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An Empirical Study of Container Growth by Delinking it with GDP

by

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Acknowledgments

"I came, I said, I conquered!"

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Rotterdam, 2017

To my dad.

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Abstract

Times have changed and globalization has become a huge determining factor in controlling human life, not exceptionally the seaborne trading activities through the containership modes. Previous studies concerning container growth that only include the GDP as an economic indicator are no longer relevant. This is due to the changes in the relationship between the container volume and the GDP: nowadays they demonstrate similar growth. Equality rates figures among the container volume growth and the GDP growth are defined as a ‘disruption phenomenon’.

Instead of only looking from an economic perspective, we thought it would also be interesting to see the container volume growth from a social perspective. Thus, in this study we conduct a quantitative analysis on the container volume growth by delinking it with the GDP and explaining the demographic trends and the protectionism impact on the four major regions (the US, China, Western Europe, and the Middle East) from 2001 to 2015. We investigate the demographic trends through three proxies (working age of the population, employment fraction, and income for personal disposable), and we take the Free Trade Agreements (FTA) that the countries have with their partners into account to consider protectionism.

This study aims to obtain clear results on what indicators beside the real GDP have an influence on the container volume growth. The results show that the working age of the population, employment fraction, and free trade agreements control container volume in a higher level than the real GDP. Meanwhile, the income for personal disposal has only little influence.

Table of Contents

List of Figures

List of Tables

List of Abbreviations

CEM	: Common Effect Model
DEA	: Data Envelopment Analysis
EU	: European Union
FEM	: Fixed Effect Model
FTA	: Free Trade Agreements
GDP	: Gross Domestic Products
HLH	: Hamburg–Le Havre Ranges
REM	: Random Effect Model
RQ	: Research Question
SQ	: Sub-Question
TEU	: Twenty Equivalent Units
UNCTAD	: United Nations Conference on Trade and Development
UNESCAP	: United Nations Economic and Social Commission for Asia and the Pacific
US	: United States
WTO	: World Trade Organization
3D	: 3 dimension

Chapter 1 Introduction

1.1 Statement of Research Problem

In today's world trade activities, seaborne trade accounts for approximately 80 per cent of the total merchandise volume (UNCTAD, 2016). Seaborne (also called ‘maritime’) trade is the backbone of globalization and lies at the heart of cross– border transport networks that support supply chains and assist international trade. During the past two decades, container volume has enjoyed higher rates of growth compared to total seaborne trade. From this phenomenon, the industrially products and the intermediate products recorded as dominant commodities (Grossmann, et al., 2007).

Development in global container volume transport is highly controlled by economic growth. The container transport is ultimately driven by economic development, with the most noticeable measure being the Gross Domestic Products (GDP) of the countries where the ports are located. The higher the GDP of the countries, the more container volumes ports can handle. Based on research carried out by UNESCAP (2007), in 2002 East Asia was noticeably the key driver for global container trade, and accounted for the highest proportion (24 per cent), followed by Europe as the second largest (22 per cent). North America had a moderate percentage (slightly below 17 per cent of the total share), while both North Asia and South-East Asia recorded exactly 10 per cent.

Historically, container transport has been analyzed almost exclusively from an economic perspective (i.e. GDP) (UNESCAP, 2007; Havenga, 2012; Dorsser, et al., 2012; de Langen et al., 2012; Drewry, 2016; UNCTAD, 2016; Royal HaskoingDHV, 2016). They rely on an econometric model by applying regression analysis as a method to investigate the present and predict future container volumes based on a multiplier relationship derived from the GDP growth from past years.

The multiplier relationship between container volume growth and GDP growth has had very high rates in the past. However, due to most of the container products being intermediate goods that nearly reach maturity in the near future, this multiplier rate slowly declined (de Langen, et al., 2012).

Some new developments in today's world are slowing down (or even countering) the rate of globalization. In some cases, container volume is currently decreasing, while the GDP is growing. The relationship between the world container trade and the global GDP growth is changing: the trade rate has been much higher than the GDP growth in the past, but now it is becoming relatively equal (WTO, 2017). We define this as a ‘disruption phenomenon’.

We are eager to know what has caused this disruption. Is GDP no longer a sole indicator for analyzing container growth? What are the relevant factors that explain this disruption?

Starting from this point, we take other variables into account in order to investigate this disruption phenomenon. It is interesting to find out how the relationship between the world container trade and the global GDP growth works from a socio-economic perspective. Thus, we hypothesize several socio-economic determinants instead of GDP that might contribute to control the container volume transport, such as increasing levels of protectionism and demographic trends.

This thesis will investigate the disruption of multiplier relationships between the world container trade and GDP growth in the past. We aim to prove the influence of socio-economic determinants on container transport, and to understand the significance of their impact. We will combine both quantitative and qualitative methods in studying these factors. For the quantitative study, we will investigate the aspects as mentioned earlier through a panel regression method and understand how significantly these indicators have affected global container growth in the past by separating it from global GDP growth. The qualitative study will analyze the impact of some indicators based on the port locations, and the current state of global development.

1.2 Research Objectives

This research aims to analyze the container volume growth by looking at some socio-economic developments as new determinants instead of the GDP. The research takes two aforementioned (protectionism and demographic trends) potential socio-economic determinants to explain container volume in some regions from 2001 to 2015. The study will cover four regions – the US, Hamburg–Le Havre (HLH) Range, the Middle East, and China – because they are globally representative samples.

To investigate the stated problem above, we set up the research question as follows:

> ***What are the significant determinants of container volume growth aside from GDP?***

To answer this question, we further dissect it into the following five sub-questions:

1. What is the current condition of the container transport, both globally and in particular regions (the US, China, Western Europe, and Middle East)?
2. What are the possible socio-economic determinants instead of the GDP that control the container volume transport?
3. What is the best method to disconnect the GDP growth from the container transport?
4. What is port performance and what indicators determine it?
5. How is the current condition of the GDP growth in the US, China, Western Europe, and Middle East?

Systematically, we represent the research question and sub-questions in Figure 1.

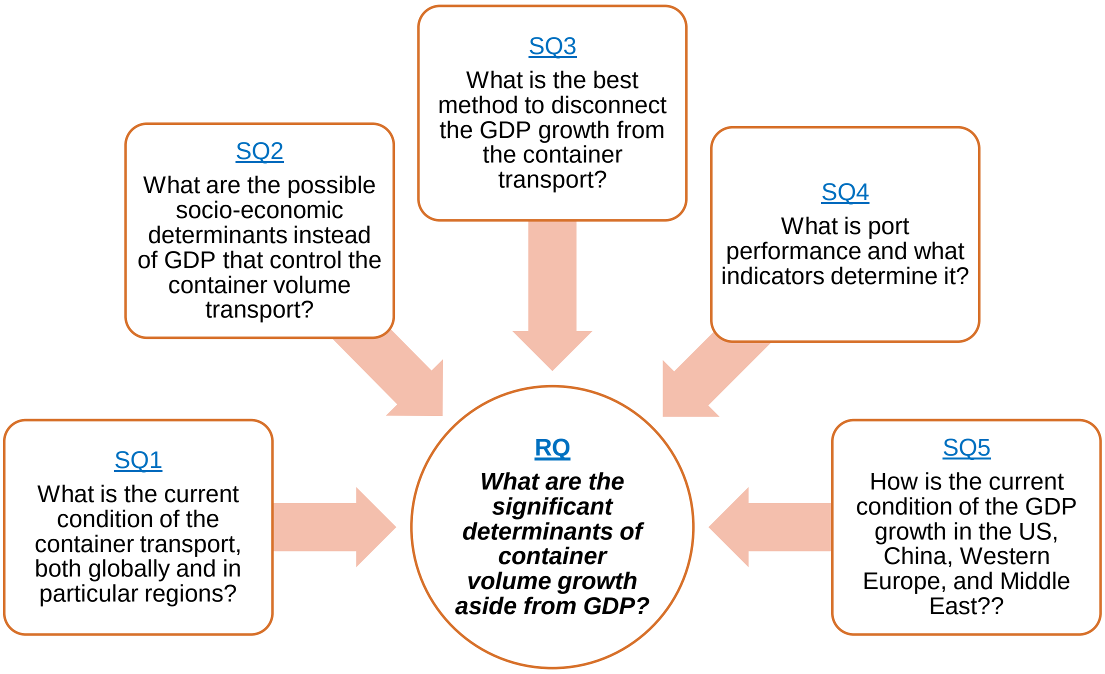

Figure 1. Research question and sub-questions of the thesis

Source: Author

1.3 Structure and Contents

The structure of this thesis is as follows: Chapter 2 provides an explanation of the theoretical framework (literature review) of the container volume growth, and is split into four sub chapters: the development of containerization, and global seaborne trade for container commodities; an overview of container growth, both globally and concerning specific regions (Asia, North America, Western Europe, and Middle East); the summary of container growth measurements from previous research; and a short description of container throughput as the main indicator of port performance. Chapter 3 briefly explains the research design, discussing the research methodology and explaining data collection. Chapter 4 interprets the results and analysis from the research. Chapter 5 answers the research question and provides some suggestions for further research by way of conclusion. Figure 2 describes the structure of this thesis.

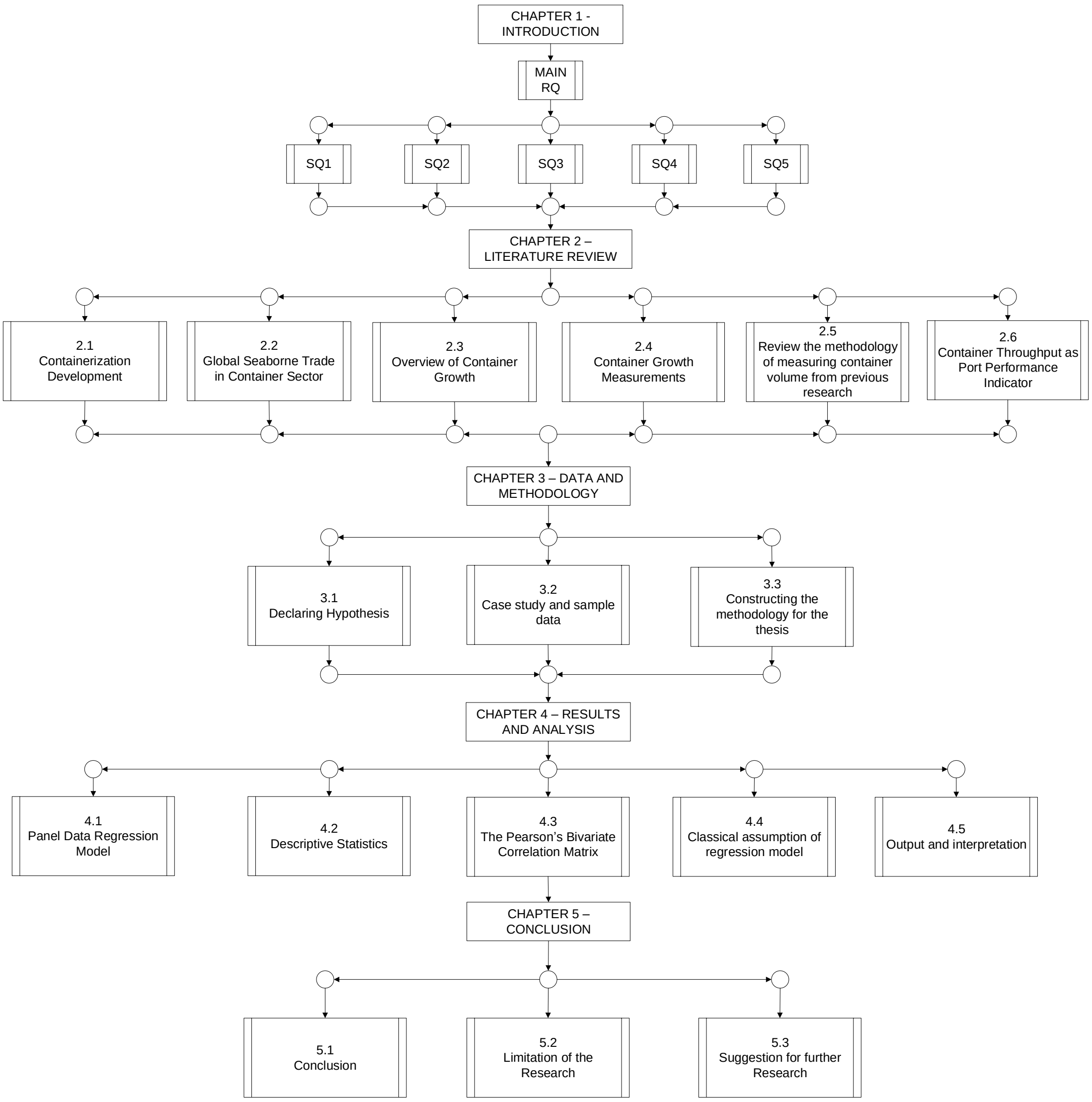

Figure 2. Thesis structure

Source: Author

Chapter 2 Literature Review

In order to clearly provide the container volume growth story, the background of the development of containerization and seaborne trade in the container sector is set out in this chapter. This chapter consists of six sub-chapters (2.1-2.6), and answers all the sub-questions that were proposed in Chapter 1.

Chapters 2.1-2.3 answers the following sub-question: “What is the current condition of the container transport, both globally and in particular regions (the US, China, Western Europe, and Middle East)?”

2.1 Containerization Development

Containerization was not just about ships; it was a new way to control the organization of transport by involving enormous capital investment to work within closed conference system (Notteboom, 2004). It has transformed the transport of goods in international trade and has progressively developed maritime traffic since 1960 (Verny and Grigentin, 2009).

Shipping containers have been popularly used since 1960 due to their easiness and efficiency for carrying the goods compared to transport of bulk goods (Verny & Grigentin, 2009). Verny and Grigentin (2009) clarify that carrying goods via containers also allows the world to move beyond the transport of bulk goods and ensures rapid, smooth, and secure trade in all types of commodities by focusing on packaging instead of content during loading and transshipment.

Notteboom (2004) claims that shipping markets indicate instability over periods as shipping lines and terminal operators could face increasingly turbulent, rapidly changing, and uncertain situations. The volatility of shipping markets results from a dynamic working environment, such as technological advances, deregulation, logistical integration systems, and organizational structures that are constantly reshaping the maritime industries and disrupting the status quo.

In the beginning of the containerization era, the shipping industry barely worried about profitability because a consortium had a crucial role in managing the service patterns and capacity of particular trade routes. Furthermore, powerful liner conferences were able to oversee freight rates and control the revenue pooling agreements according to their tariffs. This occurred until 1980s (Notteboom, 2004).

However, during the last decades, containerization began to under-perform financially compared to other industries regarding the combination of capital-intensive operations and high risks to revenues. The capital-intensive operations in shipping are mainly triggered by some assets that are owned and others are leased, and also the variable existence of cost bases (Brooks, 2000). This situation explains the short–term instability of the shipping industry. It can tackled by analyzing the financial structure that has a huge impact on cash flow to identify the true risks (Stopford, 2009). Containerization, combined with developments of other technologies has emerged the range of trading activities that leads to the volumes growth. The most significant growth of containerized products is perishable goods (UNESCAP, 2007).

2.2 Global Seaborne Trade in Container Sector

The ocean transports approximately 80 per cent of total merchandise volume today (UNCTAD, 2016). Maritime transport is the backbone of globalization and stands at the heart of cross-border transport networks that support supply chains and empower international trade (UNCTAD, 2016).

Seaborne trade is dominated by three of the largest economic centers: North America, Europe, and Asia. The thick blue line in Figure 3 represents the route for container ships and other specialized vessels, such as chemical tankers and car carriers. The three economic centers have over 90 per cent of the world's manufacturing industry (Stopford, 2009).

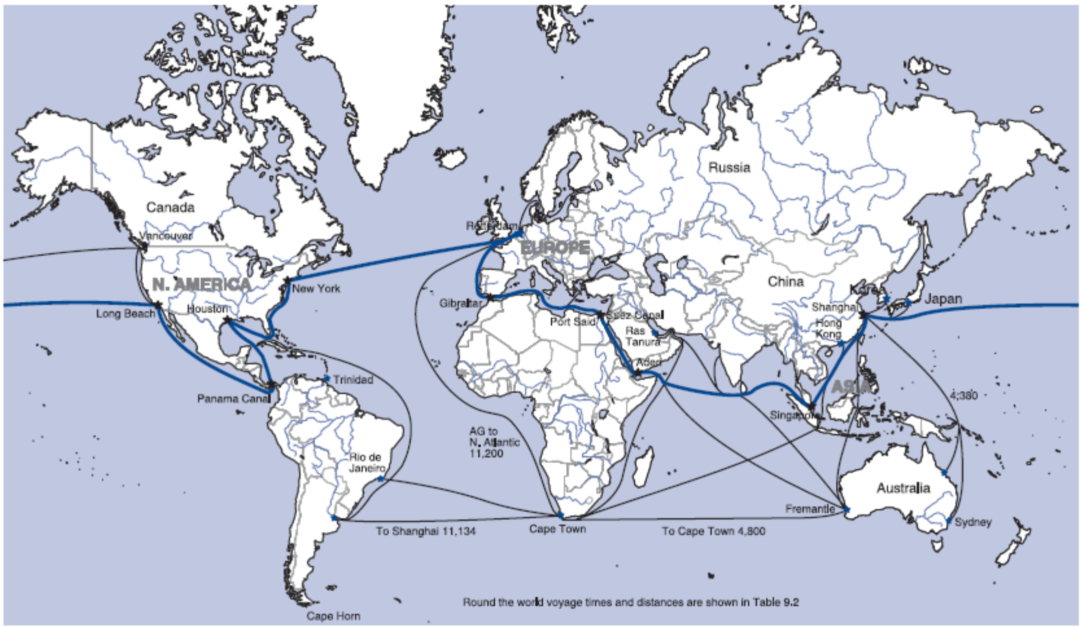

Figure 3. The global major shipping routes

Source: (Stopford, 2009)

In 2005, trade was split almost equally between the Atlantic, with 7 billion tons of imports and exports, and the Pacific and Indian oceans, with 7.1 billion tons. Atlantic trade was dominated by two major importers, North America and Europe: they accounted for 45 per cent of world imports, while the remaining Atlantic regions only provided 8 per cent. Export activities were more broadly distributed, with Europe, North America, and the east coast of South America exporting the most. Furthermore, the dominant importers in the Pacific were Japan, China, South-East Asia, and India (with all of them account for 41 per cent trade share). Other remaining regions had a very large landmass, and so only accounted for a small share (Stopford, 2009).

There are two important canals that provide short-cut links the oceans, namely the Suez Canal and the Panama Canal. The Suez Canal (opened in 1869) connects the Red Sea at Suez and the Mediterranean at Port Said and offers a much shorter route to reach the Indian Ocean from the North Atlantic compared to the alternative route via the Cape of Good Hope. It is 100 miles in length and requires 13-15 hours for transit time. The canal can accommodate vessels with beams reaching 64 meters and drafts up to 16.2 meters. Meanwhile, the Panama Canal (opened in 1914), shortens the distance from the Atlantic to the Pacific by 2,000 miles (Stopford, 2009).

UNESCAP (2007) explains the annual average total international maritime trade represented by 2.4 per cent of growth from 1980–2004; the total seaborne trade in 2004 was 70 per cent greater than that in 1980 (UNESCAP, 2007). This is illustrated in Figure 4. In other studies, UNCTAD (2016) estimated the world seaborne trade volumes would expand in 2015, surpassing 10 billion tons, even though the shipment expanded in a slower level than the historical average by 2.1 per cent. Containerized cargo traffic performed below expectations in this period. Furthermore, growth in world seaborne trade shipments is projected to capture marginally in 2016, with the relatively slow pace in historical terms. Even though the slowdown of the Chinese economy is bad news for shipping, other countries have potential for growth in seaborne trade. One example is South–South trade that can gain momentum, and are supported by planned initiatives such as the One Belt One Road, the Partnership for Quality Infrastructure, and the expanded Panama and Suez canals (UNCTAD, 2016).

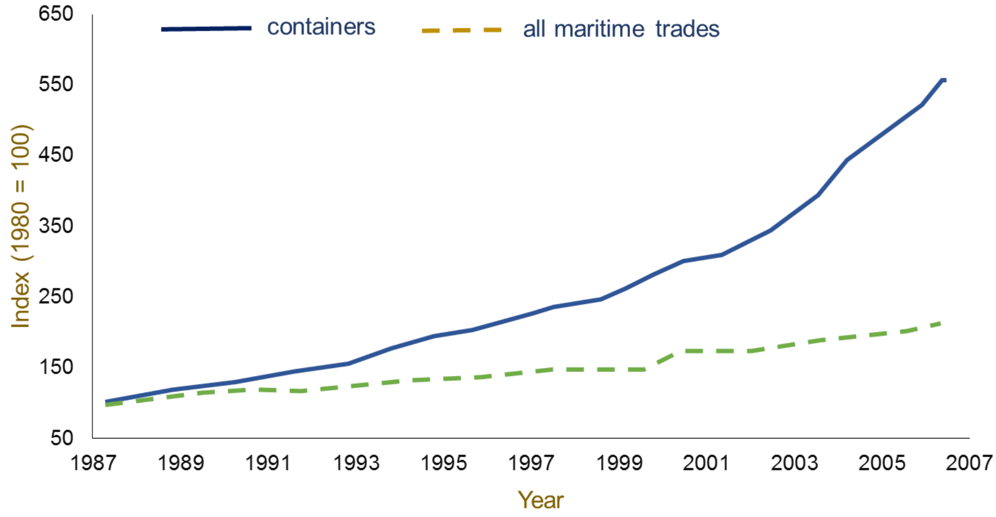

Figure 4. Growth of world maritime trade from 1980 to 2006

Source: Drewry; UNCTAD 2007

2.3 Overview of Container Growth Globally and Locally

During the last two decades, international container trade volume has increased at a higher rates compared to total maritime trade. As represented in Figure 4, there is an average 2.4 percent annual growth in container trade over twenty years from 1987 to 2007. In 2004, the total seaborne trade has inclined by 70 per cent compared to volume in 1980. A similar trend occurred for container volumes, which experienced an annual average growth rate of 8.6 per cent over the same period. Meanwhile, the total volume of container transport had grown by more than 600 per cent over the same period. This increase was mainly caused by an enormous number of trans-shipment movements (UNESCAP, 2007).

UNESCAP (2007) mapped the regional distribution of container volume shares among the major regions in 2002, and predicted the volume in 2015 (see Figure 5). Based on their research, East Asia will become the main driver for container trade globally, accounting for the highest proportion (24 per cent), followed by Europe as the second largest (22 per cent). North America had the next moderate percentage, just below 17 per cent of the total share, while both North Asia and South–East Asia recorded exactly 10 per cent. However, this world share's contribution is expected to change in 2015. In 2015, East Asia was still be predicted to be the most important driver for container trades with 32 per cent of the total share. Both Europe and North America were expected to have a smaller percentage share than in 2002, only 18 per cent and 13 per cent respectively. The shares of South–East Asia will have considerably expanded, surpassing North Asia's share (UNESCAP, 2007).

UNESCAP (2007) also estimated 6.6 per cent of annual growth for global commodities in the 2002–2015 period, indicating a decline from 8.5 per cent growth in 1980–2002. The annual average growth rate through to 2010 was predicted at 7.5 per cent, while the growth was projected to fall to 5 per cent during the following five years to 2015. Furthermore, Lloyd's list (2016) analyzed the development of the top 100 container ports; based on their research, the total container volumes handled by the world's top 100 ports accounted for 545.6 million TEUs in 2015, a slight increase of 1 per cent from the 2014 volume (Lloyd's List, 2016).

The top 20 container ports, which account for 55 per cent of the top 100 ports, dropped by 95 per cent from 5.6 per cent in 2014 to 0.5 per cent in 2015. It is important to notice here that this statistic has not occurred in other smaller ports that had larger gains (UNCTAD, 2016). In 2015, 15 container ports of the top 20 were from developing countries, mainly in Asia; three ports belonged to European countries (the Netherlands, Belgium, and Germany); the last two were from North America (Los Angeles and Long Beach, California). In 2016, the top 10 ports were still located in Asia, nine of the top 20 belonged to the Chinese, and seven of these (excluding Dalian and Hong Kong) had positive growth. Overall the performance of the top 20 container ports in China in 2015 experienced a positive growth rate with 3.7 per cent despite the economic slowdown (Journal of Commerce, 2016). Seven of the top 20 ports recorded a negative growth compared to the previous year, while two managed a small positive growth rate of less than 1 per cent.

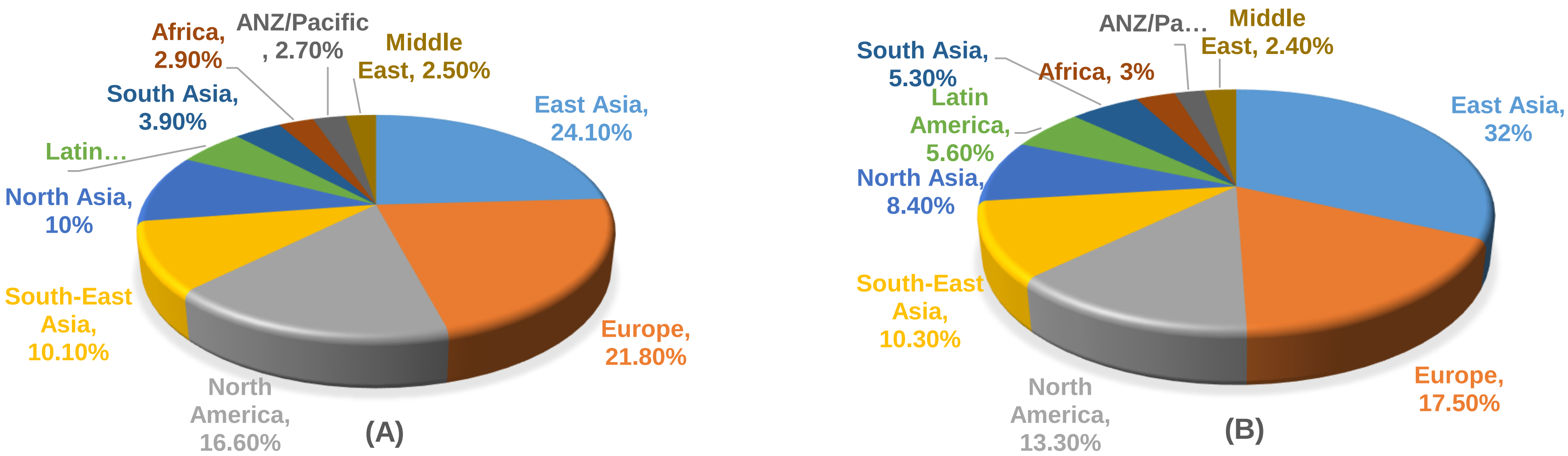

Figure 5. Distribution of actual container volume worldwide in 2002 (A) and the prediction of container volume worldwide in 2015 (B), representing the full import and export containers volume for each region.

Source: UNESCAP, 2007

The most impressive declines in 2015 ensued in Hong Kong (China) with -9.5 per cent, Hamburg (Germany) with -9.3 per cent, and Singapore with -8.7 per cent. On the contrary, Port Klang (Malaysia), Antwerp (Belgium), and Tanjung Pelepas (Malaysia) managed positive growth, by 8.6 per cent, 7.5 per cent, and 7.4 per cent, respectively. The most significant growth in 2014 is the Port of Tanjung Pelepas with 11.4 per cent rates of growth due to the infrastructure investment (UNCTAD, 2016).

Table 1. Top 20 container terminals in 2013, 2014, and 2015 (thousands of 20-foot equivalent units and percentage change)

Rank	Port Name	Country	2013	2014	2015	% change 2014 - 2013	% change 2015 - 2014
1	Shanghai	China	33,617	35,290	36,540	4.98	3.54
2	Singapore	Singapore	32,579	33,869	30,922	3.96	-8.7
3	Shenzhen	China	23,279	24,040	24,200	3.27	0.67
4	Ningbo and Zhoushan	China	17,351	19,450	20,630	12.1	6.07
5	Hong Kong	China	22,352	22,200	20,100	-0.68	-9.46
6	Busan	Republic of Korea	17,686	18,683	19,467	5.64	4.2
7	Guangzhou	China	15,309	16,610	17,590	8.5	5.9
8	Qingdao	China	15,520	16,580	17,430	6.83	5.13
9	Dubai Ports	United Arab Emirates	13,641	15,200	15,590	11.43	2.57
10	Tianjin	China	13,000	14,060	14,110	8.15	0.36
11	Rotterdam	Netherlands	11,621	12,298	12,235	5.83	-0.51
12	Port Klang	Malaysia	10,350	10,946	11,887	5.76	8.6
13	Kaohsiung	Taiwan	9,938	10,593	10,260	6.59	-3.14
14	Antwerp	Belgium	8,578	8,978	9,654	4.66	7.53
15	Dalian	China	10,015	10,130	9,450	1.15	-6.71
16	Xiamen	China	8,008	8,572	9,180	7.04	7.09
17	Tanjung Pelepas	Malaysia	7,628	8,500	9,130	11.43	7.41
18	Hamburg	Germany	9,257	9,720	8,821	5	-9.25
19	Los Angeles	United States	7,868	8,340	8,160	6	-2.16
20	Long Beach	United States	6,648	6,818	7,190	2.56	5.46
Total top 20		**Total**	**294,245**	**310,877**	**312,546**	**5.65**	**0.54**

Source: Various sources, including Port of Rotterdam (2015)

The study by Grossman, et al. (2007) indicated an 8 per cent rise in goods carried by containers over the past decades. From those statistics, industrially produced goods and intermediate product goods were dominant commodities. Nevertheless, the forecasted growth rates are still below the rates of handling figures of the ports in recent years, which averages 10 per cent annually. This fact explains that world growth trade did not only influence the growth of ports in the past. Grossman, et al. (2007) also suggested that the rise in the degree of container use in the general sector – the higher share of goods that are transported by containers – tends to increase the handling volumes in the container sector.

We will now provide the container volume growth in some primary regions, Asia, Europe, North America, and Middle East.

2.3.1 Container Growth in Asia

Studies by UNESCAP (2007) clarified that Asian ports' share of the world container volumes were predicted to grow from 55 per cent in 2002 to 61 per cent in 2015. Asia's share of containerized volume would also increase, either for the export share (from 55 per cent in 2002 to 64 per cent in 2015) or for the import share (46 per cent in 2002 to 53 per cent in 2015).

Among the world's top 100 container ports, Shanghai handled the most with 36.5 million TEUs in 2015, despite the slower annual growth rates – it went down from 5 per cent in 2016. China dominated global container ports, even though in 2015 the Chinese container exports did not perform as impressively as in previous years (Lloyd's List, 2016). Drewry (2014) estimated that in 2013, Chinese ports (including Hong Kong) had 30.8 per cent of all global container activities. This percentage was projected to rise constantly with 31.3 per cent of the share in the following year. Other studies carried out by UNESCAP (2007) indicated China's share of total port throughput including Hong Kong, China and Taiwan Province of China, recorded 48 per cent of total container throughput of the ESCAP region in 2015. In the first half of 2014, China's main ports are no longer applying a sizeable premium exceeds the average port growth globally. This aspect prompts us to consider how far the revolution on container activity in China is (Drewry, 2014).

China's major ports handled almost 164 million TEUs in 2016, which was just over 3 per cent increase from 2015, and was the slowest annual growth since the global financial crisis in 2009–2010. The 2017 performance is expected to be better, however the dark cloud of the trade war with the US could threaten these expectations. These challenges could be tackled if the Chinese government is able to handle local issues and the investment challenges at some facilities to pursue the positive impact on individual terminals' performances and overall port throughput (World Cargo News, 2017).

The slowest growth of Chinese container volumes is caused by the strong growth of South Asia that has taken over some of the manufacturing ground originally claimed by China – particularly in textile and clothing sectors (Drewry, 2016). In their research, Drewry (2016) explained that China's port handling growth must have recovered around 3.5 per cent by 2018 to provide a strong foundation for realizing Beijing's goal of smoothly rebalancing the Chinese economy.

Apart from strong Chinese performance in 2015, Vietnam's Ho Chi Minh City also experienced an increase in volume due to the country's significant development, also for Tanjung Pelepas at Malaysia, which accounted for 7.3 per cent of growth (Lloyd's List, 2016). South Asia became the regional stars by handling continuous growth rates in the first and second half of 2015. For India, this growth is mainly driven by in increase GDP that hit 7.6 per cent in 2015.

2.3.2 Container Growth in Europe

Official EU statistics distinguish the European sea areas into four categories, namely the Baltic Sea, North Sea, the Atlantic, and Mediterranean Sea. The term shipping route does not refer to the route taken by ships, but merely represents the geographical boundaries. The four categories of European seas totally comprise 471 ports, which each of them handles more than 1 million tons per year. From those four sea ports, North Sea handles the most cargo, noticeable in 2004 has 43 per cent of share, following by Mediterranean (26 per cent), the Atlantics (19 per cent), and Baltic Sea (12 per cent) (Grossmann, et al., 2007).

The highest share of Northern Sea is mainly sourced by the strong hinterland connection that spreads over Le-Havre to Hamburg, where there are more densely populated areas compared to the EU in total. Figure 6 illustrates the map of the top 10 largest ports in European shipping areas in 2004. The Hamburg–Le Havre (HLH) range entails any ports in France, Belgium, the Netherlands, and Germany, that all of ports serve North-West European hinterlands. The three European biggest ports (Rotterdam, Antwerp, and Hamburg) are located in this range (de Langen, et al., 2012).

Container throughput in the HLH range is increasing. It reflects the trade flows growth in those area due to globalization and the high needs of raw materials for the European industries. This growth stimulates some smaller ports to attract investment in facilities and provide a more attractive network of hinterland connections. Hence, this might influence the competitiveness level of the container transport in the future (Charles River Associates, 2004).

Drewry (2016) on their study over the first half of 2016 interpreted that total number of containers handled in the Port of Rotterdam has decreased by 2.1 per cent to 6.1 million TEUs due to the lessening export level to China and Brazil. The negative rate of growth also occurred in 2015 period, with just 0.5 per cent reduction of the container volume, even though the total throughput had rapid rise from crude oil shipments (Barnard, 2016). Over the same period, Port of Antwerp increased slightly to 5 million TEUs, while Hamburg handled 4.5 million TEUs that enable them to have recovery from the decline on previous year (Drewry, 2016).

Figure 6. The top 10 largest ports in each of the European shipping areas

Source: HWWI, 2004

2.3.3 Container Growth in North America

Geographically, North America is classified into three clusters: East Cost (a hilly eastern strip), where the heavy industries, such as the coal and iron ore are positioned near Chicago and Pittsburgh; Gulf Coast (a flat central region) which is a source of farming, particularly grain; and the West Coast (Stopford, 2009). Container trade volumes in North America highly depend on the overall volumes of traded goods, especially from the manufacturing sector, that are imported into North America. The main products that drive import commodities for ports on the Pacific West Coast (of North America) include household and other consumer goods from China. The total traffic of those products reached 4 million ton in 2016, and recorded an increase from 3 million ton in 2013. Nevertheless, there is a reduction in terms of share of total imports for this commodity—from 41 per cent in 2003 to 36 per cent in 2015 (Royal HaskoningDHV, 2016).

In 2015, the North America regions recorded an 8.5 per cent share of the global container market and, based on their forecast analysis, will only grow approx. 2.1 per cent in 2016, which is the slowest rates since the 2008–2009 financial crisis (Drewry, 2016).

North America constituted 12 per cent of world seaborne trade in 2005, and container has become the most important commodity for North America (Stopford, 2009). Panama Canal, one paramount passage that serves the ocean trade in the North America has expanded its locks to be much deeper and longer since 2016. It expects to handle vessels with maximum beam of 49 meters (UNCTAD, 2016).

Container traffic forecasts for 2025–2050 in North American are derived from the GDP forecasts and the TEU growth/GDP growth multipliers. Globalization has enhanced economic growth and exaggerated the connection between GDP and trade, and the low transport cost via containerization becomes a beneficiary of developments. There is a close relationship between North American trade and container ports within 1990–2014, and this has remained strongly robust even within the economic downturn periods (Royal HaskoningDHV, 2016).

In 2016, there were total 39.2 million TEUs containers in the top 10 US ports (represented by Table 2), and the LA/Long Beach Complex had the dominant throughput, with over 15 million TEUs handled (Pallis & Notteboom, 2017). The US ports accommodate a substantial volume of domestic container traffic – i.e. containers transported to/from Alaska and Hawaii (Royal HaskoningDHV, 2016). Drewry (2016) estimated port-handling growth of 2.1 per cent would occur in 2016, and this would be the slowest pace recorded since the 2008–2009 financial crisis. The US presidential election was a main factor, generating the high level of uncertainty in many aspects of life and causing public unrest (Drewry, 2016).

The US top 10 container ports amounted to a significant growth in 2007–2016 (49.9 per cent in general). This growth was relatively balanced between almost all ports, except for Norfolk, which recorded a decline in 2016 compared to 2007 (-4.1 per cent). Savannah experienced the most significant growth in 2016 (80 per cent) from all the container ports (Pallis & Notteboom, 2017).

Container volume at West Coast ports rose 7.3 per cent in the first quarter of 2016 compared to the same period in 2015, noticing a 6.4 per cent increase in imports and a 9 per cent increase in exports. At the moment, West Coast ports have recovered from the serious problems since 2014, such as port congestion and labor issues. The increased export rate is a bit surprising as there is a declining trend in the two years directly before (Mongelluzzo, 2016).

Table 2. Top 10 US Container Ports

Rank	Port	1000 TEU	Growth 2015/2016
1	LA/Long Beach, CA	15,632	1.80%
2	New York, NY	6,244	-2%
3	Seattle/Tacoma, WA	3,616	2.40%
4	Savannah, GA	3,610	7%
5	Oakland, CA	2,370	4%
6	Houston, TX	2,183	2%
7	Charleston, SC	1,943	1.40%
8	Norfolk, VA	1,504	3%
9	Port Everglades, FL	1,037	-2.20%
10	Miami, FL	1,028	2%
	TOTAL	39,167	1.80%

Source: Notteboom and Pallis (2017)

2.3.4 Container Growth in the Middle East

The Middle East consists of Western Asia and North Africa. North Africa spreads from Egypt to Algeria, and the four countries of this region have an area 254 hectares and GDP of US$220 billion. This region has been the main transport for crude oil since 1960 (Stopford, 2009). Despite this, we assume that the Middle East will still become an important region the future of the container market.

One main issue for shipping industries in 2014 was the increase in demand from the Middle East regions and Indian subcontinent market. Despite the political instability and wars in the Middle East, this region recorded a 6.9 per cent growth in demand for container volume in the second quarter of 2014. The United Arab Emirates (UAE) successfully attracted a migration of resources and funds from other parts of this area to its shores and has witnessed an increase by approximately 14–16 per cent in container throughput during the first half of 2014 (Drewry, 2014).

Some of the Middle East countries, such as Saudi Arabia, Yemen, Oman, UAE, and Iran and several Eastern African countries have some seaports that are strategically positioned for the East-West trade (represented by Figure 6). These strategic locations have encouraged modern vessels to make short calls in those ports (such as shipping lines that operating along Asia/Europe route, Asia/Mediterranean route, and Asia/US East Coast route) (Al-Eraqi, et al., 2008).

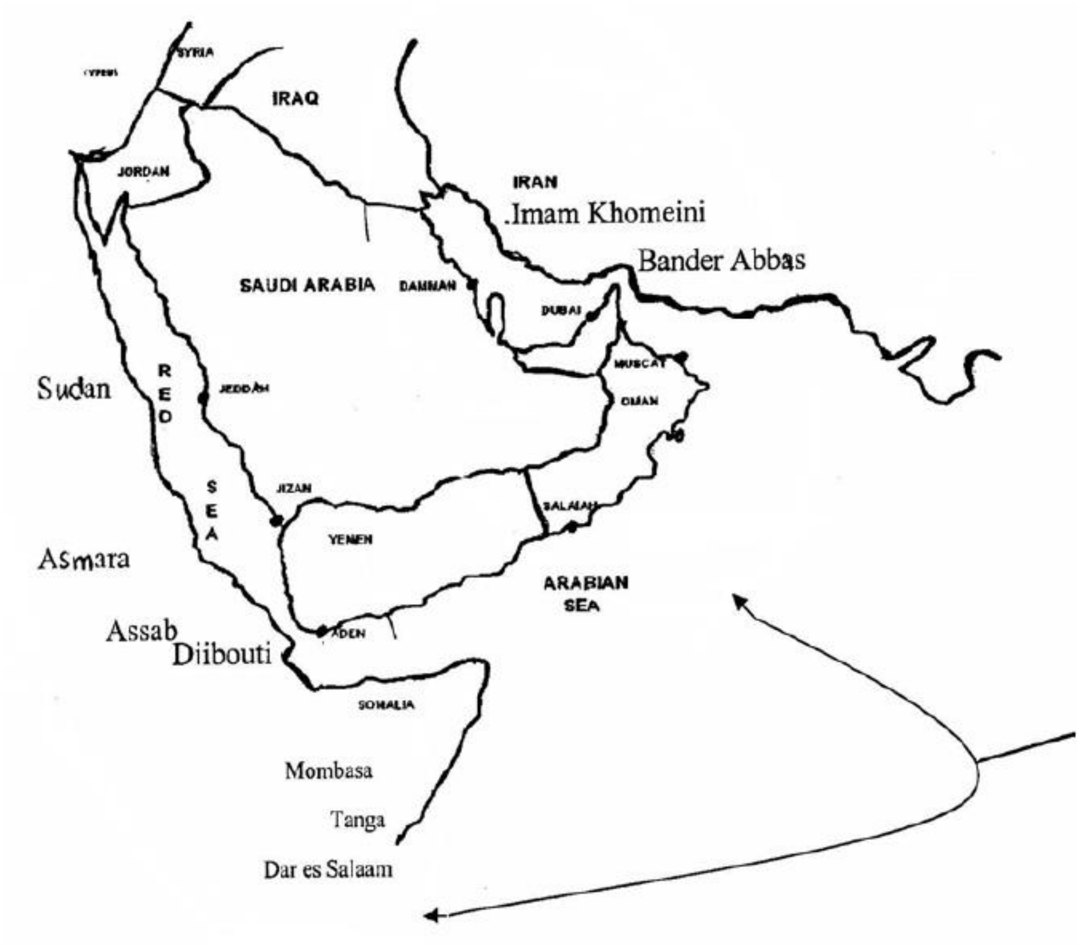

Figure 7. Map of the East-West trade in the Middle East regions

Sources: (Al-Eraqi, et al., 2008)

Additionally, Braden (2016) explains that container transport at Gulftainer – an independent owned global operator with its head office located in UAE – increased by 4 per cent in 2015 compared to in 2014, due to a strong performance recorded by its two UAE facilities that stabilized volume growth, despite weakness occurring in the European and Chinese markets.

2.4 Overview of Container Growth Studies

We already discussed the container development worldwide and in some particular regions that have the higher market share. In this part, we provide the theoretical background behind container development by correlating it with GDP growth as the main determinant and looking at other possible factors that probably best explain it. This part is aimed to answer the sub-question 1 and 2.

According to their discussion with experts and through several studies, Dorsser, et al., (2012) conclude that there is no guidebook on port throughput forecasting. Generally, port throughput forecasting studies are applied by port authorities or specialized consultants (Dorsser & Wolters, 2010). However, the literature supports the use of causal relations between container volume transport and economic growth (measured in GDP).

Dorsser and Wolters (2010) use the following approach in their forecasting studies of port throughput:

- The population in the working age class of 20–65 years old
- The labor participation fraction of the working class of 20–65 years old
- The annual number of hours worked per employee
- The development of the GDP output per employee per hour

Prior to other research, we can clarify that the world container transport mostly has been analyzed from an economic perspective, namely GDP (UNESCAP, 2007; Havenga, 2012; Dorsser, et al., 2012; de Langen et al., 2012; Drewry, 2016; UNCTAD, 2016; Royal HaskoingDHV, 2016).

Another study conducted by WTO (2017) indicates that historically, the volume growth of world merchandise trade is much higher than global GDP (approximately 1.5 times faster before 1990 and more than double in the following years before financial crisis). During the financial crisis, the ratio of world trade and global GDP decreased notably to around 1:1, and from 2001 until 2016 the ratio dropped to 0.6:1. We can deduce that in the past, world trade rates are significantly higher than global GDP growth – both variables indicating the multiplier relationship – while the rate now is almost equal (WTO, 2017). The complete rates of these indicators are represented in Figure 8.

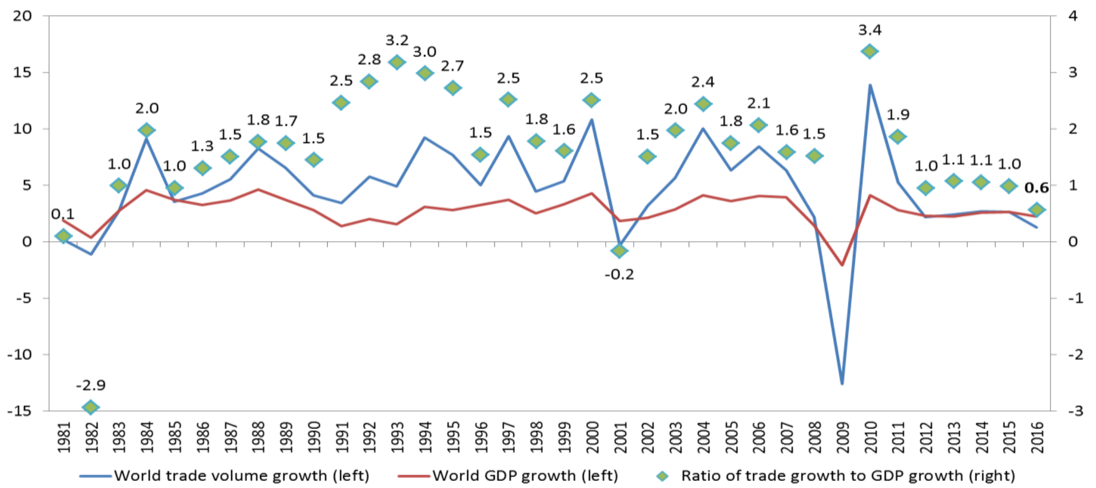

Figure 8. Ratio of world merchandise trade volume growth to world Real GDP growth from 1981 to 2016

Source: WTO Secretariat for trade, consensus estimates for GDP

Three forecasting studies related to the container transport were already conducted in the HLH ranges (OECD, 2014 and de Langen et al., 2012). Research by OECD (2014) indicates that the container growth rates highly depend on the containerization rate of cargo transport, which has radically increased nowadays. The growth share of freight that is being transported by the containers causes this figure. The container port growth and GDP growth multiplier for Ports in the HLH ranges in 1990–2010 was 3.0, meaning in each 1 per cent of GDP growth leads to 3 per cent of an average container-port growth. From this research, OECD (2014) suggests that port growth highly depends on the urban hinterlands.

De Langen et al., (2012) discusses the container growth in the HLH ranges, and found that the high multiplier trend is expected to decline in the coming decades because most of the container volumes are intermediate goods. These products have significantly grown due to global sourcing, but are expected to mature in the coming decades. In short, de Langen et al., (2012) deduces that containers are expected to be the favorite commodities in the future, indicating the fastest growth market segment, however with the extremely lower rate of projected growth than in the past decades.

UNESCAP (2007) comes to the same conclusion in their research. The development of container trade is primarily driven by economic growth – that can be represented as the GDP; there could be a wide range of determinants to explain container volume, such as exchange rate fluctuations and changes in economic circumstances (UNESCAP, 2007).

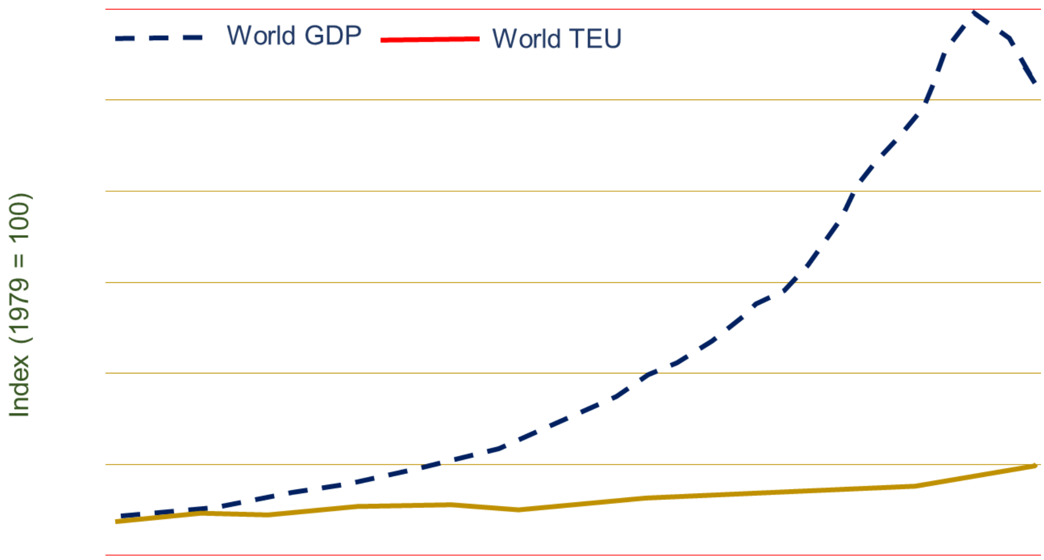

Figure 9. Growth in global container growth vs GDP growth over the 1979–2009 periods

Source: (Havenga & Eeden, 2011)

A study by Havenga and Eeden (2011) indicates that global container growth considerably outperformed global GDP growth over the 1979–2009 periods (represented in Figure 9). This phenomenon is triggered by containerization trends that started earlier in the developed countries, showing the natural deceleration of containerization over time.

Drewry (2016) describes some factors behind the slow growth of global container transport, such as:

- Weaker consumption patterns in developing countries
- Less container space required due to the volume reduction of particular goods
- Near-sourcing and re-shoring
- 3D printing, which enable products to be produced closer to the point of use

- An increase in recycling trends

Medda and Carbonaro (2007) argue that the integrated trade relationships between the EU and North African countries, such as Egypt and Morocco, are driven by either economic or demographic growth. Both aspects strengthen the present and the future growth in the seaside areas, mainly in ports and their operations.

Those factors are highly likely to be the potential determinants to investigate the container volume over time, as the additional variables of the GDP growth.

2.5 Review the methodology of measuring container volume from previous research

We write this sub–chapter to answer the sub–question 3, “What is the best method to disconnect the GDP growth from the container transport?”

Previous studies of container volume transport or port throughput are developed by forecasting methods (UNESCAP, 2007; Havenga, 2011; de Langen et al., 2012; Dorsser, et al., 2012; WTO, 2017) and investigate data from the past to predict future trends.

UNESCAP, 2007; Havenga, 2012; Dorsser, et al., 2012; de Langen et al., 2012; Drewry, 2016; UNCTAD, 2016; Royal HaskoingDHV, 2016) use the econometric model to analyze the present and future container volumes based on a multiplier relationship derived from GDP changes and historical volume trends from years past. Technically, they utilize regression analysis to define the relationship between container volumes (as dependent variables) and some economic indicators, such as GDP (as independent variables).

In their study on a very long term forecast of port throughput in the Hamburg–Le Havre range up to 2100, Dorsser et al. (2012) use ‘a very long term forecasting’ term by referring to 20 to 40 years as the research time span. They state that it is better to use causal relations instead of an extrapolation technique as the research methodology. However, they notice that one variable (GDP) is too simple to explain such a complicated issue (port throughput). In this thesis, we only include the data for 15 a year period, and there it is not necessary to apply such scenarios.

Hui, Seabroke, and Wong (2004) mention that the classical regression, which is usually applied in most of practical forecast studies, identifies ‘causal relationship’ by investigating co-movement among variables. They clarify that this method is valid only if the data series are stationary and with less variability of trend over time.

De Langen et al. (2012) use TRANS-TOOLS as a model of their analysis forecasting, by categorizing the goods that are transported in the main ports within HLH ranges into 11 commodities, one of which is containers. The forecasts of containers was built by using a multiplier between GDP growth and container volumes that are derived from the data for the past two decades, when there is a very high rate of container growth. The most interesting fact is that most of the available studies do not relate to causal models that are practically applied.

Dorsser and Wolters (2010) defined the relationship between GDP and port throughput based on regression analysis. They clarify that a regression of time-series analysis is not straightforward because the general assumptions of the regression model are often violated. In their research methodology, they point out that the regression parameters should be stationary, apart from in special cases where there is co-integration of many time series data in order to obtain the valid hypothesis testing and best fit. However, most of time series data is non-stationary, i.e. following a random walk, which results in 'the temporary shock will not dissipate after several years'. Additionally, they apply the following approaches: (1) set the very long term causal relation between port throughput and GDP; (2) define the very long term probabilistic forecast for the GDP and hinterland; (3) estimate port throughput based on the GDP forecast and causal relation. Dorsser and Wolters (2010) apply three simple linear relations to explain the correlation between GDP and port throughput, consisting of the general regression equation, the logarithmic function, and the differential of the general regression equation.

Granger and Newbold (1974) claim it is important of test the stationary level of the error term. In their research, they use an autocorrelation test and an F-statistics to test the random walks. Apart from the stationary level, they clarify the importance of including normality test of the error term.

Further, we elaborate our discussion by emphasizing the container throughput as the main indicator of port performance and how to measure it (Section 2.4). This sub-chapter is aimed to answer the sub-question 4 "What is port performance and what indicator that mainly determine it?"

2.6 Container Throughput as the Main Indicator of Port Performance

The best way to assess a particular port is by looking at their performance, which is a crucial factor for the development of any economic activity (Marlow and Paxiao, 2003). Mentzer and Konrad (1991) define performance as 'an investigation of effectiveness and efficiency in the completion of a given activity and where the assessment is being accomplished with regards to how well the goals have been met'. In this context, the term 'effectiveness' refers to the extent to which objectives are accomplished, while 'efficiency' measures how well the resources are dispensed and utilized. However, they do not evaluate the satisfaction levels of the customers in order to measure performance.

Like other industries, ports also require performance measurements to assess how well they perform. There are some indicators for evaluating the performance among ports, such as measuring various aspects of their operation. Some indicators are easy to calculate and simple to understand (UNCTAD, 1976). Understanding port performance is a vital to measuring their achievements against a set of goals and objectives, or against their competitors (Esmer, 2008).

Talley (2007) explains that port performance can be measured from engineering and economical perspectives, and through considering its performance over time alone (single-port approach) or comparing it to the performance of other ports (multi-port approach). From an engineering perspective, ports evaluate their performance through quantitative analysis by focusing on productivity indicators – commonly referred to as 'traditional methods' (Talley, 2007; Tongzon, 1995). In his research, Talley (2007) suggests that, from an engineering perspective, ports compare their actual and engineering optimum throughputs – the maximum throughput ports can handle within certain conditions. If a port's actual throughput almost equals its optimum throughput over time, we can conclude that its performance has improved. Meanwhile, from an economic perspective, a port's optimum throughput can be achieved when the throughput volume meets the port's economic targets. The economic perspective takes three aspects into account: technically efficient optimum throughput, cost efficient optimum throughput, and effective optimum throughput.

The single-port approach identifies the performance of a particular port based on its performance over time. This approach can apply engineering perspective methods that focus on the container throughput analysis. However, in a multi-port approach, the performance of an individual port is evaluated by comparing it with other similar ports (Talley, 2007; Tongzon, 1995).

Another study conducted by Marlow and Paxiao (2003) also clarifies the similar methods, but introduces different terms to Talley (2007) and Tongzon (1995). Instead of using a single-port and multi-port approach evaluation process, Marlow and Paxiao (2003) introduces intra-port and inter-port level, but with similar definitions respectively. Marlow and Paxiao (2003) suggest that port performance measurements can be distinguished in two ways: intra-port and inter-port levels. In an intra-port level, port performances are technically measured by comparing their actual and optimum containers throughputs – the number of containers moved through a port. In his study of productivity function in Israeli ports, Sachish (1996) investigated five techniques used to calculate the optimum throughputs when looking at a port as a business unit, and then selected an 'engineering approach' to measure productivity.

Marlow and Paxiao (2003), then, realize that global port performance had been measured in 20-foot equivalent units (TEUs) or cargo volume in tons. Further, they assume ports as throughput maximisers. A port's performance level strongly depends on its efficiency in handling cargo. In another study conducted by Tongzon (1995) related to container terminal performance, port performance indicators have been categorized into two classes: financial and operational. The same classification was also introduced by UNCTAD (1976), as represented in Table 3.

Table 3. Summary of port's performance indicators suggested by UNCTAD

Financial Indicators	Operational Indicators
Tonnage worked	Arrival late
Berth occupancy revenue per ton cargo	Waiting time
Cargo handling revenue per ton of cargo	Service time
Labor expenditure	Turn-around time
Capital equipment expenditure per ton of cargo	Tonnage per ship
Contribution per ton of cargo	Fraction of time berthed ships worked
Total contribution	Number of gangs employed per ship per shift
-	Tons per ship-hour in port
-	Tons per ship-hour at berth
-	Tons per gang hours
-	Fraction of time gangs idle

Source: (UNCTAD, 1976)

Due to the high competition level in port policy and management, Heaver (1995) suggests that port authority should focus on the vigilance of port performance by developing a program of performance benchmarking. This program should be initiated based on the source of the latest information concerning the performance issues from the global primary terminal. Tongzon (1995) aims to improve the program by introducing a quantitative and systematic approach to identify similar ports according to the principal component analysis. Moreover, Tongzon (1995) also considers the mandatory to develop a single performance indicator as a key aspect to assess port productivity. In other studies, Chow et al. (1994) and Estache et al. (2002) propose that traditional performance indicators are insufficiently complete to measure port performance because they failed to take efficiency into consideration. Based on the introduction of efficiency analysis, Murillo and Vega (2000) developed stochastic frontier methods and Data Envelopment Analysis (DEA) to measure the productivity efficiency in the industrial sector.

Furthermore, Bowersox and Closs (1996) explain that performance logistics can be included against other aspects of performance measures, such as cost, customer service, asset management, and quality. Current contemporary trends in logistics, and the development of new economy indicates an agility of the ports that means port performance indicators no longer depend on the traditional method. An agility of the ports enables them to compete more efficiently within the strong competitive environment. The implementation of agility within ports is aimed to support the concept of lean, flexible, just–in–time, and business process redesign. Because they are agile, ports can quickly arrange the service delivery processes linked with service–production and service–development to benefit the customer, to improve competitiveness, to learn adaptation, to deal with people and information, and to work with the partnership matters. Those benefits enhance the function of ports as the providers of integrated solutions. Ports can be classified as agile by providing such facilities, both infrastructure and superstructure requirements, such as land for road and rail modes, and specific layouts for cargo entries and exits. With regards to all those aspects, therefore, the new approach is necessary to measure port performance (Marlow & Paxiao, 2003).

Apart from those new indicators (e.g. logistics performance, sustainability, innovation, and economic impact to evaluate port performance) container movement remains a key performance indicator of ports (Pallis & Notteboom, 2017). The performance of container terminals relies on the ratio loaded against the unloaded containers: empty container boxes are not always counted statistically, but must be handled (Fourgeaud, 2000).

In summary**,** a study of previous research indicates that containers will continue to exist as the preferred commodity in the future, though the rate of its growth is not as significant as in the past. It is important to notice that the container throughput has mainly been analyzed from an economic perspective of GDP growth because there was a very close relationship between both indicators historically. The relationship follows a multiplier effect, with the world trade recording higher rates compared to the global GDP. However, at present the relationship is changing – the multiplier relationship is not relevant anymore –, since the rates between world trade and global GDP is nearly equal.

A study from Dorsser et al., (2012) becomes our main foundation for this thesis, as he clarifies that is too simple to analyze the complex issue of container volume by only taking into account one variable (i.e. GDP). Study from Havenga and Eeden (2011) – represented in Figure 8 – and supported by the research of UNESCAP

(2007) indicates that GDP is no longer relevant as the only single determinant to explain the container volume. We believe that there are some other factors that influence the growth of container volume globally, and in some primary regions where the high volume is concentrated.

These factors are notably defined as demographic trends (the population of the working age, the labor participation fraction of the working age, the annual number of hours worked per employee), the development of the GDP output per employee per hour, near–sourcing and re–shoring, 3D printing (categorized as technological advances), and an increasing trend of recycling, changes in consumption patterns within developing countries, urban hinterlands, exchange rate fluctuations and economic changes, and less container space required due to the volume reduction of particular goods. We can categorize them as socio– economic variables.

In the next chapter, we will explain the methodology that we will use to prove our hypothesis.

Chapter 3 Research Design

In Chapter 2 "Literature Review" we explain the theoretical framework behind the container volume growth and present the study about economic indicators (GDP growth) to analyze it. In this chapter, we aim to construct the sub-question 4 on "How to disconnect the GDP growth from container volume transport?"

We aim to figure out the trend of the container volume growth in several periods by delinking it with the GDP and by counting some other variables that have influence on it (causality effect). In addition, we also aim to know how significant the influence of the aforementioned socio-economic determinants to explain the container growth.

We actually plan to quantify all the socio-economic indicators that we obtain from the literature. However we face some difficulties in some aspects, for example near-shoring and re-sourcing, 3D printing, and the weaker consumption patterns in the developing countries. This difficulty comes from the availability of data and the impossibility to quantitatively analyze some indicators. Figure 10 illustrates the methodology to work for this thesis.

Firstly, we start with declaring our hypotheses, followed by the construction of the methodology. Next subchapter is the predictive validity framework. We will continue with introducing the case study and sample data gathering and processing on the following parts. Then, we formulate the regression model that we are going to execute through a statistical software.

3.1 Declaring Hypothesis

To investigate the correlation among those variables, we will draw certain hypotheses from the literature review:

H1: *The Real GDP has significant positive impact on container volume growth*
H2: *The* GDP per capita *has positive impact on container volume growth*
H3: *The real income for personal disposal has a positive influence on container volume growth*
H4: *The working age population has a positive influence on container volume growth*
H5: *The employment fraction has positive influence on container volume growth*
H6: *The number of Free Trade Agreements (FTA) has positive impact on container volume growth*

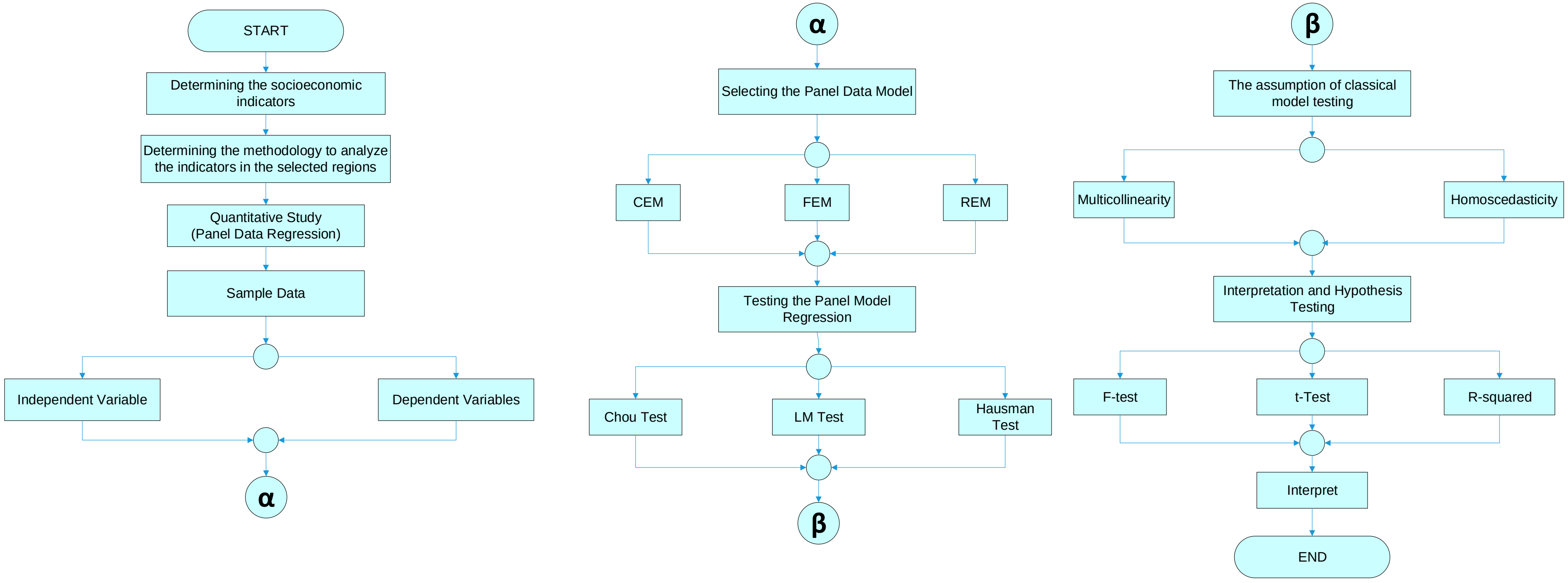

Figure 10. Flowchart of the methodology

Source: Author

3.2 Case Study and Sample Data

In this research, we will concentrate our research on four regions (as represented in Figure 11): the US (Port of Los Angeles and Port of Long Beach), the Hamburg-Le Havre Range (Port of Rotterdam, Port of Hamburg, and Port of Antwerp), the Middle East (Dubai Ports and Port of Jeddah), and China (Port of Shanghai, Shenzhen Port, and Ningbo Port).

The motivation behind the selection of those four regions in general is because we want to define them as the representative samples from around the world. Specifically, we decide to take the US and China because both countries are the powerful in the economic sector, while this Middle East is as the hub within the Mid-East and Europe. Furthermore, we decide to take the Hamburg-Le Havre Range into account firstly because is it easy to access the data from this region, and secondly, the three biggest European ports (Rotterdam, Antwerp, and Hamburg) are located there. By analyzing all of these areas, we aim to find the trends of the container transport globally and to study whether such indicators have different effect among the different ports.

This thesis includes data for certain indicators, which consist of container volume, Real GDP, demographic trends, and protectionism from 2001 to 2015 (the 15 year period under measurement).

The sample data collection can be explained as follows. The container volume is represented by the annual throughput of all the selected ports in Twenty Equivalent Units (TEUs). Clarkson Research Services Limited 2017 supports this data. The two proxies to represent the economic variable (Real GDP and GDP per capita) are gathered from Royal HaskoningDHV Database. Previous studies from Drewry (2014) and UNESCAP (2007) indicate that Real GDP is a better determinant to analyze the container volume. Including the Real GDP per capita as part of the study might also be interesting because it explains a country's economic output for each person.

Three proxies as representative of the demographic trend (population of working age, employment fraction, and real income for personal disposal) are mainly supported by Royal HaskoningDHV and partly gathered from OECD[1] to complete some of the missing data. We decide to take the population of working age and the employment fraction by considering the importance of including both variables as a part of container volume study. Dorsser and Wolters (2010) also used both indicators. Additional proxy is the real income for personal disposal, which represents 'the sum of household final consumption expenditure and savings' (OECD, 2015).

It is important to notice that the missing data of real personal disposable income for Saudi Arabia 2001–2006. In addition, we take into account Free Trade Agreements (FTA) among the investigated countries as a proxy for protectionism. The data of FTA are gathered from UNCTAD[2] database; we take the data including Bilateral Investment Treaties and Treaties with Investment Provisions that already been signed by the countries involved.

[1] The database are available here: https://data.oecd.org/
[2] The database are available here: http://investmentpolicyhub.unctad.org/IIA

Next, we merge the data from various databases into one master file to form the panel data. We define each variable with specific symbols. All of these steps belong to the preparation for data processing on STATA 14.

Table 4. Description of the indicators and the variables of measurement

Indicator	**Measurement indicator**	**Variables (Proxies)**	**Symbol**
Container Volume	Container Volume	Container port throughput	CONTVOL
Economic	GDP	• Real GDP • GDP per capita	• REALGDP • GDPPERCAPITA
Social	Demographic trends	• Population of working age • Real income for personal disposable • Employment fraction	• POPWORK • INCOME • FRACTEMP
	Protectionism	The number of free trade agreements	FTA

Source: Author

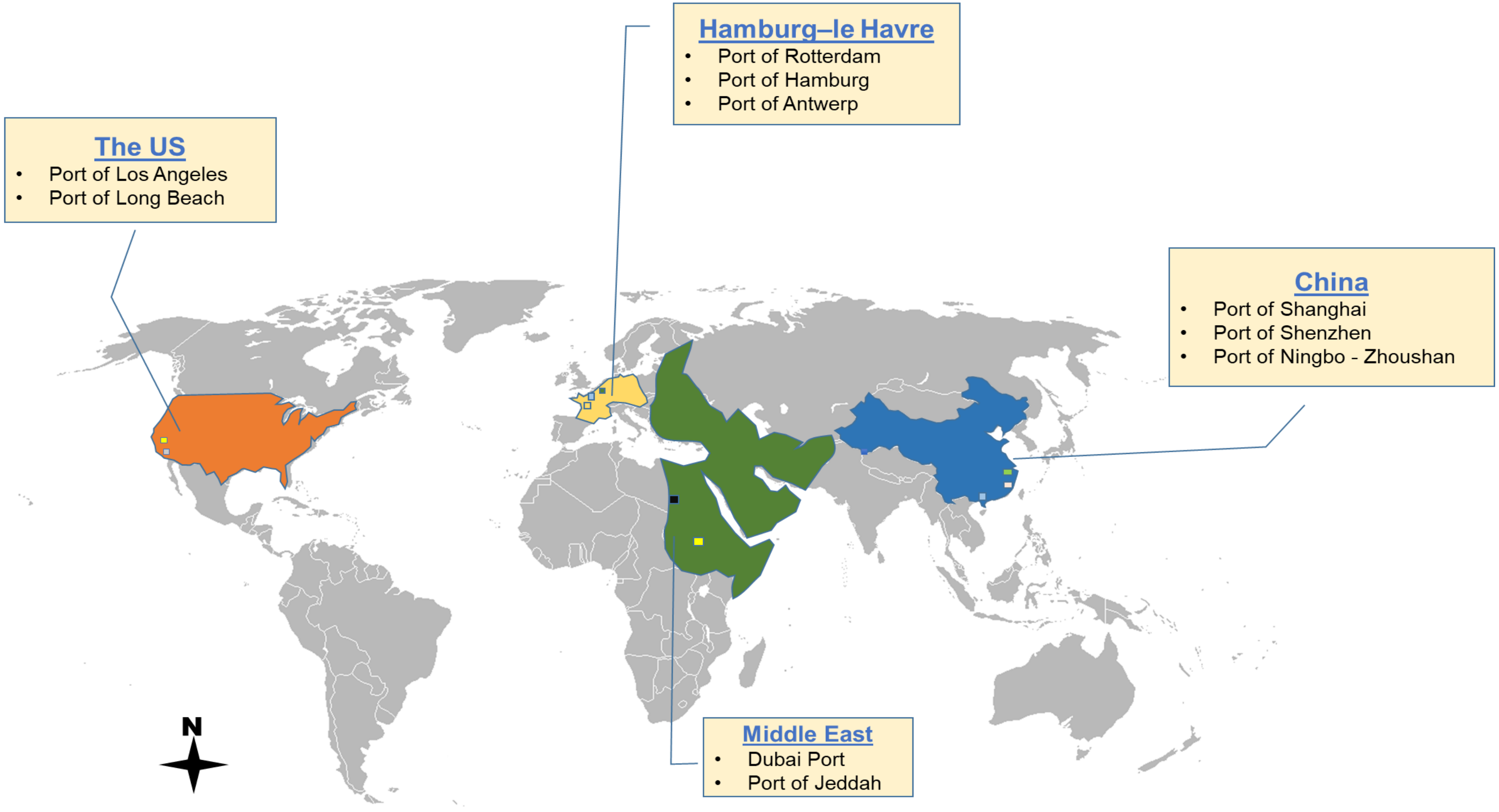

Figure 11. Geographic scope of research

Source: Author

3.3 Constructing the Methodology of the Thesis

Prior to other studies (Hui, Seabroke, and Wong 2004; UNESCAP, 2007; Dorsserand Wolters, 2010; Havenga, 2012; Dorsser, et al., 2012; de Langen et al., 2012; Drewry, 2016; UNCTAD, 2016; Royal HaskoingDHV, 2016), we finally construct the regression model by utilizing the causal relation between the container volume as a dependent variable and the socio–economic indicators as the independent variables. We decide to take this approach by considering the existence of causal relationship between container volume transport and economic growth (measured in GDP). Further, it is better to use this kind of relation instead of an extrapolation technique.

Even though we aim to know the relationships of other factors beside GDP, we cannot neglect its impact (UNESCAP, 2007). In this research, we hypothesize some socio–economic aspects as the independent variables. To represent the economic indicator, we include the GDP by generating it on two proxies, Real GDP and GDP per capita. Next, for social indicators, we take account the demographic trends and measure it with two proxies: population of working age and income for personal disposal in each country. Besides the demographic trends we also include protectionism as a part of our analysis, represented by one proxy: Free Trade Agreements (FTA).

3.3.1 Panel Data Regression

This research contains data of multiple ports (there are 10 ports, *I=10*) for multiple years (15 years observation, *t=15*), which means that we have both time and space dimensions. Therefore, we will use the combination of cross-sectional data – to explain the data that is collected on several units at one point in time – and time series data – to investigate the data that is collected on one unit over several time periods. This combination method is commonly mentioned as panel data analysis (Gujarati, 2003), and our next step is to develop the model based on this analysis.

There are certain benefits in applying panel data analysis. By using panel data, we can use a large amount of observation to create more informative data with less co–linearity among variables; more degrees of freedom; and more efficiency. It is also better suited to investigate the dynamics of change and to analyze more complicated behavioral models. Furthermore, the most important aspect gained from using panel data is the ability to take into account the heterogeneity among the individual-specific variables (Gujarati, 2003).

To analyze the panel data that we already declared in previous section, we use STATA 14 because it can provide the panel structure of the data to perform time-series calculation and analysis. STATA is a complete and an integrated statistical software package that is useful for data processing analysis, management, and graphics (STATA, 2017).

There are three types of panel data regression model, namely Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM).

Common Effect Model (CEM) is a combination of cross–section and time series data. In this model, the heterogeneity that may exist among the investigated variables is neglected. Consequently, there is a high possibility of error term correlated with some of the observed regressors. If it occurs, the result of coefficient correlations might be biased (Gujarati & Porter, 2009).

Fixed Effect Model (FEM) is the model that tolerates heterogeneity between the subjects by permitting each entity to have its own intercept value (Gujarati & Porter, 2009). Further, Gujarati & Porter (2009) state that the intercept in FEM is time–invariant: it might differ across the subjects, but it does not vary over time.

Random Effect Model (REM) is also called an Error Components Model (ECM) because the error term entails two error components (Gujarati & Porter, 2009). The composite of error consists of individual or cross section components combined with time series error.

3.3.2 Testing the Model

Testing the model type is a vital step selecting the most appropriate panel data regression model. To do it so, there are three tests that we need to follow to decide whether we should use a CEM, FEM, or REM approach. Those three tests are Chow Test, Hausman Test, and Breuch-Pagan Multiplier Test.

The first test is a Chow test to check whether a Common Effect Model (CEM) or Fixed Effect Model (FEM) is more appropriate to analyze the sample data. The hypothesis formulation is as follows:

H_0 = *CEM is more appropriate to analyze the data*

H_1 = *FEM is more appropriate to analyze the data*

The second test is Breusch-Pagan Multiplier test to check whether a Common Effect Model (CEM) or Random Effect Model (REM) is more appropriate to analyze the sample data. The hypothesis formulation of a Breusch-Pagan Multiplier is as follows:

H_0 = *CEM is more appropriate to analyze the data*

H_1 = *REM is more appropriate to analyze the data*

The third test is a Hausman test to check whether a Random Effect Model (REM) or Fixed Effect Model (FEM) is more appropriate to analyze the sample data. The hypothesis formulation of a Hausman test is as follow:

H_0 = *REM is more appropriate to analyze the data*

H_1 = *FEM is more appropriate to analyze the data*

Therefore, the next step in deciding the linear regression model is to declare the container volume as the dependent variable. We can decide what type of regression model that we will use, whether fixed, random, or common effect approach.

From the output of this model, we will estimates the parameters, including the significant level of the independent variables to the dependent variable and the error of measurement. We will eliminate the variables with insignificant levels, and decide to deal with the possibility of overlapping occurrences of the independent variables.

In order to know the two-sided relationships between the involved variables, we apply a correlation matrix. In this thesis, we will apply a Pearson Correlation Matrix to understand the strength and the direction of two or more variables. We decide to use a Pearson Correlation Matrix instead of Spearman Correlation Matrix, considering that the data for all variables is continuous.

The formulation of the linear model function has been written in Equation 1. In this case, container volume as dependent variable has casualty effect with the independent variables (socio–economic indicators). We classify the economic variable into five proxies (Real GDP, GDP in agriculture, GDP in service, GDP in manufacture, and GDP in industry), while two proxies represent the socio–economic indicators (real income for personal disposal and population of working age).

$$Container\ volume = f\ (real\ GDP, real\ income\ for\ personal\ disposable, population\ of\ working\ age, free\ trade\ agreement \quad (1)$$

3.3.3 The Predictive Validity Framework

We will present the predictive validity framework of this thesis by formulating the Libby Boxes (Figure 12) to examine the conceptual relation between the related variables. This research investigates the relationship between the container volume and the socio–economic indicators.

Finally, in this research we want to draw a conclusion: *Does the relationship make sense from the theoretical perspective?*

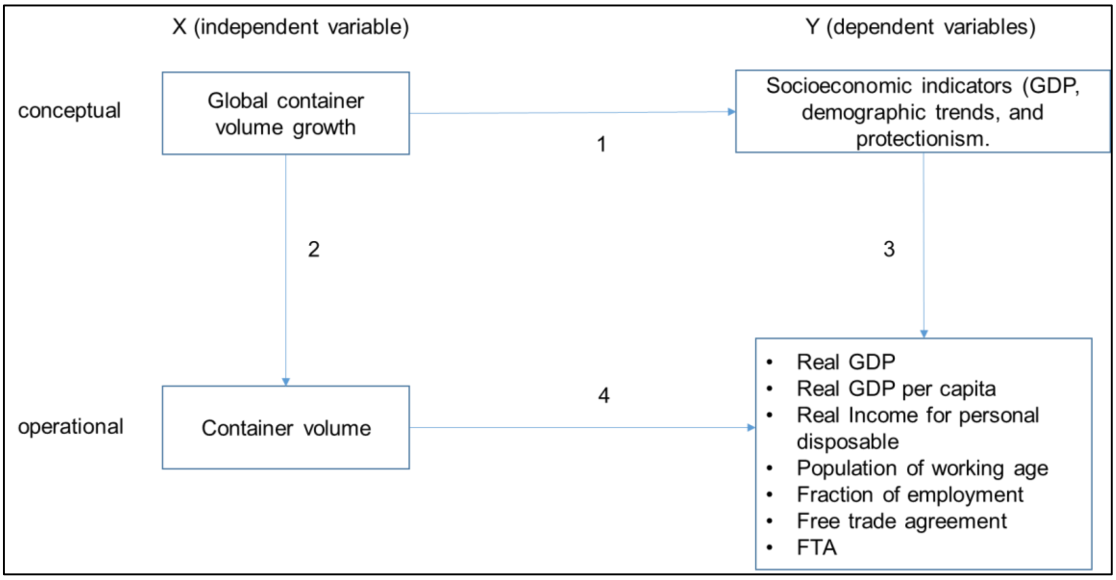

Figure 12. Libby Boxes

Source: Author

Chapter 4 Results and Analysis

4.1 Panel Data Regression Model

In this step, we formulate the series of testing to decide what type of model is most suitable to be used. First test is the Chow Test, followed by the Breusch–Pagan Lagrange Multiplier Test, and lastly the Hausman Test.

(i) Chow Test (CEM vs. FEM)

Hypothesis formulation:

H_0 = CEM is more appropriate to analyze the data

H_1 = FEM is more appropriate to analyze the data

Prob. F = 0.00 < α = 0.05, so we reject H_0. Decision: we decide to take FEM as the appropriate model instead of CEM.

(ii) Breusch– Pagan Lagrange Multiplier Test (REM vs. FEM)

Hypothesis formulation:

H_0 = CEM is more appropriate to analyze the data

H_1 = REM is more appropriate to analyze the data

Prob. chi2 = 0.00 < α = 0.05, so we reject H_0. Decision: we decide to take REM as the appropriate model instead of CEM.

(iii) Hausman Test (FEM vs. REM)

Hypothesis formulation:

H_0 = REM is more appropriate to analyze the data

H_1 = FEM is more appropriate to analyze the data

Prob. chi2 = 0.00 < α = 0.05, so we reject H_0. Decision: we decide to take FEM as the appropriate model instead of REM.

To conclude, the model analysis based on Chow Test, Breusch Pagan Lagrange Multiple Test, and Hausman test indicates that the Fixed Effect Model is the most suitable approach for the panel regression model.

The panel regression model would be:

$$CONTVOL_{it} = \beta_0 + \beta_1 REALGDP_{it} + \beta_2 GDPPERCAPITA_{it} + \beta_3 POPWORK_{it} + \beta_4 FRACTEMP_{it} + \beta_5 INCOME_{it} + \beta_5 FTA_{it} + \mathcal{E}_{it} \quad (2)$$

Where:

CONTVOL = container volume
REALGDP = Real GDP
GDPPERCAPITA = GDP per capita
POWORK = Population of working age
FRACTEMP = Employment fraction
INCOME = Real income
FTA = Free Trade Agreements

β_{0} = intercept value
β_{i} = linear coefficient of each parameter
The subscripts i denotes individual port, and t is for time period (year); i =1, …10; t = 1, … 15.
ε_{it} = error value

This is only the general model, and not the fixed one that we will regress because we still need to test the correlation between the variables involved. The correlation values for each variable is the most important indicator in deciding whether we can use all of the independent variables in one model or not. We will dissect this general model into several models based on the correlation matrix analysis on subchapter 4.3.

4.2 Descriptive Statistics

We have already checked the panel data credibility through STATA, and the results shows that the data is strongly balanced.

Table 5 describes the descriptive statistic on the observed data in original values for all variables with its own unit of measurement. CONTVOL is in million TEUs, REALGDP is in billion US$, GDPPERCAPITA is US$, POPWORK is in million people, and INCOME is in billion US$. FTA is in number and FRACTEMP is in percentage.

The number of observations *(it)* for all the variables is 150, except for the INCOME, accounted only 144. This observation takes into account 10 ports from seven different countries for 15 years of measurements. From theses medium periods of observation, we expect to obtain more precise results; as the theory clarifies that the greater the sample and the longer periods of the observation, the research would be more precise. The exception is INCOME, because we have some problems in collecting the data for "real income of personal disposable" for Saudi Arabia, and period 2001–2006 is missing. However, STATA have applied a list wise deletion by default to handle this missing data.

Table 5. Description statistics in original number

Variable	**Obs.**	**Mean**	**Std. Dev.**	**Min**	**Max**
CONTVOL	150	10.45	7.27	1.21	35.29
REALGDP	150	4,991.38	5,356.18	182.06	16,397.2
GDPPERCAPITA	150	32,151.2	16,735.19	3,867.386	51,645.9
POPWORK	150	346.37	416.79	2.80	1,007.64
INCOME	144	3,466.79	4,045.20	36.36	12,343.19
FRACTEMP	150	49.04	8.89	26.13	64.80
FTA	150	121.17	55.03	13	225

Source: Author

Overall, the data indicates the different ranges (min and max values) as the observation is taken from developed and developing countries. The standard deviation for CONTVOL is relatively high, meaning there is a high distribution level of the data. The CONTVOL values for big ports, such as Shanghai, Shenzhen, Ningbo, and ports in HLH ranges obviously differ from the volume in the smaller ports. Further, the panel– data line plots for container volume can be seen in Figure 13. The container volume for all ports has a positive trend line during 15 years of observation. Biggest container volume is Shanghai, followed by Shenzhen.

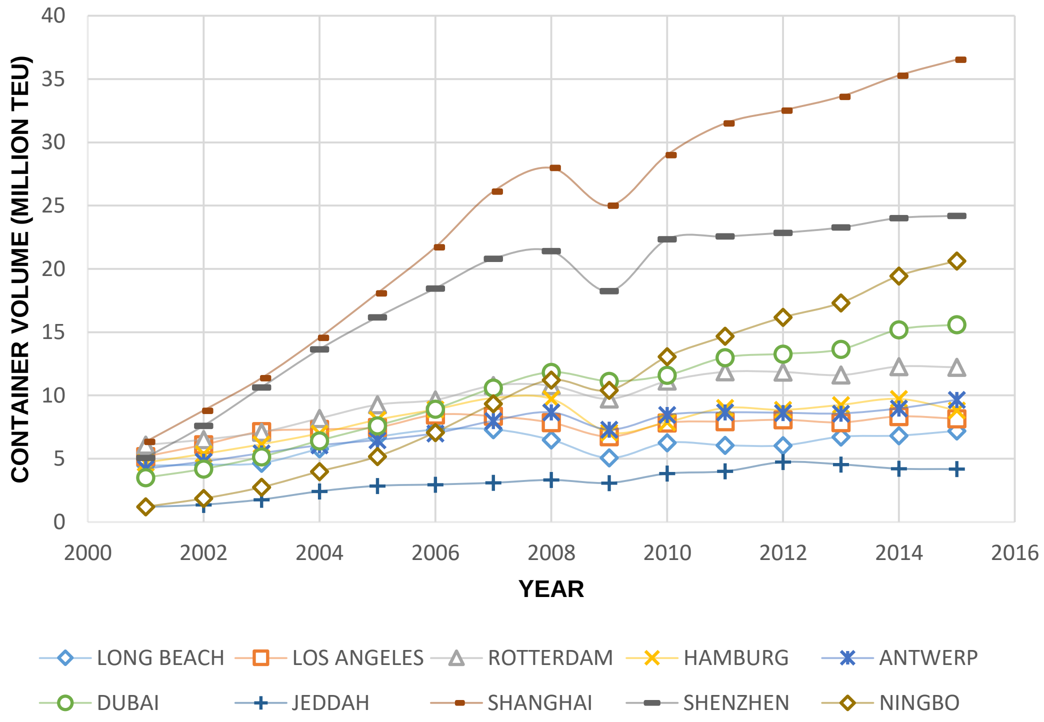

Figure 13. The panel-data line plots for container volume (2001–2015)

Source: Author

The most striking statistic is FTA, revealing a high data range with a minimum of 13 units and a maximum of 225 units, and also supported by high standard deviation. The different number of trade agreements is obviously between the western countries (e.g. the Netherlands and Germany) and the Middle Eastern countries (e.g. Saudi Arabia and UAE).

The REALGDP shows high ranges (min US$ 182.06 million and max US$ 16,397.20 million), with relatively high standard deviation (5,356.18). It indicates that the data is widely distributed. We can deduce it as a reasonable figure, because the observation involves the developed and developing countries with different levels of economics. For example, China generates more REALGDP compared to Saudi Arabia and UAE with fewer values.

The demographic trends proxies show the similar condition. FRACTEMP presents relatively high ranges (min 26.13 and max 64.8), indicating the different condition of employment rates in the developed and developing countries. The same figures are presented by POPWORK with min 2.8 and max 1,007 million people. INCOME also indicates an obvious difference in values with minimum US$ 35.36 billion and maximum US$ 12,343 billion.

4.3 The Pearson's Bivariate Correlation Matrix

The numbers are Pearson correlation coefficient *(r)*, which measures the strength of the association between the two variables. The Pearson correlation coefficient values ranges between -1 to 1. The closer the number to 1, the stronger the correlation is. The negative number indicates the inverse relationship. Meanwhile, when the Pearson Correlation *(r)* is zero, it means there is no correlation between the variables.

Table 6. Classification of the Pearson correlation level

Coefficient Value	**Strength of Association**
0.1 < |r| 0.3	Small correlation
0.3 < |r| > 0.5	Moderate correlation
|r| > 0.5	Strong correlation

Source: (Cohen, 1988)

According to the Table 7 we see that there is no perfect collinearity between the investigated variables. The container volume, as the dependent variable, reveals a small to moderate level of correlation to each of the independent variables. Most of variables have positive correlation, meaning one unit increase in one variable leads to an increase to other variable. Surprisingly, the correlation between REALGDP and CONTVOL is very low (*r = 0.09*), indicating the different story from the literature review. Meanwhile, 59 per cent of GDPPERCAPITA is correlated with CONTVOL, indicating strong relationship. Another negative correlation is performed by INCOME, though with very weak values by only *r* = 0.01. CONTVOL has a positive and significant correlation with POPWORK and FRACTEMP – *r = 0.63 and 0.52* respectively. FTA on the other hand, shows moderate correlation with CONTVOL, corresponding by 3 per cent.

Table 7. The Pearson's Correlation Matrix (including the US ports)

	CONTVOL	***REALGDP***	***GDPPERCAPITA***	***POPWORK***	***INCOME***	***FRACTEMP***	***FTA***
CONTVOL	1						
REALGDP	0.09	1					
GDPPERCAPITA	-0.58	0.18	1				
POPWORK	0.63	0.24	-0.89	1			
INCOME	-0.01	0.99	0.28	0.13	1		
FRACTEMP	0.52	0.09	-0.62	0.57	-0.04	1	
FTA	0.39	-0.02	-0.21	0.23	-0.12	0.21	1

Source: Author

Table 8. The Pearson's Correlation Matrix (excluding the US Ports)

	CONTVOL	*REALGDP*	*GDPPERCAPITA*	*POPWORK*	*INCOME*	*FRACTEMP*	*FTA*
CONTVOL	1						
REALGDP	0.75	1					
GDPPERCAPITA	-0.53	-0.69	1				
POPWORK	0.61	0.83	-0.95	1			
INCOME	-0.74	0.99	-0.64	0.79	1		
FRACTEMP	0.44	0.45	-0.66	0.55	0.43	1	
FTA	0.28	0.41	-0.11	0.21	0.44	0.19	1

Source: Author

We are really aware of the very low correlation between CONTVOL and REALGDP. Therefore, we try to uncover the reasons behind it. After doing the data testing, we find out the low correlation between CONVOL and REALGDP comes from the US ports data (Port of Los Angeles and Port of Long Beach). By excluding both ports, we have a strong correlation between CONTVOL and REALGDP, with *r = 75 per cent*. It clearly states that 75 per cent of REALGDP correlates with CONTVOL. The Pearson Correlation Matrix, excluding Port of Los Angeles and Port of Long Beach, is presented in Table 7.

Gujarati (2004) clarifies that if the Pearson correlation between two independent variables ≥ 0.8, then there is a strong correlation between those variables. We do the correlation matrix before regressing the model because we aim to know the correlation values between the investigated variables. By knowing the correlation level from the beginning, we can make sure that there is no collineairy between the independent variables. If there is a high correlation between the two independent variables, there might be a collinearity problem. This is because most contributions to those variables overlap in explaining variation in CONTVOL (Tu YK, et al., 2005).

From Table 8, overall the *r* values for all the independent variables indicate there is only collinearity between INCOME–REALGDP and GDPPERCAPITA–POPWORK. Both pairs of variables shows a superior correlation, with *r = 0.99* and *r = 0.84* respectively. If we use the four variables in the same model, they will overlap. Resuming of the decision to the independent variables from the correlation matrix can be described as follows:

(i) REALGDP and INCOME cannot be used in the same model.
(ii) POPWORK and GDPPERCAPITA cannot be used in the same model.

Therefore, we disect the General Fixed Effect Model into four mini models as follows:

MODEL 1

$$CONTVOL_{it} = \beta_0 + \beta_1 REALGDP_{it} + \beta_2 GDPPERCAPITA_{it} + \beta_3 FRACTEMP_{it} + \beta_4 FTA_{it} + \mathcal{E}_{it} \quad (3)$$

MODEL 2

$$CONTVOL_{it} = \beta_0 + \beta_1 REALGDP_{it} + \beta_2 POPWORK_{it} + \beta_3 FRACTEMP_{it} + \beta_4 FTA_{it} + \mathcal{E}_{it} \quad (4)$$

MODEL 3

$$CONTVOL_{it} = \beta_0 + \beta_1 INCOME_{it} + \beta_2 GDPPERCAPITA_{it} + \beta_3 FRACTEMP_{it} + \beta_4 FTA_{it} + \mathcal{E}_{it} \quad (5)$$

MODEL 4

$$CONTVOL_{it} = \beta_0 + \beta_1 INCOME_{it} + \beta_2 POPWORK_{it} + \beta_3 FRACTEMP_{it} + \beta_4 FTA_{it} + \mathcal{E}_{it} \quad (6)$$

4.4 Classical Assumption of Multiple Linear Regression Model

In the panel regression model, the Best Linear Unbiased Estimator (BLUE) condition should be satisfied. For this reason, there are three classical assumptions that should be met. In this thesis, we apply two classical assumption tests: multicollinearity and homoscedasticity. From this, we will see whether those assumptions are satisfied or not to ensure the reliability of the four models that we formulate.

4.4.1 Multicollinearity

A situation where high correlation exist between two or more independent variables is called multicollinearity (Wooldridge, 2012). In other words, multicollinearity occurs when the independent variable is not independent from each other. Ideally, the best model for the dependent variable can be achieved when there is no multicollinearity between each of the independent variables.

Multicollinearity can be checked through four key criteria, namely correlation matrix, tolerance, Variance Inflation Factor (VIF), and condition index. These are the options to check the multicollinearity, means not all aspects must be tested. We have done for checking the corrrelation matrix in Chapter 4.3, and we decide to only take the Variance Inflation Factor (VIF) as our next criteria to check all the four models. Gujarati (2009) clarifies that the larger VIF indicating the more “troublesome” or collinear the variable is. As a rule of thumb, VIF should not exceeds 10 to keep the variable safe from the multicollinearity issues.

Testing all the models, we can notice that the VIF values for all variables of each model is below 10, means there is no multicollinearity between those variables (Gujarati, 2003). Hence, we deduce that the model is fine from the multicollinearity testing.

Table 9. Summary of VIF values for each variables for all models

	VARIABLE	**VIF**
MODEL 1	FRACTEMP	7.95
	FTA	5.97
	GDPPERCAPITA	3.31
	REALGDP	2.01
MODEL 2	FRACTEMP	7.43
	FTA	5.93
	POPWORK	2.06
	REALGDP	1.94

	VARIABLE	VIF
MODEL 3	FRACTEMP	7.76
	FTA	6.30
	GDPPERCAPITA	3.62
	INCOME	1.94
MODEL 4	FRACTEMP	7.76
	FTA	6.13
	POPWORK	2.04
	REALGDP	1.70

Source: Author

4.4.2 Homoscedasticity

In panel data regression, homoscedasticity is one of the critical assumptions that need to be tested. Woorldridge (2012, p.93) states that the homoscedasticity assumption is present when error terms across the independent variables have the same variance. Heteroscedasticity ("the violation of homoscedasticity") occurs when the size of the error term of an independent variable has different values. Heteroscedasticity can also arise because of the presence of any outliers on the investigated data (Gujarati & Porter, 2009).

It is important to notice when homoscedasticity assumption fails, because it will create a results bias. Therefore, to prevent this, we formulate the *robust* option on STATA 14 for the whole analysis. The *robust* option obtains "robust– heteroscedasticity standard errors" (also called as Huber/white estimators). Further, using the robust option allows STATA to control the heteroscedasticity by adjusting the standard errors to some clusters in panel data (Torres-Reyna, 2014).

After successfully applying the classical assumption, the model already followed the BLUE requirement. Then, we can continue to regress the model and interpret the results.

4.5 Output and Interpretation

4.5.1 Global testing (F–Stat)

The *F* Statistic is used to see whether the entire coefficients in the model differ from zero. It is used as an analysis tool globally to test the validity if the model. The model is valid if the F-Stat < (α = 0.05). From Table 10 we notice that Prob. F-Stat < 0.05, means all models are valid for analyzing the impact of all the independent variables on the dependent variable.

4.5.2 Coefficient of determination (R–squared)

R–squared indicates the amount of variance of the dependent variable explained by the independent variables. There are three types of *R-squared* in panel regression model, but in in the Fixed Effect Model we use "*R-squared* within" as the analysis tool (STATA, 2017). Further, *R-squared* can be used to measure the best fit of the model.

The *R-squared* values range from 0 to 1; the higher the values, the better the model fits the data.

4.5.3 Interpretation of the coefficient of the regressors (magnitude and significance)

There are two important concepts to interpret coefficient regressors, namely magnitude and significance. The magnitude shows the size of the effect, indicating how much the dependent variable changes when the independent variables increases by one unit. Meanwhile, the significance is statistically used to measure the precision of the estimated coefficient. The significance level can be measured by the t-statistic, on the *p-value* from Table 10. If the *Prob. T-Stat* < *α*, the independent variable has a significant influence on the dependent variable.

Figure 14 summarizes the coefficient regressors for all models. The complete coefficient *(β_0–β_4),* including the error term ($\mathcal{E}_{it}$) for all models can be written as:

MODEL 1	$\boldsymbol{CONTVOL_{it} = -21.67 + (2.6x10^{-3})REALGDP_{it} - (3.3x10^{-4})GDPPERCAPITA + 0.4FRACTEMP_{it} + 0.08FTA_{it} - 0.90}$
MODEL 2	$CONTVOL_{it} = -55.69 + (2.88x10^{-4})REALGDP_{it} + 0.125POPWORK_{it} + 0.29FRACTEMP_{it} + (0.058)FTA_{it} - 0.99$
MODEL 3	$CONTVOL_{it} = -26.06 + (3x10^{-3})INCOME_{it} - (2.67x10^{-4})GDPPERCAPITA + 0.44FRACTEMP_{it} + 0.1FTA_{it} - 0.87$
MODEL 4	$CONTVOL_{it} = -64.28 - (2.83x10^{-4})INCOME_{it} + 0.14POPWORK_{it} + 0.35FRACTEMP_{it} + (6.4x10^{-2})FTA_{it} - 0.99$

Figure 14. Summarize of the coefficient of regressors for all models

Source: Author

Overall, MODEL 1 statistically shows the high *R–squared (0.78)* and strong significance level of all the independent variables (all *p-value* < *0.05*) to the dependent variable. The *R-squared* indicates that 78 per cent of the amount of variance of the dependent variable is explained by the independent variables.

MODEL 2 generates higher *R–squared (0.23)* than in the MODEL 1 and strong significance level to all the independent variables (*p-value* < *0.05*), except for REALGDP. Similar to MODEL 1, MODEL 3 also has high *R-squared (0.72)* and the all independent variables own a strong significance level to the dependent variable. Further in MODEL 4, 82 per cent of the variance of the dependent variable is explained by the dependent variables.

The error term as the correction term for all models is also good enough, in only producing less value (approx. -0.8 to -0.9). Hence, overall we can say that the all variables satisfy our expected results.

Testing the Hypothesis

We will answer the proposed hypotheses in Chapter 3.1.

H1: The Real GDP has positive significant impact on container volume growth

The Real GDP belongs to one of the independent variables in MODEL 1 and 2. From both models, the presence of REALGDP has a weak but significantly positive impact to CONTVOL, explained by *p-value = 0.00*. This relation differs from previous studies (UNESCAP, 2007; Havenga, 2012; Dorsser, et al., 2012; de Langen et al., 2012; Drewry, 2016; UNCTAD, 2016; Royal HaskoningDHV, 2016; WTO, 2017), in which the real GDP lies as a sole determinant in assessing the development of container growth. Most previous studies formulate a single linear regression model and in the form of time– series analysis, looking at the causal relation between the real GDP and the container volume.

Nevertheless, in this thesis we formulate a multiple linear regression model (in the form of panel data analysis) by including more than one determinant alongside the Real GDP to obtain a better approach for explaining the container volume growth globally. Formulating multiple linear regressions will also produce a better coefficient for the observed determinants (Gujarati & Porter, 2009). Hence, we consider this issue as the most reasonable answer for why the correlation value between the Real GDP and the container volume is not too high.

Other judgments come from the US ports data. We want to explain the issue of the weak correlation between the Real GDP and the container volume by processing the data excluding the Port of Long Beach and Port of Los Angeles. Surprisingly, we obtain the striking difference for the correlation value *(r)* between both variables. By looking at this issue, we propose two answers as a bottleneck: (1) the unreliability of the data (either the Real GDP or the container volume, or even both) and (2) there are some other related factors to the container trade activities in the US, such as transshipment that we do not take into account in this thesis. First opinion about the data is not too relevant, because we collect the data from the same reliable resources. Hence, we consider the second opinion as another motive why the relation between the real GDP and the container volume is not too high.

H2: The* GDP per capita *has positive impact on container volume growth

The GDP per capita is an independent variable in MODEL 1 and 3. Both models indicate that the presence of REALGDPPERCAPITA has a significant negative impact to CONTVOL, explained by *p-value* = 0.00 (less than $\alpha = 0.05$). We can also identify that the magnitude of the correlation is not too high from the same models.

Therefore, from both models we deduce to reject *H2* as the GDP per capita has a negative impact on container volume, even with a low level.

Summary from H1 and H2

H1 and *H2* represent the economic indicator to explain the container volume growth. From this model, we can see the differences of the relationship between both the Real GDP and the GDP per capita to the container volume. The Real GDP has a positive impact, while the GDP per capita presents the opposite relationship. The economic crisis of 2008–2009 had a huge impact on the statistical growth of container volume. The economic crisis caused the container volume in all regions (except Jeddah ports) to drop significantly to the lowest level throughout the 15 year observation period. It indicates how significant economic growth is to controlling the container volume.

H3: The real income for personal disposable has positive influence on container volume growth

MODEL 3 and MODEL 4 include INCOME as one of the independent variables as part of the measurement. MODEL 3 indicates that INCOME has a significant positive impact on the CONTVOL at a moderate level. Similar results from MODEL 4, INCOME also generates a significance influence to CONTVOL, explained by *p-value* = 0.008. However, it has a very weak and negative correlation.

From the two models, INCOME impacts more on the container growth in MODEL 3 compared to MODEL 4. In other words, from both models, we can see that real income for personal disposable has an inconsistent influence on container volume growth. However, looking at the magnitude of the impact quantitatively, MODEL 3 is better to use as a benchmark to test the hypothesis. Hence, we decide to accept the *H3.*

H4: The population of working age has positive influence on container volume growth

POPWORK has been included in the measurement of MODEL 2 and 4. From both models, we see the *p-value* < *α*, means POPWORK has a significantly positive effect on CONTVOL. Both models produce similar coefficient values (0.125 for MODEL 2 and 0.14 for MODEL 4). By analyzing the coefficient results from both models, we can deduce that the population of working age leads to a strong influence to the container volume.

Hence, we can accept *H4* as a positive correlation is presented between those variables.

H5: The employment fraction has positive influence on container volume growth

All models use FRACTEMP as one of the independent variables. The results show that it has a significantly positive correlation to CONTVOL, explained by the *p-value* < *α* and the positive coefficient values, around 0.30 to 0.40. From this hypothesis testing, we conclude *H5 should be accepted*.

<u>Summary from H4 and H5</u>

The working age population and employment figures influence the container volume in terms of labor productivity. The higher level of employment leads to higher productivity of labor, which will boost trading activities in a country. Higher trade levels in a country for certain commodities, especially for those that are being transported via containerized cargo, leads to an increase in the container volume.

H6: The number of Free Trade Agreements (FTA) has positive impact on container volume growth

All models also include FTA as one of the independent variables to control CONTVOL. All models generate similar coefficient values (in the range of 0.06 to 0.1). The *p-value* for all models is also low, satisfying the *p-value* < α. It means FTA significantly correlates with CONTVOL. Thus, from those models, we can accept *H6.*

Generally, FTA has a positive impact on trade, even though the results are mixed and there could be wide range of estimates (Stevens, et al., 2015). Once the FTA has been assigned, the level of trade with the signatory countries will increase. It is important to consider which countries or regions agree trade agreements. For example, Saudi Arabia assigned a couple of FTA to some countries, but in fact those countries do not belong to their main trading partners. This positive impact leads to a huge benefit for the container growth.

Table 10. Output of the four models

MODEL 1						
NB OF OBS	150					
NB OF GROUPS	10					
R-SQ (WITHIN)	0.78					
U_{IT}	-0.91					
F (4, 9)	101.16					
PROB > F	0					
VARIABLES	**Coef.**	**Robust Std, Err.**	**t**	***p-value***	**95per cent Conf Interval**	
REALGDP	0.002	0.0005	5.04	0.001	0.001	0.0038
GDPPERCAPITA	-0.0003	0.000022	-15.19	0	-0.0038	-0.00028
FRACTEMP	0.4	0.158	2.55	0.031	0.04	0.76
FTA	0.08	0.028	2.88	0.018	0.01	0.144
B0	-21.67	6.2	-3.47	0.007	-35.79	-7.54

MODEL 2						
NB OF OBS	150					
NB OF GROUPS	10					
R-SQ (WITHIN)	0.82					
U_{IT}	-0.91					
F (4, 9)	16.55					
PROB > F	0.0004					
VARIABLES	**Coef.**	**Robust Std, Err.**	**t**	***p-value***	**95per cent Conf Interval**	
REALGDP	$2.89X10^{-3}$	0.0008	0.36	0.729	-0.00153	0.002
POPWORK	0.13	0.042	2.92	0.017	0.0283	0.222
FRACTEMP	0.29	0.1326	2.19	0.056	-0.009	0.59
FTA	0.06	0.03	1.91	0.089	-0.01	0.127
B_0	-55.69	14	-3.92	0.004	-87.89	-23.52

MODEL 3						
NB OF OBS	150					
NB OF GROUPS	10					
R-SQ (WITHIN)	0.72					
U_{IT}	-0.91					
F (4, 9)	101.16					
PROB > F	0					
VARIABLES	**Coef.**	**Robust Std. Err.**	**t**	***p-value***	**95per cent Conf Interval**	
GDPPERCAPITA	$-2.68X10^{-4}$	0.000054	-5.01	0.001	-0.000388	-0.0001468
INCOME	0.003	0.0007087	4.35	0.002	0.0283	0.00468
FRACTEMP	0.44	0.2171	2.04	0.072	-0.009	0.9337
FTA	0.1	0.028	3.58	0.006	-0.01	0.1636
B_0	-26.06	10.719	-2.43	0.038	-87.89	-1.809

MODEL 4						
NB OF OBS	150					
NB OF GROUPS	10					
R-SQ (WITHIN)	0.82					
U_{IT}	-0.9955					
F (4, 9)	22.69					
PROB > F	0.0001					
VARIABLES	**Coef.**	**Robust Std. Err.**	**t**	**p-value**	**95per cent Conf Interval**	
POPWORK	0.1375	0.000054	-5.01	0.001	-0.0451	0.2299141
INCOME	-0.0000283	0.0007087	4.35	0.002	-0.025	-0.00244
FRACTEMP	0.35	0.2171	2.04	0.072		0.9337
FTA	0.064	0.028	3.58	0.006	-0.01	0.1636
B_0	-64.28	10.719	-2.43	0.038	-87.89	-1.809

Source: Model output modified by author

Chapter 5 Conclusion and Discussion

5.1 Conclusion

There is no guidebook to writing a container volume study. Most previous studies related to container volume have been conducted by consultants, usually using a time series forecasting analysis on how economic indicators (measured in GDP) influence container growth. These rely on a causal relation between both variables, using a regression technique. However, the classical assumption for regression is often violated. Benchmarking this study against previous research, we concluded that the panel regression model is the best approach to studying container volume using socio-economic indicators.

For the economic indicators, we took the real GDP and GDP per capita into account; for the socio indicators, we investigated demographic trends and protectionism. The demographic trends are represented by three proxies: namely, working age of the population, employment fraction, and personal disposable income. Geopolitical unrest, on the other hand, was represented by the number of free trade agreements (FTA). The case study examined four main regions, the US, China, Western Europe, and the Middle East, including major ports from each region. In total, we analyzed 10 ports over 15 years of observation (2001–2015).

Overall, container volume was volatile over the 15 years of observation in these regions. It went up and down in each year, presumably due changing socio-economic conditions in all regions. The real GDP for countries in each region performed similarly to that of container volume. The 2008–2009 economic crisis, for example, influenced container volume growth, leading to weaker performance.

Our study produced statistical results at a decent significance level. It also met other statistical requirements, such as the *R-squared* measurement (from all models of around 70 per cent to 80 per cent). Furthermore, our study reveals that container volume is not only controlled by economic indicators, but also influenced by social indicators. This result is surprising, especially as it shows that social indicators have a greater impact on container growth than economic factors. This did not match our initial expectations of the study outcome.

The results of the four models used in this study indicate that employment fraction and FTA have a high influence on container volume, both tending to increase container volume growth globally. Real personal disposable income has a different impact on container volume. Formulating FTA as an independent determinant in the same model as real personal disposable income, GDP per capita, and employment fraction results in a positive correlation with container volume. On the other hand, generating the FTA as an independent variable in the same model as working age population and employment fraction leads to a negative correlation with container growth. Based on this output, personal disposable income does not seem to have a strong influence on container growth.

5.2 Limitation of this research

The biggest limitation for this research is data collection and the quantification of some socio determinants – for example: the hinterland connection, the technological advances, and the re-shoring and outsourcing. Some of those determinants will probably impact container volume growth further. However, due to the difficulties in quantitatively analyzing it, we cannot include them as part of our analysis. Additionally, we do not specifically elaborate on the type of FTA in more detail, and whether it correlates with the container business or not. This might affect the results of this research.

5.3 Suggestion for further research

We suggest future studies use panel regression instead of time series analysis. Further, the more ports and more variables with longer time spans that are analyzed will give better and more valid results. We only take into account the developed countries with relatively higher GDP in this thesis. However, it would also be interesting, and might provide a more relevant result, if we include the less developed countries as a part of the research. Also, investigating the effect of GDP per composition (for example agriculture, industry, service, and manufacture) for the more detailed approach of the real GDP for each country will contribute a more precise analysis.

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