant companies expand, they tend to acquire part or the whole portion other companies within the industry. This declining trend of shipping companies might need extra attention as it may lead to oligopolistic market structure. In the short run, it may lead towards lower costs as a result of economy of scale and healthy competition. In the long run however, it may lead to cost increase as shippers has less choice with whom they do business with and become dependent with limited but highly-needed service companies, where as a consequence, bargaining position passed on from clients to service providers.

![Figure 6. Number of Liner Companies](source)

Source: Author’s Compilation, Data Source: Lloyd’s List

### 3.4. Logistics Services

With the growth of international trade, shipping companies and freight forwarders often set up its companies overseas, in this case, setting up shop the respective ASEAN
countries. Through these networks of logistics-bases, partnership, consolidation, and even further, intermodal transport are developed. One of the example routes is China and ASEAN, and then extended to Pacific Ocean - bound North America or Indian Ocean - Mediterranean Sea - bound Europe. Transport service establishes its base according to demand, which intuitively create a connected transport network.

Services can vary from intermodal transport service, cargo tracing, inventory management, to third-party logistics (3PL) services. 3PL in particular, can provide bundled and/or value-added service like consulting, planning, consolidation, and procurement.

The number of services in ASEAN, as displayed in Figure 7, shows that over time remains stagnant. This might indicate that the shipping services have already established their ground since before the LSCI index was introduced in 2004. Vietnam showed little growth starting from 2006 to 2011. While for Singapore and Malaysia in particular, there were significant reductions of shipping services starting in 2008, possibly relates to North American and European companies trying to downsize their business in their country caused by the global economic crises during that time, or to the least stay focus on their specialization of their core businesses instead of expanding their offering to new types of services.

![Figure 7. Number of Services](image)

Source: Author’s Compilation, Data Source: Lloyd’s List
3.5. Maximum Ship Size

Investment delays or state budget austerity may be imposed by governments where it can hinder further infrastructure development and provisioning of ports in order to be able to handle large vessels. Despite the healthy balance that most ASEAN countries have during the 2008 crises, they moved cautiously from investing in big projects. Figure 8 shows a big difference on how Malaysia and Singapore are able to attract and to handle super large ships while the rest of ASEAN countries are yet being able to.

Efficient ports need to find a balance on size of the ships and the efficiency of its ports. One port may have been dredged to be able to handle large ships but the speed of loading and unloading may be slow, due to overcapacity or lack of supporting infrastructure and hinterland connectivity. On another perspective, a country may have a highly efficient port with adequate supporting infrastructure, but it does not have the volume business to attract large ships to dock at the respective ports.

One aspect can be highlighted as the figure shown. Since 2004, Indonesia’s capacity on the size of ship is in a standstill if not slipping back relative to its neighboring countries. Despite having the same access to the Malacca strait, Indonesia’s reported ship capacity are comparably far behind with a large gap to Singapore and Malaysia where it shows continuous improvement. Much of Indonesia’s problem of this comparative retardation is probably attributed to lack of port infrastructure development and lack of commitment in building infrastructure to reduce congestion and to reduce dwelling time to speed-up of the flow of goods beyond the port to support the overall supply chain.
This ship size component shows Malaysia is leading Singapore. Tanjung Pelepas port was found to have qualities of outstanding location, good accessibility, and advanced integrated information technology systems. Research has found that those three criteria are key requirement in port competitiveness (Subhan & Abdul Ghani, 2008). From the TEU capacity, it shows that through factual data, the 18,270 TEU ship capacity is the Maersk Mc-Kinney Møller ship, which is the lead ship of Maersk's Triple E class that docked that port in 2014 and 2015. This Malaysian superiority in ship size is also related to Maersk Line move of its transshipment hub from Singapore to Tanjung Pelepas (Knowler, 2014).

4. Quantitative Analysis

The main objective of this paper is to answer a research question of which among the logistics indicators, in this case LSCI connectivity components, that matters the most. This quantitative analysis section is divided into two parts. First is to perform correlation analysis of LSCI components with LPI indicators. Second, an econometric analysis will be done using LSCI components, in a form of panel data, to find a relationship with a
well-accepted dependent variable. Furthermore, the validity of the model panel data and the time series nature, will be subjected to further statistical tests.

The analysis will cover only a limited period of time, thus it not cover the whole liner shipping history, that was started in 1955, or even 1980 where the container shipping started to continuously grow. LSCI data are available annually from 2004 to 2015, while LPI were only surveyed four times, in 2007, 2010, 2012 and 2014. In addition, another intersection can also be found, LSCI covers 159 coastal countries and territories, while the LPI is generated for 155 countries and economies, including land-locked countries. The LPI covers a broad range of trade logistics issues including tramp shipping and cross border land-based trade, while the LSCI is limited to liner shipping.

4.1. Correlation Analysis with LPI

How the index is built between LPI and LSCI is quite different. Scoring of the LSCI does not directly parameterize any judgement or any perception on a country’s ports or shipping. This judgement and perception are built upon a research on country’s logistics performance in correlation to how companies being surveyed. Though using LPI results with this correlation, the result may indicate that there is a trend towards a fewer, smaller-sized, and less-capacity ships being deployed by fewer services and by fewer companies (Ojala & Hoffmann, 2010). This lower level of deployment might also be the result of a country’s geographical position, trade volumes; and business attractiveness towards liner shipping companies. With the LSCI company indicator, it would imply some finding: less efficient ports with lack of infrastructure will be perceived less attractive, thus deter the traders and the shipping companies to do business with. This finding and perception on country’s performance can be researched to see the correlation to companies who were being surveyed to generate the LPI.

Using the same manner with the research conducted by Ojala and Hoffmann (2010), table 2 displays the Pearson correlation coefficients between the six components of the LPI components are divided into six core dimensions of logistics performance for ASEAN countries. The six core dimensions of LPI as responded by the logistics professionals are Customs, Infrastructure, International Shipments, Logistics Competence, Tracking and Tracing, and Timeliness.
Table 2. Pearson correlation coefficients between LPI and LSCI components

|                  | LPI                  | LSCI  | LSCI Components | LSCI Components | LSCI Components | LSCI Components |
|------------------|----------------------|-------|-----------------|-----------------|-----------------|-----------------|
|                  |                      |       | ships           | teu             | companies       | services        | shipsize        | cust            | infr            | itn             | logs            | time            | trac            |
| LPI              | 1                    |       |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |
| LSCI             | 0.879                | 1     |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |
| number of ships  | 0.828                | 0.884 | 1               |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |
| ship capacity (teu) | 0.775               | 0.868 | 0.966           | 1               |                 |                 |                 |                 |                 |                 |                 |                 |                 |
| liner companies  | 0.815                | 0.818 | 0.928           | 0.814           | 1               |                 |                 |                 |                 |                 |                 |                 |                 |
| number of services | 0.858               | 0.873 | 0.991           | 0.951           | 0.933           | 1               |                 |                 |                 |                 |                 |                 |                 |
| maximum ship size | 0.702                | 0.875 | 0.858           | 0.891           | 0.751           | 0.825           | 1               |                 |                 |                 |                 |                 |                 |
| customs          | 0.963                | 0.867 | 0.825           | 0.788           | 0.778           | 0.849           | 0.681           | 1               |                 |                 |                 |                 |                 |
| infrastructure   | 0.980                | 0.895 | 0.848           | 0.801           | 0.829           | 0.875           | 0.748           | 0.945           | 1               |                 |                 |                 |                 |
| international shipments | 0.948            | 0.831 | 0.778           | 0.736           | 0.747           | 0.805           | 0.676           | 0.906           | 0.895           | 1               |                 |                 |                 |
| logistics quality | 0.977                | 0.831 | 0.780           | 0.719           | 0.772           | 0.807           | 0.616           | 0.950           | 0.959           | 0.897           | 1               |                 |                 |
| timeliness       | 0.922                | 0.809 | 0.752           | 0.691           | 0.795           | 0.786           | 0.672           | 0.828           | 0.891           | 0.857           | 0.864           | 1               |                 |
| tracking & tracing | 0.970               | 0.816 | 0.764           | 0.699           | 0.765           | 0.797           | 0.626           | 0.901           | 0.937           | 0.917           | 0.953           | 0.891           | 1               |

LPI was benchmarked with the five components of the LSCI, whereby the overall correlation between the two is 0.879. The components included in the LPI will also likely lead to a higher LSCI; and reversibly LSCI components lead to an improved logistics performance, which is then captured in the perception survey data used to generate the LPI. The scatter plot and regression line graph is shown in Figure 9, which yields an Ordinary Least Squares (OLS) formula:

\[
LPI = 0.5376 \ln(LSCI) + 1.284
\]

Where the R-squared and Adjusted R-squared of the models are 0.7161 and 0.7032, respectively.

Among the different components, the LPI infrastructure component in particular, is
highly correlated with almost all LSCI components with coefficients of above 0.8, except for LSCI maximum ship size. The explanation of these phenomena could be that a company’s decision to provide services to/from a country’s ports using its largest ships is closely related to the country’s transport infrastructure. This same finding is almost the same if we were to use the whole world sample.

Figure 9.
Relationship between LSCI and LPI

One unique finding using the ASEAN sample is the strong correlation coefficient between the total number of ships in LSCI and infrastructure in LPI. This indicates the variety of aspect of physical infrastructure is required to improve connectivity, like port efficiency and ship turnaround time. Ship size scores less in relation to LPI’s infrastructure might indicate both the attractiveness of the country’s port, with a not so high requirement for dredging and widening the port to accept larger ships.

As it shows in this analysis building infrastructure to attain a good connectivity has the most impact. Many countries make efforts in pursuit of prosperity, and ASEAN countries are no exception. One of the ways to do so is by constructing container ports and lining major trading ports (Cho, 2014). However, it is quite challenging to have sufficient container traffic passing through country’s ports to justify a hefty upfront investment. Notwithstanding building infrastructure, strategies need to be introduced to meet the forecasted traffic volumes.

A better port infrastructure might improve efficiency however it comes at a cost beyond building the infrastructure itself. A good infrastructure may potentially increase port charges, as it might be found to offer more convenience. The burden of charges, as a
consequence, will be borne by the shipping companies. While privatization of ports may lead to investment, investors are only interested if there is a potential for profit, and if not regulated, the increased transport cost will need to be covered by shipping companies. Further analysis on balancing public-private partnership for ASEAN countries needs to be done on this regard.

4.2. Panel Data Analysis

This part will show empirical evidence on key logistics connectivity component indicators that has the most impact on international trade. Therefore, as shown in the descriptive statistics, performance indicators vary widely from one LSCI component to another, therefore highly specialized and carefully chosen indicators are required to measure a country's liner shipping performance.

All the ASEAN country’s LSCI component will be processed against dependent variable: the international trade volume. The data collected spans between countries over time a panel data would be appropriate to analyze the logistics connectivity situation. In addition, combining time-series of cross-section observations, panel data offers more informative data, more variability, less collinearity among variables, more degrees of freedom and more efficiency (Clark, Dollar, & Micco, 2004). A panel data analysis that was done for Latin American Countries (Wilmsmeier & Martinez-Zarzoso, 2010) and for analyzing already-existing Logistics Indicators in ASEAN (Reza, 2014) could also be used to model liner shipping connectivity data, also in this case for ASEAN Countries.

Figure 10.
Container Port Traffic, in TEU

Source: Lloyd’s List and World Bank
In this paper, international trade is parameterized using Container Port Traffic (CPT). CPT measures the flow of containers in TEUs. The CPT statistics for ASEAN traffic is displayed in Figure 10. The base reasoning of choosing CPT is because it gives some indication of economic growth in a country. It is worth to note however, that the statistic includes empty units, and transhipment container traffic is counted as two lifts at the intermediate port (off-load and on-load).

Despite being a good candidate as a dependent variable, when traffic is transshipment, one might argue that much of the economic benefit goes to the terminal operator and ancillary services for ships and containers rather than to the country at large. In addition, using this dependent variable, on one hand one might assume that the international trade volume using container is found to be quite generic; while on the other hand, it is worth to note that on the actual business side however, liner shipper operator carries the freight irrelevant that is inside the box, as the transport cost tends to stay the same.

The data 2004 to 2014 are taken from Lloyds List Intelligence, specifically Containerisation International Yearbook; while the data for 2015 are taken from statistics taken from the port authorities or the statistical office of the respective ASEAN countries.

In this analysis, LSCI components will be measured against CPT as left-hand side dependent variable, where it is first transformed into natural logarithm (lnCPT). A generic linear panel data model using can be presented based on the following form:

$$\ln CPT_{it} = \beta_0 + \beta_1 SHIPS_{it} + \beta_2 TEU_{it} + \beta_3 COMPANIES_{it} + \beta_4 SERVICES_{it} + \beta_5 SHIPSIZE_{it} + \epsilon_{it}$$  \hspace{1cm} (1)

Where SHIPS is the number of ships assigned to liner services from and to the country; TEU is the total container-carrying capacity of those ships (in TEU); COMPANIES is the number of companies that deploy container ships calling a country’s ports; SERVICES the number of services offered by the companies; and SHIPSIZE the maximum ship size in maximum TEU capacity. The methods of representing the error-term $\epsilon$ will vary according to the type or the panel data that is being analyzed.

|            | OLS  | FE  | RE  | RE(ASEAN-2) | RE(ASEAN-4) |
|------------|------|-----|-----|-------------|-------------|
| SHIPS      | 1.274| .312| 1.274| .618*       | -5.786      |
|            | (1.462) | (1.467) | (1.462) | (.369) | (3.542) |
| TEU        | -.360| -.014| .360 | .328**      | -5.797*     |
|            | (.551) | (.579) | (.159) | (.159) | (3.147) |
OLS is used as a benchmark, while the main analysis will use panel data methods using Fixed Effects (FE) and Random Effects (RE). RE models are used in the analysis of hierarchical or panel data as a benchmark, and when there is no assumption on FE (i.e. no individual effects) across the countries being studied.

All of the sign and significance are expected to be positive; except for β3 as the coefficient is expected to be negative based on the previous section’s descriptive analysis where companies has a tendency to converge. The results summary for OLS, FE, RE is displayed in Table 3. The coefficients are presented with its level of significance, while the standard errors are available below each parameter in brackets.

To further analyze, we can divide group into ASEAN-2 (Malaysia and Singapore), both are highly advanced in logistics connectivity, and ASEAN-4 (Indonesia, Philippines, Thailand, and Vietnam). After running the analysis with this partition, both groups show a statistical significance of the maximum ship size (independent variable: SHIPSIZE), .136 for ASEAN-2 and .657 for ASEAN-4; and ship container capacity (independent variable: TEU), .328 for ASEAN-2 and -5.797 for ASEAN-4.

This result shows that there is a great potential for ASEAN countries to perform as a transshipment hub and to improve the volume of trade. While for ASEAN-4 there is a negative relationship, with statistical significance, of -3.98 at the COMPANIES variable. This trend shows, possibly with the improvement of Information and Communications Technology and with the entry barrier which are commonly found in developing countries, there is lack of necessity to open a base office at those ASEAN-4 countries, or shippers tend to stay with the companies they regularly do business with.

|                | OLS       | FE       | RE       | RE(ASEAN-2) | RE(ASEAN-4) |
|----------------|-----------|----------|----------|-------------|-------------|
| COMPANIES      | -1.205    | -.365    | -1.205   | -.163       | -3.98*      |
|                | (1.118)   | (1.311)  | (1.118)  | (.437)      | (2.270)     |
| SERVICES       | 2.016     | 1.883    | 2.016    | 1.60***     | -4.95       |
|                | (1.274)   | (1.808)  | (1.274)  | (.351)      | (3.834)     |
| SHIPSIZE       | .297*     | .416***  | .298**   | .136*       | .657*       |
|                | (.141)    | (.150)   | (.141)   | (.074)      | (3.833)     |
| Adjusted R2    | 0.867     | 0.872    | 0.877    | 0.981       | 0.382       |
| Observations   | 72        | 72       | 72       | 24          | 48          |

*** Indicates significance level at 1%
** Indicates significance level at 5%
* Indicates significance level at 10%
4.3. Statistical Testing

For this panel data model, further statistical test is performed to determine which among models best represents the situation. To compare between RE and FE, a Hausman test is launched; where the null hypothesis is to support RE, i.e. difference in coefficients not systematic. The test yields a $\chi^2$ result of 21.95 with a p-value of .0005 which is much lower than .05, to reject the null hypothesis thus supporting the FE result. FE by design is best suited in analyzing the impact of variables that vary over time. FE removes the effect of those time-invariant characteristics so we can assess the net effect of the predictors on the outcome variable.

From the FE model, it can be seen that, there is a positive relationship where, a unit increase in SHIPSIZE component, it will lead to an improvement of .416 of ln CPT. Statistical results also suggest, with an Adjusted R2 of 0.872. From the Panel Data results, it confirms our expectation that a country’s port infrastructure in terms of being able to accept large size of ships relates positively towards higher CPT. 

After the FE model is chosen, to confirm that there are no heteroscedasticity, an additional testing needs be launched. After running the test, this model shows that there is a presence of heteroscedasticity where the standard errors are pretty dispersed. The test yields a $\chi^2$ result of 26.1 with a p-value of .0001 which is much lower than .05. This can also be caused by the lack of observations available as it only covers six countries. Figure 9, shows that the data points still tends to show that there is a trend towards positive relationship if the data is processed using pooled regression.

Further the model is tested to see an existence of serial correlation, which is called Wooldridge test for autocorrelation in panel data. Serial correlation causes the standard errors of the coefficients to be smaller than they actually are and a higher R-square. After running the test, it was found that $\chi^2$ result of 2.391 with a p-value of 1.827 which is much higher than .05. Thus no serial correlation exists.

Finally, the model is tested for panel data unit root, where it was found that all the variables are stationary, except for ship capacity where it is non-stationary. The FE result supports the increase of ship size more significantly than the ship TEU capacity, hence the TEU capacity coefficient, at the time-series perspective, is not statistically significant.

4.4. Summary of Quantitative Findings.

The result of panel data analysis strengthens the presentation of the descriptive statistics and the findings from correlation analysis, where improvement of infrastructure
plays a crucial part in every ASEAN countries. Although the finding of the panel data only suggests the improvement of port to accept the demand of the larger ship sizes and larger container volumes docking its port, it can also be complemented with a recommendation where a company’s decision deploy largest ship is closely related to the expected trade volume, variety of service, and turnaround speed a country’s port can offer.

It is clear that the port’s capacity to accept larger ship size provide the most significant impact. The magnitude however, is different for ASEAN-2 (.136) and ASEAN-4 countries (.657). This indicates that the impact on improving ports and liner shipping’s physical infrastructure, ceterus paribus, in ASEAN-4 countries is much higher whereby those countries must make building them a top priority. Table 4 summarizes the prioritization of the impact of LSCI components.

Table 4.
Prioritization of LSCI Components

|            | ASEAN-2 (Malaysia and Singapore) | ASEAN-4 (Indonesia, Malaysia, Philippines, Thailand) |
|------------|---------------------------------|-----------------------------------------------|
| First      | Services                        | Ship Size                                    |
|            | (with supporting infrastructure) | (with supporting infrastructure)             |
| Second     | Ship Size                       | Improve Liner TEU Capacity                   |
|            | (with supporting infrastructure) |                                               |
| Third      | Improve Liner TEU Capacity      | Attract New Companies                        |

The second priority differs from ASEAN-2 and ASEAN-4. For ASEAN-2, improving and attracting liner shipping services in the country takes precedence, while for ASEAN-4, with still the stagnant trend of total ship carrying capacity, improving the supporting infrastructure like improving ship frequency docking their ports, faster customs clearance, and building better hinterland connectivity, are some of the main factors to considered as priority. In order to participate in globalized trade and production processes, ASEAN-4 countries needs to rely on frequent and reliable containerized shipping services.

5. Conclusion

ASEAN’s role in maritime transport shown by the LSCI, presents how well the ports of a country are internationally connected. ASEAN’s overall good rating on the LSCI
reflects not only a good regional and global connections of its seaports, it also indicates to the fact that their harbors are proven and have great potential to further serve as hinge joints between other regional harbors and the rest of the world. Overseas goods unloaded at Tanjung Priok, Indonesia, for example, have often been shipped on a large vessel to Singapore, or Tanjung Pelepas, Malaysia first, where some of the cargo has then been reloaded on a smaller ship going to Bangkok; or on a global stage, Chinese export goods depart from Ningbo, make a transshipment in Port Klang in Malaysia, on its way to arrive at their destination in Dubai, United Arab Emirates.

This paper has answered main research question on which LSCI indicator can provide the most significant impact towards international trade, i.e. port’s capacity to accept larger ship size provide the most significant impact. While for the second question on the prioritization, the approach for Malaysia and Singapore with a world class liner shipping infrastructure is different than the one for Indonesia, Philippines, Thailand and Vietnam. For Malaysia and Singapore, in order to sustain its class and ranking, they will need to improve on the number of liner shipping services; while for the rest, improvement on the supporting liner shipping infrastructure will be the first one that needs to be taken into account.

The performance of the ASEAN economies in terms of international trade has generally performed surprisingly well. The principal contribution is the economic expansion, in terms of business and shipping connectivity, which was mainly occurred as a consequence of domestic consumption. The region’s expanding middle-class, gradual movement from low-to-middle, then middle-to-high income, and the growing number of people freed from the poverty is becoming a trend. Overall, becoming a middle-economy at the first place is no small feat. On the economic rankings it can be seen how much has changed in the economic, logistics, and more specifically LSCI ranking.

Shown by the size of exports, ASEAN might be found to be overly reliant on external markets which arguably contributing to the imbalances and political friction. ASEAN economies are still attracting growing amounts of foreign investment which feeds towards a quite high-level economic growth. ASEAN is in control to decide on what regional action it wants to take, however the overall international trade strategy it wants take are highly dependent on the dynamics of its trading partners, mainly its Northeast Asian countries counterparts. Although somewhat yet fully-inconclusive along with the limitation of the quantitative analysis, it can be seen that its development is quite remarkable, while still remains dependent on key export markets highly sensitive to economic recession.

As shown from the graphs, the logistics development of Singapore and Malaysia is considered world-class, while the rest are significantly placed at the lower tier. It would be implausible that the remaining four countries are a market for consumer goods that benefit
the World’s developed economies, despite the importance of domestic consumption and its highly commendable economic resilience. These economies, as a consequence, are highly sensitive towards the shifts in the market conditions and the government policies elsewhere around the world.

With the industrialization of ASEAN economies, it thus remain an especially a vulnerable object to shifts in consumer sentiment of the world at large. Industrialization aside, ASEAN countries still rely on the trade of agricultural and mineral commodities. Natural disasters and volatility of commodity prices, provides a strong case to weigh importance of social and political stability, especially the regions ability to feed and to provide basic infrastructure for a rapidly growing population.

On the original premise of heterogeneity, a diverse range of domestic, historical, and geopolitical factors continue to influence economic outcomes in ASEAN. It is quite difficult to make a generalized observation of this diverse group. At best we can group it into ASEAN-2, where they are highly advanced in logistics, and ASEAN-4 where despite its high economic growth, the liner shipping infrastructure development potential still remains to be seen. In spite of this, ASEAN has experienced and continues to experience impressive economic growth given the previously-discussed overwhelming diversity and potential maritime connectivity advantages and challenges.

For an emerging market like ASEAN, this study is only a kick-start to explore container transportation in the region. Some previous research done in the EU (Van de Voorde & Meersman, 2013), Latin American (Wilmsmeier & Hoffmann, 2008), and Asia Pacific (UNESCAP, 2013) countries can be used as a reference. Alternatively, comparative research can also be undertaken. It is hoped that this research inspires more in-depth empirical studies and qualitative research on the impacts liner shipping connectivity in the maritime industry.

Further research can study country-level LSCI or pair of country-level data to analyze bilateral trade, would allow us to undertake research into possible determinants of a more focused international trade flows. Further research can also be done to see how rampant corruption, growing inequality, climate change and other environmental problems, and perennially restive military are among many formidable challenges of most of ASEAN countries. One can also look a country’s specialization on a certain manufacturing sector. With regards to the environment, climate change in particular poses significant threat towards the sustainability of the region’s economic growth, especially in its efforts the eradicate poverty, and sustaining overall long-term prosperity.
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