IMPACT OF TRADE FACILITATION ON GLOBAL SUPPLY CHAIN FACILITY LOCATION DECISION MAKING: A STUDY BASED ON AUTOMOTIVE COMPANIES

AHMED HUMAIR

AN INDEPENDENT STUDY REPORT SUBMITTED IN PARTIAL
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THESIS TITLE	Impact of trade facilitation on global supply chain facility location decision making: a study based on automotive companies
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ABSTRACT

Globalization has made supply chains more international than ever before. Factories, distribution centers, warehouses of companies are located around the world. Further, many companies have outsourced their operations to reap the benefits of cheap labor, lower material costs and proximity to markets (Jenny K andersoon, Therese Wemner, 2008). However, trade transaction cost remains as one of the challenges to global supply chains. OECD estimates trade transaction cost to remain between 2% to 15% of the value of goods imported making global supply chain expensive. Trade facilitation efforts have been initiated by multilateral organization as well as countries to reduce the trade transaction cost. It focuses on harmonization, standardization and modernization of trade procedures in order to reduce trade transaction cost.

Cost, time, reliability and predictability of supply chains are major factors which determine global companies' decisions on which markets to enter, where to set up a factory or distribution center. Hence the level of trade facilitation in a particular country have an impact on global supply chain facility location decision making. This research project to understand the relationship between trade facilitation and global supply chain facility location decision-making achieved the following results. The study based on

1426 facilities of six leading automotive companies around the world and the level of trade facilitation in those countries showed they have a positive correlation between them. Countries with higher level of trade facilitation were found to have higher number of facilities of global supply chains and increasing level of trade facilitation were found to attract more facilities of global supply chains in to a country. It further revealed that dimensions of trade facilitation like logistics quality and competence, tracking and tracing were most important among the six dimensions considered in the research.

In addition, the benchmarking analysis based on different regions revealed that regions with a higher average trade facilitation have attracted more facilities of global supply chains than regions with lower average levels of trade facilitation. Interestingly, the study also showed that a trade facilitation score of 3.27 or more is critical to attract optimal number of facilities into a country.

This research confirms the impact of trade facilitation in global supply chain facility location decision making. The relevance of different dimensions of trade facilitation would help to direct the trade facilitation investments into areas that would yield high returns in terms of trade and economic development.

ACKNOWLEDGEMENT

The successful completion of this independent study would not have been possible without contribution from numerous people. I am very pleased to express my since appreciation to all of them.

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I would also like to express my sincere gratitude to all the lecturers who taught me in my two years Masters program at the University. What I learnt in each of the modules were found to be useful at various stages of this study. I am especially indebted for those who shared their knowledge and wisdom in relation to my research and guided me through the process of independent study project.

In addition, I would like to thank my wife, Riyasha Ali for proof reading my independent study report and for her continuous support during this project and my two years study program. I would like to thank my colleague, Sattra Vuthy as well for his ideas and constructive criticism which helped me improve in work. Lastly, I offer my thanks and well wishes to all those who supported me in any respect during the completion of this study.

Ahmed Humair

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF FIGURES
(Continued)

CHAPTER 1

INTRODUCTION

1.1 Research Background

Import substitute industrialization model with excessive interventionism and protectionism was the trade policy adopted by many countries after the Second World War. However, countries around the world began to embrace trade liberalization and specialization after mid-1970. Flexible exchange rate regimes, lower import tariffs and regulatory frameworks to promote foreign direct investments were implemented. As a result, import tariff applied by countries have reduced by 15% and world trade has increased from US$ 5 trillion in 1996 to US$19 trillion in 2013 (WTO, Trade anf tariffs, 2014).This shift in trade policy increased interdependence of economies marking the beginning of globalization era (Birol, 2012).

Globalization removed the barriers which previously separated the markets. To attain a competitive advantage in the newly emerged global market with players from around world, companies had to be more efficient and effective. This has increased the global supply chains especially in the areas of automobile, computer and apparel industries (Mary J. Meixell, 2005).

Companies now source their raw materials, set up their factories and distribution centers in countries where they can gain a competitive advantage over their competitors. Cost and time has become one of the two major factors that determine the competitive strategy of a supply chain (Batista, 2012; Douglas M lambert, 2000; Alessandro Nicita, 2013).

Although trade liberalization policies have considerably reduced the cost of international trade, direct as well as indirect trade transaction cost still hinders the growth of global trade and global supply chains as shown in Figure 1 (Manners, 2010; Grainger, Trade facilitation : a review , 2005).

Estimates of OECD reveals that 1% reduction in trade transaction cost could yield a benefit of US$ 43 billion worldwide (Grainger, Customs and trade facilitation: from concepts to implementation , 2007). Hence trade facilitation has become the new policy trend in international trade. It has become one of the determinants of country's role in the global supply chains (Grainger, Trade facilitation: A conceptual review, 2011; Batista, 2012; OECD, 2000).

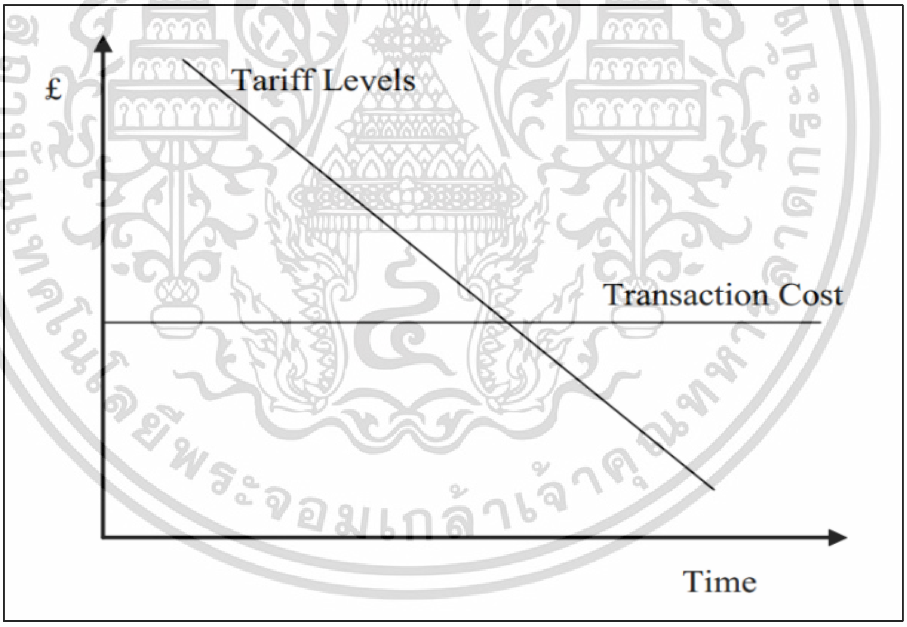

Figure 1.1 Tariff levels and trade transaction cost over time

Source: Grainger, Trade facilitation : a review , 2005.

1.1.1 Trade facilitation

Trade facilitation is a widely used concept in world trade negotiations since 1996 WTO Ministerial Meeting in Singapore. World Trade Organization (WTO) defines trade facilitation as “simplification and harmonization of trade procedures where trade procedures are the activities and practices and formalities involved in collecting, presenting and processing data required for the movement of goods in international trade” (Grainger, Trade facilitation: A conceptual review, 2011). Simplification of trade procedures attempts to eliminate the unnecessary elements and duplication in formalities, process and procedures in international trade while harmonization focuses on aligning the national formalities, procedures, operations and documents with international conventions, standards and practices. Definition of trade facilitation by agencies like United Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT) further extends the scope of trade facilitation to include standardization and procedures involved in making payment for international transactions. Modernization and transparency of international trade procedures are also often discussed under the topic of trade facilitation. The use of information and communication technology to enhance the border management procedures and reduce red tape in international trade transaction is described as modernization. Transparency refers to the availability of information and clear specification of requirements and process for cross border movements of goods.

As such, there are five main principles of trade facilitation. They are simplification, harmonization, standardization, modernization and transparency. Each of these principles of trade facilitation focus to minimize the complexity and enhance efficiency in cross border movement of goods. It attempts to minimize the direct as well as indirect trade transaction costs (Grainger, Customs and trade facilitation: from concepts to implementation , 2007).

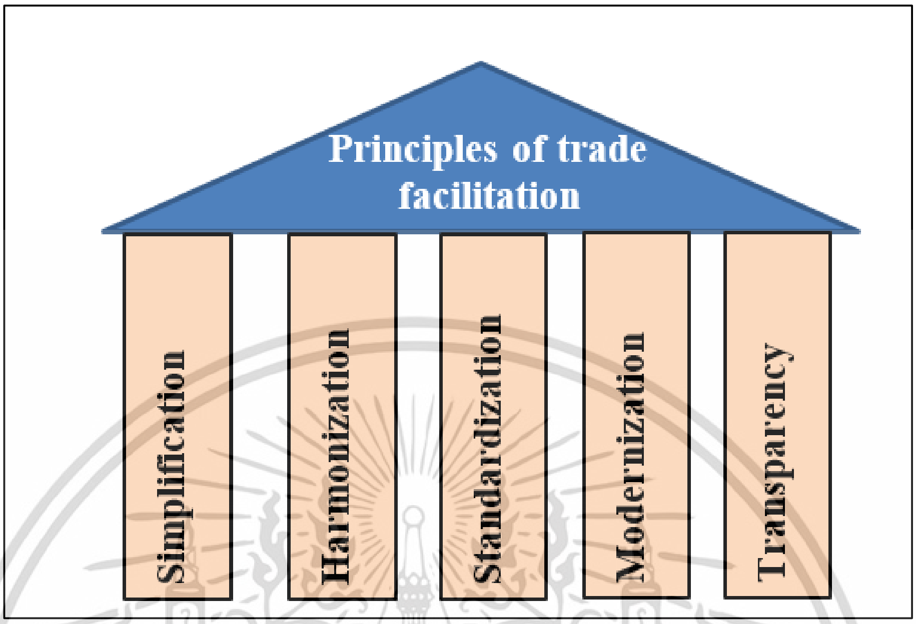

Figure 1.2 Principles of trade facilitation

Source: Grainger, Customs and trade facilitation: from concepts to implementation , 2007.

Direct trade transaction costs are the cost incurred to adhere and comply with the rules and procedures of border protection agencies. Some examples of direct trade transaction cost include fees paid to customs bonds and cost incurred on stamping documents. Indirect trade transaction costs are time delays experienced due to inefficient and inconsistent border management procedures. Congestion in inspection and contradictory documents are some examples (Grainger, Customs and trade facilitation: from concepts to implementation , 2007).

1.1.2 Global supply chain management

A supply chain is a network of business entities involved in the upstream and downstream flow of goods or services along with finance and information flow (Serdar-Asan, 2011). Martin Christopher in his book, Logistics and Supply Chain Management, defines supply chain management as “management of upstream and downstream relationship with suppliers and customers in order to deliver superior customer value at less cost to the supply chain as a whole" (Christopher, 2011). As such, a supply chain includes all parties involved in delivering final goods to consumer. It consist of not only manufacturers and suppliers but also transporters, warehouses, retailers and customers as well (Sunil Chopra, 2007).

Global supply chain is the new trend of global economy. Nearly 70% of global trade is associated with global value chains. It is not only the finished goods that are traded across borders but also parts and semi-finished products during the production process of a single product. In addition, a large proportion of global production is targeted to foreign markets. Hence the impact of trade cost arising from poor infrastructure and complex cross border trade procedures are higher than before.

A global supply chain consist of parties involved in the supply chain network in more than one country. Apart from the common entities in a domestic supply chain like suppliers, manufacturers, distributors, retailers and consumers, the border protection agencies of countries become a part of global supply chains. Hence collaboration with customs, immigration, port health agencies and quarantine services are important in optimizing the global supply chain network. A global supply chain makes the management of upstream and downstream relationships in the supply chain more complex. Involvement of cross border movements of goods and information within these networks is the main reason for increased complexity. International movement of goods adds more operational steps such as packing, storage, haulage to the port, port entry, customs clearance and loading onto a vessel prior to exportation. Further operational steps such as off-loading, storage, and release from the port and customs clearance are performed once arrived to the importing country (Grainger, Trade facilitation: A conceptual review, 2011).

Number of parties involve in global supply chains are much more than that of a domestic supply chain. Some of such parties are transport operators, trucking and haulage companies, freight forwarders, customs brokers, banks and finance companies, insurance companies, port operators and stevedores and IT system suppliers. A high degree of coordination and communication among these business entities involved in the process international trade is necessary to comply with the procedures involved in the movements of goods. Due to the red tape involved in international trade procedures, it takes 116 days to export a container from the Central African Republic to the nearest port (Simeon Djankov, 2006). It is also estimated that more than 200 data elements are requested in a trade transaction of which 60-70% are re-keyed and almost 15 % are re-typed three times (Grainger, Trade facilitation: A conceptual review, 2011).

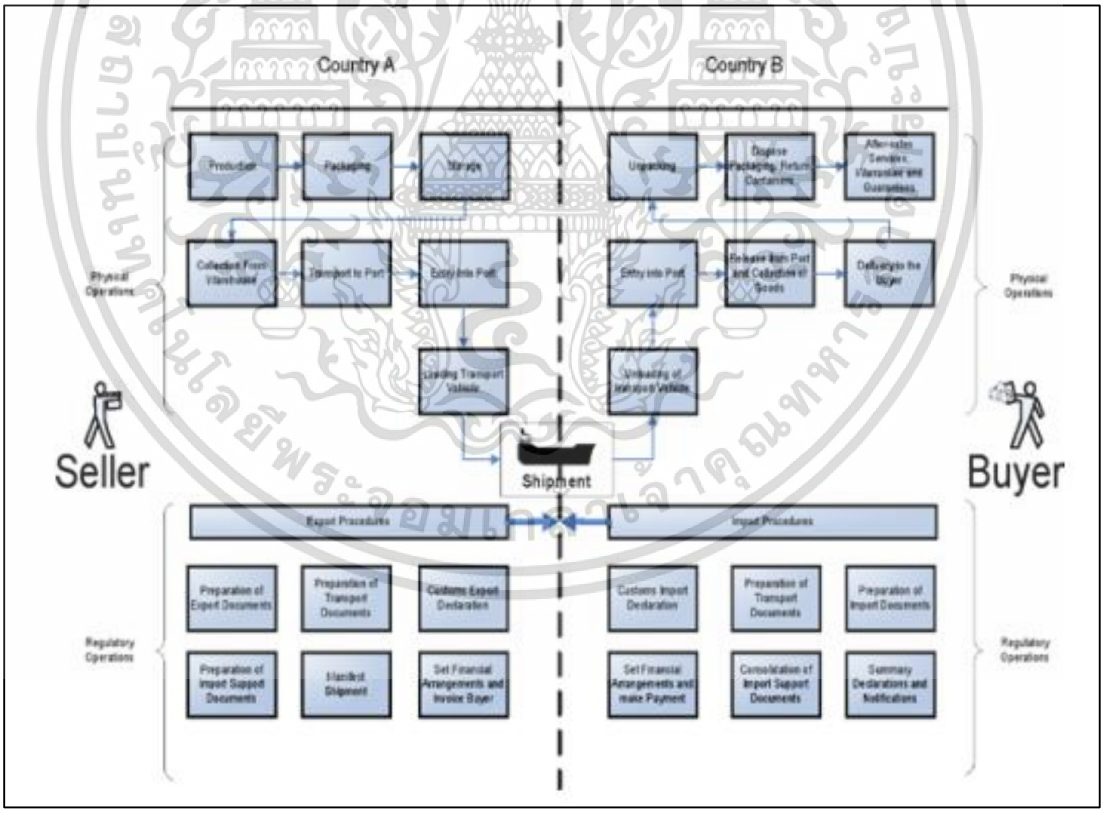

Figure 1.3 Business process in a typical cross border trade movement

Source: Grainger, Trade facilitation : a review , 2005.

The global nature of supply chains have made trade facilitation an important aspect of supply chain management decision making. Supply chains that can quickly response to the changing needs of customers are crucial to success in the globalized market. In an era where a company's sourcing, manufacturing and distribution operations are based in different countries, trade facilitation is essential to ensure reasonable cost and supply chain reliability to cater to the changing needs of customers. High direct and indirect trade transaction costs increase the time delays and cost of the product, making the company less competitive (Douglas J. Thomas*, 1996).

1.1.3 Automotive industry and global supply chain management

The auto industry is among the largest industries around the world. Automobile production is estimated to exceed 100 million vehicles in the 2017 (Hermes, 2014). The globalization of automotive industry dates back several years. Companies like Chevrolet had their production plants in India as early as 1920. However the industry was transformed in early 1990's as a result of trade liberalization (Humphrey, 2003). It is now hard to find an automotive company that does not participate at some level in global supply chains.

Automotive companies have become the most production fragmented companies (KPMG International, 2009). An automotive company is estimated to have 4000 suppliers involved in different stages of supply chain. These suppliers and part manufacturers are dispersed around the world. According to KPMG's globalization index, the auto manufacturers from Western Europe has highest number of plants located around the world with a globalization index score of 90.2%. The manufacturers from United States, Germany and Asia are also equally globalized with a score of 78.5%, 78.5% and 76.1% respectively (KPMG International, 2009).

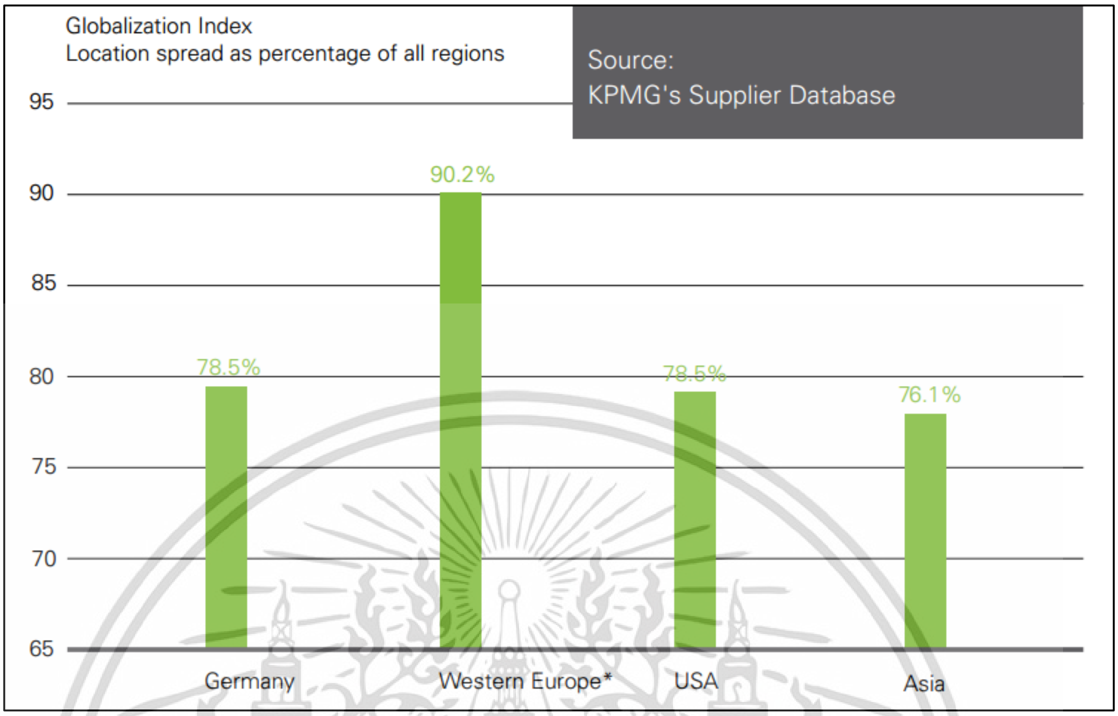

Figure 1.4 Automotive suppliers spread across all regions

Source: KPMG International, 2009.

Moreover, the internationalization index shows the percentage of foreign plants in relation to total plants of automobile companies. German automobile manufacturers have 80.1% of its plants located in foreign countries and Western European auto manufacturers have 84.9% of its plants located in foreign countries. The internationalization among United States and Asian auto manufacturers are 68.1% and 73.6% respectively. Apart from this, auto industry has been the industry pioneering the art of supply chain management, setting best practices and standards for other industries as well. Modern supply chain management practices like just in time supply chain management and lean production originated from this industry (nexus, 2008). Hence auto industry's suitability for this study cannot be over emphasized. Whether or not just in time and global supply chains could co-exist is a question asked by many researchers in this field. According to those researchers, the complexities of global supply chains set off the benefits of low inventory strategies as saving from just in time are much lower than logistics cost and increased lead times brought by global supply chains (nexus, 2008 ; The University of Tennessee, 1999).

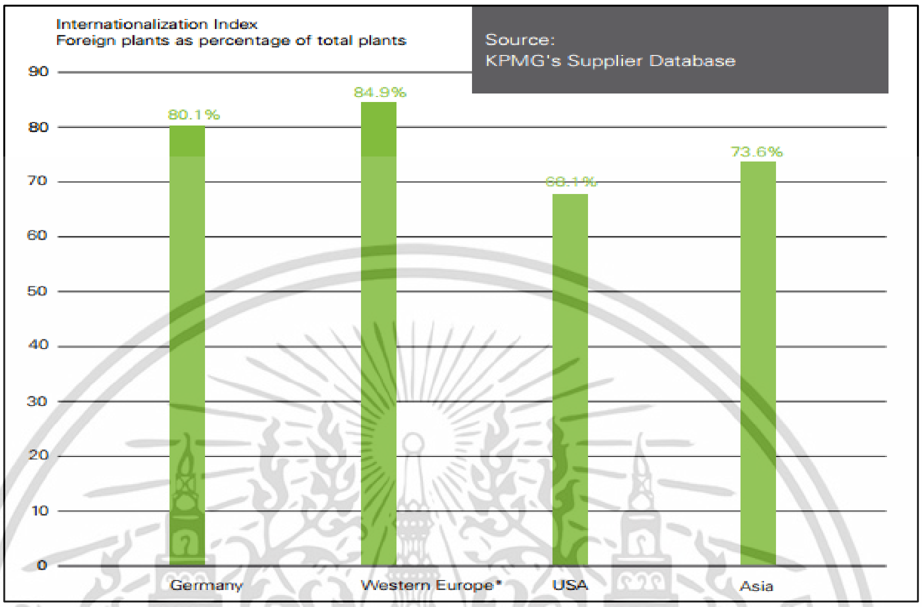

Figure 1.5 Foreign plants as a percentage of total plants of automotive companies

Source: KPMG International, 2009.

1.1.4 Supply chain security and reliability

After the September 11, 2001 terrorist attack on United States of America, supply chain security issues have gained particular importance. Due to the number of parties involved in the supply chain, it is faced with security risks like terrorist attacks, hijacking, human trafficking, and illicit drug trafficking and other illegal cross border activities. These risks within the supply chains are likely to disrupt the flow of goods and information in the supply chain (The national board of trade, Sweden, 2008).Modern production systems like Just in Time have increased the magnitude of impact of supply chain disruptions. Companies are heavily dependent on their contractors or subsidiaries located in different parts of the world to deliver raw materials, parts and finished goods required for their operation. Hence, it requires high degree of coordination, cooperation and transparency of activities carried out between the parties in the supply chain. A little disruption in the supply chain is likely to produce severe financial, marketing and operational challenges (The national board of trade, Sweden, 2008).

The principles of trade facilitation increase the supply chain security and reliability. Trade facilitation provides a mechanism for legitimate parties in the global supply chain to enjoy more lenient border protection measures while diverting the limited resources of border protection authorities to riskier trade transactions (Hua L Lee, 2004). Therefore, trade facilitation efforts by countries are critical for global supply chains to operate efficiently and create a competitive edge as a supply chain (Just in time manufacturing and supply chain management: Auditor risk assessment considerations, 2007; Gordhan).

1.2 Problem Statement

Global supply chains have dramatically increased over the past two decade and it is changing the nature of global trade. A large proportion of global trade now consist of vertical intra industry trade. However non-tariff barriers of trade have remained as one of the main challenges to global supply chains. Thus, level of trade facilitation in a country has an impact on the attracting global supply chains into the country. It influences just in time supply chains, supply chain security, agility, reliability, visibility and competitiveness. Since non- tariff trade barriers have been identified as major impediments to global supply chains, understanding the relationship between the efforts to reduce non- tariff trade barriers and increase trade facilitation and global supply chains is prominent to properly direct and increase the benefits from trade facilitation related investments. The theory in this field are focused on analyzing the relationship between trade volume, bilateral trade and trade margin and trade facilitation. Nevertheless less attention has been given to study the impact of trade facilitation in a supply chain management perspective. Hence this research attempts to study trade facilitation in a global supply chain management perspective.

In the broad field of supply chain, this research aims to understand the relationship between trade facilitation and global supply chain facility location decision making. Attracting facilities of global supply chains are most important for a country in terms of trade and economic development. The results of this research would positively contribute to obtain a more direct approach towards investments related to trade facilitation.

1.3 Objectives of Study

Growing importance of global supply chains are evident in every corner of the world. The challenges confronted by non-tariff trade barriers to growing global supply chains cannot be overstated. Hence by studying trade facilitation in a supply chain management perspective, this research aims to provide insight into the role of trade facilitation in attracting the facilities of global supply chains. In this regard, this project would analyze the location of different facilities of major automotive companies. It would then study about the level of trade facilitation in those countries to draw conclusions on the relationship between them.

The first objective of this research is to understand the nature of relationship between trade facilitation and global supply chain facility location decision making. Through a benchmarking analysis based on regions and countries, this research would give a detailed account on the impact of trade facilitation on regional and country level.

Further, the research aims to highlight the circumstances where trade facilitation has a greater impact in attracting facilities of global supply chains.

Secondly, the research aims to understand the statistical relationship between trade facilitation and facilities of global supply chains. Hence, using regression analysis, the research would determine the correlation between the two variables and discuss the predictability of number of facilities in a country based on level of trade facilitation.

Apart from this, the research would also focus on different dimensions of trade facilitation. Based on six dimensions of trade facilitation discussed under Chapter 3 of this report, it would identify which dimensions of trade facilitation are more important in attracting the facilities of global supply chains.

CHAPTER 2

LITERATURE REVIEW

In this chapter, a review of the literature on the subject matter of trade facilitation and supply chain network design are discussed. A large portion of literature on trade facilitation is based on its relationship with trade, foreign direct investment and export promotion. Hence, an analysis of related studies of trade facilitation with these three major topics are discussed under the first three headings of this chapter.

Literature review on supply chain network design discusses about the factors that affect supply chain network design, the sources of complexities in global supply chain network design and on-going as well as emerging issues in the field. In addition, some of the facility location decision making models of supply chain network design are also discussed. The chapter concludes with a discussion on relationship between trade facilitation and supply chain network design in accordance with the reviewed literature.

2.1 Trade costs

Although tariff rates have been falling over the past years, trade costs arising from non-tariff measures have remained as major impediments to global trade. Non-tariff measures increases transaction costs of trade. These trade transaction costs are sometimes direct like fees which shall be paid to border protection agencies and indirect like time delays, local standards and complex border procedures. Trade facilitation aims to minimize these non-tariff measures by simplifying, harmonizing and standardizing the cross border trade procedures (Grainger, Trade facilitation : a review , 2005). Trade costs arise from set of trade policies adopted by a country. Transport infrastructure investment, law enforcement, laws on property rights, informational institutions, regulations and language are major areas related to trade cost. Direct policy instruments like tariff, quotas, trade barriers in terms of licenses, local standards and exchange rate policies also partly contribute to trade cost (James E Anderson, 2004).

James E. Anderson and Eric Van Wincoop estimates that the cost increase from the factory to the retailer in the importing country sums up to 170% of the total value of the product. The 170% cost increase consist of 21% transport cost, 44% border related trade barriers and 55% retail and wholesale margin. Trade facilitation is focused on reduction of the 44% of cost associated with border related barriers (James E Anderson, 2004). Complexities in customs clearance is one the major factors contributing to trade cost. The issues related to customs are key drivers to expected changes in international supply chains (Hamari, 2009). A typical export transaction requires 42 approval signatures in the Democratic Republic of Congo, 40 in Azerbaijan, 39 in Nigeria, and 33 in Mali—but only 2 in Australia, Austria, and Canada and 1 in Germany.100 percent of imports coming into Sri Lanka and nearly 100 percent coming into Nigeria are subject to comprehensive inspection, while 2 percent are inspected in Germany and only 1 percent in Canada. In Namibia, the costs of all trade related transactions for a 20-foot FCL container, including inland transport from the ocean vessel to the factory gate, amounts to more than $3,000 and in Georgia, that amount is close to $3,000. In Germany these costs amount to only $813 and in Sweden to a little more than $500 (Uma Subramanian, 2005). The figure below shows the average number of days required for customs clearance for shipments by sea in various countries. While Germany takes less than 2 days, countries like Egypt and Argentina takes 14 to 16 days for the same process.

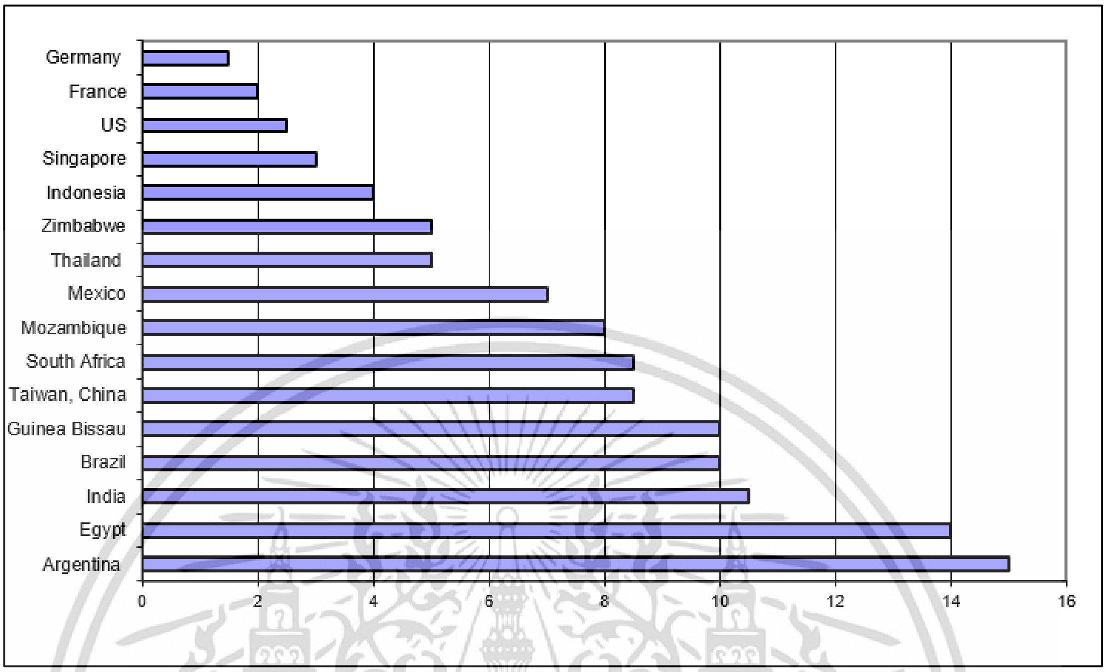

Figure 2.1 Numbers of days required to clear shipments by sea

Source: Grainger, Customs and trade facilitation: from concepts to implementation , 2007.

In terms of transportation cost of international trade, a study done by World Bank in 2002 revealed that transportation cost barriers are much higher than tariff barriers for 77.77% of US trading partners. Moreover UNCTAD estimates that 1% reduction in fees charged for maritime and air transport services could increase Asian GDP by US$3.3 billion (World Bank, 2004).

Modernization of customs procedures like electronic customs systems and single window and expediting customs clearance process could also reduce trade cost. A joint study done by Australian Department of Foreign Affairs and Trade and Chinese Ministry of Foreign Trade and Economic Cooperation showed that adopting an electronic documentation system in cross border trade could save 1.5% to 15% of the cost of imported items (Australian Department of Foreign Affaris and Trade and

Chinese Ministry of Foreign Affairs and Economic Cooperation, 2001). A similar study done based on Chilean Customs showed introduction of Electronic Data Interchange in Chilean Customs Administration saved over US$ 1 million per month to the organization (WTO, Trade facilitation : Chile's experience with the modernization of customs adminstration based on the use of information technology, 2000).

Complying with the regulatory requirements of a country could also add to the trade transaction costs of supply chains. Regulatory requirements exist for health, safety and environmental reasons and they are enforced by different border protection agencies. Recently, these agencies have adopted supply chain management perspective for effective implementation of the regulations. Authorized Economic Operator (AEO) program introduced by WCO is one such program implemented in many Customs Administrations. The program allows Customs Administrations to approve any party in a supply chain as best practitioners of security and regulatory standards. Such parties are then given a lenient treatment at cross border. When all the parties in a supply chain become Authorized Economic Operators, the easy cross border flow of goods of the whole supply chain is facilitated (Grainger, Supply chain management and regulatory controls : A case for trade facilitation, 2003). Apart from these programs, harmonization of standards, mutual recognition agreements were found to be helpful in reducing cost of product redesign and testing (OECD, 2000).

2.2 Trade facilitation and trade

Trade facilitation has become the way forward for countries to participate in the global supply chains. Through the participation in global supply chains, countries can get more access to markets, attract more investment and enhance employment opportunities (Uma Subramanian, 2005). It is estimated that if countries were able to reduce the barriers hindering trade by 50%, the global Gross Domestic Product (GDP) will grow by 4.7%. Singapore is one the best examples of how trade facilitation can boost economic growth in a country. Its tremendous achievements in terms of trade facilitation has given it a competitive edge over other countries in the region. OECD calculates that each 1% saving in trade related transaction costs yields a worldwide benefit of US$43 billion (OECD 2003).

Uma Subramanian (2005) studied the impact of trade facilitation on bilateral trade. By using country level data on time and cost of moving a one TEU from port of entry to a populous city or from the city to port of exit, he found that 1% reduction in the distance measure could increase the bilateral trade by 1.4159%. In addition, he found that 1% reduction in total trade related processing cost would increase bilateral trade by 0.2508% (Uma Subramanian, 2005).

Furthermore, a study done to determine the effect of time delay on international trade, Simon Dijankov et al 2006 concludes that each additional day a shipment is delayed prior to shipping reduces trade by 1%. In other words, a time delay of 1 day distances a country from its trading partners by 70 km on average. Similarly, it was found the impact of time delays is higher for developing countries relative to developed countries. A 10% increase in time of exports in a developing country is likely to reduce exports by 8 -12% (Simeon Djankov, 2006).

Korin Olofsdotter and Maria Persson (2013) analyzed the impact of trade facilitation on foreign direct investment. The empirical analysis was based on estimating a gravity model of bilateral foreign direct investment taking into account the level of trade facilitation in the receiving country. The study found that countries which have a low level of trade facilitation receives less foreign direct investment. Further the research highlighted that small countries can benefit more from trade facilitation than larger economies (Karin Olofsdotter, 2013).

Alberto Behar and Phil Manners in 2010 investigated the relationship between logistics and bilateral exports using the logistics performance index of the World Bank. In the study, they concluded that logistics can reduce effective distance between trading countries as it lowers the total cost of trading. The study also estimated that one standard deviation improvement in the exports logistics quality would raise the exports by almost 60% (Manners, 2010).

The OECD estimates that trade transaction costs lie between 2% and 15% of the value of imported goods. Trade facilitation by minimizing the non-tariff barriers supplement lowering of tariffs and result in an increase in the world trade volume, enabling the world economy and participating economies to be better off (Ocampo, 1998).

A global supply chain has many advantages though it comes with increased transportation cost and complex decision making process. Lucino Batista highlights that trade and transport facilitation is of utmost importance in this digital era for countries to seize the opportunities opened up by globalization. Further, he states that global supply chain management decisions like which consumer markets to enter, where to source from and which countries to locate in are influenced by the level of trade facilitation of a country (Batista 2012).

Uma Subramanian in his view on trade logistics reform emphasizes that speedy, flexible and cost effective global sourcing strategies are critical for companies as competitive international market demands lean, rapid and responsive supply chains. He also states that the impediments faced by importing and exporting firms in developing countries are not only poor infrastructure and high transport cost but also institutional constraints in the form of complex laws, burdensome regulations, poor definition and enforcement of rules of engagement, onerous documentation and other procedures causing delays at customs and other border crossings, pilferage in transit and other restrictive protocols on movements of cargo (Subramanian, 2001).

In a general sense, 1% reduction in ad valorem tariff rates would increase global trade by 1.2%. The World Bank study on assessing the benefits of trade facilitation analyzed the trade improvements brought from different categories of trade facilitation like port efficiency, customs environment and improving regulatory environment. The study found positive relationship between port efficiency and trade improvement. It further highlighted that port efficiency brings a greater boost to exports than imports. Trade facilitation efforts related to customs environment is expected to bring 0.47% increase in trade while improvements related to regulatory environment is likely to increase trade by 0.28% to 0.62% (John S. Wilson, 2005).

2.3 Supply chain network design (SCND)

Spinnaker, a supply chain consulting, execution and support company, defines supply chain network design as "locating and rationalizing the facilities within the supply chain, determining the capacities of these facilities, determining how to source demand through the network and selecting modes of transportation in a manner that provides required level of customer service at the lowest cost" (Spinnaker, 2016). As understood from the definition, supply chain network design includes determining the role, location and capacity of the facility. Moreover, it also includes decision about which markets to cater from the facility and selection of suppliers. Supply chain network design plays a crucial role in balancing supply chain cost and level of customer service provided by the supply chain. Analysts argue that 80% of the supply chain cost is predetermined based on supply chain network design (Spinnaker, 2016).

Optimization of supply chain network depends on optimization of the strategic supply chain, distribution supply chain as well as transport strategy. Strategic supply chain is optimized when required service levels are provided at the lowest possible cost, while distribution strategy optimizes the product sourcing and inventory deployment rules to meet the expected demand. Transportation strategy is optimized when available transportation resources within the given supply chain network are enhanced (Spinnaker, 2016).

Strategic supply chain network design decisions are the most important decisions of supply chain management as implications of these decisions are long lasting. Once a facility is set up, changing the location is difficult and shutting down is expensive. In addition, supply chain network design determines the supply chain configuration and set constrains within which other supply chain drivers can be used to achieve supply chain objectives (Sunil Chopra, 2007; Dogan, 2012). All the supply chain drivers, logistics and cross functional drivers, shall be taken into account to optimize supply chain objectives when designing supply chain network (Dogan, 2012). Important supply chain network design decisions like an inefficient location of a facility would not only result in higher cost but also would lose the competitive edge. Setting a supply chain configuration within which optimization of other objectives are impossible would result in frustrated workforce and in poor customer service. (Dogan, 2012; Mary J. Meixell, 2005).

Some of the on-going issues in the global supply chain includes increase in international manufacturing sources especially in the automotive industry. Automobile companies have increased international manufacturing sources partly to reduce cost, increase revenue and improve reliability of the supply chain. This strategy have reduced cost as many countries have adopted tariff and trade concessions to such investments. International manufacturing sources also provide access to international markets thereby increasing revenue. Close proximity to customer as well as suppliers have promoted organizational learning and improved reliability of the supply chain (Mary J. Meixell, 2005).

Together with increasing international manufacturing sources, management of global supply chain have become more complex. Despite reduced cost, increased revenue and improved reliability, the complexity added due to substantial geographical distance, cultural differences, infrastructural deficiencies, inadequate factors of production has raised questions about maintaining a global supply chain. Geographical distance in the supply chain increase transport cost and complicates inventory cost trade-offs due to increased lead time. Cultural differences, language barriers and work ethics diminishes the efficiency. In addition, transport and communication infrastructure deficiencies adds to the cost of the supply chain and lack of skilled labor, mismatch in equipment and technology used in the manufacturing process and limited supplier availability increase challenges of global supply chain management (Mary J. Meixell, 2005).

Moreover, global supply chain face unique risks like exchange rate fluctuations. Exchange rate, political and economic instability and changes in regulatory environment are risks exclusive to global supply chains. Exchange rate fluctuations could hamper the performance of the supply chain while changes in regulations and political and economic instability could totally alter the decision matrix (Mary J. Meixell, 2005).

Apart from the on-going issues which researchers have focused in the literature, there are new issues emerging in the field of global supply chain management. One such issue is increasing outsourcing to both domestic and global locations. Supplier selection decisions changes global supply chain design in fundamental ways. Supplier selection criteria includes the supplier's ability to satisfy the needs of the manufacturer in terms quality, quantity, delivery, price and service needs of the firms. Lot size, supplier capacity, geographical preference and restriction on vendors also have an impact on supplier selection process of most global supply chains (Mary J. Meixell, 2005).

Secondly, integration of decision making process across supply chains have become the new standard practice. Hence, several such practices have emerged like Vendor Managed Inventory (VMI), Collaborative planning, forecasting and replenishment (CPFR) and Advance Planning Systems (APS). This has compelled global supply chains to be more transparent and information technology oriented, adding pressure to countries to meet these standards to attract global supply chains.

Thirdly, most supply chain performance matrix in the past was aimed at minimizing cost. However, introduction of lean management and just in time production system has broadened the supply chain management performance matrix to include reliability, responsiveness, flexibility, and assets. Companies that previously looked in to their international manufacturing sites as low cost advantage now rely on their global production sites for improved access to customers, suppliers and skilled employees.

2.3.1 Factors affecting supply chain network design

With the on-going and new issues in the supply chain network design, there are several factors that have an impact of facility location of global supply chains. These factors are taken in to consideration by supply chain managers when making decisions to set up a facility of the supply chain in a country.

1. Strategic factors

A firm's competitive strategy plays a crucial role in determining the design of supply chain network. A firm which aims to obtain a cost advantage over its competitors would locate its facilities in the lowest cost locations even if the location is far from customers. On the other hand, if the firm's competitive strategy is focused on responsiveness, it would locate its facilities near the market even if the location is expensive (Sunil Chopra, 2007).

Each facility of global supply chains have a strategic role. An offshore facility is a low cost facility for export production located in countries where cost of labor and other cost of production are cheap and a source facility is a low cost facility for global production. The main objective of source facility is to lower cost and it becomes the primary source of a product for an entire global network. These facilities are located in places where cost is relatively low, infrastructure is well developed and skilled labor is available (Sunil Chopra, 2007).

A server facility is the regional production facility of the supply chain to serve the domestic market in which the facility is located. A server facility is often the result of tax incentives, local content requirement, tariff barriers or high logistic cost. Moreover, a contributor facility is a regional production facility with development skills. Such a facility not only serves the market where it is located but also assumes responsibility for product customization, process improvements, product modifications or product development.

An outpost facility is a regional production facility to gain local skills located to obtain access to knowledge or skills that may exist within a certain region. Given its location, it also plays the role of a server facility. Such facilities of automotive companies are commonly located in Japan and Germany despite the high cost. Finally a lead facility creates new products, processes and technologies for the entire network. Lead facilities are located in areas with good access to a skilled workforce and technological resources.

Facility locations of global supply chain is determined based on competitive strategy and strategic role of the facility. For example, an offshore facility of an automotive company is likely to be located in countries like Bangladesh and Cambodia where labor cost and operational cost are low. Similarly server facilities are likely to be located where there is a considerable size of domestic market.

2. Technological factors

The level of economies of scale which the production technology can achieve plays a vital role in supply chain network design. If the production technology can enjoy economies of scale, a few high capacity locations are most effective. If the facilities have a lower fixed cost, many small facilities are preferred over a one high capacity facility.

During the early days of auto industry, mass production introduced by Ford Motor and General Motors was proved to be successful. However, Toyota Motor emergence as the leader in the industry with its lean production system has changed it. Nevertheless, still many auto companies practice mass production to a large degree. Thus sufficient market to cater from each plant is necessary to achieve economies of scale (Womack, 2007).

3. Macro-economic factors

Macro – economic factors like corporate taxes, tariffs and exchange rates play a critical role in location decisions of global supply chains. Most developing countries use tariff and corporate tax incentives to their advantage to attract facilities. Automotive facilities provide much needed job opportunities for the developing country, hence import and export tariffs related to such investment are eliminated or reduced. In addition, developing countries also provide corporate tax incentives for such companies to operate in the country (Mary J. Meixell, 2005).

Regional free trade zones are also commonly formed by developing countries to attract the facilities of global supply chains for a particular region. Association for South East Asian Nations (ASEAN) and South Asian Association for Regional Corporation (SAARC) are some of examples. Such regional free trade zones collectively reduce import and export tariff rates for global supply chains to operate in the region (Hiratsuka U. e., 2008).

Exchange rate fluctuations could result in loss of profit for global supply chains. Depending on the exchange rate, operational revenues earned in local currency when covered to US dollars could lose in millions. Therefore, global supply chains mitigate this risk through a well - designed supply network. By creating over capacity in facilities, these supply chain shifts production volume based on the exchange rate.

4. Customer response time and local presence

Locating facilities closer to customers is indispensable for convenient stores and coffee shops. On the contrary, it is not the same for supermarket chains and automotive dealers. For example, convenient store supply chain like Seven Eleven have a much higher number of facilities compare to supermarket chain like Sam’s Club. Thus, number of facilities depends on the value customer place on response time. If the supply chain targets to cater to a customer segment who values short response time, the number of facilities would be higher (Sunil Chopra, 2007). Fast delivery of products to customers allows some supply chains to limit the number of facilities. The emerging online retail industry and fast food delivery services are such examples. However, the transport cost for such supply chains increases when they limit the number of facilities. Therefore optimal number of facilities and their location is based on the transportation cost and facility cost of the supply chain (Sunil Chopra, 2007).

5. Logistics and facility costs

Logistics and facility costs vary based on the number of facilities, their location and capacity. Inventory and facility costs are directly related to these aspects of supply chain while transport cost is inversely related to them. In other words, increase in number of facilities will increase inventory and facility costs and decrease the transport cost of the supply chain. Adopting total logistics cost concept is critical, when designing supply chain network, to address this inventory and transport cost paradox. Rather than optimizing transport cost or inventory cost as individual cost elements, total logistics cost concept attempts to optimize logistics and facility cost of the whole supply chain (Alan Rushton, 2010; Sunil Chopra, 2007).

The material transformation at each stage of the supply chain also have an impact of facility location of supply chain. For example, in auto industry, the volume and weight of the product increases at every proceeding step of the production process. Therefore, total logistics can be lowered when facilities are located near final customer rather than the material supplier (Sunil Chopra, 2007).

6. Competitive factors

Whether to locate a facility close to a competitor's facility, is one of the question which needs to be answered when designing supply chain network. The answer to this question depends on existence of positive externalities. Positive externalities refers to the collective benefit gained by competing supply chains when their facilities are located in close proximity to each other. The case of first foreign auto manufacturer in

India, Suzuki is one such example. When Suzuki built a good supplier base in India despite the hardships, other auto manufacturers were quick to set up their facilities once the supplier base was established. However, when there exist no positive externalities, the target of each facility of the supply chain is to capture the largest possible market (Sunil Chopra, 2007).

2.4 Facility location models

The number of research papers on decision models of global supply chains has increased tremendously over the years. For example, almost double the number of researches published in this area in 2004 was published in 2007. European Journal of Operations Management, Computers and Operational Research and Interface and Transport Research has been the major forums which has brought new developments and results in this field. European Journal of Operations Management alone has contributed 50 research articles in the field while Computers and Operational Research has contributed 20 research papers over the years (T. Melo, 2007).

The facility location models try to answer the question of where to locate a particular facility of a global supply chain among the given alternatives (Dogan, 2012). The facility could be a supplier factory, assembly plant, manufacturing plant, distribution center, a warehouse etc. The models differ from one another based on which supply chain driver or which combination of supply chain drivers the model attempts to maximize. Each facility location decision is faced with trade off related to supply chain drivers.

Table 4
Globalization considerations

	Tariffs/ duties	Non-tariff trade barriers	Currency exchange rate	Corporate income tax	Transportation time	Inventory cost	Worker skill/ availability	Industry context
Hodder and Dincer (1986)	×		×	×				None specified
Breitman and Lucas (1987)	×	×	×				×	Automotive
Cohen and Lee (1989)	×	×	×	×				Personal Computer
Cohen et al. (1989)	×	×	×	×				None specified
Haug (1992)			×				×	High tech products
Kogut and Kulatilaka (1994)			×					None specified
Arntzen et al. (1995)	×	×	×	×	×	×		Electronics
Gutierrez and Kouvelis (1995)	×		×	×				None specified
Canel and Khumawala (1996)	×	×	×	×		×		Agricultural chemicals
Rosenfield (1996)			×					Camera, film, cell phones
Huchzermeier and Cohen (1996)	×		×	×				None specified
Kouvelis and Gutierrez (1997)			×					Apparel
Dasu and de la Torre (1997)	×	×	×					Textile fibers
Munson and Rosenblatt (1997)		×	×					None specified
Vidal and Goetschalckx (2001)	×		×	×	×	×		None specified
Hadjinicola and Kumar (2002)			×			×		None specified
Lowe et al. (2002)	×	×	×				×	Chemical
Nagurney et al. (2003)			×			×		None specified

"×" denotes that consideration is included in the model.

Figure 2.2 Factors considered in global supply chain design models

Source: Mary J. Meixell, 2005

It should be noted that 44% of the researches based on global facility location model have considered non-tariff barriers as a decision variable. Some other decision variables included in these models include tariff rates, currency exchange rate, transport cost, inventory cost and skill availability. Decision variables like transportation cost and inventory cost are also indirectly related to the non-tariff barriers at cross border transactions. Hence non-tariff barrier can be deduced as one of the most important decision variable in facility location of global supply chains (Mary J. Meixell, 2005).

Global supply chain design research began in early 1980. Some of the earliest researches in this field include Hodder and Jucker research on plant location modelling for multinational firms and international plant location model under price and exchange rate uncertainty (Hodder J.E J. J., Plant location modelling for Multinational firm, 1982; Hodder J.E J. J., International plant location decision under price and exchange rate uncertianity, 1985) and Hodder and Dincer research on the multifactor model on international plant location and financing under uncertainty (Hodder J.E D. M., 1986). The most notable model in this period was PLANETS model developed at General

Motors by Brietman and Lucas in 1986 (Brietman R.L, 1986). This model included various global supply chain features including tariff, local content, trade complementation, balance of trade and transport cost.

Cohen and Lee work in 1989 developed a model consisting of several policy options that a firm can choose for global manufacturing strategy. Suppliers, assembly plants, distribution centers and market locations were all included in the model. The objective function of the model was to maximize after tax profit subject to taxes, tariffs and transfer prices (Cohen M.A, 1989).

One of the earlier models in which both cost and time are incorporated in the objective function of the model was developed in 1995 (Arntzen B.C, 1995). The model takes into account production time and transit time along all the links in the supply chain. The cost inputs in the model include taxes and duties, local content and duty drawbacks. The objective of the model was to minimize the time of the supply chain.

Some of the supply chain network models developed in late 1990 that shall be highlighted in this paper include Dasu and de la Torre model (Dasu S, 1997) for multinational companies with partially owned subsidiaries and Munson and Rosenblatt model emphasizing on supplier sourcing with local content (Munson C.L, 1997). Dasu and de la Torre in their models included tariffs, transport cost and exchanges rate and Munson and Rosenblatt included implication of regulatory environment in global supply chain network design.

Models that can be seen in the literature in the years of 2000 are more comprehensive and reflect the challenges faced by global supply chain today. For example, Vidal and Goetschalckx's developed a model for multinational corporations that outsources parts of production while continue in house production for some parts. Consideration in the model is given to select facility locations, flows between facilities and allocates transport cost to shipper or receiver. Global supply chain costs like tariff and corporate tax rates are included in this model (Vidal C.J, 2001).

The network equilibrium model developed by Nagurney in 2003 is particular importance as the model considers, specifically transaction cost associated with obtaining the product. This model is based on three tiers – manufacturer, retailer and consumer and maximizes profit at each tier based on what consumers are willing to pay (Nagurney A, 2003).

By integrating Bayesian networks and total cost of ownership approach to address the complexity in facility locations decisions for a manufacturing company, Ibrahim Dogan developed a holistic approach with quantitative as well as qualitative factors. Among the factors that are considered in this research project, 25% are related to trade facilitation. Some of the broader factors considered in this model include regulatory environment, quality of transportation, government efficiency and quality of infrastructure. Under regulatory environment, environmental regulations, tax structure, customs duties are taken into account. Under government, bureaucracy and business regulation as considered (Dogan, 2012).

Reducing supplier base and arranging them in a tiered structure and relying on few leading suppliers has become the standard practice in auto industry for supplier management. This practices has helped auto manufacturers with faster delivery, decreased production lead time, reduced cost and increased quality. Thomas Y Choi and Janet L Hatley research on supplier selection process across the supply chain based on companies involved at different level of auto industry showed that the most important factors when selecting direct as well as indirect suppliers were quality, delivery, reliability, relationship, flexibility, price and services. Trade facilitation is key to consistency in delivery and reliability. It also influence the overall price at which parts are supplied to the manufacturer (Thomas Y. Choi, 1996).

Financial factors were found have a greater influence on supply chain configurations, according to a review on facility location and supply chain management by M.T Melo, S. Nickel and F. Saldanha-da-Gama. According to the research, financial factors include international factors, incentives and budget constraints. International factors are duties, tariffs, local content rules, exchange rate and transfer prices while incentives include concessions offered by governments for facility investment. Budget constrains refer to the fund availability for the project (M.T. Melo, 2009).

2.5 Global supply chain and trade facilitation

The early focus of literature on trade facilitation has been on its impact on promoting bilateral and multilateral trade and reducing cost of trade. As noted by Andrew Grainger, the literature on trade facilitation and international supply chains are still very young (Grainger, Customs management in multinational companies, 2014).World Customs Journal’s contribution to this topic is higher than any other journal especially on topics related global supply chains and customs administrations.

Catherine L Mann in her research about supply chain logistics, trade facilitation and international trade concludes that there is a positive relationship between improved trade facilitation and global supply chains. She explains that if a country has a lower matrix of trade facilitation compared to its competitors, the business in the particular country is operating at a disadvantage in the global market place (Mann, 2012) .

She further highlighted that effectiveness of different trade policy reforms are unique to each country depending on the product type and supply chains that country is part of. The most important trade facilitation policies in general are adherence to international standards and adoption of information technology in the border management process. For example, adherence to the standards of International Organization for Standardization (ISO) is considered as a precondition by supply chains to set up its business in a particular country (Mann, 2012).

A further research related to this field was done by Michael J. Ferrantiono for United States International Trade Commission in 2012. In the research, he analyzed the cost of non-tariff barriers and the advantages of trade facilitation using a supply chain analysis. The conclusion of the research indicates that the impact of non-tariff measures accumulate in global supply chain where sourcing, manufacturing and distribution is carried out in geographically dispersed locations linked by international trade. One such example is discussed in Hiratsula research in 2005 about vertical intra-regional production networks in East Asia. A disk drive assembled in Thailand produce only 11 components in Thailand while 43 components are procured from 10 other countries. Hence there are 10 or more cross border movements in this supply chain which multiplies the impact of non-tariff barriers (Hiratsuka D. , 2005).

The study also found evidence that trade costs are more important to technology goods and globally dispersed supply chains. Manufactured goods like automotive has a complex supply chain with several stage of assembly and parts of parts and components of components are traded across border. Assuming the trade cost of moving goods from one country to another is ‘t’ on an ad valorem basis, ‘t’ would be then multiplied by the number of times the products is traded across the border till the product reaches final consumer (Ferrantino, 2012).

Customs is the leading border agency in many countries. Thus trade facilitation available at customs administration like electronic customs systems are crucial to international supply chains. Andrew Grainger study on customs and international supply chains concluded that customs play an integral part in the management of international supply chains. Level of trade facilitation available at customs administration can make or break deals as trade facilitation approaches of customs not only reduce cost but provides benefits that can add value to the international supply chain. One such example is existence of preferential tariff. A television set imported to Europe from Malaysia would be subject to a duty rate of 14% while a television set imported from Thailand would be taxed at 9.8% only. In addition, duty rate is 7.3% if brought from South Africa and no duty would be charged if imported from Poland (Grainger, Customs and international supply chains , 2000).

In a report published by KPMG titled Location Strategy for Automotive Suppliers, KPMG said “Low risk makes globalization more attractive and higher cost makes globalization necessary”. As can be understood from this statement, cost is one of the most important driver of global supply chains. Given the luxury nature of the product, amid the global economic slowdown in the past couple of years, the automotive industry was one of the hardest hit industry. Sales of automotive companies dropped especially in developed countries like United Sates of America, Japan and in European Countries. The growth was picked up by emerging economies like China and India from the Far East of the world (KPMG International, 2009).

2.6 Automotive industry and supply chain network design

Senior principal at McCallum Sweeny Consulting Inc. writes that competitive advantage is the key criteria driving the auto industry assembly plant location. His article published on the website of the consulting company highlighted that logistics, human resources, schedule, business climate and operation cost are key to achieving the competitive advantage (McCallum, 2014).

Larry Gigerich, managing director of Ginovus however includes a longer list of factors that shall be accounted for successful location modelling in auto industry. In an article published on Invest Stanford, he wrote information on workforce, real estate cost, available economic development incentives, demographic statistics, cost of living, utility rates availability and redundancy, tax rates, infrastructure availability, transportation options and regulatory environment are all important aspects in facility location decision of auto manufacturers (Gigerich, 2013).

The auto industries of developing countries were transformed in early 1990 with trade liberalization. As highlighted on John Humphrey research paper on Globalization and Supply Chains: The Auto Industry in Brazil and China, there were two reasons for this transformation. One reason is dismantling of tariff, quantitative restrictions, investment controls by the government of these countries. Second is promotion of industry through investment incentives, local content requirements, export incentives, duty drawback schemes and tariffs (Humphrey, 2003).

Global location strategy for automotive suppliers published by KPMG in 2009 highlighted five main drives of global location decision of auto suppliers. They are growth, cost, innovation, risk and research and development. Among the cost driver, logistic cost is one of the concern of the companies. According to the report, lower labor cost comes often with higher logistics cost. Government incentives, trade facilitation agreements are among the factors considered under cost driver (KPMG International, 2009).

A study conducted by Horacio C. Faustino and Nuno Carlos Leitao on fragmentation in the automotive manufacturing industry found that economic integration is a critical factor to increases global supply chains. According to them, facilitating trade by abolition or reduction of trade and non- tariff barriers increase economic integration. The research also found positive correlation between trade cost and distance between trading partners. This implies that the impact of trade costs would be higher when trading partners are distant from each other (Horacio C. Faustiono, 2011).

The importance of trade facilitation in the global supply chain facility location decision making has been highlighted in very recent researches as well. Jaroslaw Witkowski research in 2017 about the micro and macro factors taken into account by Japanese companies while setting up production facilities in Poland concluded that low transportation cost, well developed market for forwarding and logistics service and adequate transport infrastructure in the regions have influenced on their production facility location decision. Similarly, the research emphasized on the importance of macro environmental factors like economic, social and political situation at the initial stage of decision making. As per the research, only after consideration is given to macro- environmental factors, micro economic factors come under consideration (Jaroslaw Witkowski, 2017).

CHAPTER 3

RESEARCH METHODOLOY

This chapter consist of the scope, data collection and data analysis methods used in the research. The scope of the study gives a detailed account of limitation in research application and interpretation of the main concepts like trade facilitation and global supply chain facility location decision making. Logistics Performance Index (LPI) is being used in this research as a measure of trade facilitation. Hence a brief discussion on the construction and dimensions covered by LPI are also discussed in this chapter.

3.1 Scope of the study

The objective of the study is to understand the impact of trade facilitation on global supply chain facility location decision making. The research attempts to understand these impacts by collecting data on facility locations of automotive companies and comparing the number of such facilities in a country with the trade facilitation. Hence the scope of the research is limited to automotive industry.

Seven major automotive companies' data on facility location decisions were collected to analyze the global supply chain facility location decisions. The seven automotive company selection was based on Forbes list of biggest auto companies of 2014 (Forbes, 2014). They are Toyota Motor and Honda Motor of Japan, Volkswagen Group, BMW Group and Daimler of Germany, Ford Motor of United States and Hyundai Motor of South Korea.

The facility of an automotive company is referred to as the distributors, manufacturing and assembly plants based in countries other than the origin country of the automotive company. The research excludes third party suppliers from the definition of a facility and thus they are not included in the data set. Further it is also important to note that, the count of number of distribution facilities of an automotive company implies the number of companies distributing vehicles under the name of the above listed seven companies in a country. Hence, even though such a distribution company has more than one distribution facility operating in the country, they will be counted as one facility. It is because the number of distribution facilities within a country is dominated by market size and not necessarily by level of trade facilitation.

Automotive industry has been chosen as a sample industry for this research mainly for three reasons. It has a great economic impact on a country's economy and it follows the state of the art supply chain practices. In fact, the concept of supply chain management was originated from this industry. In addition, it is one of the most globally fragmented industry due to cost sensitiveness and local content requirements.

The production of total passenger and commercial vehicles is expected to reach 100 million by 2017 (Lacroix, 2014). This is likely to provide employment for 15 million people directly in production of vehicle and auto parts. This is nearly 8.33% of the total manufacturing jobs (OICA, 2016). It provides jobs to 5.6% of the European Union labor force and accounts to 6.5% of the Union Gross Domestic product (ACEA, 2016).

Automotive industry is increasingly outsourcing the production of automotive parts and accessories to external suppliers. Some of the parts supplied by these suppliers include fuel systems, steering systems and outer vehicles components. The total number of suppliers in the automotive industry makes up to 50 million. Due this nature of automotive industry, it is the most suitable industry to study for the research (Statista, 2016).

In addition, automotive industry has been one of the most advanced industry in the art of supply chain management practices. Supply chain management practices like lean and just in time principles are most successfully applied in this industry. Hence to study this industry to understand their practice in factory, distribution locations and supplier selection could be applied to other industries as well.

3.2 Data collection

The data used for this research is based on secondary sources. Data about trade facilitation is based on the Logistics Performance Index of the World Bank. This is an interactive benchmarking tool to help countries identify and improve trade related logistics and supply chain problems (LPI, The Word Bank , 2016).

The first LPI report was published in 2007 and since then, four more reports have been published with latest report being LPI 2016. Nevertheless Logistics Performance Index of 2014 is used in this research as 2016 Logistics Performance was only released recently (LPI, The Word Bank , 2016).

Data of facility locations of automotive companies are collected from the global, regional and dealer's website of those automotive companies selected for the study. Data was first collected and re-checked for its authenticity and only the sources mentioned in the global websites of these automotive companies were used to obtain data.

3.2.1 Logistics performance index

Logistics Performance Index (LPI) is an index produced by World Bank every 2 years. The first LPI report was published on 2007. LPI is calculated based on a standard questionnaire with two parts. Part one studies about the International LPI in which six main areas of logistics performance in eight of their main overseas markets are assessed. Part two studies about the Domestic LPI where qualitative and quantitative data in domestic logistics environment are analyzed. Based on this survey, an LPI score is allocated where 5 being the highest and 1 being the lowest score (LPI, 2014). The overall logistics performance is determined based on six dimensions. They are customs, infrastructure, international shipments, logistics quality and competence, tracking and tracing and timeliness. Customs measures the efficiency of customs and border clearance and infrastructure measures the quality of trade and transport infrastructure. International shipments measures the ease of arranging competitively priced shipments and tracking and tracing measures the ability to track and trace shipments. Finally logistics quality and competence measure the competitiveness of logistics service providers and timeliness measure the frequency with which shipments reach consignees within scheduled or expected delivery times (LPI, 2014). Logistics Performance Index has been identified in the literature as a measure of trade facilitation (Batista, 2012; Wilson, 2003). One of such research is Translating Trade and Transport Facilitation into Strategic Operations Performance Objective by Luciano Batista. This research highlights that Logistics Performance Index among other measures such as Doing Business Survey and Enabling Trade Index as a measure of trade facilitation. Logistics Performance Index is most appropriate as a measure of trade facilitation to be used in this research as it measures performance of logistics as well as supply chain of a country (Batista, 2012).

3.3 Data analysis

The trade facilitation and automotive facilities location data were analyzed using benchmarking, correlation and regression analysis. Benchmarking analysis compares trade facilitation with global facility locations of automotive companies based on countries and regions. This methodology has been prescribed in the literature to understand the relationship between trade facilitation and global sourcing and international trade (Mann, 2012). Since a lower trade facilitation implies that a country is operating at a disadvantage compare to the other potential countries in the region in which the facility could be located, regional benchmarking would reveal significant insights about impact of trade facilitation global supply chain facility location decision making.

Regression analysis attempts to determine a statistical relationship between trade facilitation and global facilities locations. It is one of the most common statistical tool used by researchers to understand the relationship between two variables (Barry Render, 2012). This methodology would help to determine the statistical relationship between trade facilitation and global supply chain facility locations.

The first benchmarking is based on comparison of six continents with the average trade facilitation and facility locations in each continents. The six continent chosen for comparison in this research are Asia, Europe, Africa, Oceania, South America and North America. Secondly, benchmarking was carried out based on regional grouping of countries. The final benchmarking is based on different levels of trade facilitation. For this analysis, different ranges of trade facilitation are set and the number of facilities in each of these ranges were analyzed. The ranges of trade facilitation chosen for analysis are 1.5 – 2, 2- 2.5, 2.5 – 3, 3 – 3.5, 3.5 – 4 and 4 – 4.5.

Regression analysis attempts to understand the statistical relationship between trade facilitation and number of facilities of global supply chain in a country. It also attempts to identify the dimensions of trade facilitation which has most impact on the attracting facilities of global supply chains. Hence correlation between trade facilitation and number of facilities in a country as well as correlation between different dimensions of trade facilitation were calculated.

Moreover, regression analysis was carried out to determine the significance of the different dimensions of trade facilitation on facility location. As such, the six dimension of trade facilitation were compared with the number of facilities. This analysis is helpful to analysis which dimensions are most effective in attracting more facilities of global supply chains. The results and further commentary on interpretation of results will be included in the next chapter of this report.

CHAPTER 4

RESULTS AND DISCUSSION

This chapter presents discussion of results obtained from the analysis. The discussion of results of this study is based on three parts. The first part benchmarks the logistics performance index of different countries with the number of facilities of automotive companies operating in the country. In part two of the discussion, the linear relationship between the logistics performance index and number of facilities of automotive companies are discussed. Finally, linear relationship between different dimensions of the logistics performance index and number of facilities in a countries are discussed.

4.1 Logistics performance index

Logistics performance index as mentioned earlier has been used in literature as a measure of trade facilitation (Batista, 2012). The World Bank published the first logistics performance report in 2007 and so far, 5 reports have been published to date while logistics performance index 2016 being the latest report. The logistics performance of 160 countries of the world based on several dimensions including customs, infrastructure and quality of logistics service are determined based on a worldwide survey. However logistics performance index of 2014 is considered in this report as part of the research was done before 2016 report was published (LPI, 2014; The World Bank, 2016).

Germany scored the highest in logistics performance index of 2014 with a score of 4.12 and Somalia scored lowest among the 160 countries with a score of 1.77. The 5 countries on top of the list who scored more than 4.0 are Germany, Netherlands, Belgium, United Kingdom and Singapore. Hence it can be deduced that these are the countries with highest level of trade facilitation.

It is understood from the logistics performance reports that, countries with high level of trade facilitation or a higher logistics performance score enjoy higher income levels. Most of the countries in the top of the logistics performance index are high income countries and most countries at the bottom of the index are low income countries. All the OECD countries as well as 18 European countries scored more than 3 in the logistics performance index of 2014.

The average logistics performance index score is highest in Europe compared to any other continent. The average score of the 40 countries participated in the survey in Europe is 3.38 while the average score in African continent is just 2.5. Asia, North America and Oceania compete closely with one another with score of 2.9, 2.99 and 3.0 respectively. The average score of South American countries is bit lower with 2.77.

Hungary and South Africa are the two leading nations in the African continent with logistics performance index score of 3.46 and 3.43. No other country scored more than 3 with Egypt scoring close to 2.97. 20 countries participated in the logistics performance index in Asia scored more than 3 with Singapore, Japan and Hong Kong among the top 3 countries in Asia. 31 out of 41 countries included in 2014 logistics performance index from Europe scored more than 3. Germany, Belgium, United Kingdom and Netherlands score more than 4 becoming the top 4 countries in Europe with highest level of trade facilitation.

United States has the highest level of trade facilitation among North American countries with a score of 3.92. Canada scored closely to United States with 3.86 and Mexico is the country with third highest level of trade facilitation in the region. New Zealand and Australia score the highest in logistics performance index in Oceania with

3.81 and 3.64. Panama, Argentina and Brazil enjoys the highest levels of trade facilitation in South American region with scores of 3.19, 2.99 and 2.94 respectively.

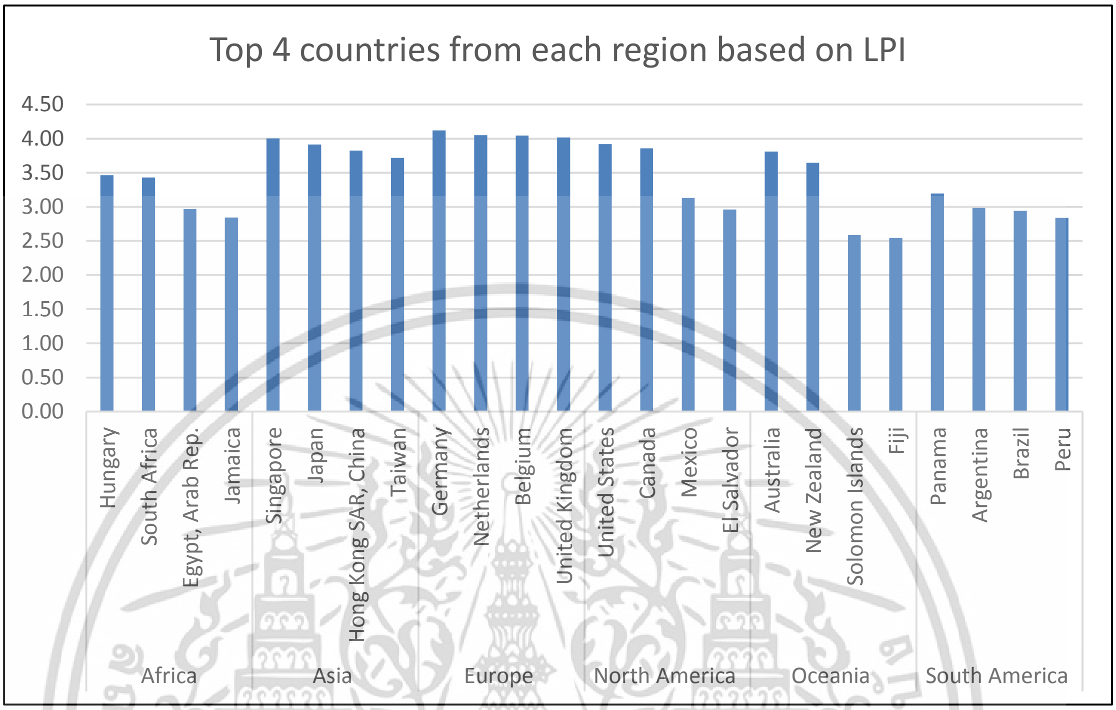

Figure 4.1 Top 4 countries from each region based on LPI

4.2 Facility locations

Data of 1426 facilities of the 7 top automotive companies were collected for this research and organized based on the logistics performance index 2014. The top 10 countries which had most number of facilities of these companies are China, United States, Japan, Brazil, India, Thailand, Mexico, Australia, United Kingdom and Russian Federation. All these countries have more than 23 facilities of these 7 automotive companies located in the country. China has the most number of facilities of these companies with 88 facilities. United States, Brazil, Thailand and United Kingdom all have more than 23 facilities of these companies located in those countries.

Most attractive continents to locate facilities as per the companies studied in this research are Europe and Asia. Number of facilities located in these continents are 423 in Europe and 480 in Asia. Africa and North America as the second most attractive continents with 201 facilities in Africa and 169 located in North America. South America and Oceania have the least number of facilities of these companies with just 46 in Oceania and 107 in South America.

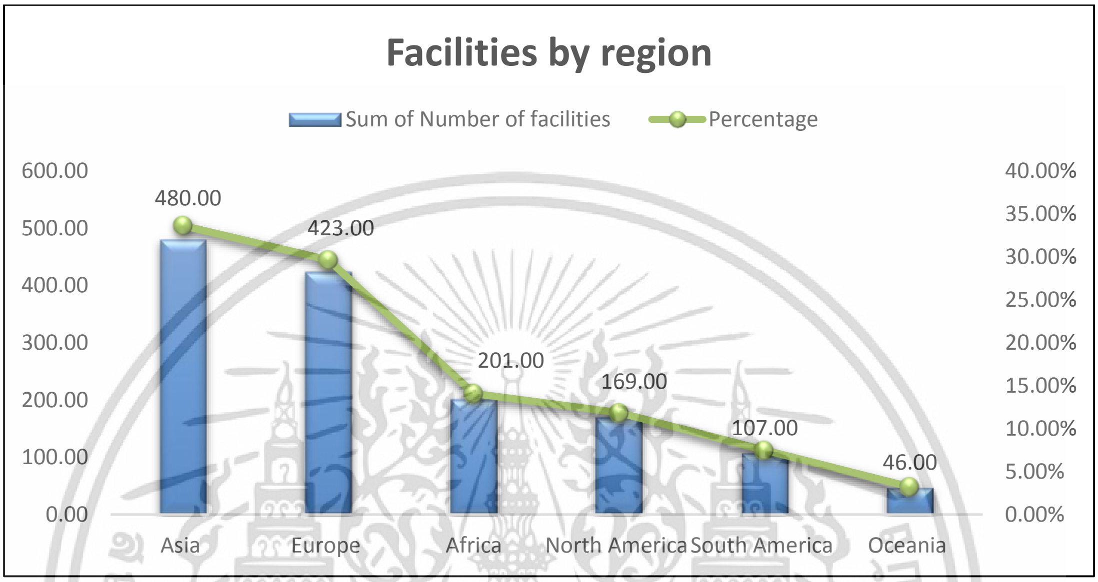

Figure 4.2 Number of automotive facilities by region.

The most attractive country for a foreign company to locate a facility in Europe is United Kingdom as there are 25 facilities of the 7 automotive companies studied in this research located in United Kingdom. France has 22 facilities of these automotive companies and Germany has 19 facilities of these companies. Netherlands, Sweden and Belgium each have 14 facilities located in those countries.China is the most attractive country in Asia for the automotive companies to locate a facility. As per the data, China has 88 facilities of these companies located in the country. The second most attractive country in Asia is Thailand with 23 facilities and thirst most attractive country is India with 20 facilities. Turkey, Malaysia, Indonesia and Russian Federation all look attractive for automotive companies as each country have more than 13 facilities.

United States come on top in North America based on the number of facilities located in North America. There are 46 facilities of these companies located in United States. Mexico and Canada comes second in the list with 17 facilities in Mexico and 16 facilities in Canada. Brazil has the most number of facilities in South America with 24 facilities located in the country. Venezuela has the second most number of facilities with 10 facilities located in the country.

Australia and South Africa are the two most desired destinations for the automotive companies to set up a facility in Oceania and Africa respectively. Australia have 11 facilities located while South Africa have 13 facilities of the 7 automotive companies located in country.

4.3 Benchmarking analysis

Comparison of regions and countries based on their level of trade facilitation and number of facilities of automotive companies revealed that trade facilitation had a significant impact on number of facilities of automotive companies in a particular country. Although this is the general trend, some countries had more number of facilities with a lower level of trade facilitation while others had a lower number of facilities with higher level of trade facilitation. In each of these cases, it was found another major factor like the size of the domestic market, availability of skilled or cheap labor minimizing the net impact of trade facilitation.

When designing a global supply chain network, companies initially determine a region based on their target market to serve from the facility. Location is then determined based on the region in order to optimize cost and service level (Sunil Chopra, 2007). Therefore, the benchmarking analysis follows a similar approach. Initial benchmarking analysis is performed based on average logistics performance of the continents and number of facilities in the particular continent. Secondly, benchmarking analysis of regional grouping of countries were done with final analysis based on different ranges of trade facilitation.

It can be deduced from the analysis of data that continents that have a higher trade facilitation have attracted more facilities of automotive companies studied in the research (see Figure 4.2). Europe has the highest average logistics performance score and has attracted most number of facilities. Asia has the second most number of facilities but has a lower average LPI score than Oceania and North America. Oceania and North America's average LPI score is high for two reasons. The number of countries from those regions in LPI are handful and thus Australia and New Zealand in Oceania and Canada and United States in North America's high logistics performance score have very much influenced the average score.

To further support this scenario, data of countries with most number of facilities are considered. The average LPI score of the top 10 countries with highest number of facilities is 3.51 and the average LPI score of the bottom 10 countries with least number of facilities is 2.7. In addition, if a country has an LPI score of more than 3, at least 4 facilities of these automotive companies operate in the country.

Every country except Brazil among the top 10 countries with most number of facilities have an LPI score more than 3. However Brazil logistics performance score is 2.94. To explain this special case of Brazil in the top countries among the most number of facilities, it is important to highlight the framework of global supply chain network design. As discussed in the literature review, when designing a global supply chain network, the region is selected based on the strategy of the company. Other factors come into play only after the decision of region. As such, it is evident that Brazil has one of the highest level of trade facilitation in South America after Argentina and

Panama. Other factors like the booming Brazil economy and the huge market potential in Brazil could have gained an edge over the two other countries with a little higher level of trade facilitation.

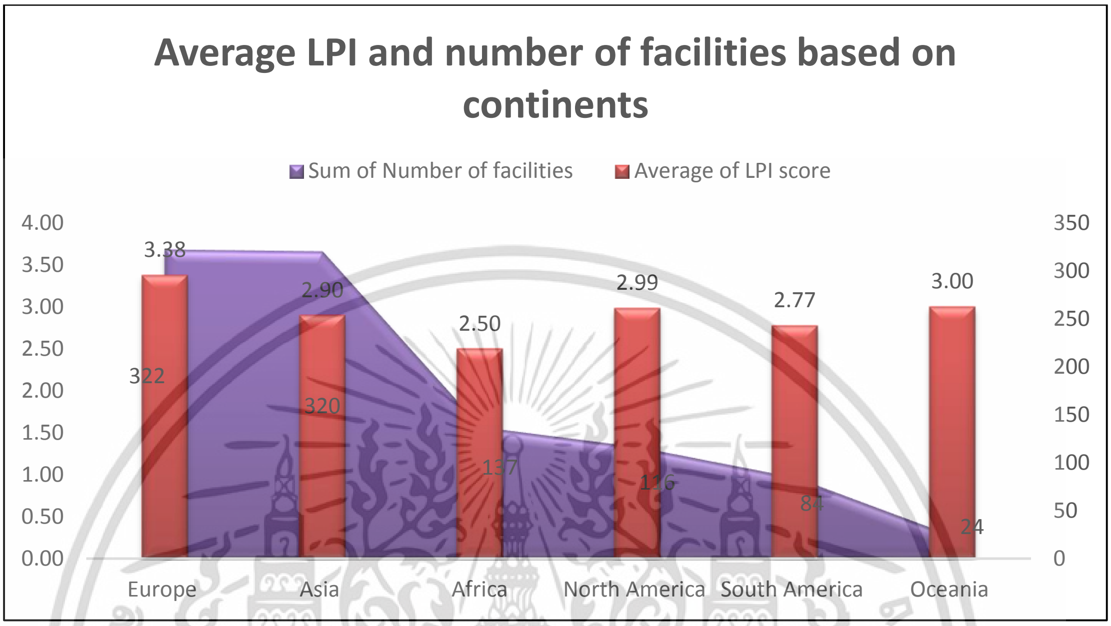

Figure 4.3 Comparison of average LPI and number of facilities of automotive companies in each region

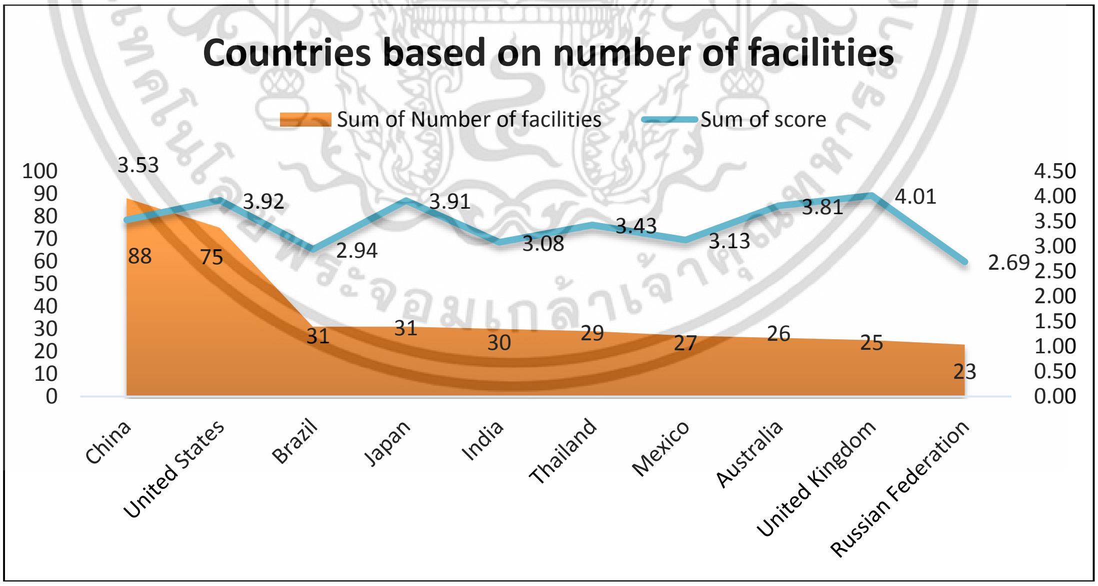

Figure 4.4 Countries based on most number of facilities

Region specific comparison is a more appropriate approach for benchmarking due to the nature of global supply chain network design decision making as discussed earlier. Benchmarking analysis based on regional grouping unveiled two main findings with regard to the impact trade facilitation has on supply chain facility location decision making. Firstly, it was found that the impact of a country's level of trade facilitation was less when all the countries in the region have a high level of trade facilitation. In this case, facilities of automotive companies are distributed among the countries based on other factors that are involved in global supply chain decision making. Secondly, it was also found that the impact of trade facilitation was higher when one or few countries in the region have a higher level of trade facilitation compare to other countries in the region.

Western Europe is one such example of where the impact of trade facilitation of each country had a less impact on facility location decision making as all the countries have a higher level of trade facilitation. Among the 18 countries of Western Europe, Germany has the highest level of trade facilitation with 4.12, followed by Netherlands, Belgium and United Kingdom. All these countries have an LPI score more than 4.0. Even the country with lowest level of trade facilitation, Malta has an LPI score of 3.11. The average LPI of the Western Europe is 3.79 which is much higher than global average of 2.89.

The total number of facilities of automotive companies in Western Europe is higher than most other regions like North America or South Asia to name some. However, number of facilities in a country and the level of trade facilitation seems to have no relationship as all the countries in the region have a very high level of trade facilitation. Spain, France and United Kingdom have the highest number of facilities with 25 in United Kingdom, 22 in France and 20 in Spain. Nonetheless, Netherlands, Belgium and Germany have higher level of trade facilitation than the three countries with highest number of facilities (see Figure 4.5).

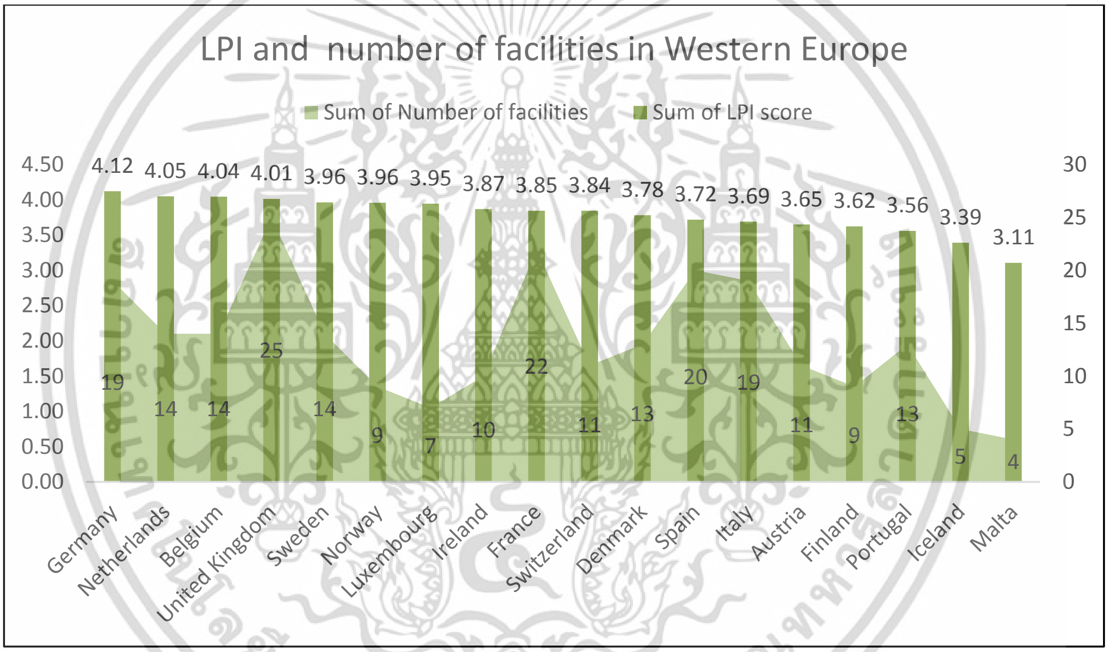

Figure 4.5 Comparison of LPI and number of facilities of automotive companies Western European countries

Another such example is Eastern Europe. The average LPI score of the region is higher than global average of 2.89. The region also has 167 facilities of the 7 automotive companies selected for the research. As can be seen in Figure 4.6, Poland, Czech Republic and Hungary have the highest level of trade facilitation. The three countries also have the highest number of automotive companies. Nevertheless, Latvia, Estonia and Slovenia with third, fourth and fifth in line in terms of trade facilitation have less number of facilities compared to countries like Romania, Slovak Republic and Greece, which have lower levels of trade facilitation. When considering the general trend in the number of facilities compared with the level of trade facilitation in the region, it is evident that factors other than trade facilitation are affecting the facility location of automotive companies.

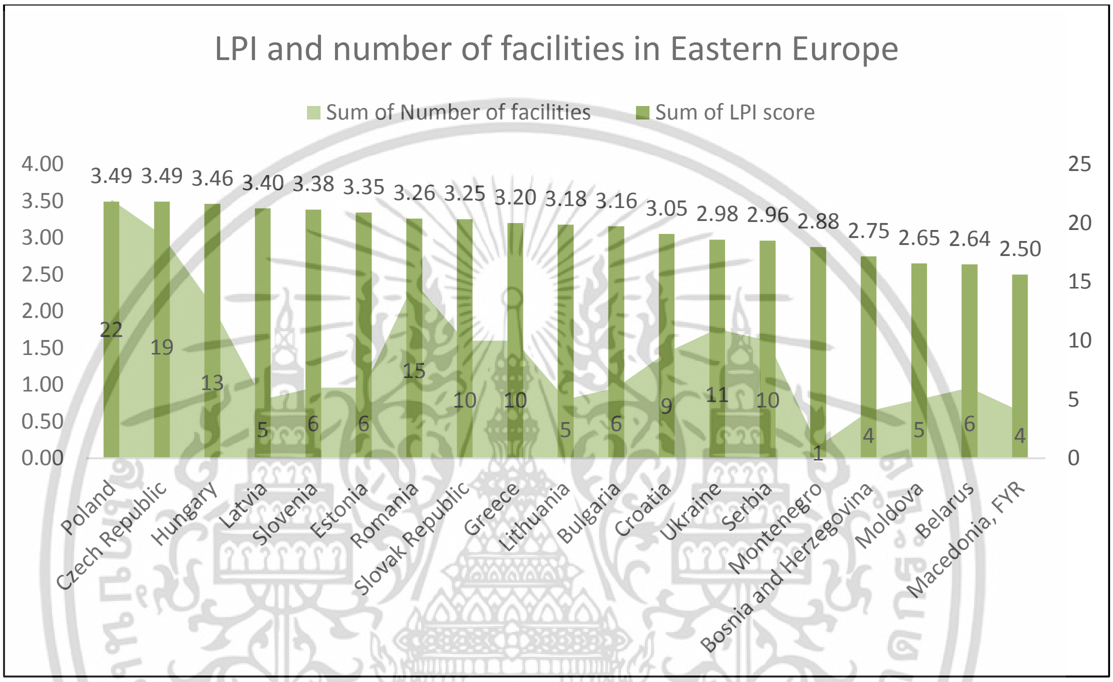

Figure 4.6 Comparison of LPI and number of facilities of automotive companies in Eastern European countries.

In South America and South East Asian regions, the scenario is different. In these regions, the impact of trade facilitation was higher among the countries with a lower level of trade facilitation while the impact of trade facilitation was lower among the countries with higher levels of trade facilitation. South America has 11 countries. Chile, Argentina and Brazil has the highest level of trade facilitation among them. The facility distribution among these three countries are more influenced by factors other than trade facilitation. Argentina and Brazil also have the most number of facilities of automotive companies located in those countries. Brazil has 31 facilities, which is more than any other country in the region. Other factors like cheap labor and growing economy in Brazil along with trade facilitation in the country has contributed to most number of facilities in Brazil. The rest of the countries in the region seemingly follow a linear trend. For these countries, higher trade facilitation for most part has meant higher number of facilities of global supply chains (See Figure 4.7).

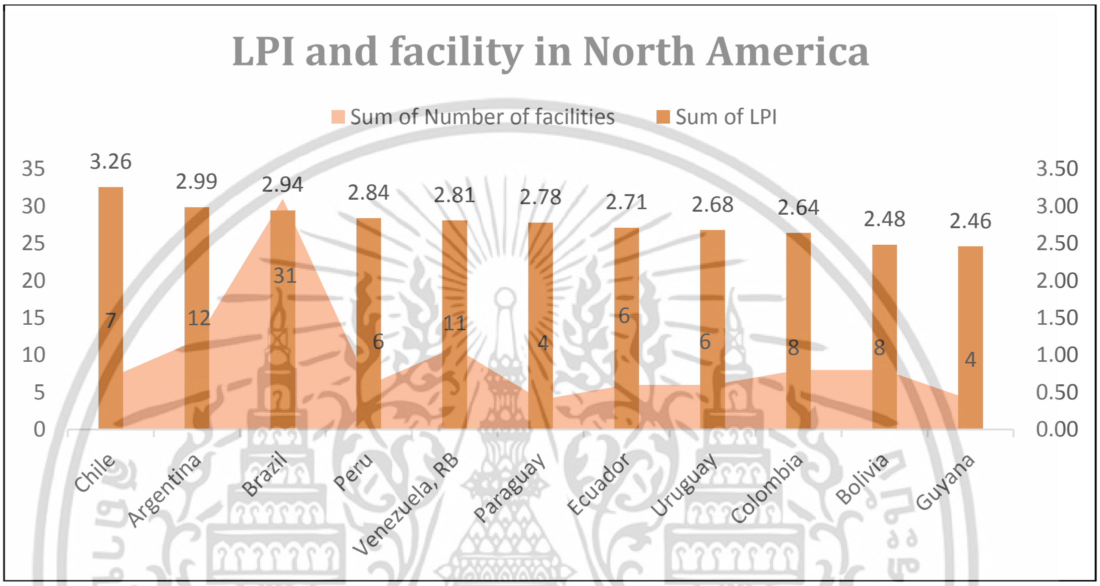

Figure 4.7 Comparison of LPI and number of facilities of automotive companies in North American.

Thailand is the leading country with most number of facilities in South East Asian region in terms of number of facilities but has a lower level of trade facilitation than Singapore and Malaysia. In addition Malaysia has more number of facilities than Singapore despite Malaysia ranking second in trade facilitation after Singapore. Rest of the countries have number of facilities more or less proportionate with the level of trade facilitation with Myanmar having the lowest number of facilities as well as lowest level of trade facilitation.

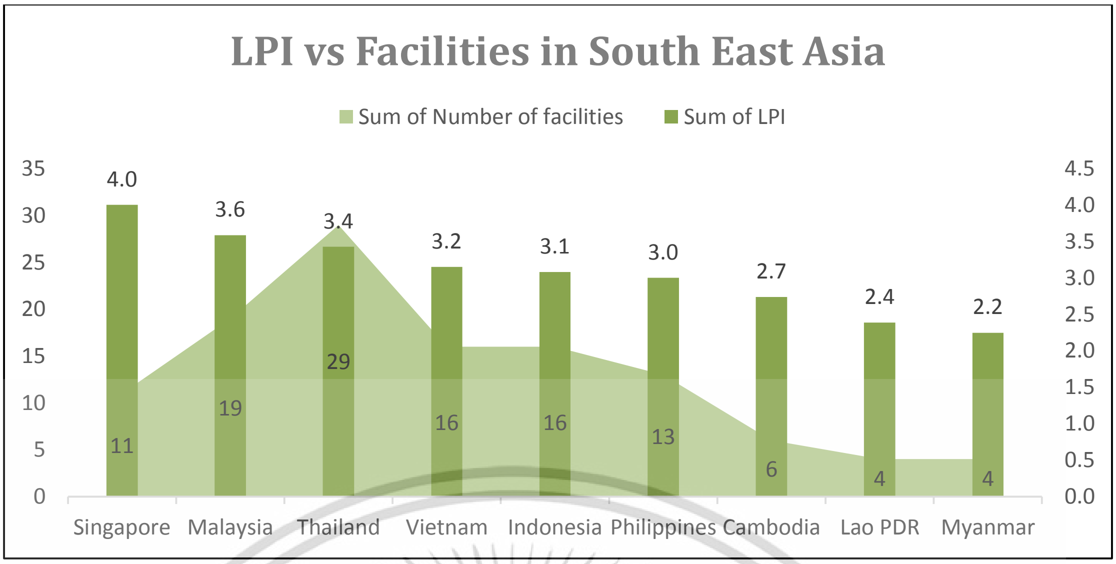

Figure 4.8 Comparison of LPI and number of facilities of automotive companies in South East Asia.

The special case of Thailand is because of the policies adopted by the government and its historical place in automotive manufacturing industry. Since the early stages of Japanese auto industry, they have set up facilities in Thailand bringing the skill needed for the industry.

The most obvious example, where the impact of trade facilitation was higher when one or few countries in the region have a higher level of trade facilitation compared to other countries, can be seen in North Africa. Among the countries in North Africa, Egypt has the highest number of facility as well as the highest level of trade facilitation. Algeria and Tunisia has almost a same level of trade facilitation but Tunisia has one facility more than Algeria. Libya with a trade facilitation level of 2.5 has only 3 facilities.

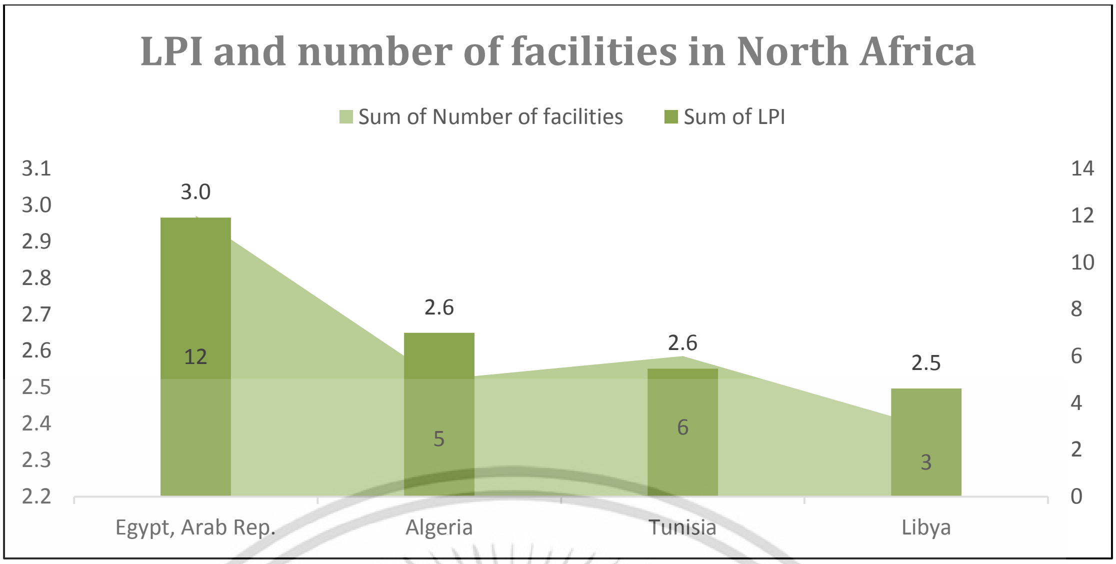

Figure 4.9 Comparison of LPI and number of facilities of automotive companies in North Africa

South Asian region also shows this similar tend as North Africa. India dominates South Asia automotive industry in terms of number of facilities. It has 30 facilities of the 7 companies studied under this project. That is more than 2% of total facilities. The Indian dominance in this region in auto industry can be attributed to two main reasons. One is India's high level of trade facilitation compared to other countries in the region. India scored 3.08 in LPI and Pakistan with second highest scored only 2.83. Second reason of India's dominance is the huge skilled labor force and size of the domestic market.

Bangladesh despite scoring less than Nepal, Sri Lanka, Maldives and Pakistan in Logistics Performance Index, has more number of facilities than any of the countries. This is because of the cheap labor and foreign investment oriented regulatory environment existing in the country. The labor in Bangladesh is cheapest compared to most parts of the world and the country provides substantial benefits to foreign investments.

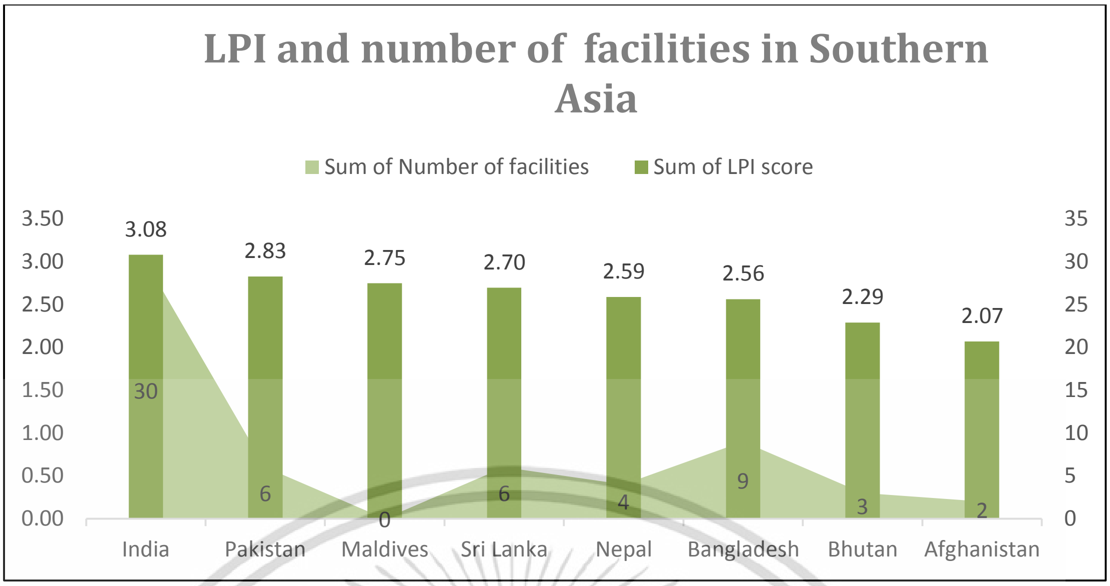

Figure 4.10 Comparison of LPI and number of facilities of automotive companies in Southern Asia

Figure 4.11 studies number of facilities at different levels of trade facilitation. The country with the lowest level of trade facilitation scored 1.77 in LPI index while the country with highest level of trade facilitation scored 4.27. Range of trade facilitation is arranged in such a way that there is a 0.5 difference between them. As such, the graph analyses the number of trade facilitation a country could expect at each level of trade facilitation.

It is evident that a higher level of trade facilitation attracts more facilities of automotive companies in to a country. If a country has a trade facilitation level of 1.77 to 2.27, it can expect to have 1 to 2 facilities of global automotive companies and if the country has a trade facilitation of 2.27 to 2.77, it is highly likely that the country would have 3 facilities of automotive companies. If a country could further increase the level of trade facilitation to 2.77 - 3.27 range, it could expect to double the number of facilities in the country. At a trade facilitation range of 3.27 – 3.77, around 12 facilities of automotive companies can be expected to locate in the country.

At a certain point, number of facilities does not increase even if the level of trade facilitation of a country increases. When a country's level of trade facilitation increases from the range 3.27 - 3.77 to 3.77 - 4.27, there is no increase in the number of facilities rather it remained the same. Thus it can be deduced that, 3.27 - 3.77 is a range of trade facilitation where companies are satisfied with the level of trade facilitation to invest in a particular country and increasing level of trade facilitation might not bring much additional investment on this regard. However such improvements could be crucial for other types of investments.

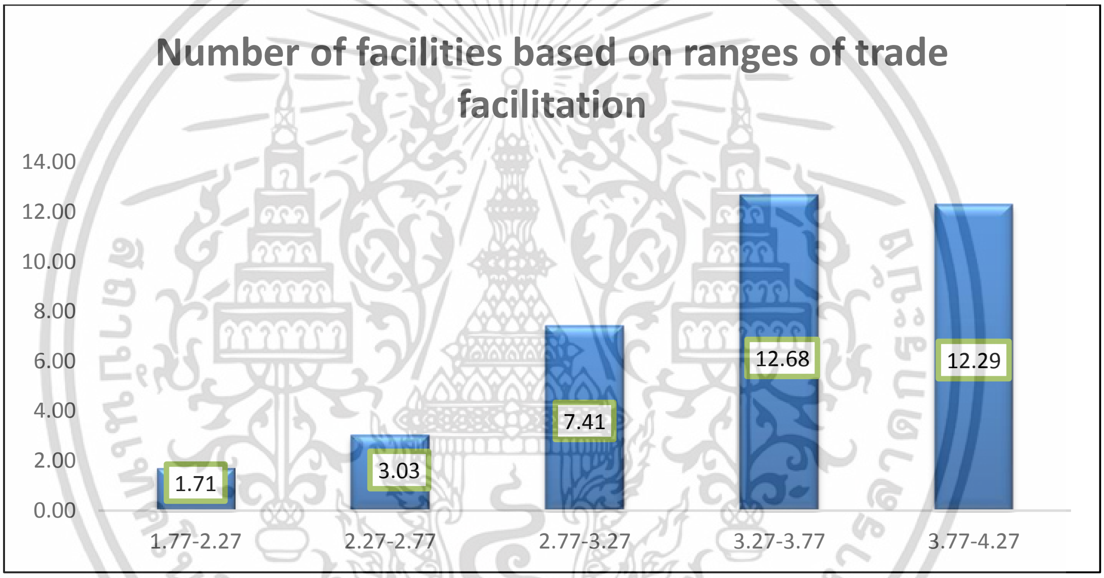

Figure 4.11 Number of facilities of automotive companies based on specific ranges of LPI

4.4 Regression Analysis

The regression analysis to understand statistical relationship between trade facilitation and global supply chain facility location decision making and different dimensions of trade facilitation and global supply chain facility location decision making revealed some noteworthy results. The overall logistics performance of a country explains 31% of the variation in the number of facilities located in a country. Dimensions of trade facilitation like logistics quality and competence and tracking and tracing contributes more than other dimensions like customs and timeliness. Trade facilitation efforts at customs have the least impact on number of facilities in a country. Infrastructure, timeliness and international shipments also are considerably important with these dimensions responsible for around 40% variation in number of facilities.

The relationship between number of facilities of automotive companies and the level of trade facilitation in a country is significant. These two variables have a positive correlation with a correlation coefficient of 0.56. A positive correlation implies that when trade facilitation of a country increases, number of facilities of automotive companies are also likely to increase. In addition, a correlation coefficient of 0.56 indicates a statistically significant relationship between them.

When a linear model is developed using number of facilities in a country and level of trade facilitation of the country, trade facilitation explains nearly 31% of the variation in number of facilities of automotive companies in the country. The model equation is as follows:

$$\text{Number of facilities} = 6.5134 * \text{level of trade facilitation} - 9.7.$$

According to the model, a country with an average level of trade facilitation is likely to have nearly 9 facilities of automotive companies while a country with a trade facilitation score close to 4 is likely to have more than 16 facilities.

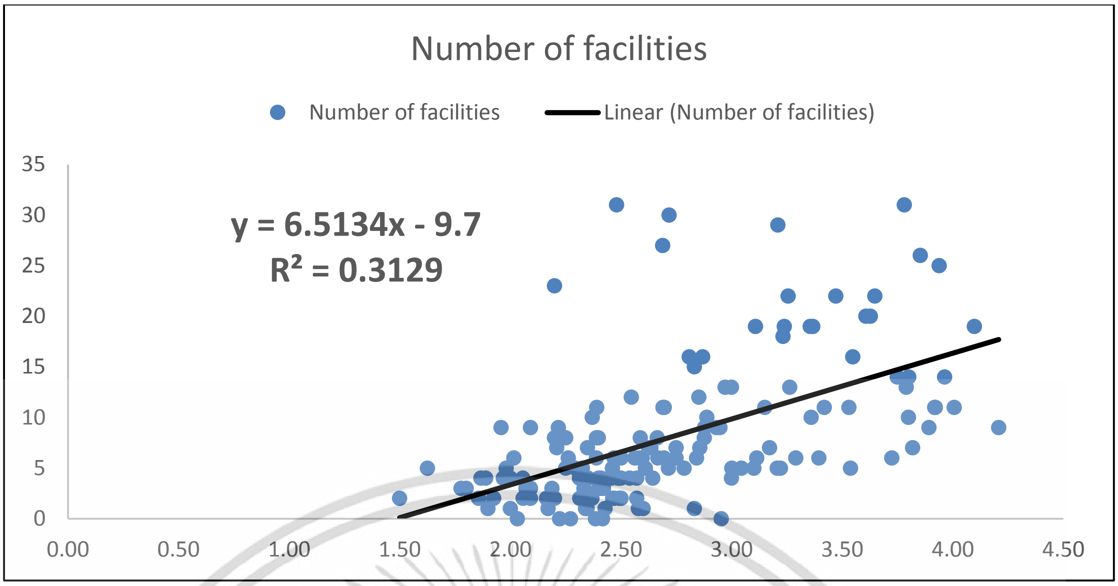

Figure 4.12 Regression analysis of LPI and number of automotive companies in different countries

Although level of trade facilitation and number of facilities of automotive companies shows statistically significant correlation, this linear model is not appropriate and cannot be used to make predictions of number of facilities in a country based on level of trade facilitation. Since variation of number of facilities of automotive companies explained by the model is only 30%, this is not a statistically significant to make predictions based on the level of trade facilitation. One particular reason for the insufficiency of the model to make predictions is the high standard deviation of the data points of number of facilities of in a country. When mean number of facilities were close to 9, the observed data points of number of facilities had a standard deviation of 10.7 with a variance of 114.6.

As such, it can be deduced that trade facilitation is one of the factors that impacts the global supply chain facility location decision making. However it is not the only factor and it cannot be solely used in a linear model to make predictions of number of facilities of global supply chains in a country. It should be modelled together with other factors like strategic, political and geographical factors as discussed in the literature review.

Considering different dimensions of trade facilitation, the study revealed that all the 6 dimensions of trade facilitation contribute fairly equally in attracting facilities of global supply chains. Regression analysis showed the r-square of all the dimensions with respect to the number of facilities in a country range from 0.31 to 0.44. Logistics quality and competence and tracking and tracing attributes of the trade facilitation have the highest r-square among all. Those two dimensions together contributed to 88% in explaining the total variation explained by the trade facilitation. This finding has significant relevance to the growing importance of supply chain visibility and reliability of the global companies. Hence, trade facilitation investment of countries could focus more on improving logistics quality and competence and tracking and tracing of shipments in relation to other dimensions.

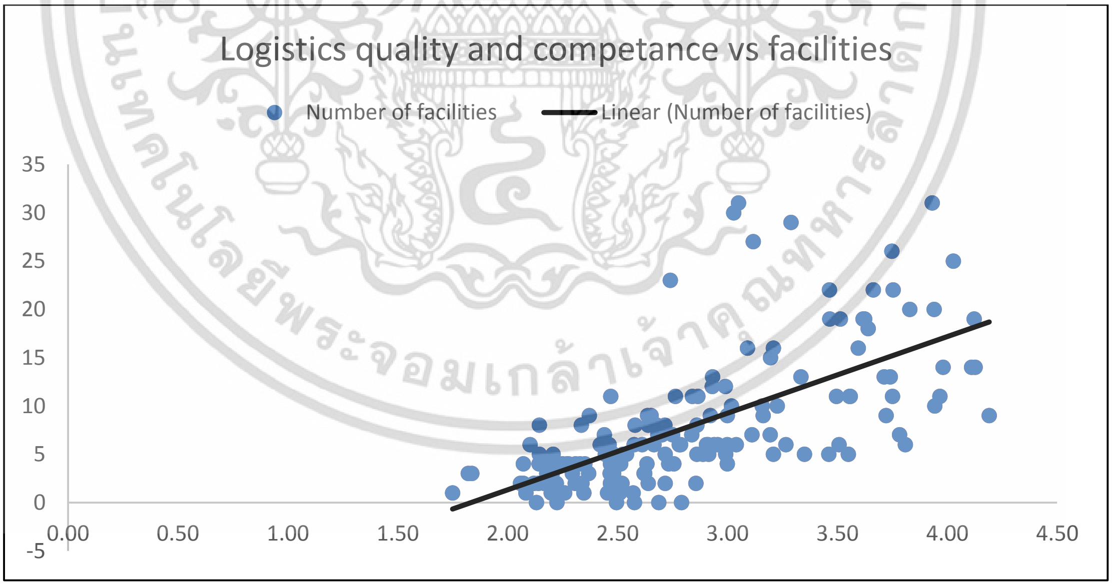

Figure 4.13 Regression analysis of logistics quality and competence and number of facilities of automotive companies in different countries

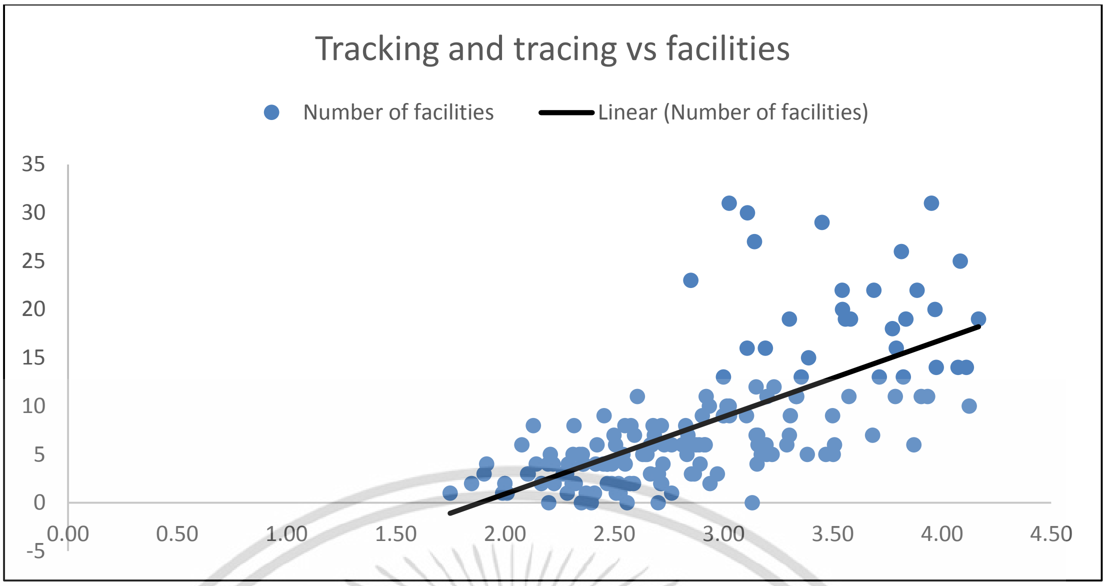

Figure 4.14 Regression analysis of tracking and tracing and number of facilities of automotive companies in different countries.

Infrastructure, ease of arranging international shipments and timeliness aspects of trade facilitation also plays a significant role in attracting global supply chain facility location decision making as it contributes to 42%, 41% and 39% respectively in explanation of total variation. Trade facilitation efforts in areas of customs is found to be less important compared to other 6 dimensions of trade facilitation. Only 31% of the variation in number of facilities in a country explained by trade facilitation is expected to have an impact on customs related trade facilitation.

Since the linear model based on trade facilitation and number of facilities of global supply chains was proven to be an insufficient model, several other models were tested for sufficiency. One of these models were levels of trade facilitation and number of facilities based on different regions. For these models, Africa and Europe model reflected the result of our initial model. The r-square for the models for these two continents were 0.40 and 0.37 respectively.

For Asian countries, the r-square deteriorated to 0.25. North America, Oceania and South America had very few data plots. North America had just 10 data points while Oceania had just 5. Due to this, the models developed for these continents showed an unrealistic r-square of 0.66 and 0.89. Although South America reflected the result of initial model, even that result cannot be relied upon as the continent alone had only 10 data points.

In addition, models were tested based on different companies as well. For this models, level of trade facilitation and number of facilities of each 7 companies selected for this study ware analyzed separately. The data sets created for these models does meet with the conditions required to develop a linear model. When data set was separated based on companies, they were not homoscedastic and the residuals were not normally distribution.

A more extensive multiple linear model was also tested based on the six dimensions of trade facilitation. In this model, number of facilities in a country was taken as dependent variable while the six dimensions of trade facilitation were taken as independent variables. Testing this model proved there were high level of multicollinearity between the independent variables. All the correlation coefficients between the independent variables ranged from 0.82 to 0.93. Hence, such a multiple linear regression model was also found to be insufficient.

CHAPTER 5

CONCLUSION AND FUTURE RESEARCH AREAS

Supply chains are disrupting the patterns of global trade. Trade in intermediate products represent around 40% of world trade in goods. Vertical intra industry trade (VIIT) consist of more than 1/3 of the United States trade (Horacio C. Faustiono, 2011). Hence it is critical to study trade in a supply chain management perspective. Countries should focus more on the patterns of global supply chains when formulating bilateral and multilateral trade agreements. As it is the location of facilities of those global supply chains that is going to transform the trade of a country, focusing merely on bilateral and multilateral trade attributes rather than supply chain in mind, might not bring the perceived outcome from such investments and agreements.

The focus of this study was to understand the relationship between trade facilitation and facility location decision of global supply chains. Attracting more facilities of the global supply chains into a country would increase the trade of the country. Hence it is prominent to understand the factors that influence global supply chain facility location decision making. In this research, one of such factor; trade facilitation is taken into account to study the impact it has on global supply chain facility location decision.

Benchmarking analysis revealed that regions with high trade facilitation have attracted higher number of facilities of global supply chains while regions with low level of trade facilitation attracted fewer of them. Europe and Asia with highest average level of trade facilitation also leads the number of facilities of global automotive companies in the region with 322 and 320 respectively.

Apart from this, benchmarking analysis also found that the number of facilities in a country increases as level of trade facilitation increased. However it was also found, the increasing rate diminished when a country reached to certain level of trade facilitation. Countries with a trade facilitation level of 1.77 to 2.27 on average had 1 to 2 facilities while countries with 3.27 – 3. 77 on average had 12 facilities. Further, it was found that when level of trade facilitation goes beyond this level, the number of facilities does not increase but rather stayed around the same level.

It was also found that when few countries in a region outperform in terms of trade facilitation compare to other countries, it contributed immensely to attract more facilities into the country. In the same manner, when most countries in the region enjoy higher level of trade facilitation, the impact of other factors in play were found be more significant impact on facility location decisions.

Significant correlation between facility location of automotive companies and trade facilitation was identified in the regression analysis of the research. Thus it is undeniable that countries need to focus on trade facilitation related investment to improve trade and economic development. Further, this analysis prioritized the dimensions of trade facilitation to focus on in order to maximize the return on investment on trade facilitation. As such, the focus areas of trade facilitation investment should be on improving infrastructure, tracking and tracing and logistics quality and competence.

The understanding of the underlying factors of global supply chain decision making can be further understood when studied by a combination of other factors. As the literature and the results of this research pointed out, trade facilitation is one of the factors affecting global supply chain facility locations decision along with many other factor. A combination of factors highlighted in the literature studied together could produce more advancement in this field of study.

Moreover, the facilities of the automotive companies considered under this research is limited to the distributors, parts manufacturing and assembly plants. It does not include the second and third tier suppliers of those companies. If the scope of the research can be further broadened to include them, it would produce more practical and substantial results. Similarly, the count of number of facilities of automotive companies in a country is based on the company and not on actual number of facilities. For example, it is likely that a dealer company in a country might have more than one facility in the country. However in this research, they are counted as one facility of a global supply chain.

The scope of trade facilitation specific in this research can also be further extended to cover the wider dimensions of the subject matter. Only the attributes of trade facilitation covered in the logistics performance index is included in this research. The dimensions of trade facilitation in logistics performance index does not cover the ease of financial arrangements in international trade transactions.

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APPENDIX

Table 1: Compiled data of LPU and number of facilities of automotive companies in different countries.

Country	LPI score	Number of facilities
Germany	4.12	19
Netherlands	4.05	14
Belgium	4.04	14
United Kingdom	4.01	25
Singapore	4.00	11
Sweden	3.96	14
Norway	3.96	9
Luxembourg	3.95	7
United States	3.92	75
Japan	3.91	31
Ireland	3.87	10
Canada	3.86	20
France	3.85	22
Switzerland	3.84	11
Hong Kong SAR, China	3.83	6
Australia	3.81	26
Denmark	3.78	13
Spain	3.72	20
Taiwan	3.72	16
Italy	3.69	19

Korea, Rep.	3.67	22
Austria	3.65	11
New Zealand	3.64	11
Finland	3.62	9
Malaysia	3.59	19
Portugal	3.56	13
United Arab Emirates	3.54	11
China	3.53	88
Qatar	3.52	5
Turkey	3.50	18
Poland	3.49	22
Czech Republic	3.49	19
Hungary	3.46	13
South Africa	3.43	19
Thailand	3.43	29
Latvia	3.40	5
Iceland	3.39	5
Slovenia	3.38	6
Estonia	3.35	6
Romania	3.26	15
Israel	3.26	5
Chile	3.26	7
Slovak Republic	3.25	10
Greece	3.20	10
Panama	3.19	11
Lithuania	3.18	5
Bulgaria	3.16	6

Vietnam	3.15	16
Saudi Arabia	3.15	7
Mexico	3.13	27
Malta	3.11	4
Bahrain	3.08	6
Indonesia	3.08	16
India	3.08	30
Croatia	3.05	9
Kuwait	3.01	6
Philippines	3.00	13
Cyprus	3.00	9
Oman	3.00	7
Argentina	2.99	12
Ukraine	2.98	11
Egypt, Arab Rep.	2.97	12
Serbia	2.96	10
El Salvador	2.96	9
Brazil	2.94	31
Bahamas, The	2.91	5
Montenegro	2.88	1
Jordan	2.87	6
Dominican Republic	2.86	6
Jamaica	2.84	8
Peru	2.84	6
Pakistan	2.83	6
Malawi	2.81	5
Kenya	2.81	9

Nigeria	2.81	7
Venezuela, RB	2.81	11
Guatemala	2.80	7
Paraguay	2.78	4
Côte d'Ivoire	2.76	3
Rwanda	2.76	2
Bosnia and Herzegovina	2.75	4
Maldives	2.75	0
Cambodia	2.74	6
Sco Tomi and Principe	2.73	0
Lebanon	2.73	5
Ecuador	2.71	6
Costa Rica	2.70	8
Kazakhstan	2.70	5
Sri Lanka	2.70	6
Russian Federation	2.69	23
Uruguay	2.68	6
Armenia	2.67	7
Namibia	2.66	0
Moldova	2.65	5
Nicaragua	2.65	8
Algeria	2.65	5
Colombia	2.64	8
Burkina Faso	2.64	4
Belarus	2.64	6
Ghana	2.63	9
Senegal	2.62	5

Liberia	2.62	2
Honduras	2.61	11
Ethiopia	2.59	3
Nepal	2.59	4
Solomon Islands	2.59	2
Burundi	2.57	1
Bangladesh	2.56	9
Benin	2.56	4
Tunisia	2.55	6
Fiji	2.55	4
Angola	2.54	2
Chad	2.53	2
Tajikistan	2.53	2
Mauritius	2.51	5
Georgia	2.51	7
Macedonia, FYR	2.50	4
Libya	2.50	3
Mali	2.50	3
Botswana	2.49	0
Bolivia	2.48	8
Guinea	2.46	1
Zambia	2.46	4
Guyana	2.46	4
Azerbaijan	2.45	4
Papua New Guinea	2.43	3
Guinea-Bissau	2.43	1
Comoros	2.40	1

Uzbekistan	2.39	3
Niger	2.39	4
Lao PDR	2.39	4
Madagascar	2.38	4
Lesotho	2.37	0
Central African Republic	2.36	2
Mongolia	2.36	8
Equatorial Guinea	2.35	1
Zimbabwe	2.34	4
Tanzania	2.33	3
Togo	2.32	2
Turkmenistan	2.30	2
Iraq	2.30	5
Cameroon	2.30	2
Bhutan	2.29	3
Haiti	2.27	8
Myanmar	2.25	4
Gambia, The	2.25	2
Mozambique	2.23	6
Mauritania	2.23	2
Kyrgyz Republic	2.21	0
Gabon	2.20	4
Yemen, Rep.	2.18	5
Cuba	2.18	1
Sudan	2.16	4
Djibouti	2.15	2
Syrian Arab Republic	2.09	3

Eritrea	2.08	1
Congo, Rep.	2.08	2
Afghanistan	2.07	2
Congo, Dem. Rep.	1.88	3
Somalia	1.77	1

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