Norwegian School of Economics
Bergen, Fall 2016

NHH

How did the oil price influence the freight rates for VLCC crude oil tankers between 2005 and 2015?

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Master thesis in Finance

NORWEGIAN SCHOOL OF ECONOMICS

Executive summary

The subject of this thesis is "*How did the oil price influence the freight rates for VLCC crude oil tankers between 2005 and 2015?*" The oil price is important for the development of world economic activity, as oil is a primary energy source. Given that oil is mainly transported in tankers, the oil price has substantial influence on crude tanker freight rates. The period 2005-15 was eventful with large movements in both the oil price and freight rates.

The analysis in this thesis is based on a basic supply and demand model, as well as a more specific model of the shipping market developed by the shipping economist, Martin Stopford. The correlation between the oil price and freight rates varies across time, and the oil market affects freight rates both directly and indirectly. The freight market is influenced by predictable factors such as economic activity and fleet growth, which develop gradually over time. However, "random shocks" is the most important variable in Stopford's model. One such shock was the global financial crisis, when oil prices and freight rates dropped significantly. While oil prices recovered quickly, freight rates remained low for years. Another random shock was the American shale oil revolution, which led to substantial increases in oil production. Subsequently, the Organization of the Petroleum Exporting Countries sacrificed their objective to maintain stable and high oil prices and instead chose to protect their market share. Consequently, the oil prices dropped, while the freight rates started to increase following the growing demand for cheap oil.

This thesis demonstrates how unpredictable elements, such as oil price movements, have influenced the tanker market, and thus the fortunes of tanker owners. Fluctuations have always been an important part of the shipping market, and make the shipping sector an interesting object of study.

Preface

My interest in shipping began in the fall of 2007 when I traveled to Singapore with the Shipping group (STG) at Norwegian School of Economics. We visited shipping companies, banks and ship brokers involved in different aspects of shipping, and had a site visit at the Keppel shipyard.

During my 2009 summer internship in New York with Gard North America Inc, a subsidiary of the Norwegian maritime insurance company Gard, the shipping interest was truly sparked. As a CEMS student I am required to complete an internship of at least 10 weeks abroad. During my 10 weeks in New York I got a good introduction to shipping, primarily through the eyes of an insurance firm. Through assisting claims executives in all aspects of marine insurance claims, as well as attending presentations and social events in the industry I found a fascinating diversity and an international industry that I enjoyed being a part of that summer.

As a Master student at Norwegian School of Economics, I took the class "Shipping Economics" for a broader insight into the mechanics of shipping, as well as learning about new areas. Choosing the general topic for my thesis came natural, and I am grateful for this opportunity to increase my knowledge about this fascinating industry even further.

Acknowledgements

I would like to express my profound gratitude to my thesis advisor professor Stig Tenold of Norwegian School of Economics (NHH) for the continuous support, and for motivating me throughout this process. His guidance, enthusiasm and willingness to share his knowledge and ideas have made it an enjoyable learning experience. He also played an important role in the realization of this paper.

I would also like to thank *Norges Rederiforbunds fond ved NHH* for the scholarship I received in relation to my thesis. A great thanks also to Kay Erik Stokke at DNV GL who supported my work, made me feel welcome at the office and showed great understanding when unexpected events prompted a new direction.

Thank you to friends and family that have cheered me on and shared the joy of my progress. A special thanks to those who took the time to read my work and share their valuable comments; my father Bjørn, my sister Monica, my brother-in-law Svein Olav and my host mother Lauri.

Finally, I must express my profound gratitude to my fiancé, Torbjørn, for being my sparring partner, motivator and proofreader. I could not have done it without you, thank you!

Norwegian School of Economics

Bergen, September 2016

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1 Introduction

The development of the oil price is an essential factor for the economic development in the world, as oil is one of the most important sources of energy. Oil is the largest commodity in international trade, the oil industry is fundamentally international and the majority of the oil that is consumed has been transported across borders. The oil price is also a key factor in shipping, as the majority of the world fleet still uses derived products as fuel, and in the tanker market in particular as it influences the demand for the vessels that transport more than half of the global crude oil production. The tanker market, as other shipping markets, experiences cycles with peaks and troughs. The decade from 2005 to 2015 was a particularly exciting time as there were large movements in both the oil price and the freight rates.

The main question for the thesis is:

> *How did the oil price influence the freight rates for VLCC crude oil tankers between 2005 and 2015?*

The thesis employs a combination of economic models and empirical data to analyze the influence the oil price had on the tanker market between 2005 and 2015.

Chapter 2 is an introduction to oil production and the tanker market. The basic characteristics of oil are examined in Chapter 2.1, as well as how the various benchmark oils differ. The two main oil characteristics are density, as oil can be either light or heavy, and the sulfur content, which makes oil sweet or sour. The crude oils are termed dirty, while the refined products are characterized as clean. To give context to the current oil market and explore the diversity the historic development of oil production is examined by looking at the United States, Russia, the Middle East and Norway. In Chapter 2.2 the tanker market is explored. The fleet of tanker vessels is primarily divided according to the cargo type that they transport, either dirty or clean cargo, and the size of the vessels from small tankers to Ultra Large Crude Carriers (ULCCs). The primary focus will be on Very Large Crude Carriers (VLCC) transporting crude oil between the continents, and the "typical voyage" is between Ras Tanura in Saudi Arabia to Rotterdam in the Netherlands. The main export and import regions, as well as the major trade routes that link them, are described including limitations to vessel size due to straits and canals. Lastly, the historical tanker rates between Ras Tanura in Saudi Arabia and Rotterdam in the Netherlands are commented upon in order to see the bigger picture.

The overall theoretical framework for the thesis, presented in Chapter 3, is the concept of supply and demand. Changes in prices have a significant effect on the shipping industry, and it is also important for the other theory applied. The shipping market supply and demand model developed by Martin Stopford explores the intricate relationships between variables on the supply and demand sides, and how they come together in the freight market to balance the two. On the demand side the five variables are world economy, seaborne commodity trades, average haul, random shocks and transport costs. The five variables that make up the supply side are world merchant fleet, fleet productivity, shipbuilding production, scrapping and losses, and freight revenue. The model is later used to structure the analysis of the tanker market in Chapter 5.

In Chapter 4 the Brent blend is the chosen oil benchmark, and it is explored in further detail. The development of the oil price from 2005 to 2015 is discussed, with emphasis on global events influencing the oil price. In 2008 the tension between Iran and the West led to soaring oil prices, before the global financial crisis resulted in a significant drop in the oil prices until OPEC reduced their oil production to support the price of oil. Turmoil in the Middle East with growing fear of Saudi Arabia's involvement in the Arab Spring of 2011 led to a strong increase in oil prices. The large production of shale oil in the United States combined with a slowing demand for oil, as well as the continued supply in a market overflowing of oil resulted in rapidly decreasing prices from the summer of 2014. OPEC decided to protect their market share rather than cutting production to support the prices, which led to prices under USD 40 per barrel at the end of 2015.

Chapter 5 contains the analysis and is based on a combination of historical facts and the shipping market model described in Chapter 3. In short it can be said that from 2005 to the end of 2008 the oil price started out low and increased, while the freight rates were relatively high. From 2009 the oil price increased and stayed high until 2014, when it dropped again. During the same period the tanker rates were low. To employ the shipping market model in the analysis, compound annual averages are calculated for five time periods in the decade in focus. The figures show the direction of the various demand and supply variables throughout the decade, and what global events that affect them. Random shocks are hard to quantify, and are described in the analysis. Two variables are omitted, transportation costs and freight revenue, as it makes little sense to analyze the freight rates with freight rates.

Throughout the five time periods in the analysis, the variables from the shipping market supply and demand model influence the freight rates in different ways in every period. The two most important events were the global financial crisis, which impacted both the oil prices and the freight rates for VLCCs with a significant drop. And secondly, the shale oil revolution in the United States. The strong shale oil production resulted in reduced import volumes of crude to the US and subsequently to the opening for crude export. Another important implication of the shale oil was OPEC’s works to protect their market share by increasing their oil production, which in turn resulted in low oil prices and higher demand for transportation by tankers. The factor that emerges as the most important element from theory is random shocks. The analysis confirms that random shocks play an important role in the development of both the oil price and the freight rates for VLCC vessels.

2 Oil production and the tanker market

This chapter covers two main topics; the oil market and the tanker market. The main objective for this chapter is to provide the reader with the necessary knowledge of oil and the vessels that transport it around the world. Oil can be divided according to several characteristics such as sweet or sour, heavy or light and clean or dirty. The features of the oil determine what vessels are most suitable for the transportation. The tanker fleet ranges from vessels transporting less than 20,000 to over two million barrels, from local deliveries to global deep-sea trade.

2.1 Oil market

Petroleum is a general term that covers both oil and natural gas. This exhaustible energy source is extracted from the earth in dark liquid form as oil, and in clear and volatile form as gas. The main focus in the thesis will be on oil.

If the oil has a high sulfur content it is called sour, while low sulfur content is termed sweet. Crude oil with a high density is referred to as heavy, and light for the low density. Large tankers often transport dirty cargo such as fuel oil, crude oils, both heavy and light, as well as diesel oil. The smaller tankers typically transport clean cargo, meaning refined products such as paraffin spirits and naphta, which requires clean tanks and more specialized vessels.

Following the early commercial production of oil in the 1850s there were varied possibilities for using oil including numerous medicinal uses in addition to fuel. The development of the oil production bloomed in the United States, and was later developed in Russia, the Middle East and Norway, to mention a few. The prices of crude oil have varied significantly when considering the real value, following changing supply and demand, wars and shortages.

2.1.1 Introduction to oil and the oil market

Petroleum is a non-renewable source of energy, a fossil fuel like coal, which has been formed over millions of years from dead plants and animals pressed together (San Joaquin Valley Geology, 2015a). Crude oil is oil in its natural state, dark and heavy, as it is pumped out of the oil fields. Petroleum that is clear and volatile is called a condensate, or a natural gas.

One of the events that truly changed the oil market in the past ten years is the development of shale oil in the United States, which has led to reduced import and initiated export of oil. Shale is a sedimentary rock formed by minerals and fragments of other materials found in shale formations (EIA, Glossary of Shipping Terms, 2011). The U.S. Energy Information Administration (EIA) defines shale gas as "a natural gas produced from wells that are open to shale formations". Contrary to oil, which is restricted by new layers, shale is the source as well as the reservoir for the natural oil/gas. Despite the existence of shale formations all around the globe, the production of shale gas/oil in commercial volumes is still limited to the United States, Canada and China (Orcutt, 2015). In 2015 the United States produced 1.3 billion cubic meters per day, while China estimated around 17 million cubic meters per day at the end of 2015.

Three characteristics determine what vessels are used for transporting oil; the oil density, the cleanliness required and the quantity of the cargo that is shipped (Stopford, 2009). In the following subsections the three physical characteristics; oil density, degree of care and cleanliness and parcel size will be explored further, and Table 2.1 below will help summarize some of the main elements.

	Density at 15°C		Degree of care and cleanliness		Parcel size
	Specific gravity	**°API**	**Cargo type**	**Special characteristics during transport**	**Typical cargo size, tonnes**
Heavy fuel oil	0.98	13.53	Dirty	Cargo heating	50-80,000
Heavy crude oil	0.95	17.34	Dirty	Cargo heating	60-300,000
Diesel oil	0.86	32.92	Dirty		40,000
Light crude oil	0.85	34.85	Dirty		60-300,000
Gas oil (light fuel oil)	0.83	38.86	Mainly clean		30,000
Paraffin	0.80	46.36	Clean	Clean tanks	30,000
Motor spirit (petrol)	0.74	59.58	Clean	Clean tanks	30,000
Aviation spirit	0.71	67.65	Clean	Clean tanks	30,000
Naphta	0.69	73.43	Clean	Clean tanks	30,000

Table 2.1 Oil product characteristics (Stopford, 2009, p. 440)

Table 2.1 above shows a range of oil categories as well as their specifications ranked by their specific gravity, which will be discussed in this section. A substance's specific gravity is measured by comparing its weight with an equal volume of water at 15°C (Petroleum.co.uk, Glossary). The specific gravity of water is 1.0 (Stopford, 2009). There is a large variety of oil in the world. They have two main characteristics that differentiate them – the API gravity and the sulfur content.

Density of the oil

API gravity

The American Petroleum Institute (API) is the trade association for the American oil and natural gas industry, and works to establish standards for production, refining and distribution of petroleum products (Petroleum.co.uk, API Gravity). The API gravity standard is used to measure the specific gravity or density of crude oils in degrees API[1]. (EIA, Glossary). Light - API>31.1 Medium - API 22.3-31.1 Heavy - API <22.3 Extra Heavy – API <10.0 (Petroleum.co.uk, API Gravity). The light crude oils are priced higher as the refineries can easily refine it into gasoline. (Petroleum.co.uk, Glossary). An API of 10 has equal density as water.

Sulfur content

Sulfur, also known as brimstone, is present in many fossil fuels and is released upon combustions, which is considered a danger to the environment (EIA, Glossary). Oil with low sulfur content is usually traded at a premium price. Sweet crude oil means that the sulfur content is below 0.5%, and sour oil has higher sulfur content. The sulfur content of fuel has become more important for shipping after the International Maritime Organization (IMO) reduced the legal limit of sulfur from 1.00% to 0.10% on January 1, 2015 in the emission control areas. These areas consist of ”the Baltic Sea area, the North Sea area, the North American area (designated coastal areas off the United States and Canada, the United States Caribbean Sea area (around Puerto Rico and the United States Virgin Islands)” (IMO, 2014). Outside the emission control areas the current limit is at 3.5% sulfur in fuel, which will drop to 0.5% on January 1, 2020. Shipowners can choose between using a distillate fuel with low sulfur content, by cleaning the exhaust gas to comply with the regulations, or in the longer-term purchase vessels that are fueled by liquefied natural gas (LNG) (Clarksons, Shipping Review and Outlook, 2010a). However, in order for LNG fueled vessels to be a realistic alternative for the vessel owners, the infrastructure for the LNG fuel needs to be improved (Clarksons, Shipping Review and Outlook, 2014a).

OPEC

The Organization of the Petroleum Exploring Countries (OPEC) was established in 1960 by Iran, Iraq, Kuwait, Saudi Arabia and Venezuela as a permanent intergovernmental

[1] Degrees API = (141.5 / Specific gravity) – 131.5 at 15°C (Petroleum.co.uk, API Gravity). Specific gravity usually uses water for reference.

organization (OPEC, Brief history). Later nine other members have joined; Qatar, Indonesia, Libya, United Arab Emirates, Algeria, Nigeria, Ecuador, Angola and Gabon, and the current member total is 13. The objective is "to co-ordinate and unify petroleum policies among member countries, in order to secure fair and stable prices for petroleum producers; an efficient, economic and regular supply of petroleum to consuming nations; and a fair return on capital to those investing in the industry" (OPEC, Our Mission).

Benchmark oils

Benchmark crude oils are used as a reference for buyers and sellers when pricing oil. The geographical location of the oil fields is used to describe the various crude oils. World wide there are about 160 various benchmark oils, with the three main ones being: Brent Crude from the North Sea between Scotland and Norway, West Texas Intermediate (WTI) from Texas and Oklahoma, and Dubai Crude from the Persian Gulf. The Tapis from Malaysia is known as the "world's costliest oil" due to the extremely high quality with a very light and very sweet crude oil, as well as the central location in Asia that minimizes transportation costs compared to the Brent and WTI crudes (Petroleum.co.uk, Benchmark oils). The OPEC basket is another widely known benchmark, which is made up of the weighted average of the thirteen OPEC countries with the average quality (OPEC, OPEC Basket Price).

The world's largest oil reserves are found in the Middle East, particularly in Saudi Arabia and Iran (CIA, 2015a). In economic terms the North Sea is the second most influential crude oil field, and currently has sizeable reserves (Petroleum,co.uk, An introduction to petroleum).

The Brent field in the United Kingdom originally made up the Brent benchmark, but as production declined further fields and other blends were added. The current Brent blend consists of oil from: the Brent and Forties fields in the United Kingdom and, the Oseberg and Ekofisk fields on the Norwegian continental shelf, (EIA, 2015c). In Chapter 4 the Brent crude will be elaborated on further.

Figure 2.1 below shows some of the most common oil benchmarks, the country of origin, as well as their sulfur content and API gravity. The Brent crude is quite similar to the WTI only slightly heavier, but the Brent is currently trading at a higher price. Brent is considered the primary price indicator of the world's oil prices as it provides a more accurate indication than WTI of the current supply and demand in the global oil market. This is because Brent is used as a benchmark also in Africa, the Mediterranean and some Asian countries (Schmollinger and Al-Rikabi, 2012). The different crude oils are favored for their distinctive applications and the preference will often vary among the refineries depending on the desired output.

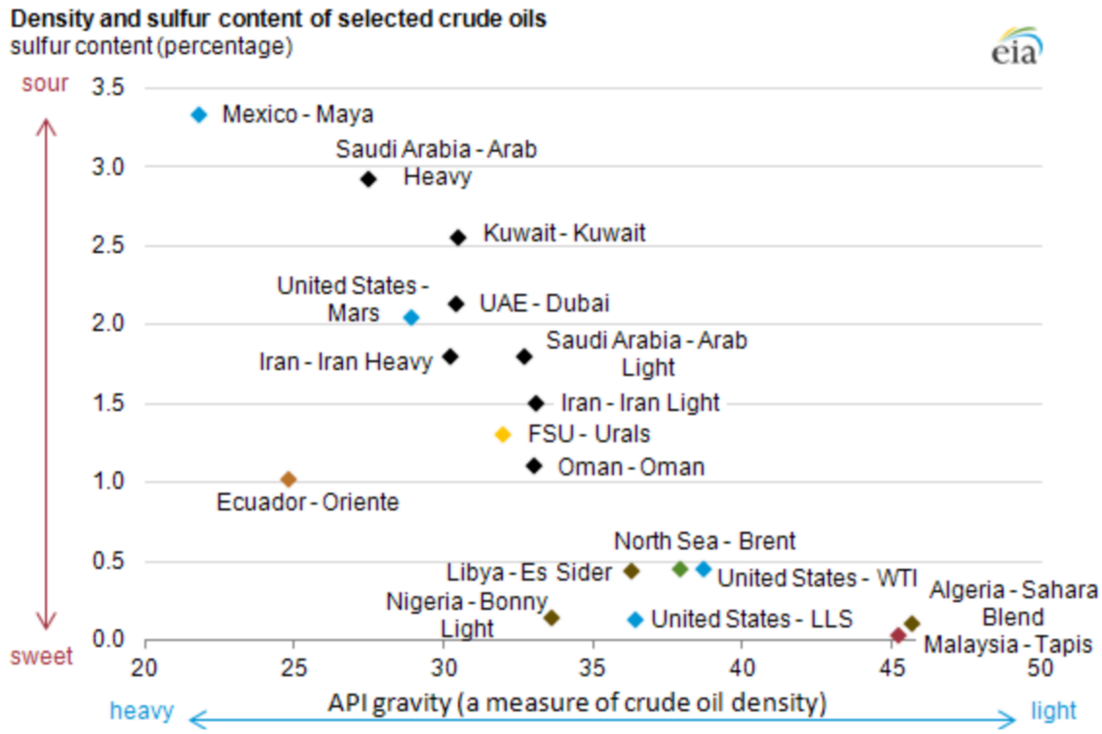

Figure 2.1 API gravity and sulfur content of selected crude oils (EIA, 2012a)[2]

Degree of care and cleanliness

In Table 2.1 at the beginning of the chapter, the oil products were divided in clean and dirty cargo types. A clean trade is the transportation of refined products, such as gasoline, diesel fuel and jet fuel. The transportation of crude oil and black products, such as fuel oil and diesel oil, is defined as dirty trade.

The crude oils have a wide range of uses and can be refined to a number of different products. As the crude oils are unrefined at the time of transportation the degree of cleanliness of the vessels are not as important. The heavy fuel oil and the heavy crude oil requires cargo heating, which means that the oil needs to be kept at a temperature high enough to avoid hardening during transportation.

[2] United States-Mars is an offshore drilling site in the Gulf of Mexico. WTI = West Texas Intermediate, LLS= Louisiana Light Sweet, FSU = Former Soviet Union, UAE = United Arab Emirates

Refined products that are classified as clean products require special care during transportation to avoid contamination from previous cargo, and are typically transported in vessels with coated tanks (Stopford, 2009). Due to the more specialized nature of the products, as well as the more specific transportation requirements, the oil products are primarily transported in smaller sized vessels from the refineries to the consumers.

Refinery

The process of converting crude oil into useful products is referred to as refining. A barrel[3] of crude oil can produce a large range of products; 42% gasoline, 22% diesel, 9% jet fuel, 5% fuel oil, 4% liquefied petroleum gases and 18% other products (Petroleum.co.uk, Fuel from crude). The products are listed based on the percentage of the barrel that they make up.

Refineries will source different oil types depending on the wanted output. For instance light crude oil is the preferred oil product if the refinery produces gasoline, as the output of gasoline is much higher compared to if they were to use heavy crude oil (Petroleum.co.uk, The Classification of Petroleum).

In the past decades the trends have varied between refining products primarily close to the consumer or the producer. In the 1950s the refining of products was typically done close to the producer, which led to a high level of clean trade (Stopford, 2009). In following decade this shifted to a higher concentration of refineries closer to the consumer, meaning a larger part of the goods transported was crude oil. The last refinery to be built in the United States was in 1980, and in Europe in 1989, and in addition the existing facilities have not been expanded to match the increasing demand (UNCTAD, 2009).

The global refinery capacity has increased from 85.1 million barrels per day (m bpd) in 2005 to 98.5 m bpd in 2015 (Clarksons, Oil & Tanker Trades Outlook, 2008 and 2016a). In 2015 the refineries in the United States had a capacity of 18.1 m bpd. The volume has seen a small rise from 17.1 m bpd in 2005, and the capacity is estimated at 18.2 m bpd in 2018, a minimal increase over three years. The two countries that stand out with a higher increase in capacity are China from 6.2 m bpd in 2005 to 16.6 m bpd in 2015, and India from 2.3 m bpd to 5.1 m bpd, a growth of over 120% for the latter. For the projected capacity of the refineries, the

[3] One barrel is the equivalent of 159 liters.

Middle Eastern counties are expected to have a strong increase, from modest levels. The utilization of the refineries on a global scale was at 79.6% in 2014, which according to BP was the lowest since 1987 (BP, 2015a).

In Table 2.2 below the growth in absolute volumes for regional refineries is listed. North America has seen an increase in added capacity of 0.3 million barrels per day from 2010 to 2015. The general global trend is an increase of capacity, with Europe as the exception with a decrease of 1.3 million barrels per day.

Refinery capacity Million barrels / day	2010-2015
North America	0.3
Europe	-1.3
Middle East	1.9
Asia	5.0
Others	0.4
Global total	**6.6**

Table 2.2 Growth in volume for regional refinery capacity from 2010 to 2015 (Clarksons, Oil & Tanker Trades Outlook, 2016a, p.19)

Parcel size

Oil tankers come in a large variety of sizes, from small tankers to the Ultra Large Crude Carriers, which will be discussed in more detail and look at their specifications in Chapter 2.2.2. In Table 2.1 at the beginning of the chapter, the typical cargo sizes for the different oil types were given.

Crude oil is generally transported from the oil fields in pipelines to the shore, or in shuttle tankers. Then they could be transported as crude oil, or be refined and transported as clean products. Typically heavy crude oil and light crude oil are transported in the largest tankers, with maximum deadweight capacity up to 300,000 tonnes (Stopford, 2009). Clean products with specialized needs during transportation are mainly transported in smaller vessels, often around 30,000 tonnes as could be seen in Table 2.1.

2.1.2 Historic perspective

In 1900 a petroleum production of 150 million barrels was enough to meet the world's annual needs, while the global consumption of oil had reached more than 92 million barrels per day in 2014 (Encyclopædia Britannica, Petroleum) (BP, 2015). The production rose quickly following the World War I as more fuel was needed in the industry and as fuel for vehicles.

In 2014 the United States, Russia and Saudi Arabia produced approximately the same amount of oil, around 12% each of the global oil production[4] (BP, 2015). In comparison Norway had a mere 2% share. The expected recoverable oil reserves in existing oil fields, fields that have been discovered, as well as expected fields that are yet undiscovered are in 2016 estimated at 264 billion barrels in the United States, with slightly less in Russia and Saudi Arabia a little lower again. The majority of the remaining oil reserves in the United States are shale oil (Raval, 2016).

The development of the crude oil price has been greatly affected by international events like war, embargo, financial crisis and other political events. More direct oil related events include the oil boom in Pennsylvania, the beginning of Russian and Middle Eastern exports, and newly discovered oil fields.

Development of the oil around the world

The first known mention of oil was in the 6th century BC in what we know as Iran, where oil was utilized in weapons of fire when the local army attacked cities and fortresses (Russum, 2012). In the early times oil was used to create a light source, heating and for medicine. In 1273 Marco Polo documented the collecting of oil in Baku, a Persian city. In the United States the first oil was produced in Pennsylvania in 1815 as an undesirable byproduct from brine wells (San Joaquin Valley Geology, 2015b). The first documented commercial production of petroleum was in Romania in 1857, followed by the United States in 1859 (Encyclopædia Britannica, Petroleum).

[4] More precisely, the respective shares for oil production were: the United States 12.3%, Russia 12.7% and Saudi Arabia 12.9% (BP, 2015). Their shares of world export were: the United States 1.1%, Russia 11% and Saudia Arabia 17% (Workman, 2016).

The development of the modern day oil production in the United States, Russia, the Middle East and Norway, will be explored in more detail to show the diversity of the progress in various areas around the world.

United States

The modern oil industry in the United States commenced by accident around 1815 when salt-water wells also began to produce the black greasy crude oil. The waste product was found useful as medicine, refined for burning, and as demand increased the search for oil began. The first well was drilled and oil was found only 69.5 feet below ground in August of 1859 (Flaherty and Flaherty, 2014). The modern oil industry had started. The development of kerosene as a flammable liquid, which made it possible to work longer hours with artificial lighting was essential in the second industrial revolution (Bidness, 2003). Crude oil production then increased from 2,000 barrels in 1859, to 4 million barrels in 1869, and 10 million barrels in 1873 (Strauss, 2015). The next major milestone in US oil history was on January 10, 1901, when the Spindletop oilfield was discovered on a salt dome formation in Texas, and a stream of oil blew 30 meters into the air. The flow was estimated to 100,000 barrels per day (Wooster and Sanders, 2010). Oil production increased from 63 million barrels in 1900 to 209 million barrels in 1910 (EIA, 2016a). As a result of the increase in oil production, oil prices dropped from USD 2 per barrel to less than 25 cents (AOGHS, Spindletop).

In 1910 the United States was the world’s largest oil producer by far, accounting for 63% of the global production. From the early 1970s both Russia and Saudi Arabia established themselves as top three oil producers. Since around the millennium Saudi Arabia has been the world’s largest oil producer for most years (The Shift Project – data portal, 2016a).

Although shale oil projects had been worked on earlier, it was not until 2004, when the technology of horizontal drilling combined with pressure-induced hydraulic fracturing succeeded that shale oil became more attractive (Rogers, 2011). In the United States shale gas represented 1% of domestic gas production in 2000, but grew to 20% by 2010 (Stevens, 2012).

On December 18, 2015 the United States Congress passed the Consolidated Appropriations Act 2016 (Papavizas, 2015). One of the main implications is that crude oil export is allowed, after the strong growth of regional supply in shale oil production in recent years. Crude export has been mainly prohibited since 1975, after the Arab-Israeli war when an oil embargo towards the United States from 1973 to 1974 caused car petrol shortages (Wingfield and Arnsdorf, 2014)(U.S. Office of the Historian, 2013). The majority of the exported oil from the United States is likely to get transported to Europe and Asia, mainly on Aframax and Panamax tankers because of port restrictions in the United States (Clarksons, Oil & Tanker Trades Outlook, 2016a). The Jones Act[5] requires domestic transportation in the United States to be performed by vessels built and flagged in the United States (Maritime Law Center, n.d). International vessels are limited to voyages where either the port of origin or the destination port is in a foreign country.

Russia

During the 1890s the areas that would later make up the Soviet Union, now Russia, was going through a forced industrialization process with strict protectionist policies. Private entrepreneurial start-ups were encouraged and substantial foreign loans were used to invest in the oil fields by the Caspian Sea (Moe and Store norske leksikon, 2015). In the late 1800s the monarch of the Russian Empire saw the prospective benefits of developing the oil fields, but lacked both technology and money. Therefore American and European companies were invited to develop the oil fields in Baku and Volga by the Caspian Sea (Goodrich and Lanthemann, 2013). In 1898 the oil production of Baku exceeded that of the United States (Bahramov and Hasanov, Transforming the oil business). As the export of oil commenced around 1882 the revenue represented 7% of the country's total export income, by the 1950s around 50% of the export earnings and in 2013 half of the national budget.

In 1991 the Soviet Union was dissolved, which led to the privatization of companies, including the oil industry. Still the remains of Soviet socialism affect the Russian society's assimilation to the modern global economy with advantages and difficulties (Gerber, 2014). Under Putin's leadership the central government has increased, and the reabsorption of the oil company Yukos following its bankruptcy has resulted in a close relationship between the oil industry and the Russian government. The oil industry is primarily controlled by the

[5] The Jones Act refers to the Merchant Marine Act of 1920, specifically § 883 *Transportation of merchandise between points in United States in other than domestic built or rebuilt and documented vessels; incineration of hazardous waste at sea* (Legal Information Institute, n.d.)

government, which during the financial crisis and low oil prices of 2008 led to a general crisis for the Russian economy.

As one of the world's biggest oil producers Russia has collaborated with OPEC in the past to help support oil prices (Saefong, 2016). However, the cutbacks have been limited considering their total exports, and short-lived as Russia has quickly increased exports again from the agreed level. Again in 2016 it is debated how optimistic one should be to Russia's talk of new alliances with OPEC and other non-OPEC members with crude oil prices currently at a 12-year low (Chilcote, Bierman and Clark, 2016).

Russia has the largest confirmed reserves of natural gas in the world, and is a large exporter, but also a considerable consumer with a vast country with long and cold winters (Goodrich and Lanthemann, 2013).

Middle East

The Iranian oil discovery in 1908 marked the beginning for the oil industry in the Middle East with its first important oil field (Owen, 2008). Around the same time the Anglo Persian Oil Company, later BP, was formed (The History channel, Britain's oil hunters). The construction of pipelines to transport the crude oil to the world's largest refinery at the time by the gulf was an important step for export. Later followed discoveries in Iraq in 1927, the Persian Gulf in 1931 and then the other countries surrounding the Persian Gulf (Owen, 2008). During World War I the need for oil to fuel tanks, vessels and planes made oil an important resource and strategic advantage, which in World War II became even more fundamental and contributed to the allied victory (Russum, 2012).

The oil production in the Middle East has experienced an incredible growth from 0.5 million barrels per day in 1945, and 19.1m barrels per day in 1975 to 27.9m barrels per day in 2014. Saudi Arabia has been the largest oil producer in the region during the period from 1945 to 2014 with a share of 40% (The Shift Project – data portal, 2016b).

At the end of 2014 the Middle East had 47.7% of the world's total proved oil reserves, and supplied 34.8% of the world's crude exports (BP, 2015a). However, refineries to process the crude to much needed products like gasoline and jet fuel have been scarce, which has resulted in significant import of clean products refined outside the region from the Middle Eastern crude (Said, 2015).

Norway

The prospect of finding petroleum in the Norwegian part of the North Sea increased in Norway after the Dutch discovery of a gas field in 1959, and further when Phillips applied for permission to explore the North Sea (Norwegian Petroleum Museum, Tidslinje). Following the Geneva Convention, the North Sea continental shelf was divided between Great Britain, Norway and Denmark based on the median line, and they each acquired sovereignty of their areas. After over three years of searching, the Ekofisk discovery was announced on December 23, 1969, and the production started in June 1971 (Norwegian Petroleum, 2016). Ekofisk turned out to be one of the world's leading offshore oil and gas discoveries. The strategy chosen was to explore the most promising areas first, which led to many renowned findings.

The state kept 50% ownership in all production licenses. In the beginning foreign companies were essential in exploration and developing of the first oil fields. The American oil company Mobil was granted rights to develop the Statfjord field, and agreed to teach the newly established state-owned Statoil the necessary skills. The goal was that Statoil would be able to take over the production after 10 years (Ryggvik, 2014). While acquiring the knowledge of oil operations, Statoil retained the responsibility and hired overseas companies to perform the work. Today Statoil is a leading company in the global production of oil and gas (Statoil, Home Page). As time has passed Norway has transitioned from a few big fields to having 82 fields in production in 2015 (Norwegian Petroleum, Production). During the first 40 years about 40% of Norway's estimated oil reserves were extracted. If this continues at the same pace, the remaining reserves are expected to last another 60 years (Norges Bank Investment Management, 2015a).

Compared to the previous experience of the international oil companies with oil explorations in the Gulf of Mexico, the Norwegian oil fields proved to be more difficult as they were located at greater water depths and with harsh weather conditions. These challenges demanded more of both the equipment and crew.

One of the things that distinguish Norway from other oil producing countries is the Government Pension Fund Global, previously the Petroleum fund. To avoid an overheating of the domestic economy as well as shielding it from the impacts of changing oil prices the profits from the oil industry has from 1996 been deposited into the fund (Norges Bank Investment Management, 2011). Through long-term investments and strict guidelines based on transparency, responsible investments and ethical guidelines the fund has grown to NOK 7,241 billion by September 15, 2016 (Norges Bank Investment Management, the Fund).

Historical crude oil prices

Figure 2.2 below shows the development of the crude oil prices from 1861 to 2014 in both the nominal value per year as well as the real value in 2014 USD. At the top of the figure some important historical events that influenced the oil prices are marked and give context to the development.

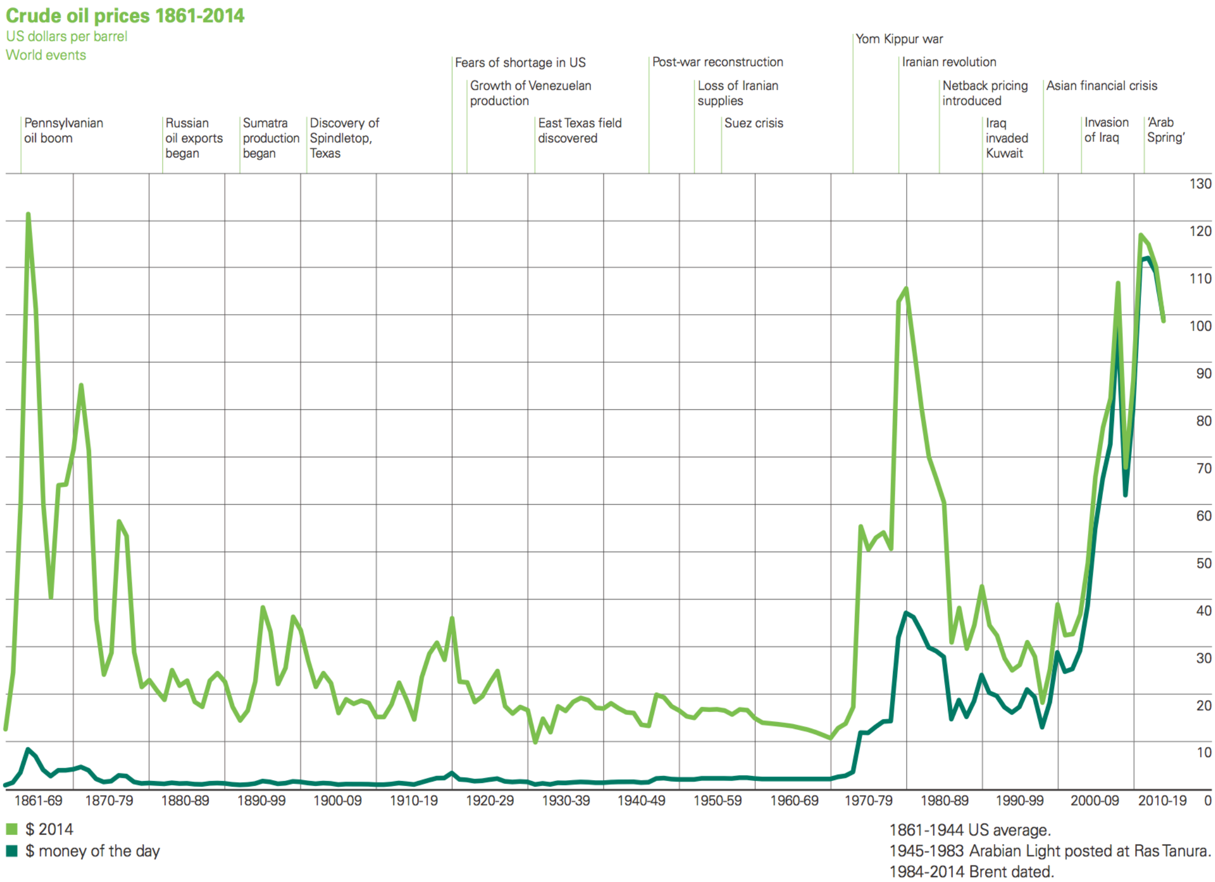

Figure 2.2 Crude oil prices between 1861 and 2014 (BP, 2015a, p.15)

The first event, the Civil War in the United States, was financed by a federal spending boom between 1861 and 1865, which resulted in the printing of money to finance the government's expenditures (King, 2006). The capital from wealthy New York banks was spent on equipment in the Pennsylvania iron industries to dig for oil after the discovery in 1859, and the deserters from the Civil War provided the necessary labor force. The oil boom in Pennsylvania was the result of sky-high oil production and the following price collapse. For instance, in 1864 a barrel of oil cost USD 8.06, an equivalent of USD 121.50 in 2014 (BP, 2015b).

Following the American emergency aid to Israel during the conflict known as the Yom Kippur War, the Organization of Arab Petroleum Exporting Countries (OAPEC) now OPEC, started an oil embargo on the United States (Corbett, 2013). The cuts in oil production led to a change in oil price from USD 2.90 per barrel before to USD 11.65 in January of 1974. Due to strong price growth, no spare capacity in the American oil production and then the embargo, the domestic industry was unable to accommodate the increased demand, hence prices rose.

Due to the Iranian revolution from 1978 to 1979 the Iranian export of oil declined by 4.8 million barrels per day, which at the time amounted to 7% of the global production (Graefe, 2013). The disruption alone was less important than the increased fear of further disruptions, which in turn led to extensive stockpiling of oil. The result was a rapid increase in oil prices, and the cost doubled from April 1979 to April 1980. Also worth mentioning for the period is that the inflation in the United States was very high for a developed country, at over 12% in 1974 (Bryan, 2013). Despite the works of the United States Federal Reserve to reduce the inflation, it continued to grow to 14.5% at the end of the 1970s due to the efforts made to reduce unemployment. As the inflation grew, the value of the dollar weakened. From Figure 2.2 above it can be seen that the 1980 crude oil price of USD 36.83, corresponds to the real dollar value of USD 105.81 (BP, 2015b).

In Chapter 4 the development of the Brent crude oil price between 2005 and 2015 will be discussed in further detail.

2.2 Tanker market

In the global tanker fleet there is a wide variety of vessels, which can be differentiated by the cargo transported and the vessel size. Tanker vessels are used to transport liquids or gases in bulk. The main liquid groups of cargo are clean products and dirty crude oil and chemicals. The ships can vary between small boats transporting goods short distances along the coasts, to Ultra Large Crude Carriers (ULCC) traveling across the world. Ships that transport crude oil are primarily at the larger end of the scale with Very Large Crude Carriers (VLCC) and ULCCs as the biggest ones to date. The clean products are generally transported in specialized tankers with multiple holds to accommodate the need for coated tanks and smaller cargo sizes. There is no clear distinction between crude tankers and product tankers restricting them to remain in their original class. If the opposite segment is doing particularly well they are able to make small adjustments to change sector. The same goes for vessel sizes; a large vessel can choose to take a partial cargo and fill part of the ship for less money, to get some income.

For the purpose of this paper the focus will be on tankers starting with handy size vessels that are used in global trade, not including chemical tankers.

2.2.1 Description of the tanker market

The three main types of tankers are oil tanker, chemical tanker and gas carrier. Oil tankers can be divided in crude oil tankers and product tankers. In this paper the focus will be on oil tankers in global deep-sea trade, with ships ranging from handy size to ULCCs.

With over 9,500 vessels, oil tankers make up almost 30% of the world cargo fleet in deadweight tonnes, with 503.4[6] million deadweight tonnes per January 2016 (Shipping Intelligence Weekly, 2016). More than 97% of the oil tankers are over 10,000 deadweight tonnes, which is a strong indication of the economies of scale in the tank market. Over 6o% of the world's oil production is transported by sea, the majority by VLCCs (EIA, 2014).

Figure 2.3 below shows that there was a growth in the bulk fleet of 85% from 2008 to 2015. However, in the fleet of oil tankers, the growth was only 33%, so when the oil prices suddenly dropped and the demand for oil grew quickly, few vessels were available which drove the

[6] Oil tankers > 10k dwt 490.1 + oil tankers <10k dwt 13.3 = 503.4 million dwt

prices up. This topic will be described in more detail in Chapter 5 for the analysis of the tanker market.

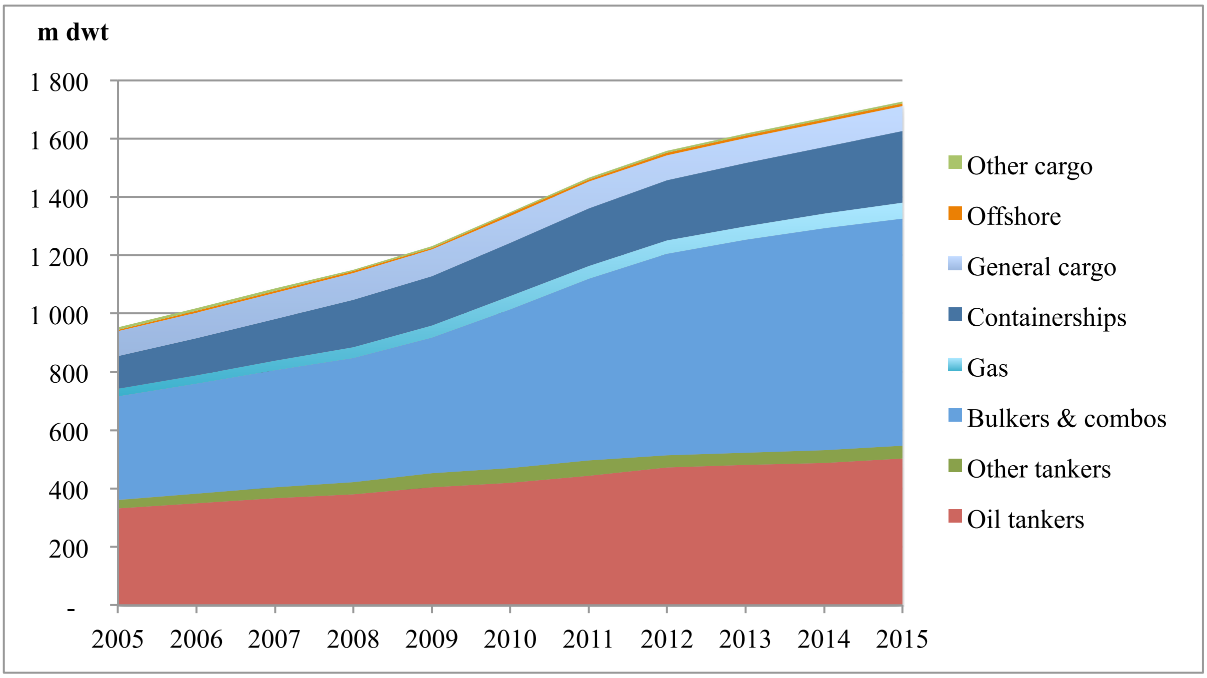

Figure 2.3 The development of the global cargo fleet from 2005 to 2015 (Clarksons, Shipping Intelligence Weekly, 2009, 2013 and 2016) [7]

2.2.2 Ship types

Tanker vessels are typically categorized by three characteristics; the deadweight tonnage capacity, the number of tanks and the capacity for transporting oil measured by the million barrels of oil. Clean products are often transported in small to medium sized ships, often with coated tanks, while dirty products, such as crude oil, are generally shipped in the larger vessels. To minimize the risk of oil spills the hulls are double on all modern oil tankers.

Deadweight tonne

Deadweight tonnage (dwt) is the main unit for cargo capacity measured in metric tonnes of 1,000 kilograms (Clarksons, Glossary of Shipping Terms, 2011). It includes essential items such as fuel, ballast water, fresh water, crew, passengers and luggage. For a ship of medium size, the non-cargo weight averages about 5% of the total deadweight, and the percentage decreases with larger ships (Stopford, 2009). Deadweight can also be measured as the difference between the loaded ship displacement and the lightweight, the latter being the

[7] A table with the data material that the graph was made from can be found in Table 7.1 in the appendix.

weight of the vessel as built including boiler water, lubricating oil and the water for the cooling system.

Ship specifications

In Table 2.3 below six general groups of oil tankers are listed with the typical characteristics. Oil tankers can accommodate anything from 19,000 to over two million barrels per shipment. Interestingly the number of tanks does not grow with the size of the vessel, which indicates that the larger vessels transport larger cargoes, but not a larger variety as only one type of cargo can be contained within one tank.

	Deadweight tonnage (dwt)	Draught (depth)	Beam (width)	Thousand barrels	Average number of tanks
Small tankers	Under 10,000	6.0 m	15.0 m	35.9	12.4
Handy	10,000- 59,999	10.5 m	27.1 m	222.1	16.3
Panamax	60,000- 79,999	13.4 m	32.8 m	482	10.9
Aframax	80,000 – 119,999	13.3 m	41.7 m	702	10.9
Suezmax	120,000 – 199,999	16.6 m	46.7 m	1,011	11.9
VLCC	Over 200,000	21.2 m	58.4 m	2,040	14.2

Table 2.3 Ship sizes for oil tankers (Stopford, 2009, p. 596)[8]

Stopford's division of six segments in Table 2.3 is one of many ways to systematize the oil tanker fleet. However, the range of deadweight tonnage for each category is not consistent worldwide, or over time. What a handy size tanker can transport in terms of dwt differs between sources such as Stopford and Clarksons. Also, the Panamax, which is the largest ship that can currently navigate the Panama Canal will remain in service, but be replaced by the larger Post-Panamax as the vessel with the largest capacity able to utilize the canal after the expansion.

Another way to see it in a standardized way is the AFRA scale. Figure 2.4 below shows the combination of vessel size and the cargo type that they transport.

[8] Weighted averages for small tankers and handy

The AFRA Scale

The Average Freight Rate Assessment (AFRA) Scale is a classification system used for the global fleet of crude oil tankers and product tankers to "standardize contract terms, to establish shipping costs, and to determine the ability of ships to travel into ports, or through certain straits or channels" (EIA, 2014, p.3). Royal Dutch Shell established the AFRA Scale. From 1954 the London Tanker Brokers' Panel, formed by five tanker brokers, has published the monthly AFRA Scale for their members as an independent and impartial party (London Tanker Broker's Panel, (n.d.)). In the global tanker market the Long Range (LR) vessels are the most common type, as they can ship both refined products and crude oil, and their size allows them to access the majority of desired ports (EIA, 2014).

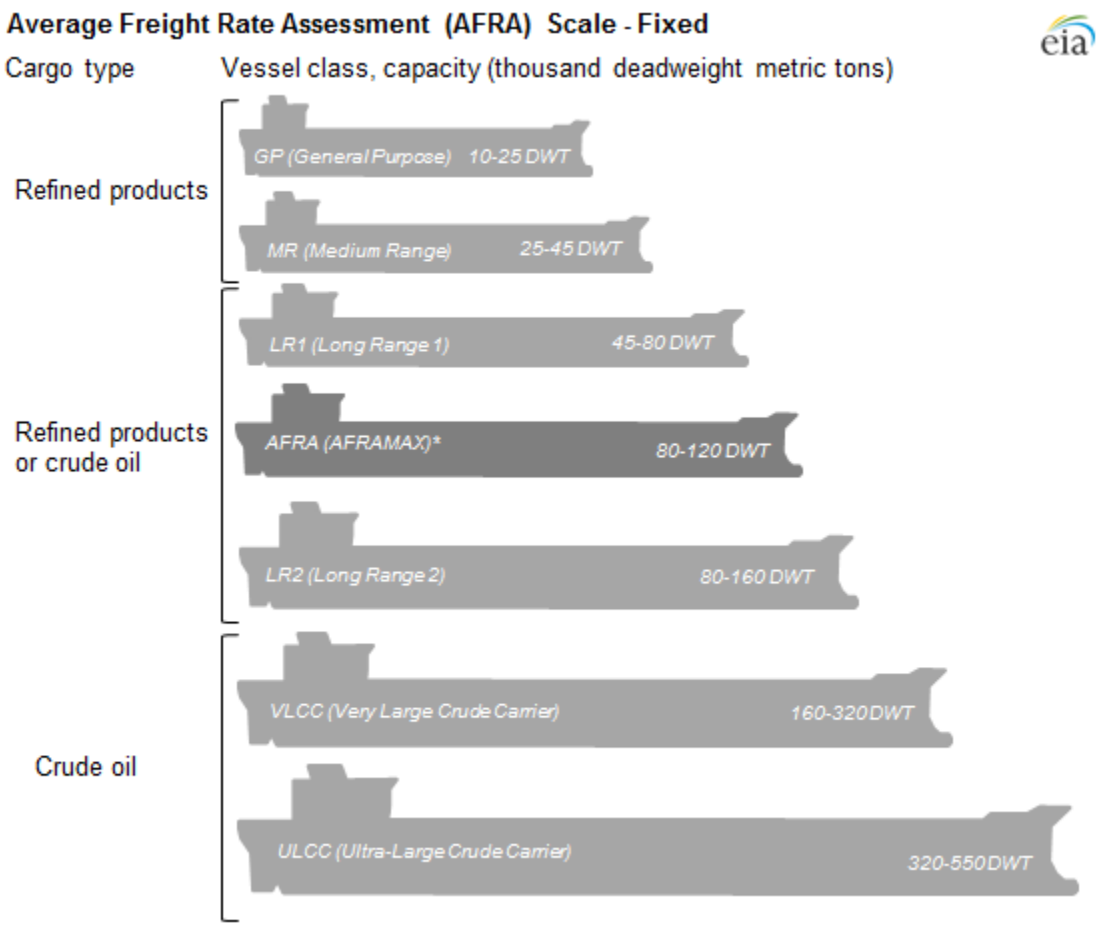

Figure 2.4 Average Freight Rate Assessment (AFRA) Scale - Fixed (EIA, 2014)[9]

Clean and dirty trade

The main way to divide the tanker market is in clean and dirty trade. As previously discussed in Chapter 2.1.1, clean trade is the transportation of refined products, and dirty trade refers to

9 AFRAMAX shown for comparison, but it is not an official vessel classification.

crude oil and black products. Figure 2.4 above shows that refined products are typically transported in vessels at the smaller end of the scale. The Long Range and Aframax vessels in the middle of the scale can accommodate both clean and dirty trade, while crude oil is the preferred cargo for the VLCCs and ULCCs.

In 2014 crude oil made up 17% of the total international seaborne trade in terms of million tonnes, and 9% was petroleum products (UNCTAD, 2015). This was the result after crude oil saw a decrease in contracted shipments of 1.6% from 2013, while petroleum products increased with 1.7%. However, the tonne-miles for crude oil trade remained stable as a result of an increase in longer voyages to Asia, primarily China and India, with the largest vessels. Tonne-mile is by EIA defined as "the product of the distance that freight is hauled, measured in miles, and the weight of the cargo being hauled, measured in tonnes. Thus, moving one ton for one mile generates one ton mile" (EIA, Glossary of Shipping Terms, 2011).

As Table 2.4 below illustrates, the most drastic development in crude imports from 2008 to 2014 is that China has gone from 178.8 to 309.2 million tonnes (BP, 2009 and 2015). Crude exports from the Middle East have declined from 895 to 850.1 million tonnes. The United States has transitioned from a net importer to a net exporter of products in the past seven years, with imports decreasing from 149.5 to 90.1 million tonnes and exports increasing from 87.7 to 179.9 million tonnes.

	2008				2014			
Imports and exports	Crude imports	Product imports	Crude exports	Product exports	Crude imports	Product imports	Crude exports	Product exports
United States	487,2	149,5	6,9	87,7	365,4	90,1	16,9	179,9
Former Soviet Union	< 0,05	7,1	311,3	93,5	0,1	6,4	294,8	144,1
Middle East	11	9,7	895	105,7	11,4	43,2	850,1	128,6
China	178,8	39	3,7	15	309,2	63,7	0,4	25,8
India	127,7	22	< 0,05	34,4	189,7	19,9	< 0,05	61,3
Sum others	1176	500,6	752,7	391,7	1002,4	688,3	714,1	371,9
Total world	1969,9	727,9	1969,9	727,9	1876,4	911,5	1876,4	911,5

Table 2.4 Import and export of crude oil and products in 2008 and 2014 (BP, 2009 p. 21 and 2015a p. 19)

The tonne-mile unit, which considers the distance travelled, presents a more precise measure of the demand for shipping transportation, and is a major factor in determining the capacity of the fleet over time (UNCTAD, 2015). With the increasing domestic oil production in the

United States, crude imports have declined and vessels from the Middle East have transported the crude oil to the Far East instead, which with the longer transportation distances increased the tonne-mile ratio (BRS, 2015).

Table 2.5 below compares the million tonnes of transported crude oil and oil products to the tonne-miles in 2005 and 2015. The trend is that oil products have seen an average growth of 4.4% in tonne-miles, and approximately the same average growth in terms of million tonnes, which implies almost unchanged average haul. For crude oil the tonne-miles increased slightly, while the volume in tonnes remained unchanged. This indicates that the distance to the receivers of oil has increased somewhat. In 2005 crude oil was transported 53% further than oil products, and increased to 63% in 2015. Crude oil is also transported in larger quantities. This is reflected in the composition of the tanker fleet, in January 2005 the total tanker fleet consisted of 3,665 vessels over 10,000 dwt with a capacity of 318 million dwt. Product tankers made up 42% of the fleet measured by the number of vessels and 21% in terms of the dwt capacity in 2005. By January 2015 the tanker fleet had expanded to 5,885 vessels that were able to transport 508 million dwt. The share of product tanker vessels remained stable at 43%, but the vessels were larger, and measured in dwt the capacity had increased to 26% (Clarksons, Timeseries, 2016e). However, it is important to keep in mind that the product tankers can be used to transport crude oil, but crude tankers are unable to carry clean products.

	2005		2015	
	Crude oil	**Oil products**	**Crude oil**	**Oil products**
Million tonnes	1,879	740	1,877	1,058
Billion tonne-miles	8,610	2,205	9,179	3,173

Table 2.5 Development of positions for crude oil and oil products in 2005 and 2015 (Clarksons, Seaborne Trade Monitor, 2016, p. 4-5)

Double hull requirement

The International Maritime Organization (IMO) works to make shipping safer, and issues worldwide rules and regulations. The International Convention for the Prevention of Marine Pollution from Ships, MARPOL, was first adapted in 1973 (IMO, List of conventions). Later MARPOL has been revised to include new regulations for pollution from regular trade, as well as for accidents. The single-hull was the most used ship design for tankers until the

1990s (Stopford, 2009). In 1992 MARPOL was modified, and tankers ordered from July 6, 1993 were required to have double hulls for extra protection in case of an accident to minimize the risk of oil spills (IMO, Tanker safety). Single-hulled tankers were phased out with continued acceleration after oil spills, and in 2010 the last were banned from world trade; however, local administrations retained the ability to make bilateral agreements to allow for prolonged use (Stopford, 2009). The United States banned single-hull tankers from trading in US waters from January 1, 2015 (BRS, 2015).

2.2.3 Trade routes

The trade routes of oil are based on the location of the countries exporting oil and importing. As previously described, the oils around the world have different qualities, which results in countries importing oil from several areas, and also importing even with a domestic oil production. The large oil tankers demand specialized infrastructure for both port and terminals that meet the local needs. Straits and canals are natural chokepoints, which influences the global shipping market with shorter routes for the vessels that meet the geographic requirements. With increasingly bigger vessels to take advantage of economies of scale, the canals are expanding their capacity.

Exporters and importers

Seaborne crude oil exports originate from oil producing countries, with the Middle East region accounting for the majority share at 17.9 million barrels per day (m bpd) or 47% of global crude oil exports in 2015. Saudi Arabia is the largest crude oil exporting country with 7.4 m bpd in 2015 or 19.7% of world exports. In comparison Africa accounts for 6.4 m bpd, Latin America 4.9 m bpd and the North Sea, with United Kingdom and Norway, for 2 m bpd (Clarksons, Oil and Tanker Trades Outlook, 2015a).

Importing countries either have no or limited crude oil production of their own, or have insufficient capacity to meet the internal demand. Asia is the region with highest imports, 53% of global imports, with China accounting for 31% of this volume. EU is the region with the second highest imports, 25% of total imports (Clarksons, Oil and Tanker Trades Outlook, 2015a). Germany is the largest importing country in the EU, and has limited oil reserves of its own[10] (CIA, 2015a). The United States has until recently been the country with the largest crude oil imports; however, following the shale oil revolution, imports have declined by 37% since 2011 (BP, 2015a)(Clarksons, Oil and Tanker Trades Outlook, 2015a).

An example of a country that is both an exporter and an importer is Venezuela. Being the country with the world's largest oil reserves and producing 2.69 m bpd in 2014, the country still imported 132,000 barrels of crude oil per day in 2012 (EIA, 2015d and 2012b). The country needs to import light oil to mix with the domestic oil that is very heavy in order to balance the quality for export and facilitate their customers' needs for refining (CNN Money, 2016a). Between the two world wars Venezuela was the wealthiest country in Latin America because of the oil, and it was the world's largest oil exporter until the 1970s (Lundberg and Hagland, 2009). In April of 2016 president Nicolás Maduro ordered the population to take Fridays off work for the following two months to save electricity, as the country is struggling with power outages due to lacking maintenance. Venezuela is severely affected by the low oil prices, in addition to domestic challenges as recession, lack of food and medicine as well as inflation of several hundred percent (DN, 2016a). Venezuela is one of 40 countries that are subsidizing domestic oil and gas, which leads to a consumption of 2.5 times more than non-subsidizing countries. In 2015 a liter of car petrol cost two cents, which entails large costs for the government and lower oil revenues (Westshore, 2016).

Based on the supply and demand of crude oil the main trade routes for crude oil are formed, see Figure 2.5 below. As previously discussed in Chapter 2.1 there are several different types of oil characteristics which impacts the trade patterns, as one region will be importing from several parts of the world, perhaps in addition to exporting some of their own oil reserves. Following the recent change in the United States' law to allow for export of crude oil, it is likely that there will be some changes in the trade patterns, with increased trade between the United States and other countries in the Americas.

Large oil tankers require dedicated port infrastructure and terminals used in oil trade, as well as adequate water depth and space for the length of the berth. Port infrastructure can include transportation of oil from the producer using pipelines and ground transportation to storage tanks in the port. The oil and product onshore tanks need to be of sufficient size and number

[10] On the list of countries ranked by proved oil reserves Germany is number 57 (CIA, 2015a).

for the local conditions, and with the necessary pipes and pumps to allow for loading and discharge from the vessels. Onshore tanks for crude oil are typically large, while product tanks tend to be smaller and more specialized; this mirrors what was observed in the tanker fleet. At the receiving end, transportation from the port storage to the refineries is essential. The size of the refineries and/or plants in the area and their desired input types and quantities are important when considering what vessels will likely be using the terminal (Stopford, 2009).

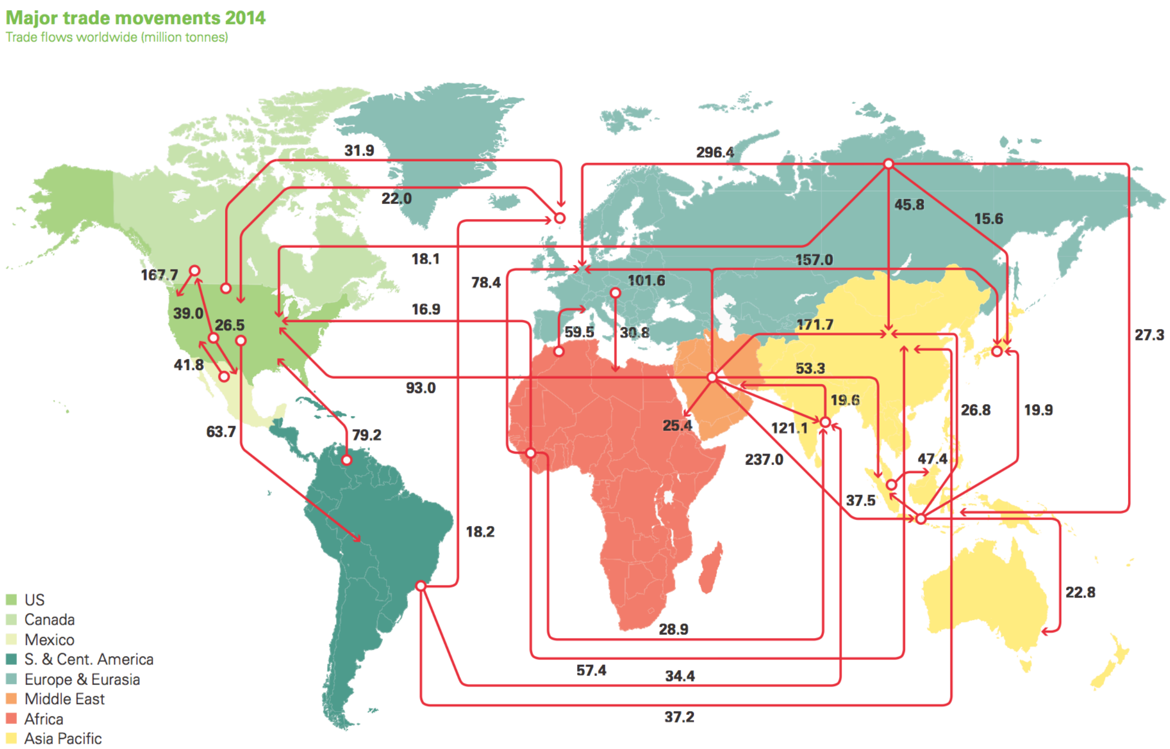

Figure 2.5 Major trade movements in oil, 2014 (BP, 2015a, p.19)

Another important consideration in the competitive market is high efficiency. Factors that can lead to lower shipping costs include; adequate space for docking, the number of cranes and pumps as well as organizational improvements. In a market with several ports to choose from, the productivity is an important consideration, as extra time spent in port could be spent earning money (UNCTAD, 2015).

Limitations of key shipping lanes

The geographical constraints have been important in determining vessel specifications such as draught, width and length. With the expansion of channels shipowners take advantage of economies of scale by ordering larger vessels adapted to the new constraints. Straits have natural limitations and affect transport patterns by their narrow nature and the option to avoid longer journeys. Figure 2.6 below shows the major trade routes for oil, as well as the amount of oil and oil products in million barrels through the main chokepoints.

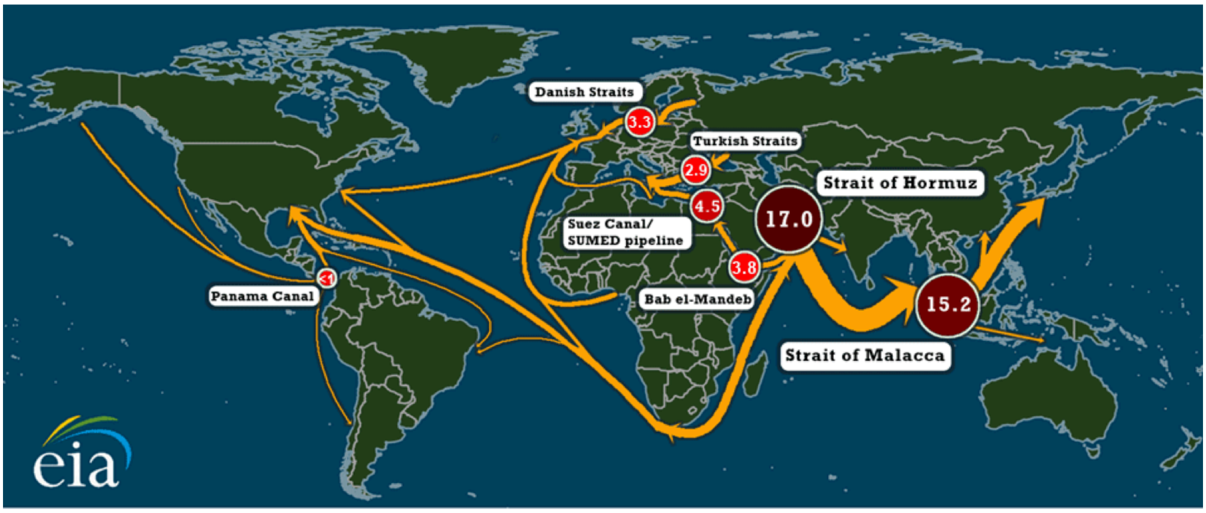

Figure 2.6 Million barrels crude oil and oil products transported through chokepoints per day in 2013 (EIA, 2014)

The Strait of Hormuz and the Strait of Malacca

According to the EIA the Strait of Hormuz, at the gate of the Persian Gulf, is the primary chokepoint for crude oil exports. 17 million barrels are transported through this strait every day from the Middle East primarily to Asia, and through the world's second largest chokepoint, the Strait of Malacca, located between the Malaysian peninsula and Indonesia (EIA, 2014).

The Strait of Hormuz is 21 miles wide at the narrowest point, and consists of two shipping lanes of two miles each that are separated by a safety zone. The strait is able to accommodate the largest crude tankers in terms of depth and width. In 2013 30% of all seaborne oil was transported through this bottleneck.

With only 1.7 miles wide at its narrowest point, the Strait of Malacca is the shortcut to China and Indonesia to avoid sailing through the Indonesian archipelago. With 15.2 million barrels being transported through the strait daily, collisions, grounding and oil spills are potential dangers, in addition to piracy (EIA, 2014). The depth of the canal limits ULCCs from passing with a draught over 21 meters (Stopford, 2009). In January 2015 a 2,400 km long pipeline from the coast of Myanmar to Yunnan, China opened to create a direct and shorter connection for oil transported to China, and without having to go by sea through the Strait of Malacca. As 80% of the imported oil to China goes through the strait, the Chinese would like to decrease their vulnerability of a potential blockade in the Strait of Malacca by the Americans in case of a geopolitical crisis (Meyer, 2015).

The Suez Canal

The world's first artificial canal made for trade and travel was the original Suez Canal, mandated by the Pharaoh of Egypt and finished 1874 B.C. linking the Red Sea and the Mediterranean (Suez Canal Directory, Canal history). The canal was repeatedly abandoned and rebuilt, until it was officially opened in November 1869. Until the expansion in 2010 Suezmax was the largest vessel type to go through the canal. After the expansion VLCCs may pass through, although not fully loaded, and ULCC vessels are too large (EIA, 2014). An alternative for a fully loaded VLCC is to use the Suez-Mediterranean pipeline, SUMED, to offload a partial cargo before passing through the canal, and reload once through. SUMED is a 320 km long pipeline from the Red Sea to the Mediterranean Sea (SUMED, n.d). In 2013 8% of the world's seaborne oil trade was transported through the Suez Canal or the SUMED pipeline. Should both be closed it would increase the voyage from Saudi Arabia to the United States by about 2,700 miles due to the longer route around the Cape of Good Hope in South Africa (EIA, 2014).

The Panama Canal

The Panama Canal is approximately 80 km long, and provides a shortcut of 7-9,000 km when travelling from the Atlantic Ocean to the Pacific Ocean compared to around Cape Horn at the southernmost point of South America (Canal de Panama, This is the canal)(Stopford, 2009). The canal opened in 1914. It is currently going through an expansion of a third lane that will be able to accommodate larger vessels with a deeper and wider lane (Canal de Panama, What is the expansion program). The result will be doubled capacity. The old locks limited ships to the Panamax of 5,000 TEU or 85,000 dwt, but with the expansion the Post Panamax vessels carrying 13,000 TEU or 180,000 dwt will be accommodated (MARAD, 2013). A twenty-foot equivalent unit (TEU) is the standard container, and is frequently used to define the capacity of container ships (Clarkson, Glossary of Shipping Terms, 2011). The two most popular trade routes through the Panama Canal are from the East Coast of the United States to the Far East, and from the West Coast of the United States and Canada to Europe. From a tanker point of view the Panama Canal is less relevant as only 1.4% of the world's seaborne crude oil and petroleum products were transported through the canal in 2013 (EIA, 2014). However, this might change after the expansion, which will able to accommodate larger vessels. In addition, the United States has opened for shale oil export originating mainly east of the Panama Canal, and China, a large oil importer, is located west of the Panama Canal.

2.2.4 Historical rates

The tanker rates were quite stable at low levels with some short-lived spikes. Geopolitical events, typically combined with varying expectations in the market, have resulted in large movements over a relatively short period of time.

Figure 2.7 below shows the historical spot rates measured in Worldscale (WS) for a VLCC of 280,000 dwt traveling from Ras Tanura in Saudia Arabia to Rotterdam in the Netherlands. WS, or the Worldwide Tanker Nominal Freight Scale, is an index of the costs of operating a standard tanker on a set route and is published annually. The current market rates are quoted as a percentage of Worldscale (Teekay Marine Solutions, Glossary).

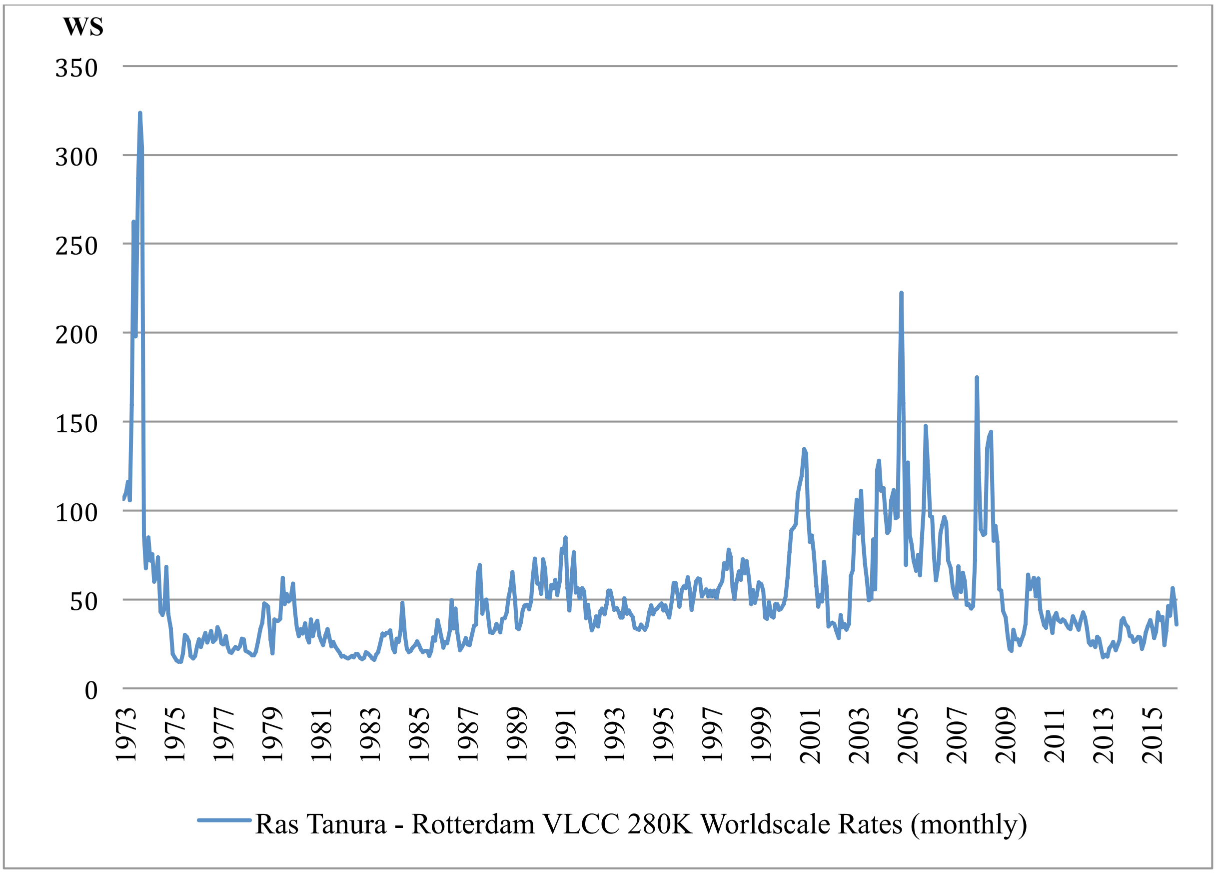

Figure 2.7 Historical VLCC earnings between Ras Tanura and Rotterdam, monthly data from 1973 to 2016 (Clarksons, Timeseries, 2016a)

The highest peak of the tanker rates during the time between 1973 and 2016 was from 1973 to 1974. Between 1963 and 1973 the demand for transportation by tankers increased with an average of 17.5% annually. At the beginning of 1974 the orderbook for tanker ships was at 90% of the existing fleet. The supply increased significantly, and in addition to declining demand in the following decade, the large expansion of the fleet led to a sharp and long-lasting decline in the rates (Tenold, 2001).

The next significant peak was in year 2000. The Asian economies went into recession and a weak market was expected. However, the recession only lasted for a few months, and in the spring of 2000 the industrial production grew at record speed, around 11% per year. The previous pessimistic sentiment in the tanker market had resulted in scrapping of vessels at a large scale. As a result the VLCC earnings peaked at USD 80,000 per day in December 2000. The burst of the dot-com bubble in early 2001 resulted in a recession and a decline in the industrial production, which in turn led to VLCC earnings of USD 10,000 per day (Stopford, 2009).

3 Theory

3.1 Supply and demand

The framework for the entire thesis is the theory of supply and demand. The dynamic of why prices change is fundamental for a great deal of understanding the global shipping market. This subchapter is primarily based on “Microeconomics” by Pindyck and Rubinfeld (Pindyck and Rubinfeld, 2005).

According to Pindyck and Rubinfeld, the supply curve shows how much a producer is willing to sell of their goods or services at a given price, while all other factors remain equal. The slope of the supply curve indicates how much more of a product the seller is willing to provide for a certain increase in price. A steep supply curve indicates a large price increase is required to get a small increase in volume. In shipping the supply can be enlarged in the short-term by vessels increasing their speed. However, when all vessels sail at full speed, no additional supply can be provided in the short term. In the long-term shipowners can order new vessels, but this takes time.

The demand curve shows how much a consumer is willing to buy of a commodity or service at a given price, while the other factors are kept constant. The slope of the demand curve indicates how much more a consumer is willing to buy of a product or service at a given price decrease. A flat demand curve indicates a limited willingness to pay more for additional goods. When the demand curve is steep a large change in price results in a limited change in volume, this may be the case for someone who has to transport the goods regardless of the cost.

3.2 The shipping market supply and demand model

"Maritime Economics" by the shipping economist Martin Stopford is the primary source for this subchapter, specifically pp. 135-174, where the shipping market model is described (Stopford, 2009). The model as a whole is helpful to explain the tanker market.

The model consists of three main parts – demand, supply and the freight market, and will be described in further detail. The freight market is where the supply and demand factors are linked through the cash flow.

3.2.1 Demand

The five variables affecting the demand side of the shipping model are world economy, seaborne commodity trades, average haul, random shocks and transport costs. Figure 3.1 below is an illustration of how the variables are connected, and how they affect the freight market, abbreviated FM in the model.

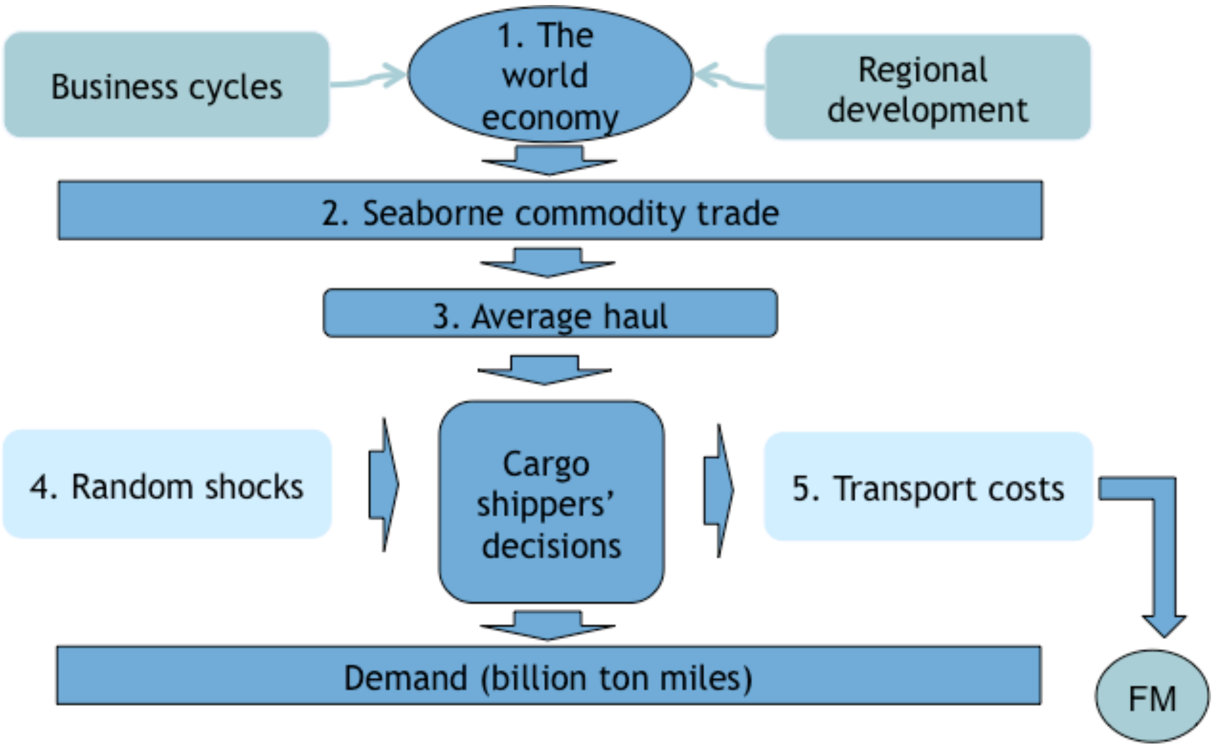

Figure 3.1 The demand side of the shipping market model (Stopford, 2009, p. 137)

World economy

The global economy is influenced in the short term by business cycles, while the growth tendency in various regions is important in the medium to long-term. As the world economy is the leading factor to affect the demand for seaborne trade in the world, a strong correlation is anticipated between the two. Stopford shows that the gross domestic product (GDP) and the growth rate of maritime transportation have followed each other closely between 1966 and 2006. Business cycles are affected by both external and internal factors, and though they vary, they have some common denominators. External factors can be drastic fluctuations in demand due to unexpected changes in the price of goods like oil and coal, or unexpected events such as wars. Time-lags, stockbuilding and mass psychology are some of the most usual internal factors that influence the global economy through business cycles.

With public anticipation of economic growth or decline, the expectation might be self-fulfilling because it was predicted. The power of mass psychology may contribute to stronger cycles. If the general opinion is that the stock market is developing into a boom, people are eager to buy stocks and get in on the action, which in turn will drive the prices up.

Another significant factor is the economic structure or growth structure in individual countries; the development of industrial economies from young and inexperienced with high demand for products to help build the country, differ from more mature economies where the growth rate inevitably will begin to slow down. The relationship between the local supply and demand of raw materials and food is another factor in the growth of the world economy. If there is a shortage in one region, global suppliers will be crucial to meet the local demand, resulting in seaborne trade for transportation.

Seaborne commodity trades

The demand for transportation of cargoes such as crude oil and oil products, as well as grain and containers, is affected by developments in each specific commodity market. With an exceptionally good harvest of grain, the demand for transportation of grains for export will increase to export the country's excess harvest. Reversely, if the harvest is very poor the need for import will lead to an increase in shipping to supply the deficit. The two main perspectives are short-term and long-term trends in the commodity trade. Short-term variations are led by seasonality, while long-term trends are due to changes in demand for a specific product, changes in supply sources, changes due to relocation of the processing and changes in the shipper's transport policy.

Seasonality is the main factor in the short-term trends. Seasonal variations in the demand for transportation of both agricultural goods and oil are yearly, yet it is hard to plan the exact timing and the shippers need to use the spot market. For oil the need for heating in the winter is the predominant reason for the rise in oil demand before the cold season. The transportation of grains is also in high demand in the fall, while citrus fruits are in season during the winter. Another consideration in the global market is that the northern and southern hemispheres have opposite seasons, and quite a few of the agricultural commodities are in season at various times around the globe.

Especially three types of changes influence the medium to long-term trends in the commodity trade:

- Changes in the demand for a particular product, or alternatively fluctuations in the demand for the finished merchandise where the raw material is part of the finished product.
- Superior quality, inadequate local supply and exhaustion of natural resources are some reasons that can lead to changes in the origin of the resources. The effect on seaborne trade can be substantial depending on the change in distance from the source to the market.
- Relocation of the processing of raw materials impact the demand for vessels, as some vessels transport the unprocessed material while other vessels typically transport the processed product. As previously mentioned, the location of refineries has varied over the past decades, which have resulted in varying needs for both crude tankers and products tankers.

Average haul

The average haul is the average distance that a commodity is transported. As previously discussed in Chapter 2.2, the tonne-mile is a useful indicator when considering the average distance traveled with the cargo, instead of solely observing the distance covered. The tonne-mile for vessels transporting different commodities vary over time depending on for instance the commodity's price in each regional market, transportation costs and each market's regional share. In the past, the closure of the Suez Canal has led to drastic increases in the distance traveled for ships, when the shortcut through the canal has been impassable and the best alternative has been around the Cape of Good Hope.

Random shocks

Random shocks often have considerable impact, not only on the shipping market specifically, but the global economy in general. They can be related to the weather, as well as economic and political shocks. Changes in weather or natural disasters, such as hurricanes and tsunamis, can damage the natural resources and the surrounding facilities disabling the trade, as well as the demand for commodities.

When a random shock takes place, the impact on the economy can be accelerated or cause a domino effect. The Great Depression was triggered by the 1929 crash of Wall Street, and the financial crisis of 2008 was in large part sparked by the bad credit and housing risk taken on by certain large corporations that collapsed at the same time with little diversification to minimize their losses.

Political events are another type of unsystematic shocks, and can be due to outbreak of war or a revolution, workers striking to obtain better conditions or the nationalization of foreign assets. Particularly political disagreements in the area surrounding the Suez Canal have largely impacted the shipping market in the past, which as previously mentioned is because of the significant detour of the alternative route.

Transportation costs

The cost of transportation is important when deciding from where to source the raw materials and the commodities. Unless the quality is superior to support a higher price, the transportation costs will decide if it makes sense to buy cheaper products from further away. With improved efficiency, for instance in loading and offloading in port and economies of scale with increasing vessel sizes, have led to reduced transport costs over the past century. Another factor has been changes in the operations of the shipping organizations to achieve higher efficiency.

3.2.2 Supply

The time frame is an important aspect of the freight rate, as the rate is a combination of the present along with the expectations of the short- and long-terms. Time is an essential factor for the supply of seaborne transportation, as the supply varies significantly depending on the considered time frame.

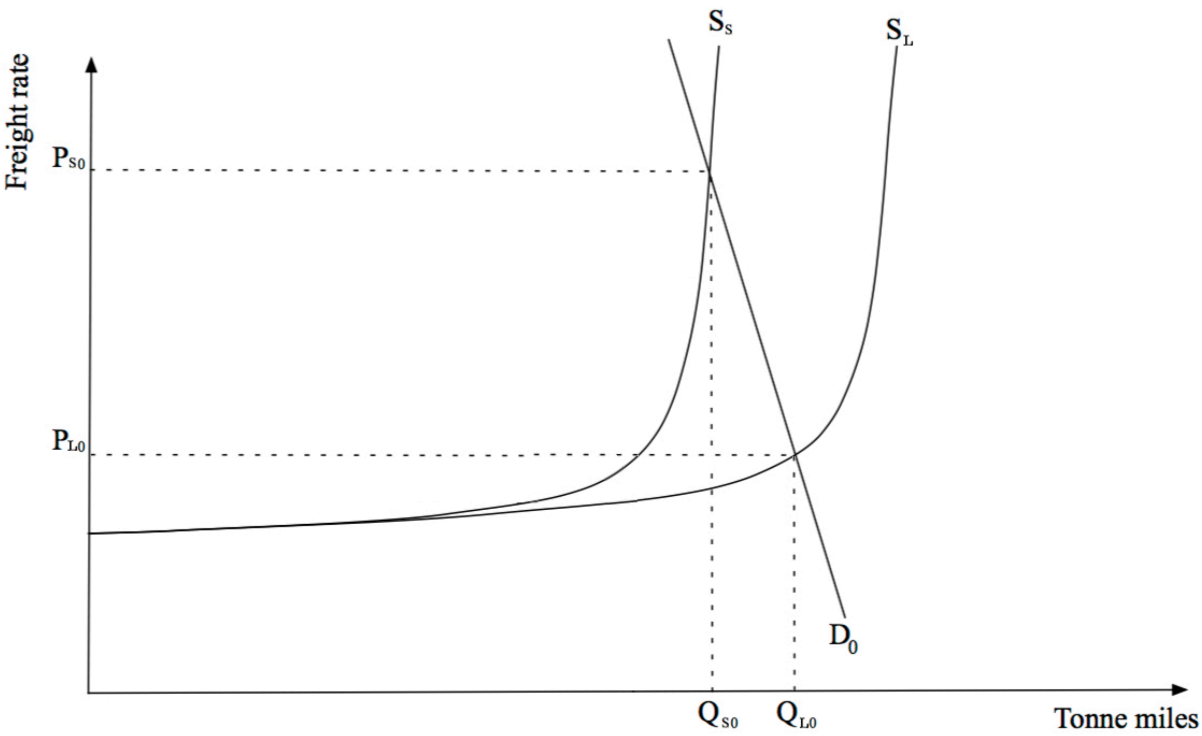

Figure 3.2 Supply and demand functions with increased supply (Thorsen, 2010, p.66)

In the short-term there are limited options to adjust the supply of transportation. In Figure 3.2 above, the short-term supply is given by S_S. On the left side of the supply curve the freight rates are so low that shipowners prefer to put their least efficient vessels in lay-up and the operative vessels slow down. Moving right on the supply curve it begins to slope upwards, the freight rates increase, the shipowners have the entire fleet back in operation and the vessels begin to sail faster. Further up the curve the freight rates are even higher, and at this point the fleet is operating at full speed. At the maximum freight rates the supply is utilized optimally and the only way to enlarge the supply further is building more vessels. Other than increasing the speed, shipowners can ensure more efficient use of the vessels.

In the long-term there are more choices available for the decision makers. The supply of vessels is decided by the shipowners. They decide when to order new ships, when to put existing vessels in lay-up in anticipation of better times and when to sell or scrap the old vessels. By building new vessels the shipowners can increase the tonne-mile capacity, and S_S shifts to S_L, as illustrated in Figure 3.2 above. The freight rate aspect of changes in demand, price and quantity will be discussed in the following section, Chapter 3.2.3.

Supply variables

On the supply side of the shipping market model, the five variables are world merchant fleet, fleet productivity, shipbuilding production, scrapping and losses, and freight revenue. The decision-makers are the main players who influence and control the supply by altering the capacity of the fleet. Decision-makers are considered to be shipowners, shippers or charterers, bank lenders and regulators. With such a limited group of executives relationships are formed and the participants try to predict the actions made by the others before analyzing the options and making their own decisions. This results in other outcomes than if they were making decisions independently.

The shippers of goods can affect the supply through the time charter contracts with shipowners, or they can decide to take on the role as shipowner themselves for further control. The banks lending to the shipowners have influence when it comes to the investments that a company is able to take on, and in rough financial times will sway the clients to limit investments and reduce the advance rate on loans. The regulators, who pass policies and laws concerning the environment and safety in the global or national arena, have a more administrative role. As previously mentioned in Chapter 2.2.2 the IMO issues global rules and regulations with the main goal to make shipping safer. With the double hull requirement IMO imposed specifications on the design of tankers, and the shipowners were obliged to follow the new legislation and adapt their fleet to the new rules in their geographical area.

World merchant fleet

The composition of the global fleet can be viewed as a long-term supply function that changes over time in response to developments in the demand. As the vessels have an expected lifespan of about 25 years, alterations in the size of the fleet take time, both when demand grows and declines. The main segments are oil tankers, bulk carriers and container ships. More specialized vessel types are combined carriers that can carry both dry cargo and liquids, multipurpose vessels that can transport both containers and other cargo such as forest products, ro-ro that carry rolled cargo that is rolled on and rolled off, chemical vessels and LPG and LNG vessels carrying liquefied petroleum gas and liquefied natural gas respectively.

Although the segments might seem separated due to specialization, the markets are not self-contained. Taking advantage of profitable conditions in other sectors by moving the vessel between segments is common in order to benefit from the loose limits of the shipping markets. Some vessels are built for flexibility between segments, such as combined carriers, which can transport oil on one leg and dry bulk cargoes on the return voyage, or make periodical switches. Vessels may also make less drastic switches, such as between clean and dirty petroleum products. A general observation is that the vessel sizes are growing to take advantage of economies of scale. The bulk and tanker markets have experienced the most significant growth, though in the tanker market the peak was reached in the late 1970s.

Fleet productivity

The fleet productivity is reflected in the short-term supply function. Productivity is the main factor determining the supply of shipping capacity in the short-term, as the number of vessels in the fleet is given. Important factors that influence the efficiency are speed, time spent in port, deadweight utilization and the relationship between loaded days and non-trading activities. When the demand for seaborne transportation rises, shipowners can adjust the supply of vessels by increasing the speed, exploiting the capacity to the maximum by avoiding partial cargoes and maximizing the time spent at sea by delaying non-essential repairs and cutting time in ports.

Slow steaming, operating at speeds lower than the design speed, is common and can be used as a means to reduce emissions as well as saving bunker costs. The good organization of port infrastructure helps to reduce time in port, and with adequate capacity in port, congestion can be minimized. The amount of space that bunkers take up of the total deadweight of the vessel affect the overall productivity by influencing the amount of cargo that can be transported. A high share of loaded days compared to idle days is important to be profitable. When the demand for seaborne transport is low and the day rates decline, vessels that are not able to make money are put in lay-up or can be used for storage.

Shipbuilding deliveries

The business of shipbuilding is one of the reasons for the long cycles in shipping. The time-lag from shipowners order new vessels to when they are delivered is about one to four years. Projections based on the expectations of the demand for transportation in the long-term are the shipowner's most important tool, but are unreliable. Political intervention to support jobs or to obtain the status as a leading shipbuilding nation, can influence shipping cycles as the politicians make decisions that are in the best interest of their country, and not the shipping market.

Scrapping and losses

The removal of vessels from the world fleet is primarily done through scrapping, where the ships are sold for the steel value, taken apart and the steel is reused. Scrapping is primarily influenced by the age of the vessel, as it affects the general state of the ship with increased needs for maintenance, which costs money and takes time away from trading activities. The technical specifications of the ships and gear develop continuously; consequently, with time the vessels and equipment become outdated. The current earnings determine if a ship is profitable or not, and is the key determinant for scrapping. Scrap steel prices are also a factor; however they tend to be low when the market is struggling and scrapping is a more sensible alternative. The market expectations are essential for the shipowners' decision to scrap or to hold on to an unprofitable vessel for a while to wait for an upswing in the market. The four main countries for demolition are India, China, Pakistan and Bangladesh (Clarksons, Shipping Review and Outlook, 2015b).

Freight revenue

The ultimate regulator of the supply market for maritime transportation is the freight revenue. In the short-term the rates encourage the decision makers to make adjustments to the capacity that they control in the market, for instance by taking ships from lay-up as prices increase or by speeding up to increase productivity. When it comes to the long-term perspective the main factors for the decision makers are to implement cost reductions and to upgrade the services that they offer. The rates affect the investment decisions of when to order new ships and when to scrap vessels.

3.2.3 Freight market

The freight market is the third part of the shipping market model, and it is the mechanism that balances the demand and supply. The shipowners negotiate with the charterers to agree on a freight rate, which reflects the current equilibrium in the market of available vessels and cargo. When the fleet operates at close to full capacity and there is limited ability to enhance the efficiency of the ships, the freight rate is high. Freight rates are low when there is an oversupply of vessels. The freight rate is adjusted in order to clear the market by balancing the supply and demand. High rates stimulate added capacity of vessels, and lay-up becomes an alternative if the rates are low enough.

The supply and demand functions

From Figure 3.2, under the supply side theory in Chapter 3.2.2, it was stated that in the short-term the supply is set at S_S, while in the long-term it can expand to S_L and the supply increase as the freight rate rises. Figure 3.3 below shows additional shifts in the demand curve and the effects on the freight rate.

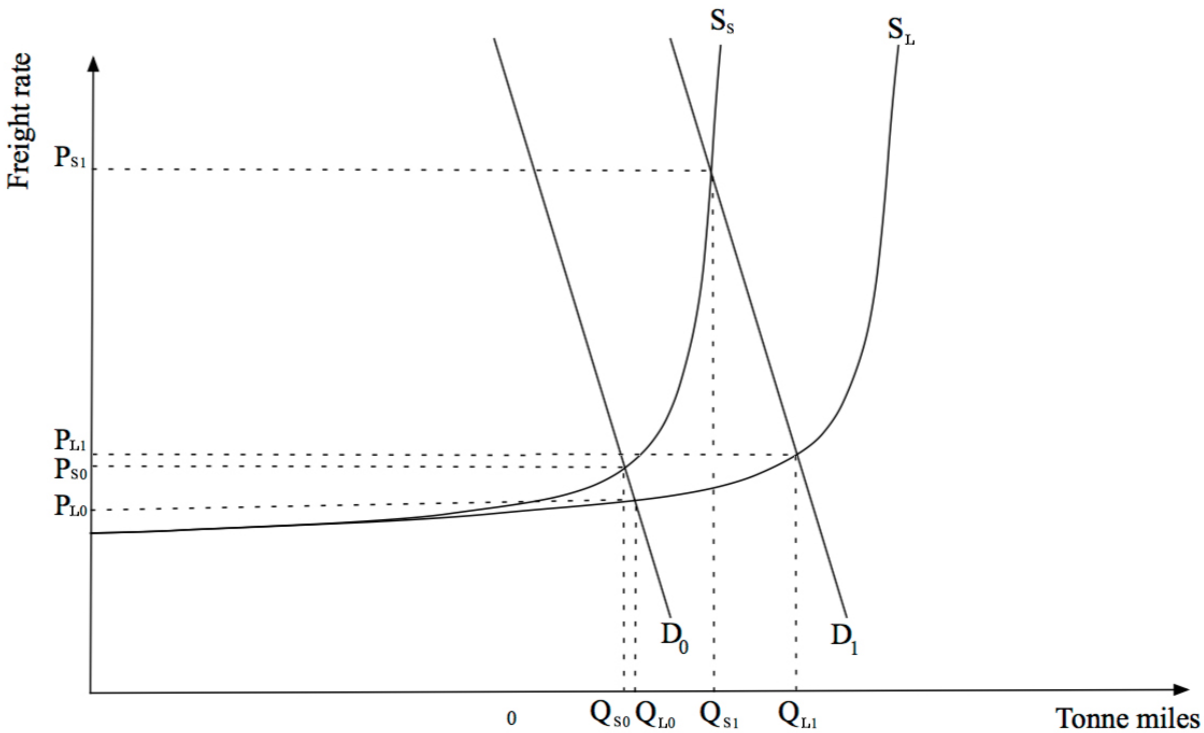

Figure 3.3 VLCC fleet supply and demand functions with shifts for both

In the short run the freight rate is P_{S0} for the initial demand, D_0. If the demand suddenly increases, while the supply curve is unchanged in the short-term, the freight rate will rise to balance the supply and demand again, this time at P_{S1}, a significantly higher rate. At this point the whole fleet will be working with limited spare capacity and the quantity of goods transported has increased from Q_{S0} to Q_{S1}. With a longer time frame shipowners have the option to order additional vessels to expand the fleet and tonne-mile capacity, and the supply curve moves to S_L. As a result of the increased supply the quantity transported, Q_{L0}, with the initial demand, D_0, is minimally larger, and the freight rate is at P_{L0}. If demand increases, shown by a shift in the demand curve to D_1, the amount shipped increases significantly now that the supply of vessels for transportation has increased. The new volume is Q_{L1}, and the corresponding high freight rate, P_{L1}. At Q_{L1}, the highest volume in the graph, the freight rates are still at the low end of the scale and capacity is not pushed to its limits either.

Importance of time

As previously mentioned in Chapter 3.2.2, the time frame is an essential aspect of the freight rate. The three time intervals to assess equilibrium are momentary, short-term and long-term. Momentary equilibrium is the spot market where contracts are agreed for immediate completion, which leads to regional markets of shortages and surplus. The short run equilibrium gives shipowners some time to adapt to the supply by taking vessels in or out of lay-up, adjusting the speed or to switch markets in terms of regions or cargoes carried. In the long run building new ships, trading used vessels in the second hand market and scrapping old vessels are options for the shipowners, and the charterers can change the demand of raw materials to alter the needs for transportation. As freight rates decline in poor economic times, the value of used vessels decrease some to scrap prices, where scrapping irrevocably removes them from the market. Low demand can also lead to the conversion of surplus tonnage, for instance temporarily repurposing crude tankers for oil storage or converting offshore vessels for use in wind farms either temporarily or permanently. In favorable markets, the freight rates increase and shipowners would like to add more ships to their fleet. Some charterers may expand their operations by purchasing vessels to integrate shipping instead of outsourcing the transportation. The price of used vessels may even exceed the price of new ships, as prompt delivery and generation of earnings in the strong market is valuable, compared to waiting for a vessel to be built and delivered in uncertain or weaker market conditions.

The effect of sentiment in a market leads to other results than the basic supply and demand of the market that has been described previously. It can shift rapidly and it is harder to anticipate. For instance, if shipowners have more confidence, have superior knowledge and are willing to retain vessels, they may obtain higher earnings than the given balance of supply and demand normally would achieve. Likewise, if charterers are strong, assertive and well informed they might be able to negotiate a lower rate than usual. Generally, shippers have the advantage when negotiating freight rates during recessions, while shipowners have the upper hand during booms.

The time-lag between the time a decision is made and the time it comes to life is the dynamic adjustment process. The time-lag of shipbuilding results in excessive ordering when the rates are high, however, as the ships are not delivered for a few years and if a significant part of the orderbook is delivered at the same time, the rates decline. As the market has a tendency to diverge from the path predicted before shipowners placed their orders, the new ships entering the world fleet may end of further disturbing the current balance. Next, emotions and not always rational decisions play an important part of cycles, and tend to cause investors to respond to the top and bottoms of the cycles that can be volatile and sudden. Lastly, major crisis prompts a significant adjustment in the fleet, larger than the cycles of newbuildings and scrapping.

4 Development of the oil price from 2005 to 2015

In this chapter the focus will be on the development of the oil price between 2005 and 2015. For this purpose the Brent blend is the chosen crude benchmark to explore in further detail. Brent is the main global benchmark for crude oil, and it is the marker to price two-thirds of the world's physical crude market.

4.1 Brent blend

As previously mentioned in Chapter 2.1, the Brent blend crude benchmark is a light and sweet blend of oil from four oil fields in the North Sea. Originally the benchmark Brent was based solely on the single Brent field. At the peak in 1984 the field produced over 400,000 barrels per day, but after varied and declining output the other fields were added to the Brent blend. In 2015 the Brent field was producing less than 1,000 barrels per day, and it was expected that the field will be closed down and the Brent blend will continue without the Brent crude (EIA, 2016c). The discussions on what will happen to the Brent blend is intensified due to the weakening output from the three other fields as well, and further enhanced with the low oil price, which has given the producers little incentive to invest in the mature fields to boost production. Suggestions to secure Brent as the main benchmark include adding more oil fields in the region to the blend, most likely British Flotta, and Statfjord and later Johan Sverdrup from Norway. Others suggest widening the scope and including oil from new regions, apparent candidates being the Russian Urals and West Africa, both with concerns regarding the differing quality from the current Brent blend and the geopolitical environment, and frequent disruptions and differing loading schedules respectively. After the United States lifted the ban on crude oil exports WTI might regain strength as an international benchmark and possibly take back the position as the primary global price reference (Martén and Jiménez, 2015).

4.2 Oil price fluctuations

The historical development of the oil price in a long perspective was commented on in Figure 2.2 in Chapter 2.1.2, while Figure 4.1 below shows the price of the Brent blend from 2005 to 2015 in USD per barrel. In the following the oil price is referred to in USD, while it is understood that the price is per barrel.

The oil price is the result of two main factors, the supply and demand in the market and the future expectation. The supply is subject to problems with weather and geopolitics, demand is closely related to the economic activity, as well as seasonal needs for heating and air conditioning. Expectations of an oil price increase can lead to increased investments or stocking, and reversely (The Economist, 2014).

Between 2003 and 2008 the world experienced periods of substantial growth of demand in general, and demand for oil in particular. That was combined with slow supply growth worldwide due to little excess capacity to expand the production in order to respond to the increasing demand (EIA, 2016d). As with any other commodity with a limited supply, the prices for crude oil rose, particularly from 2005.

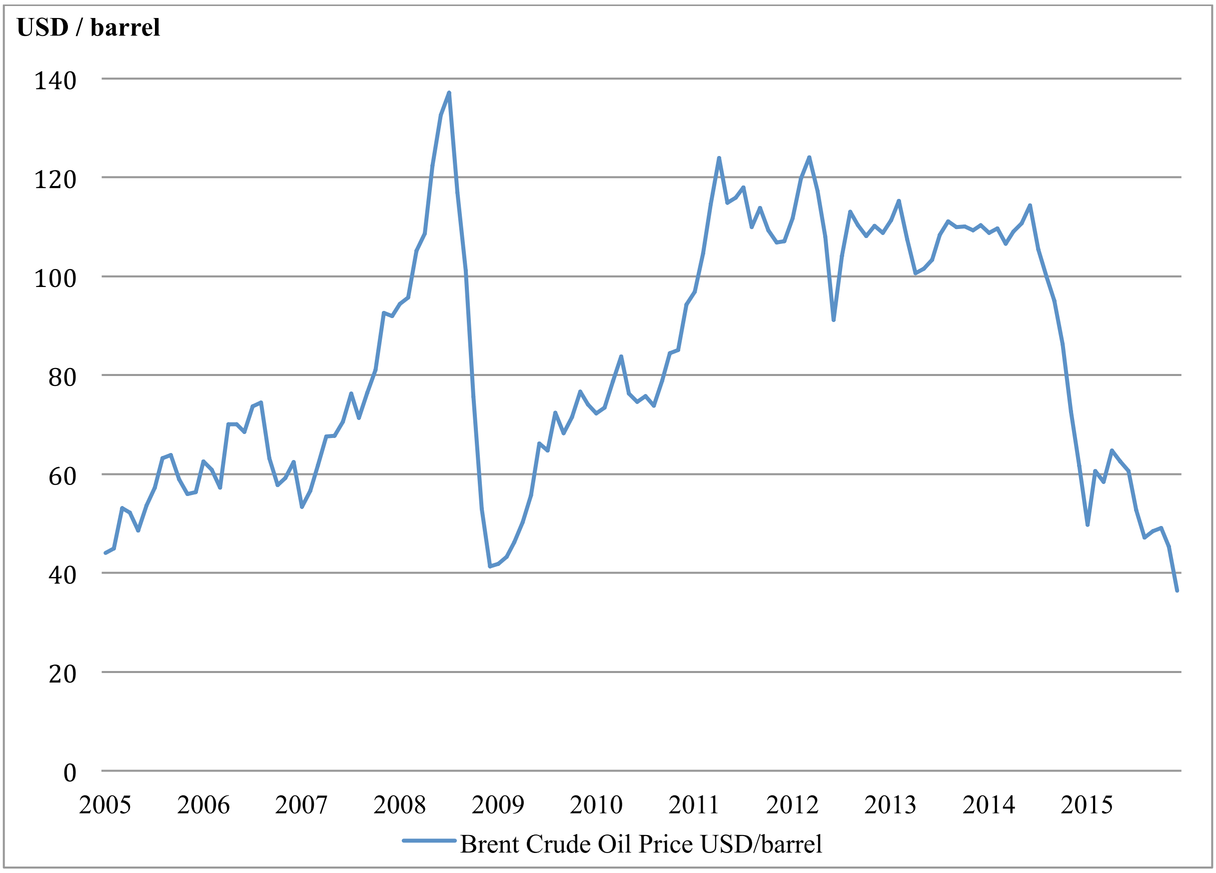

Figure 4.1 The Brent crude oil price, monthly data from 2005 to 2015 (Clarksons, Timeseries, 2016b)

Economic growth has a strong influence on the consumption of oil in non-OECD countries, thus when the global economic crisis hit in 2008 the prices on Brent crude dropped quickly, like the GDP, before it came back up. In OECD countries there has been a strong correlation between increases in the oil price and lower demand for oil. OPEC reductions in the targeted production of 4.2 million barrels per day contributed to raise the oil price from a low of USD 32. With higher expectations about the growth of the global economy, the crude price increased. Another important factor behind the increasing prices from 2011 was the unplanned disruptions of the oil supply around the world, which tightened the supply of oil and led to further price escalations (EIA, 2016d). Subsequently, the significant reduction in crude imports by the United States as a result of the shale oil production, led to less demand for oil and falling oil prices. To protect their market share OPEC decided to let the market correct itself and allow the prices fall instead of reducing the production to support the prices.

4.2.1 Main tendencies

There was substantial volatility in the oil price between 2005 and 2015. It is possible to divide the era in six periods of broad changes in the oil price, and this will be used as the framework to elaborate on the development of the oil price and see it in context with global events. A similar, though slightly different, division will also be used in the analysis of the tanker market in Chapter 5.

2005 – 2006: some volatility

The oil price went up by 40% in 2005, however, in a long-term perspective 2005 and 2006 had some volatility, with prices ranging from USD 44 in the beginning to a high of USD 74 in August 2006, before declining to USD 57. The oil price went up as a result of Hurricane Katrina that hit the Gulf of Mexico in August and caused refineries and pipelines in the region to close down. As the facilities re-opened the prices stabilized (USA Today, 2005).

2007 – July 2008: steep increase

From early 2007 the oil prices had a steep increase until July 2008 as a result of a strong demand for oil, particularly from China, while the supply was stagnating. In the past Saudi Arabia had been quick to adjust the production to keep the oil price stable, however, this time export volumes declined. The unexpected decline, despite the high demand, contributed to the rising oil prices. Another possible reason for the strong growth in oil prices is speculation in future contracts of commodities by investment funds that assisted in driving up the prices (Hamilton, 2009). OPEC reduced the production quotas twice in the fall of 2006 and winter of 2007, which caused the balance of supply and demand for oil to tighten, and as a result the oil prices increased (Clarksons, Shipping Review and Outlook, 2007b). The depreciation of the American dollar, limitations in refinery capacity in the fall due to maintenance, and extreme weather were other factors that affected the oil sector during 2007 (UNCTAD, 2008). As the tension between Iran and the Western world increased in July of 2008 when Iran tested missiles, the oil prices surged to the record high USD 147 per barrel. The market feared military pressure by the United States or Israel might prompt Iran to block the Strait of Hormuz where, as mentioned in Chapter 2.2.3, 40% of the global tanker traffic passes through (Hopkins, 2008).

August 2008 – December 2008: dramatic decline

The oil price started to decline in August of 2008, and significantly from October, after the Lehman Brothers was declared bankrupt without intervention by the American government. This led investors in the western markets to flee their investments in banks in fear of the increased risk, which forced governments to support the banks with large capital injections to enhance the solvency and prevent further collapses and panic. The global financial crisis is considered the most severe crisis to hit the international economy since the Great Depression (Elliott, 2011). In the fall, oil prices fell by 70% due to the weakening of the global economy and subsequent reduction of oil consumption. The members of the OPEC cartel agreed to reduce their production target with 4.2 million barrels per day effective January 1, 2009, which corresponded to about 5% of the production worldwide (Mouawad, 2009).

2009 – April 2011: increased oil prices

Following the reductions in production by OPEC, which were held with unusual discipline to respect the agreement made, the oil prices stabilized and started rising from the low of USD 32 per barrel. By October the oil price had risen to USD 71, supported by a weak dollar as well as optimism over the recovery in the global economy.

The Arab Spring of 2011 started in Tunisia in December 2010, and the turmoil and violence spread to Egypt and other Arab countries as the populations' desire for freedom and democracy grew. In February of 2011 the Brent crude jumped 15% in four days to USD 120 per barrel due to fear that the uproar in Libya and Bahrain could spread to other Middle Eastern countries with large oil production, such as Saudi Arabia. The oil production in Libya had dropped by 75%, with only 400,000 barrels remaining per day. At the time Saudi Arabia supplied 10% of the global demand, so a disruption would create severe oil shortages and further increases in prices, which in turn would harm the global recovery process following the financial crisis (Kollewe, 2011). The short-term effects on the oil market were the fear of contagiousness and changes in the dynamic of the oil price. While Egypt is a small oil producer, it controls the Suez Canal, and as mentioned in Chapter 2.2.3 the shortcut was used for 8% of the global maritime oil trade in 2013. The geopolitical influence in terms of the probability of disruptions in the region gained importance in the analysis of oil market dynamics, which was reflected in the oil price level and volatility (Darbouche and Fattouh, 2011).

The long-term effects of the Arab Spring on the oil markets include more frequent disruptions in oil productions in the region and reduced capacity of production in the long run. Some governments have kept the domestic energy prices very low in order to distribute the wealth from the oil to the population. Plans of reform for higher prices were put on hold during the turbulent time, and government expenditures were increased for housing, creating jobs, higher minimum wages and unemployment benefits. The higher government expenses make the oil producing countries more dependent on the income from high oil prices (Darbouche and Fattouh, 2011).

April 2011 – June 2014: volatility

The oil price remained relatively stable from the peak in April 2011 at USD 123 to June 2014 when a barrel was priced at USD 114. However, there was an increase in the fall of 2011 and a sharp decrease from March to June of 2012. The price of oil increased due to the shrinking of spare production capacity after Saudi Arabia grew its production. In March 2012 the global production of oil surpassed the consumption, as a result of steady increase in capacity as well as the consumption that had started falling at the end of 2011 due to energy efficiency and the economic downturn (Philips, 2012). As a result of the high oil prices, energy saving technology became more cost effective, and it also made new oil sources more advantageous, for instance shale oil in the United States and new offshore oil fields in the Gulf of Mexico and Brazil (Clarksons, Shipping Review and Outlook, 2013a). Throughout the late part of the phase the oil price primarily stayed around USD 110.

June 2014 – 2015: downturn

The most recent dramatic drop in the oil price commenced after a peak of USD 115 per barrel in June of 2014. The supply of oil increased significantly with the shale oil fields in the

United States. This also dramatically decreased the import to the United States, and the demand from Europe and China fell. The OPEC cartel decided to abstain from cutting their output and market share to strengthen the oil price. The demand for oil has decreased due to the weak economic activity, switching to other fuel sources as well as an upturn in efficiency. The Saudi countries have a vast oil reserve that is inexpensive to extract compared to other regions. The oil platforms in the North Sea are high-cost projects of maturing fields at large water depths that require a higher oil price to be profitable (The Economist, 2014). The risk-seeking investors in the American shale industry placed capital acquired cheap in shale oil companies, which worked well at the high oil prices. Currently the collapse in the oil price has led to companies saddled in debt and unable to expand at the recent price levels (Bertelsen, 2016).

The slight improvement in the oil prices in the first few months of 2015 was due to a reduction of 24% in the number of American offshore rigs from October 2014 to January 2015, which received massive attention from analysts (Lindeberg, 2015). However, the rise in prices was short-lived and it fell further as a result of extensive stocking of oil to wait for higher prices and continued supply of cheap oil in a saturated marked. The lowest oil price during the decade was USD 36 in December of 2015.

The overview of oil price developments above has shown that while economic activity in general is clearly an important factor, both changes in expectations and sudden political developments can have a massive effect on the oil price in the short term. This volatility, which comes on top of long-term developments, certainly poses massive challenges for tanker companies, whose activities depend on the oil price and production patterns.

5 Analysis – the effect of the oil price on the tanker market

In this chapter the theory of the shipping market model, which was introduced in Chapter 3, will be applied to explain the developments in the main shifts to the tanker rates.

5.1 Factors driving the development

Figure 5.1 below shows the development of the Worldscale (WS) earnings for a VLCC voyage from Ras Tanura to Rotterdam, and the price in USD per barrel of Brent crude oil, both from 2005 to 2015.

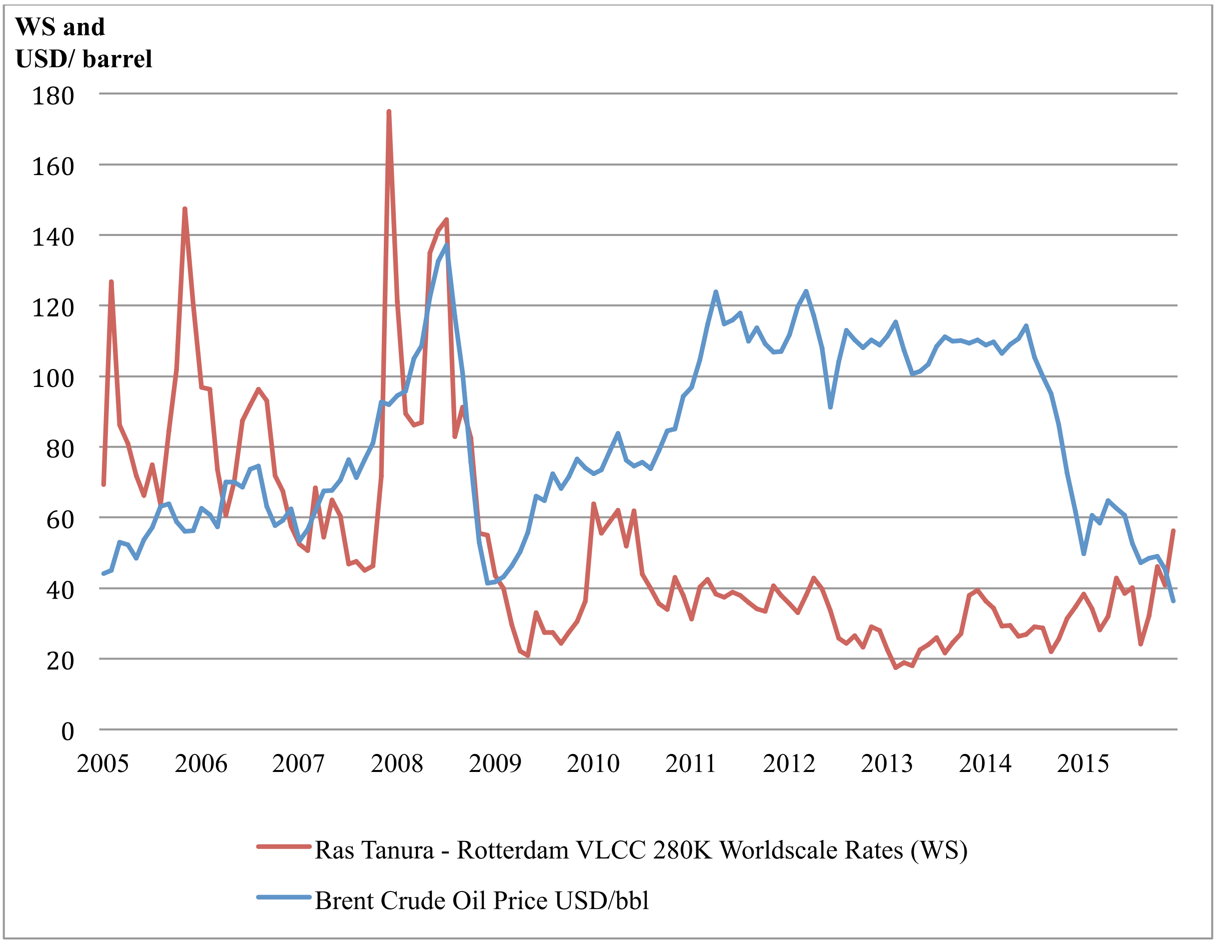

Figure 5.1 VLCC earnings from Ras Tanura to Rotterdam and Brent crude oil, monthly data from 2005 to 2015 (Clarksons Timeseries, 2016f)

Looking at Figure 5.1 the decade can be divided at the end of 2008. During the first period, from 2005 to 2008, the tanker rates typically were high while the oil price started out low and then increased. In the second period, from 2009 to 2015, they moved in opposite directions, and the oil prices were constantly high and the tanker rates were low. In October 2015 they moved in opposite directions again, after almost seven years at differing ends of the chart, when there was an increase in the Worldscale and a decrease in the oil price. A higher degree of correlation between the two can be seen in the period from 2007 to 2009, before they diverged. However, to give a more nuanced analysis the era will be divided into a few more periods.

The division of the six periods in Chapter 4 was made based on the broad changes in the oil price. However, in order to be able to work with annualized numbers in the analysis, some changes have been made. For this chapter there are five periods, as seen in the left column of Table 5.1 below. The demand and supply variables from the shipping market model are the main categories. The figures in the table refer to compound annual average growth rates for the years in the left column, compared to the last year before the beginning if the period in question. Transport costs and freight revenue are two complementary variables from the Stopford model that have been omitted, as it makes little sense to analyze the freight rates with freight rates.

	Demand			Supply			
	World economy	Seaborne commodity trade	Average haul	World merchant fleet	Fleet productivity	Shipbuilding deliveries	Scrapping
2005 - 2006	5.3%	1.2%	0.5%	4.2%	-2.9%	5.5%	0.1%
2007 - 2008	5.7%	0.3%	-0.2%	3.1%	-1.9%	7.4%	0.3%
2009 - 2010	1.5%	-0.8%	-0.4%	4.6%	-5.0%	10.4%	1.8%
2011 - 2014	4.3%	-0.9%	1.8%	4.5%	-2.1%	7.1%	1.8%
2015	3.4%	3.9%	-0.9%	3.1%	1.2%	3.2%	0.3%

Table 5.1 Compound average annual change of the demand and supply variables (Sources: see text below)[11]

[11] A table with the underlying data material can be found in Table 7.2 in the appendix.

The results have been divided into three colors in order to give a visual aid to the main developments. Green is given to positive figures over 1.5%, yellow is for figures from zero to 1.5% and red is given to negative figures:

- The "world economy" is measured by the average annual world GDP growth (Clarksons, Timeseries, 2016j).
- The tonnes of crude oil transported annually is used to measure the average growth in "seaborne commodity trade" on an annual basis (Clarksons, Seaborne Trade Monitor, 2016).
- "Average haul" is calculated by dividing the tonne-miles for all types of crude tankers by tonnes of crude transported to find the distance in miles for the average voyage, and the average annual change (Clarksons, Seaborne Trade Monitor, 2016).
- The "world merchant fleet" is measured by the annual average change to the total dwt of the VLCC vessels, as it gives a more accurate description of the capacity than the number of tanker vessels (Clarksons, Timeseries, 2016h). The change is the result of deliveries, conversions, losses and scrapping.
- The "fleet productivity" is calculated by the utilization rate; dividing the total tonne-miles for crude oil by the dwt capacity of the total crude tanker fleet. The figure in the table refers to the average annual change (Clarksons, Seaborne Trade Monitor, 2016) (Clarksons, Oil & Tanker Trades Outlook, 2008, 2012 and 2016a).
- "Deliveries" and "scrapping" refer to the average annual change in dwt for VLCCs compared to the existing fleet (Clarksons, Timeseries, 2016h).

"Random shocks" are hard to measure quantitatively, and are described in a qualitative approach in the subsections that follow.

Figure 5.2 below gives a graphic presentation of the development of the average distance and average deadfreight for VLCC vessels. The development differ slightly from that presented in Table 5.1, as the entire fleet of crude tankers was used to calculate the average haul, while this is an illustration of solely the VLCCs. As for the deadfreight, this is a productivity measure of the VLCC fleet, however, it only considers vessels that are trading and does not include vessels in lay-up as it does in the fleet productivity stated in Table 5.1. Deadfreight is the unused space on a vessel that a charterer has paid for but did not use (Law and Sea, 2014).

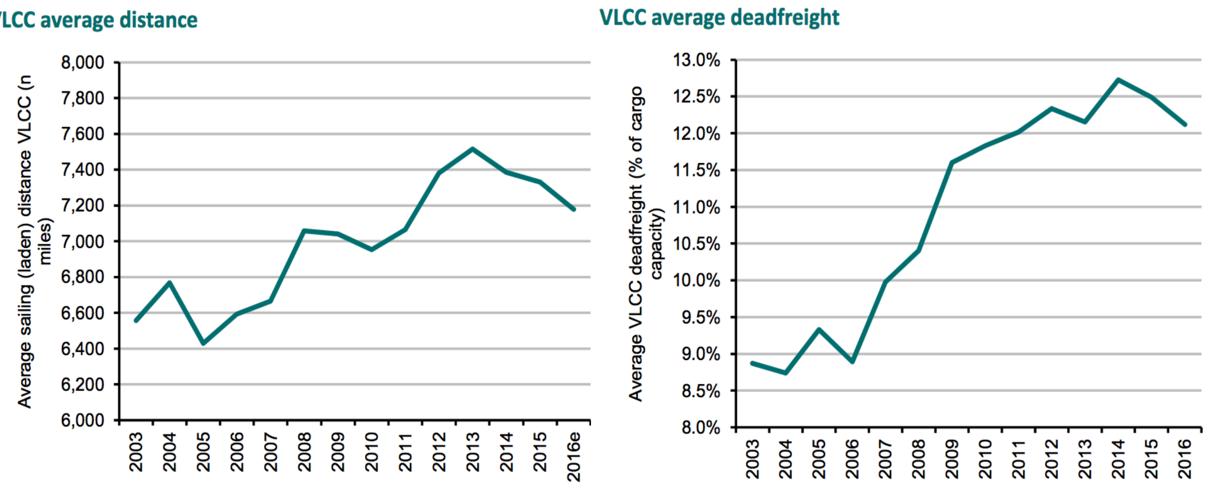

Figure 5.2 VLCC average distance and VLCC average deadfreight from 2003 to 2016 (DNB, 2016b)

5.2 Oil price and freight rates in five different periods

5.2.1 2005 – 2006: emerging markets drive growth

Throughout the two years, the oil price climbed from a low starting point and ended at USD 62 in December 2006. For the tanker rates there were two distinct peaks during the time period – in February and November of 2005. The increases were rapid and the decreases following the peaks almost equally sharp. However, when looking at the freight rates at the end of 2004 they were much higher, and the rates in January 2005 were a strong correction before the upwards rebound in February. The peak in November was a result of seasonal swings combined with a shortage of VLCC vessels. In short one can say that in this period the tanker rates were high, while the oil prices were low.

Demand

Throughout 2005 and 2006 the world economy continued to grow, with particularly rapid growth in emerging economies as India and China. The global trade of merchandise grew by an average of 5.3% annually during 2005 and 2006, as a result of increased globalization and economic integration. The global seaborne trade was significantly strengthened in 2005 with a growth rate of 3.8% and 4.3% in 2006. China continued the strong increase in export with over 20% per year, which as mentioned in Chapter 3.2.1, is quite common for economies working to advance to developed countries (UNCTAD, 2006 and 2007).

The VLCC rates started increasing towards the peak in November 2005 due to seasonal variations. The upcoming winter in the Northern Hemisphere annually drives up the demand for oil to use for heating, and with that the demand for transportation by tankers. The rate increase was further lifted due to a shortage of VLCC vessels with double hulls to discharge in the Gulf of Mexico in October. December was a slower month in the market, as usual, and the rates dropped again (Clarkson, Shipping Review and Outlook, 2006a). In the summer of 2006 the oil prices increased in part as a result of speculation on the upcoming hurricane season before softening, as it was significantly less bad weather than the previous year (Clarksons, Shipping Review and Outlook, 2007a).

As stated in Chapter 4.2.1, Hurricane Katrina hit the Gulf of Mexico hard in August 2005, and can be considered a random shock to the economy. For the oil industry this resulted in the closing of 14 refineries for weeks, which normally have an output of 2.2 million barrels per day. With the American refineries working at a capacity of 90%, the effect of unanticipated downtime was strong and resulted in a short-term increase in the demand for oil products across the Atlantic. However, this is only visible indirectly on the Ras Tanura to Rotterdam voyage of the example.

The difficulties for the refineries were further amplified by the stricter regulations for sulfur emissions from gasoline imposed in January 2005 by the European Union, as well as several Asian countries that shifted the production to the desired gasoline. Due to the large supply of Middle Eastern oil, as well as other new fields at the sour and heavy end of the scale, the global demand for refineries able to handle heavier crudes was anticipated to increase (Clarksons, Review and Outlook, 2005a). Furthermore, the only facility for offloading VLCC tankers in the United States was closed for a fortnight due to the damages (UNCTAD, 2006). This resulted in inadequate local supply of oil in the medium term, which caused alterations in the demand for oil in the global market. In this case the damages to the offloading facility contributed to higher demand in the United States for the sweet crude from West Africa rather than the sour crude from the Caribbean, that was shipped east instead (Frontline, 2005a). As previously mentioned in section on density of the oil in Chapter 2.1.1, refineries favor different benchmark oils for their characteristics and desired output.

The shift in demand caused changes in the trade routes of the crude tankers with longer distances and, combined with the high seasonal demand before the winter, the freight rates were pressured upwards. In 2005 the transportation of oil, including both crude and products, grew by 3.8%, and in 2006 by 2.8%. The average haul increased only 0.5% on average during

2005 and 2006 for the transportation of crude. The cost of transportation increased, as the bunker prices increased by USD 100 per tonne during the two years (Clarksons, Timeseries, 2016i). Although this sounds like a large increase for bunkers considering that the cost of oil went up with USD 18, the two are tightly correlated. The increase in bunkers price led to bunkers costs representing a larger share of the total freight costs, and peaked at 40% of the freight costs during the fall of 2005. This was a significant increase from the long-term average of 19%, leaving relatively less profit for the shipowners (Clarksons, Shipping Review and Outlook, 2005b and 2006b). Although the profit margin decreased in relative terms as a result of higher bunker prices, the significant increase to the freight rates still made it possible for the shipowners to make a profit, as they maintained a lower percentage of a higher figure. In the fall of 2006 the average VLCC vessel earned 145% above the 1990s average value. The average was pulled up by high spot rates and one-year time charter contracts, while the five-year contracts experienced a slight decline. The VLCC rates increased more than the smaller oil tankers, indicating a preference for the larger vessels (Clarksons, Shipping Review and Outlook, 2006b).

Supply

In 2005 the global VLCC fleet consisted of 449 vessels, of which 284 had double hulls. The worldwide fleet of tankers increased the dwt capacity by an average of 4.2% in 2005 and 2006 (Clarksons, Timeseries, 2016h). The age profile of the VLCC fleet was relatively modern at the end of this period. The large expansion of the fleet in the 1970s had been phased out, and with few vessels delivered in the following years the dwt capacity of the vessels built in the early 1980s was low. As a result of the low capacity of vessels near the likely demolition age of 25 years, it was expected that the scrapping of VLCCs would remain low in the next few years. Looking at the age structure of the fleet there were two periods of large deliveries: in 1993 and around 1999 to 2005 (Clarksons, Shipping Review and Outlook, 2007a).

The productivity of the fleet is the main focus for shipowners in the short-term. Due to Hurricane Katrina and the repercussions with closed refineries and damaged oil installations, tankers in the area were delayed. This limited the supply of vessels in the short-term and lowered the productivity (ISL, 2006). Looking at the utilization rate presented in Table 5.1, it can be seen that it decreased by an average of 2.9% annually during 2005 and 2006 compared to the level in 2004. This tells us that the number of tonne-miles transported during the year did not increase enough to absorb for the larger dwt capacity for the total crude fleet, which resulted in the decrease. During the last half of 2006 the VLCC rates declined in a unseasonal downturn due to decreasing oil demand in OECD following mild weather, as well as lower oil export by OPEC to support the oil prices (Clarksons, Shipping Review and Outlook, 2007a).

For the VLCC fleet there were a total of 49 deliveries in 2005 and 2006, or an average annual growth of 5.5% of the current fleet, increasing the number of double hull tankers in the fleet in anticipation of the new IMO regulations (Clarksons, Timeseries, 2016h). The orderbook in 2005 amounted to about 19% of the fleet at that time, and that share almost doubled to 38% in 2006 (Clarksons, Timeseries, 2016h).

Between 2005 and 2007 only one VLCC vessel was demolished, in 2005. This further supports the fact that the current earnings were too favorable to consider reducing the fleet by scrapping. If a shipowner wanted to reduce his fleet, the secondhand value was far more advantageous than the potential income from scrap steel, and selling it to another shipowner would be a more likely choice. In 2006 the average age of tankers was 10 years, which compared to the lifespan of a crude tanker that can vary between 20 and 30 years, could be considered a young fleet (UNCTAD, 2007). If an average vessel has an expected lifetime of 25 years, the expected yearly demolition would be about 4% of the fleet (Clarksons, Shipping Review and Outlook, 2014a).

5.2.2 2007 – 2008: from boom to bust

Throughout the first six months the tanker rates continued a slow descent, before turning in August 2007 and climbing rapidly to a peak in December 2007, and then softening in early 2008. The peak was due to the reduction of tanker capacity as single-hull VLCC vessels were converted for other purposes, a shortage of VLCCs available for hire in the Middle East, as well as a delay in the seasonal cycle (Clarksons, Shipping Review and Outlook, 2008a). In May 2008 the rates were growing quickly again, and the rates at the end of May were nearly twice those at the beginning of the month. Simultaneously the oil price increased strongly with a record high peak in the summer of 2008 at USD 137 per barrel, before suddenly dropping 40% in August. The descent of the oil prices continued for the last half of the year, as did the tanker rates. In short, both the tanker rates and the oil price were high for the majority of the time period, and then both dropped suddenly in the last quarter.

Demand

The world economy maintained the position as the main driver in the shipping market, including the tanker market. Measured by volume, more than 80% of the global trade of merchandise is transported by sea (UNCTAD, 2008). The firm growth, with an average increase of 5.7% annually for 2007 and 2008, was one of the strongest rates since the 1970s. However, the growth slowed suddenly at the end of 2008 due to the global financial crisis (UNCTAD, 2009). Particularly the developing countries, including Asia with China in the lead, as well as Eastern Europe and Russia, all maintained a robust growth (Clarksons, Shipping Review and Outlook, 2007a and 2007b). However, the global credit crisis led to a rapid drop in world trade influencing all transportation sectors, which included seaborne trade (Bondareff, 2009). Europe, the United States and Japan experienced significantly declining growth rates due to the slowing economy in 2008 (Clarksons, Shipping Review and Outlook, 2008a). The decreased demand for oil in the developed world during the third quarter of 2008 resulted in a reduction in the global demand for oil for the first time since the 1980s (UNCTAD, 2009).

During this period both the tonnes of crude oil transported and the tonne-miles associated with the voyages remained relatively stable when looking at the average annual change. In reality the volume of seaborne trade experienced a decelerated growth in the last half of 2008 across all sectors due to a substantial drop in the demand for consumer goods, a reduced industrial production in major economies as well as a reduced demand for energy. During 2008 the global tanker trade represented a third of the total seaborne trade (UNCTAD, 2009).

The high oil price in November of 2007 prompted an increase in oil production by OPEC to take advantage of the high earnings, which combined with low stock levels in both Asia and Europe resulted in a strong increase in the demand for tankers and consequently the tanker freight rates (UNCTAD, 2008). A significant drop in all tanker rates characterized the beginning of 2008 due to surplus tonnage after the holiday season and only moderate delays in the Turkish Straits that could have helped increase the demand for tankers. Another reason for the reduced freight rates was the halt in production due to the seasonal maintenance for the refineries, which led to lower demand for crude oil. The record high oil price was a strong influence on the increasing tanker rates and vessels were used for storage, which removed vessels from the market and further limited the supply of vessels. Another consequence of the high oil prices was that shipowners turned down the speed in order to reduce costs. This further limited the supply of vessels. While the tanker rates on the Ras Tanura to Rotterdam route declined by two thirds from December 2007 to December 2008, the majority of the other tanker routes experienced less severe declines. The routes from the Persian Gulf to Europe, Eastern Asia and Americas usually follow the season of the Northern Hemisphere with increased needs for heating during the winter. However, following the record high oil prices in the summer of 2008 that led to increased demand for oil involving speculation in further price growth, the freight rates collapsed when the oil prices dropped (UNCTAD, 2009).

During this two-year period the most influential random event was the global financial crisis, which as previously mentioned in Chapter 4.2.1, originated in the United States. The crisis was primarily due to banks taking on high risk with subprime loans without proper precautions. When the government refrained from saving the large financial institutions, with Lehman Brothers as the most well known example, agents in the global financial market realized the severity of the situation and panicked. In the globalized and interdependent economy the repercussions of the initial events spread quickly across the world influencing advanced as well as developing and emerging economies. The credit crunch resulted a reduction in trade finance. As banks did not issue letters of credit, cargoes could not be lifted, and this impacted global seaborne trade (UNCTAD, 2009).

During the first 18 months of this period the cost of 380cSt[12] bunkers in Rotterdam increased by almost 300%, while the oil prices increased by about 260%. During the remaining six months, both dropped to below the level at the beginning of the period (Clarksons, Timeseries, 2016i).

Supply

As previously mentioned in Chapter 2.2.1, there was limited VLCC fleet growth in the previous decade. The orderbook was at around 20% of the existing fleet throughout most of the previous decade, and some years as low as 6%. In 2007 the orderbook remained stable from the previous year, while in 2008 it increased strongly to about half of the total current global VLCC fleet, the highest of all the years studied (Clarksons, Timeseries, 2016h). During this two-year period the dwt capacity of the VLCC fleet increased by an average of 3.1%

[12] CentiStokes, cSt, is a centimeter-gram-second unit used to measure kinematic viscosity. 380 cSt is a typical reference grade bunkers. The low sulfur bunkers is more expensive

annually. However, as the growth in crude trade slowed, and the capacity was not reduced by congestion or a random shock as a hurricane, the tanker rates declined (Clarksons, Shipping Review and Outlook, 2007b). With the decreasing rates due to the economic crisis in all segments, the tanker market was fortunate and owners were still able to cover all costs in the fall of 2008 (Clarksons, Shipping Review and Outlook, 2009a).

From Figure 5.2, it can seen that during 2007 and 2008 there was an increase in both the distance travelled by VLCC vessels, as well as the average deadfreight of the cargo capacity of the vessels trading. This indicates that the fleet travels slightly longer distances, but with an increasing portion of the tanks empty. The high oil prices during the majority of the period resulted in shipowners adjusting the speed to save on fuel costs. As a result the overcapacity of the fleet was reduced when more vessels were required to service the same route (UNCTAD, 2008).

The delivery of VLCC vessels during 2007 and 2008 rose, reaching an average annual growth of 7.4% in terms of dwt compared to the existing fleet (Clarksons, Timeseries, 2016h). The vessels delivered during this time period were ordered before the financial crisis, at a time when continued strong demand growth was expected. The growing fleet capacity and the global economy experiencing a downturn resulted in a strong decrease in the freight rates towards the end of the time period (UNCTAD, 2009).

The average annual growth for scrapping during this period was 0.3% of the current fleet, which although low, was an increase from the previous period. All VLCC vessels demolished during the period were removed from the fleet in 2008, and as scrapping and the development of freight rates are negatively correlated, it corresponds well with expectations (UNCTAD, 2008). With the very low number of VLCC vessels demolished both during the previous period as well as this one, the backlog of potential vessels to scrap increased. Moreover, in anticipation of the IMO regulations for double hulls mentioned in Chapter 2.2.2, an increasing number of single-hulled VLCCs were removed from the tanker fleet. The vessels were converted to floating production storage and offloading vessels (FPSO) and very large ore carriers (VLOC), for use in the offshore industry and bulk market respectively. The removal of the single-hull vessels helped limit the supply of available vessels and helped stabilize the freight rates (Clarksons, Shipping Review and Outlook, 2008a).

5.2.3 2009 – 2010: recovery from the financial crisis

In January of 2009 both the freight rates and the oil price started out low, the lowest point for both so far during our time period, at WS 41 and USD 41 per barrel respectively. While the oil price started increasing quite quickly, the VLCC rates continued the downward path with a further 25% drop from February to March, but the bottom was not reached until May. In one year the rates had dropped almost 80%. In the following year the rates increased little. In early 2010 the oil prices picked up as a result of the increase in the oil price and optimism for the recovery, combined with a cold winter in the Northern Hemisphere. As the owners of VLCCs used for storage decided to take advantage of the higher oil prices and re-enter the market, the demand turned out to be inadequate to support the growing supply and the tanker rates weakened again (UNCTAD, 2010). While the demand for tankers responds quickly to changes in the economy, the supply side adjusts gradually, which causes capacity problems until the market balances again. At a glance, one would say that both the tanker rates and the oil price remained low during the time period, although the oil price experienced a healthier recovery.

Demand

Following the global financial crisis of 2008, the world economy took a serious dip. The industrial production declined sharply, with a 14% decline in the United States and Europe combined, and slightly more in Asia by February 2009 from the same time the previous year. The drop in industrial production was the most severe since 1950 (Clarksons, Shipping Review and Outlook, 2009a). In April 2009 the global industrial production hit the bottom and the slow growth started, particularly in Asia (Clarksons, Shipping Review and Outlook, 2009b). After the financial crisis the growth in industrial production helped increase the demand for oil in the emerging markets, primarily China, the Middle East and non-OECD Asia (Clarksons, Shipping Review and Outlook, 2009a). During this two-year period the average annual GDP growth in the world slowed significantly, to 1.5% (Clarksons, Timeseries, 2016j). In the developed countries the consumer confidence took a serious hit during the global financial crisis and changed the spending habits from the carefree attitude that was responsible for the boom in the world economy from 2003 to 2007, to being more cautious (Clarksons, Shipping Review and Outlook, 2009b). High public spending to support demand, as well as governmental intervention in terms of fiscal and monetary aid, was important to aid the recovery from the recession (UNCTAD, 2010).

In the period from 2009 to 2010, the amount transported of crude oil declined. As for the average haul, the negative trend continued from the previous period, and declined at a higher pace. However, in reality the decrease took place in 2009 for both the tonnes transported and the associated tonne-miles, but the increase in 2010 was not quite strong enough to make up for the reduction (Clarksons, Seaborne Trade Monitor, 2016). In 2009 the demand for crude imports fell by 7.9% in the United States and the same for the EU, while Japan experienced almost the double (Clarksons, Shipping Review and Outlook, 2010b). The expected reduction in the tonne-mile was offset as China invested heavily in oil in Latin America (Clarksons, Shipping Review and Outlook, 2009b). Chinese import from both Venezuela and Africa, at the expense of countries of closer proximity in the Pacific, helped increased the tonne-mile demand for VLCC tankers (Clarksons, Shipping Review and Outlook, 2010b). Throughout 2009 the demand for oil transported by sea fell by about 4% (Clarksons, Shipping Review and Outlook, 2010a). To save costs other than by slow steaming shipowners opted for longer but less costly routes for instance by avoiding the fees of using the canals discussed in Chapter 2.2.3 (UNCTAD, 2010).

Although there were no significant random shocks that took place during this period, the repercussions of the shock from the financial crisis in the previous period were still strong.

Supply

The growth in the global VLCC fleet increased again after a period with few deliveries; however, the net growth was reduced due to the phase out of single-hull tankers. As the oil price experienced a strong contango situation that started with the drop in the oil price in 2008, a large part of the global tanker fleet was used for storage. Contango occurs when the market expects that the oil price will go up in the future, which results in contracts for purchasing oil in a month are more expensive than the spot price of oil. By the beginning of 2009 about 90 million barrels of crude oil were stored aboard vessels waiting for the global economy to recover and for the oil prices to increase. The contango situation continued throughout the majority of 2009. Also, storage on shore was filled up, including the largest oil hub in the United States, Cushing, which more than tripled its oil reserves from September 2008 to the summer of 2012 (Philips, 2014).

The significant increase in the fleet of crude tankers, at the same time as the world economy slowed down, resulted in lower freight rates and a substantial reduction of the average annual utilization rate of -5.0%. Throughout the two previous periods there had also been a negative growth in utilization, but the change was more substantial during this period. As the tanker rates dropped in the summer of 2009 the owners were fortunate if they could cover their capital costs with the freight rates received, but most could only cover the operating expenses (Clarksons, Shipping Review and Outlook, 2009b).

A tighter balance between the supply and demand for tankers brought on the strong increase in tanker rates that started in September 2009. The number of vessels used for floating storage increased and the bad weather caused delays, at the same time as the demand for transportation from the Middle East and West Africa grew, which led to a rapid increase in the tanker rates (BIMCO, 2010). However, the oil price halted its growth trajectory, as the demand could not support higher prices and the number of VLCCs used for storage fell (Clarksons, Shipping Review and Outlook, 2009b).

The average annual growth in deliveries continued the strong increase with 10.4% of the existing fleet's dwt capacity. This was a result of both the vessels that were ordered during the boom and the vessels that were ordered in anticipation of the double hull regulations that took effect at the end of 2010 entered the market. However, the delivery of new tankers was 25% lower than estimated in 2009 (BIMCO, 2010). Part of the delay could be attributed to capacity issues at the shipyards. With the strong increase in orders after a long period of slow growth, as observed from the fleet development in Chapter 2.2.1, the shipyards were still expanding to handle a growing number of orders. New businesses were also just entering the market and were still struggling to get started. However, with the abrupt reduction in demand for tankers and few new orders placed, a lower production of vessels is not as negative as it might sound at first (Clarksons, Shipping Review and Outlook, 2010a). Other causes for the slippage in deliveries include shipowners that worked to delay or cancel their order as the demand for tankers was reduced and the expected earnings dropped significantly since the order was placed. The economic and credit crisis both influenced the demand for vessels, and the availability of banks interested in financing the orders placed during the boom (Clarksons, Shipping Review and Outlook, 2009a). In 2009 the orderbook for VLCCs declined significantly with a drop of 11%, while the negative growth in 2010 was less substantial (Clarksons, Timeseries, 2016h).

Demolition of VLCC vessels increased to an average of 1.8% of the existing fleet in terms of dwt. There was also a continued removal of older single-hull vessels for conversion, which helped reduce the capacity of the fleet, but not enough to maintain the favorable freight rates. The IMO regulations state that at the end of 2010 all single-hull tankers must be phased out, with some exceptions (Clarksons, Shipping Review and Outlook, 2009a). Owners of single-hull vessels were waiting until the deadline to scrap the vessels in anticipation of a last spike in the market (Clarksons, Shipping Review and Outlook, 2009b). The average single-hull vessel in the spot market carried only 2.4 cargoes during 2009 compared to 7 in 2006, which indicates that the demolition or conversion of the vessels would not affect the supply and demand significantly as they were carrying minimal cargo (Clarksons, Shipping Review and Outlook, 2010a). As the dry bulk market was also soft, it became less favorable to convert vessels into bulkers (UNCTAD, 2010). In 2010 the average age of demolished VLCC vessels was below 20 years, a strong decrease since the peak of 29 years in 2005. This is a reflection of the poor market condition and expected earnings for the owners (BIMCO, 2015).

5.2.4 2011 – 2014: unstable global economic development and new sources of oil

The price continued its slow ascent with only minor and short-lived dips. In February 2011 the USD 100 mark was reached per barrel of oil. Starting at opposite ends, the freight rates were low, while the oil price was approaching record highs for the decade in focus. In the subsequent three years the VLCC rates continued the bumpy ride with short-lived ups and downs, but in general they were at a low level. The low freight rates were largely due to the rapid expansion of the fleet in preceding years, as well as the significant reduction in crude imports by the United States. For the most part the rates remained stable, apart for a period of three months in the winter of 2013 when the rates fell as far down as WS 18. The oil price, however, had recovered after the financial crisis and stayed high during this time. However, the second half of 2014 was a long downward hill for the oil price. During the four years, the oil price was high for all but the last seven months. The tanker rates in turn, were low throughout the whole time period.

Demand

After the slow growth during the previous period, the average annual growth in the world GDP picked up. Although the GDP gives a positive image of the global economy, the economic situation varied considerably from strong growth in Germany and China to problems in Greece and Japan. The world economy evolved from the previous global financial crisis concerning the banks, to that of sovereign debt as a consequence of the strong government spending used to ease the recession, which merely delayed the financial problems. Especially Greece struggled to fulfill their government obligations from the summer of 2011 (Clarksons, Shipping Review and Outlook, 2011b). While the world GDP grew significantly in 2011, it slowed in 2012 with the recession in Europe and Japan, as well as slower growth in China as the country entered a more mature phase and declining imports (Clarksons, Shipping Review and Outlook, 2012b). The growth in Chinese industrial production decreased from 14% in 2011 to 8% in 2014 (Clarksons, Shipping Review and Outlook, 2015b). The growth in global GDP continued the decline during 2013 and 2014.

The average annual growth in tonnes of crude oil transported during the period remained negative, at about the same slightly declining rate as during the previous period. The demand for crude oil continued its descent in Europe and the United States as a result of insufficient credit, growing unemployment numbers and low consumer confidence. However, the increasing demand in China and India contributed to the growth in demand for transportation going east from the Middle East, and along with the increasing demand from other emerging economies, it almost outweighed the decrease in demand from the developed countries. The freight rates for the corresponding routes of crude oil transported east increased significantly due to the higher demand, however this is not observed as strongly in the freight rates from Ras Tanura to Rotterdam, which is the main focus (Clarksons, Shipping Review and Outlook, 2012a). Throughout this period the global demand for oil remained slow, which resulted in stagnant demand for tankers (Clarksons, Shipping Review and Outlook, 2014b).

During this four-year period, the average haul increased quite sturdily at 1.8% compared to the previous three time periods in terms of the average annual growth. On a lot of the long distance routes there were significant increases in the distance travelled. The increase in average haul was a result of the realignment of trade with increasing oil demand in Asia dominating the trade from the Middle East, as the demand in Europe and the United States decreased. This shift in demand was reflected in the freight rates, with increasing rates going east from the Middle East, and decreasing rates going west (Clarksons, Shipping Review and Outlook, 2012b). Clarksons estimated that during 2013 72% of total crude oil volumes transported by VLCC would be to Asia (Clarksons, Shipping Review and Outlook, 2013a). The increase in demand for crude oil was the result of the expansion of refinery capacity in

China and India, as well as the filling of Chinese oil reserves (Clarksons, Shipping Review and Outlook, 2014a). Between 2009 and 2012 there was a strong growth on the long haul routes from West Africa to the Far East, and from the Caribbean to Asia. Some of the demand replaced voyages from the Middle East with longer transportation distances, while a great deal was additional demand (Poten & Partners, 2015).

In March of 2011 an earthquake hit Japan and caused a tsunami, which damaged several nuclear power stations as well as refineries. With the anticipation of substantial down time, the demand for tankers to transport crude and other dirty oil products for power generation increased (Clarksons, Shipping Review and Outlook, 2011a and 2011b).

The continued strong industrial growth in China and India and associated demand for oil from the Middle East absorbed much tonnage from the market, however the number of vessels available was too large to result in an increase in the tanker rates. The bunker prices grew continuously due to the increase in oil prices, increased demand with a larger fleet, and increasingly firmer regulations that require bunkers with lower sulfur levels. For a VLCC vessel built in the 1990s the bunkers cost represented over 90% of the income in the fall of 2011 when the freight rates plummeted due to excess supply of vessels and slow steaming became a more popular way of saving money for the shipowners. As a result of IMO's sulfur pollution regulations, the limit of sulfur in bunkers was lowered from 1.5% to 1.0% in two emission control areas covering the North Sea, the Baltic Sea and the English Channel from July 1, 2010 (Clarksons, Shipping Review and Outlook, 2011a). In August of 2012 a third area was added, which covered the coasts of the United States, and affected all vessels of more than 500 dwt entering all North American ports (Clarksons, Shipping Review and Outlook, 2011b). Further expansions of the emissions control areas included the Canadian coast in 2013 and parts of the Caribbean Sea in 2014. During the first half of 2014 the low sulfur fuel in Rotterdam was on average 6% more expensive than the 380 cst bunkers (Clarksons, Shipping Review and Outlook, 2014b). As previously mentioned in Chapter 2.1.1 the shipowners will face continuously stricter emission regulations in the future.

During 2012 the demand for imported crude oil by the United States declined significantly as a result of the domestic oil production, which grew with unexpected strength (Clarksons, Shipping Review and Outlook, 2012b). From 2008 to 2013 the daily production of crude oil in the United States increased by 46% (Clarksons, Shipping Review and Outlook, 2014a).

Shale oil made up about 49% of the domestic production of crude oil in the United States in 2014 (EIA, 2015e). The import of crude oil by the US was reduced by a third from 2011 to 2014 (Clarksons, Oil & Tanker Trades Outlook, 2015a). The increased development of shale oil was triggered by the high oil prices, as well as the improved technology for extraction from the ground, and the United States, the world's largest oil importer until 2014, ramped up the domestic oil production. Saudi Arabia increased its oil production during 2013, which helped support the global supply for oil in a time when Libya and Iraq exported less, and Iran did not export any oil (Clarksons, Shipping Review and Outlook, 2013b and 2014b). The United States experienced an increase in export of refined products, particularly during the last part of this period, while as previously mentioned in Chapter 2.1.2 the export of crude oil was not allowed (Clarksons, Shipping Review and Outlook, 2014b).

During the summer of 2014 the oil price started its rapid descent, and by the beginning of 2015 it had been halved to USD 49 per barrel. This was due to the random shock of strong shale production, as well as OPEC's increased production. In November 2014 OPEC decided to abandon their previous goal to maintain high oil prices by adjusting their supply of oil to defend their market share and leaving other countries to adjust their output. This resulted in a market flooded with oil from both the old oil producer OPEC and the United States with the recent shale oil revolution. During 2015 the OPEC member countries experienced a 46% decline in their income from oil, compared to 2014, due to the significant drop to the oil prices (Aarø, 2016). For the tanker market the freight rates improved as speculators and importers wanted to take advantage of the declining prices and contango position. They chartered vessels to store the oil, at the same time selling the oil forward and likely realizing a profit after paying the storage cost for the oil in the vessel. However, as the future price curve for oil flattened and the freight rates increased, the number of vessels used for storage decreased (Clarksons, Shipping Review and Outlook, 2015a).

Supply

At the beginning of the period there were still 32 VLCC vessels waiting to be converted following the phase out of single-hulled vessels. The new regulation that was initiated 20 years earlier was finally fulfilled, and while some vessels were trading under special bilateral agreement allowing single-hulls, the majority of the tankers were now double hulled (Clarksons, Shipping Review and Outlook, 2011a). The marginal increase in demand for oil globally was not enough to contribute to a meaningful increase in demand for tanker vessels, which resulted in low freight rates for a world fleet that was slowly growing.

The average growth in the global tanker fleet remained stable from the previous period. A long time with low tanker rates was expected before supply and demand would balance again, due to the considerable increase in the tanker fleet compared to the global demand growth and the limited scrapping of vessels. During 2012 waiting, as well as slow steaming, soaked up the majority of the surplus capacity of the fleet, and few vessels were removed from the market or put in layup (Clarksons, Shipping Review and Outlook, 2012b).

During this four-year period the fleet productivity decreased, but on average at a slower rate than in the previous period. The high bunker costs continued to encourage owners to lower the speed, which resulted in a higher demand for tankers to transport the same amount of cargo. The trend favored larger vessels, such as VLCCs and Suezmaxes. Because the cargo size was more, it resulted in only partial loads. In 2013 Platou estimated a decrease in productivity of 0.6% annually over the past decade due to reduced load factor, or increased deadfreight (Platou, 2013). Figure 5.2 at the beginning of the chapter shows the same trend, with increasing volumes that could have been filled with cargo, but was left empty.

Compared with the previous period, the delivery of VLCC vessels slowed down slightly, but the growth was still strong. However, compared to the growth in world trade or the global tanker fleet, the delivery of VLCCs grew by about twice the speed as the average growth rate. This was a substantial increase of supply. After the record large orderbook of half the VLCC fleet in 2008, the orderbook decreased annually until it reached a low of 14% in 2012 and remained at that level for the rest of this time period. Two factors can explain the difficulties for the shipowners to get credit for new vessels. Firstly, the banks' problems with the credit ratings limited their ability to provide new loans. Secondly, decreasing earnings and vessel values resulted in low collateral values for the shipowners' current fleet. In turn this led to few new ships being ordered as the financing slowed significantly. For the orders that were placed, the trend was more fuel-efficient vessels with the ability to steam at slower speeds as a response to the high bunkers prices (Clarksons, Shipping Review and Outlook, 2013a).
The average rate of scrapping remained unchanged from the previous period, while the tanker rates remained low and relatively stable in the interval between WS 20 and WS 40. A large number of the demolished vessels in the previous period were due to the phase out of single-

hull vessels. In this period the average level of scrapping remained at the same level, which was likely due to the continued low freight rates that resulted in also vessels younger than 25 years being scrapped.

5.2.5 2015: surprises in both markets

The rates moved slowly with some short-lived ups and downs. During 2015 there was a continued decline in the oil prices, and the prices dropped 47%. After a brief spike to the oil prices from February to July 2015, it continued the descent to December 2015 at USD 36. However, during the last part of the year the tanker freight rates started increasing relatively rapidly, and the sentiment in the market became more positive than at any time over the last six years. In general the oil price remained low throughout the year, while the tanker rates started low before doubling in the second half.

Demand

The world economy experienced a slower growth in GDP during 2015 than the average annual growth for the past four years. The United States experienced some normalization in the economic activity and employment market during 2015, so that the Federal Reserve decided to raise the interest rates at the end of the year by 0.25%. This was the first increase made since 2006 (BBC, 2015). The low oil prices helped ease the continued slow growth and improvements to the European economy through higher demand and increased consumption of oil. China continued the transition from a country focused on heavy industry and towards a more diversified and mature economy (Clarksons, Shipping Review and Outlook, 2016).

The substantial growth in seaborne commodity trade was a strong driver for the tanker market in driving up the freight rates. The demand growth for oil was still dominated by India and China despite the continued softening of the pace, while OECD experienced a weak increase in the demand (Clarksons, Oil & Tanker Trades Outlook, 2015b). The drop in oil prices was caused by a global surplus in the production of oil compared to the demand, which continued in 2015. The low oil prices resulted in higher global demand for oil, which led to an increased growth in seaborne crude trade after two years of declining growth. The growth in demand was driven by consumption, building of oil reserves and storage of oil to be sold when the prices increased (Clarksons, Shipping Review and Outlook, 2015b). The global imbalance in supply and demand was at about 2 million barrels per day throughout the year (Clarksons, Shipping Review and Outlook, 2016). During 2015 the import of crude oil by EU countries grew by 7% due to improved margins for the refineries following the decline in the oil prices (Clarksons, Oil & Tanker Trades Outlook, 2016a). The crude imports by the United States decreased from 8.5 m bpd in 2005 to 4.2 m bpd in 2015, while the total crude demand in the United States decreased from 20.8 m bpd to 19.4 m bpd respectively (Clarksons, Oil & Tanker Trades Outlook, 2008 and 2016a). The demand for oil from other large economies, such as China, continued to grow with 9% from the previous year. The average import of crude oil to China in 2015 was at 6.7 m bpd, and all except 7% of this was transported by sea (Clarksons, Oil & Tanker Trades Outlook, 2016a).

Despite the increase in the transported amount of crude oil, the average haul declined during 2015. This indicates that the distance between the producers and the refineries or customers have decreased. The import of crude oil from the Middle East declined as the United States continued to expand their oil production, although at a more modest pace as a result of the pressure to the oil price. Instead a lot of the oil from the Middle East was transported east to India and China, where the refinery capacity continued to grow in 2015. This is a shorter distance, and partially explains the reduction in average haul (Clarksons, Shipping Review and Outlook, 2015b).

As described in Chapter 2.1.1 and Chapter 4.2.1 the shale revolution in the United States drastically changed the global oil market with the large supply of oil. When a large or dominant country radically changes its trading pattern, it can be considered a random shock to the global economy (Koch, 2013). In 2015 about 24% of the total consumption of crude oil and petroleum products in the United States was imported. This was the lowest level since 1970 (EIA, 2016e). As previously mentioned in Chapter 2.1.2, the United States opened for export of crude oil on December 18, 2015, with the most likely destinations being Europe and Asia. However, due to the significant discount that the WTI was trading at compared to Brent, the short-term expectations were limited (Clarksons, Oil & Tanker Trades Outlook, 2016a).

Starting January 1, 2015, increasingly strict regulations were placed upon the emission control areas, which lowered the allowed sulfur emissions from 1.00% to 0.1% as previously discussed in Chapter 2.1.1. The drop in the oil prices reduced the burden for the shipowners on bunkers, as price general increases with cleaner fuel, and older and more polluting vessels became profitable to maintain in the fleet. Due to the shipowners' expectation that the oil prices will stay relatively low for some time, the demand for eco-friendly vessels softened along with the oil prices (Clarksons, Shipping Review and Outlook, 2015b).

Supply

In 2015, the growth of the world merchant fleet of tankers slowed down. Although the fleet has been growing a little faster than demand in the past few years, there was a relatively low build-up of capacity for the tanker fleet prior to the oil price decrease. The limited fleet growth, combined with continued slow steaming as the demand for transportation increased, limited the supply of vessels available for spot contracts. This tight supply and demand balance can explain the upward pressure on the freight rates. Another factor was the expectation of higher oil prices in the future, which led to the use of tankers for storage. Hiring VLCC vessels for storage was particularly popular at the beginning of the year, until the increasing freight rates made it less profitable despite the continued contango situation (Clarksons, Shipping Review and Outlook, 2015b and 2016).

For the first time during the five periods analyzed in this thesis, the growth in the utilization rate of the crude tankers increased by as much as 1.2%. The freight rates for VLCC vessels increased as the supply and demand balance tightened (Clarksons, Shipping Review and Outlook, 2016). As previously described in Chapter 3.2.2, there are four important factors to improve productivity in the short-term; to minimize time in port while loading and offloading cargo, to transport fuller loads, to use higher speed, and lastly to delay repairs and reclassifications that are not urgent. With low oil prices the cost of bunkers became less of a concern, and the demand for transportation increased, while slow steaming was not as important a tool to save money and spend time. However, shipowners continued to use speed below the optimal speed. This resulted in higher freight rates as the productivity of the fleet declined. If all vessels speed up immediately after an advantageous adjustment in the freight rates and/or the bunker prices, it will still take time for the increase in supply of vessels to appear in the spot market. This is because the vessels will have to fulfill the current charter and possibly a ballast voyage to a new port (DNB, 2016a). The future implications of increased speed is likely to be limited as eco-friendly vessels with lower operating speed become the standard for new vessels (Clarksons, Shipping Review and Outlook, 2016).
The growth rate for the delivery of VLCC vessels slowed significantly and was reduced by more than half the average growth rate from the previous time period. The strong market conditions during 2015 resulted in a growth in the orderbook for the VLCC fleet by 46% from

the previous year, ending at about 20% of the current fleet (Clarksons, Timeseries, 2016h). The drop in oil prices and increase in freight rates were important factors in the shipowners' decisions to order more vessels after three years of very low orderbooks.

Scrapping was reduced to a minimum as the tanker rates improved, and ended at 0.3% of the total VLCC fleet in terms of dwt, just two vessels (Clarksons, Shipping Review and Outlook, 2016). The shipowners were less inclined to demolish their vessels due to the strong increase to the freight rates following the drop in the oil prices, combined with the modern age profile of the fleet. The general scrapping in all shipping markets slowed during 2015. Cheap Chinese steel imported to India and the surrounding countries suppressed the demand for recycled steel, and consequently the scrap prices fell to record low (Clarksons, Shipping Review and Outlook, 2015b).

5.2.6 Summary

The analysis has shown how the shipping market model with supply and demand variables can be used. The variables in the model come into play at different times during the eleven-year period. For instance, there is only significant positive growth in scrapping during two periods, while fleet productivity had negative growth in the first four periods before changing to modest positive growth during the last period. Another interesting fact is that none of the periods experience identical changes for all the variables. The most influential variable has been random shocks, and among them the global financial crisis. Although both the oil price and the freight rates were affected by the financial crisis, the oil price only experienced a short-term trough, before increasing quite rapidly. The freight rates on the other hand, experienced a long-term weakening and did not fully recover during the decade in focus of this thesis.

The monthly correlation between the oil prices and the freight rates varies significantly between the time periods, from -0.45 to 0.73, as seen in Table 5.2 below. The random events have had strong influence on both the oil prices and the freight rates. However, the correlation is only -0.15 between the oil prices and the freight rates for VLCC vessels from Ras Tanura to Rotterdam during the period from 2005 to 2015 as a whole. The low correlation implies limited movement in the same direction, and the correlation does not state which factor influences the other. Although the correlation for the decade as a whole is low with a slight tendency for opposite movements, there are periods where the oil price and the freight rates move aligned, but also periods when they move in considerably different directions. However, the development of the main elements in the oil market, which determine the oil price, has strong influence also on the demand for transportation by tankers. These factors include expectations of the future oil prices, the varying capacity for oil production around the globe and the regulations in individual countries that affect the global market.

Time period	Correlation
2005 – 2006	-0.14
2007 – 2008	0.73
2009 – 2010	0.34
2011 – 2014	0.17
2015	-0.45
Whole period 2005 - 2015	**-0.15**

Table 5.2 Correlation between the oil price and the VLCC freight rate, monthly data from 2005 to 2015 (Clarksons, Timeseries, 2016f)

5.2.7 2016 and beyond

In January 2016 the oil price experienced a 12-year low level at USD 27 per barrel. Since then the oil prices have increased despite significant volatility, with a high of USD 52. The oil price has since the middle of August remained in the range between USD 45 and USD 51. In September 2016 there is talk of production freeze for six months by OPEC. However, if the chosen limit is equal to the production level of the past few months, the effect is likely small, as the majority of the countries are already producing at maximum capacity (Lorch-Falch, 2016). The freight rates for VLCC vessels have decreased during the first seven months of the year to almost half. This is likely the result of 24 newbuilt VLCCs that have been delivered in the same time period, while no vessels were removed through demolition or conversion (Clarksons Timeseries, 2016k).

The profitable freight rates in most of 2015 resulted in a doubling of the orderbook for VLCCs in terms of dwt and ended at 21% of the fleet at the end of 2015 (Clarksons, Timeseries, 2016k). The VLCC tanker fleet dwt capacity is expected to grow by 7% during 2016 and 5% in 2017. This is because there will be more vessels delivered and the age distribution of the fleet makes it less likely that there will be significant scrapping (Clarksons, Shipping Review and Outlook, 2016). Whether this increase in the fleet is too large to support continued growth in the freight rates will primarily be determined by the demand for oil, and subsequently transportation, and the occurrence of random shocks in the future.

Two factors are likely to affect the dynamics of the oil market as well as the trade pattern going forward; that the United States lifted the export ban of crude oil in December 2015, and that after 3.5 years of European oil embargo, the sanctions on Iran were removed in January 2016 and crude import was allowed by European countries (Blas, 2016). While the export from the United States is expected to be limited, Iran increased the production immediately and planned on a rapid expansion (Clarksons, Shipping Review and Outlook, 2016).

Another important aspect of the development of both the oil prices and the freight rates is the future oil production. In 2015 it was the lowest level of new oil discoveries since 1947, and the amount only covers the current global consumption for 28 days (Norli, 2016). As a result of the oversupply of oil and subsequent drop in oil prices there has been a decline in investments made in the oil production for two consecutive years, for the first time in three decades. The supply and demand of oil is expected to balance in 2017 as supply stabilizes and demand grows. As the oil prices rise, the shale oil producers in the United States will probably increase the production to take advantage of the higher prices, and the higher supply of oil will likely result in lower oil prices again depending on the growth in supply. However, as the demand for oil continues to grow, a sharp increase in the oil price is likely as there will not be enough new oil fields available following the current low investment levels (Takla, 2016). The oil prices are expected to rise in the future, while the freight rates for the tankers are harder to predict and they are likely to depend on an increase in investments to develop new oil fields as well as a moderate growth in the fleet.

6 Conclusion

The relationship between the oil price and the freight rates in the tanker market has shown varied dependency. From 2005 to 2015 the two variables have both been moving in parallel, and in opposite directions with one experiencing strong growth and the other rapid decreases, in both combinations. Some periods have had correlation close to zero. One of the most important factors that influenced the oil prices and the freight rates during this decade has been the global financial crisis, which resulted in significant drops for both the oil prices and the freight rates. Another factor was the rapid growth in the American shale oil production, and subsequent flooding of the global market with cheap oil, which increased the demand for transportation by tankers.

The oil price is determined in part by actual supply and demand, and in part by expectations. The actual demand for oil is closely linked to economic activity and seasonal changes in temperature. The supply is influenced by global geopolitical events, as well as the weather, which can delay the loading of cargo or cause disruption in the production or refineries. Between 2005 and 2015 the oil price was influenced strongly by global one-off events.

The shipping market supply and demand model by Martin Stopford is useful in explaining the relationship between the oil price and the freight rates during the decade in focus. The demand side has been influenced by the world economy, seaborne commodity trades, average haul and random shocks. The world merchant fleet, fleet productivity, shipbuilding production as well as scrapping and losses are variables that have affected the supply side. The extent to which the various elements have been important has varied over time. The most important variable from 2005 to 2015 was random shocks.

2005 – 2006:

During this period the oil price had a steady increase, while the VLCC freight rates were on average flat. However, there were two sharp peaks to the oil price, the first in February 2005 as a continuation of the 2004 peak that was even higher. In August 2005 hurricane Katrina hit the Gulf of Mexico and caused devastation to refineries and production shutdowns. The second peak, in November 2005, was caused by strong seasonal growth in demand, in addition to a shortage of available VLCC vessels with double-hulls in the Gulf of Mexico. This illustrates that there are several regional markets in the short-term perspective, and that the freight rates are a result of the demand and supply of vessels at a specific time and location. The advantageous freight rates resulted in minimal scrapping. During this period the freight rates and the fleet utilization rate were relatively high. When seasonal demand for oil is added, this causes peaks in the freight rates, as the supply of vessels is quite limited in the short-term. As a result, it can be summarized that for this period the increase in the oil price, and the higher demand for oil, was one factor that influenced the spikes in freight rates.

2007 – 2008:

The oil price and the VLCC freight rates were well correlated at 0.73 on a monthly basis during this period, which means that they moved largely in parallel. Both increased significantly, although the freight rates had another spike prior to the peak of the oil price in 2008. The spike can likely be attributed to the seasonal demand for heating in the Northern Hemisphere, and subsequently the increased demand for VLCCs. During the last half of 2008 the global financial crisis hit, which resulted in large drops in both the oil prices and the freight rates. The random shock continued to affect the global economy, as well as the freight rates, for a long time, while the oil price recovered more quickly. During this period the same effects as in the previous period triggered peaks in the freight rates with regards to fleet utilization and additional seasonal demand for oil. Although triggered by a random shock, the demand for oil, and the oil price, declined as a result of the financial crisis of 2008, and this significantly impacted the VLCC freight rates.

2009 – 2010:

In January 2009 the oil price reached a trough of the first nine years of the decade in focus. The annual growth in world GDP was significantly lower in the aftermath of the financial crisis. From 2009 to the summer of 2011 the oil prices started the recovery process, aided by OPEC's lower oil production to support the prices. Although the oil price increased by 125% in the two-year period, and the VLCC rates decreased by 13%, the monthly correlation during this period was positive. The decrease in freight rates can likely be explained in part by the increased number of VLCC vessels delivered at 10.4% average annual growth. A lot of new double hull vessels were delivered before the deadline at the end of 2010 for removing single-hull vessels from the fleet. However, the deliveries outpaced the removal of single-hull vessels, resulting in fleet growth. A share of the delivered vessels was ordered during the years of high freight rates. This illustrates how the time-lag can have negative consequences when large orders are made, and the vessels delivered, after the freight rates have dropped significantly. As a result the added dwt capacity further weakens the supply side and the freight rates.

2011 – 2014:

As the after effects of the global financial crisis were winding down, and the average annual growth of the global GDP picked up again. Throughout the majority of the four years the oil prices remained high, while the VLCC freight rates were low. At that time there was limited spare capacity for oil production, until the production capacity was expanded and the consumption of oil started declining. During this period the crude oil import to the United States dropped by a third as a result of the strong increase in the shale oil production. The increased production combined with OPEC's decision to protect its market share, rather than maintaining high oil prices, resulted in a significant drop in the oil prices during the last half of 2014. Continued high deliveries of VLCCs, and fleet growth, prevented the recovery of the freight rates even though the oil prices and the production of oil were high.

2015:

The oil price continued the downward path during 2015, from around USD 50 per barrel in January to USD 37 per barrel in December. The VLCC rates experienced a volatile period, however, the trend was undoubtedly positive. The monthly correlation between the oil prices and the freight rates was at -0.45, which shows that they clearly moved in different directions. The decrease in oil prices led to increased demand for oil, which directly impacted the tanker freight rates since oil had to be transported from the producers to the consumers. In addition, the shape of the forward curve for oil led to additional demand for oil tankers to be used as floating storage. In this way the oil price had a clear impact on the tanker rates in this period.

2005 – 2015

To summarize the five periods, random shocks have had a clear influence on the oil prices, which again influences the freight rates in the tanker market. In addition there have been random shocks that affect the tanker market directly, such as the double hull conversion regulation by IMO with effect from the end of 2010. While it was a gradual process over 18 years from the decision was made until single-hull vessels were banned from worldwide oil trade, it was a hard deadline for removal of the vessels, which created a reduction in supply at a distinct point in time. Even though the markets are affected by “normal” growth in supply and demand, random shocks in both the oil market and the tanker market have resulted in the largest movements of the freight rates, as it is difficult to adjust the supply of VLCC vessels, especially in the short-term.

The oil price had a varied influence on the VLCC freight rates between 2005 and 2015. To better understand the dynamic it is important to keep in mind that the oil price is derived in the oil market. At the beginning of the decade the supply of oil was relatively stable. An increase in the demand for oil resulted in an increase in the oil price, and subsequently higher demand for additional tonnage to export the oil with growth in the freight rates. In the last period the supply of oil increased significantly, while the demand for oil remained relatively stable. The substantial increase in the supply of oil, caused by the American shale oil and OPEC, resulted in a decrease in the oil prices. The demand for oil increased as the oil price dropped. The increased demand for oil resulted in higher demand for transportation and in turn higher VLCC freight rates. However, in the latter example it was the increased supply of oil and the following decrease in oil price that initiated the increase in freight rates, and not increased demand for oil. One could as such say that it is not the oil price in itself that influence the freight rates, but instead the demand for oil.

These large fluctuations, created among others by random shocks and slow supply side adjustments, result in the potential for the shipowners to make a fortune by being correctly positioned at the right time. However, reversely, getting carried away and purchasing vessels at the top of the cycle, can lead to the vaporization of equally large fortunes in a short period of time. These natural cycles are in the nature of the shipping markets, unlike many other markets, and makes shipping an interesting sector to analyze.

7 Appendix

7.1 Development total global cargo fleet

Total Cargo Fleet					Year end						
m Dwt	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Oil tankers	332	349	368	379	405	420	445	473	482	488	503
Other tankers	30	33	37	43	47	50	52	41	42	42	44
Bulkers & combos	355	377	401	425	466	545	623	691	730	762	779
Gas	26	29	32	37	41	44	44	44	46	50	54
Containerships	112	128	144	161	169	184	197	207	216	228	244
General cargo	86	88	90	93	92	93	92	87	86	86	86
Offshore	4	5	5	6	6	7	8	8	9	9	10
Other cargo	9	9	9	6	6	6	6	6	6	6	6
Total World Fleet	953	1 017	1 086	1 151	1 232	1 348	1 466	1 557	1 617	1 671	1 727

Table 7.1 The development of the world fleet from 2005 to 2015 (Clarksons, Shipping Intelligence Weekly, 2009, 2013 and 2016)

The table above contains the underlying data for Figure 2.3.

7.2 VLCC fleet development

	Annual world GDP (% growth)	Tonnes crude oil (m)	Tonne-miles crude oil (bn)	Total crude fleet (m dwt)	VLCC fleet (m dwt)	VLCC deliveries (m dwt)	VLCC scrapping (m dwt)
2005	5.4%	1,879	8,610	247.80	137.91	9.58	0.26
2006	4.85%	1,892	8,825	259.60	141.94	5.49	0
2007	5.49%	1,913	8,732	269.10	147.44	8.99	0
2008	5.65%	1,904	8,851	270.90	150.70	12.78	0.77
2009	3.02%	1,817	8,132	283.80	160.27	16.39	2.35
2010	-0.05%	1,874	8,637	293.40	164.48	16.58	3.45
2011	5.41%	1,853	8,723	313.60	176.65	19.09	3.25
2012	4.22%	1,906	9,166	328.80	187.22	15.33	2.75
2013	3.46%	1,837	8,945	326.20	190.20	9.50	5.00
2014	3.28%	1,806	8,915	330.60	194.25	7.63	2.35
2015	3.41%	1,877	9,179	336.50	200.28	6.25	0.54

Table 7.2 The development of the VLCC fleet in million dwt from 2005 to 2015 (Sources: see text below Figure 5.1)

The table above contains the underlying data for Table 5.1.

7.3 Abbreviations

API	American Petroleum Institute
bn	Billion
BP	British Petroleum (former), now only BP
Bpd	Barrels per day
cSt	CentiStokes
D	Demand
Dwt	Deadweight tonne
EIA	U.S. Energy Information Administration
GDP	Gross domestic product
IMO	International Maritime Organization
m	Million, i.e. million barrels of oil
MARPOL	The International Convention for the Prevention of Marine Pollution from Ships
NOK	Norwegian crowns
OAPEC	Organization of Arab Petroleum Exporting Countries, now OPEC
OPEC	Organization of the Petroleum Exploring Countries
S	Supply
TEU	Twenty-foot equivalent unit – a standard container
ULCC	Ultra Large Crude Carrier
US /U.S.	United States of America
USD	United States dollar
VLCC	Very Large Crude Carrier
WS	Worldscale
WTI	West Texas Intermediate – crude benchmark

8 Bibliography

In addition to literature directly referenced in the thesis, this bibliography also contains other pieces of work that have been consulted during the writing process.

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