AN ANALYSIS OF THE RELATION BETWEEN THE COMMODITY PRICES AND FREIGHT RATES

NAVLUN ANALİZİ: EMTİA FİYATLARININ

NAVLUN İLE OLAN İLİŞKİSİ

Written by

ARDA BALAKAN

Thesis Advisor

PROF. DR. ERHAN ASLANOĞLU

PİRİ REİS UNIVERSITY

2018

AN ANALYSIS OF THE RELATION BETWEEN THE COMMODITY PRICES AND FREIGHT RATES

Thesis Submitted to

"The Graduate School of Social Sciences"

in partial fulfillment of the requirements for the degree of

"Master of Science (MS)"

in

"*Maritime Business and Economics Graduate Programme*"

At Piri Reis University

Written by

ARDA BALAKAN

Advised by

PROF. DR. ERHAN ASLANOĞLU

AN ANALYSIS OF THE RELATION BETWEEN THE COMMODITY PRICES AND FREIGHT RATES

APPROVED BY

Prof. Dr. Erhan ASLANOĞLU (Thesis Supervisor)

Name Surname Prof. Dr. Nazım ENGİN

Name Surname Prof .Dr. Erhan ASLANOĞLU

Name Surname Prof .Dr. Sadullah ÇELİK

DATE OF APPROVAL: 08/05/2018

ACKNOWLEDGEMENTS

First of all, I would like to give a huge thank to my advisor Prof. Dr. Erhan ASLANOĞLU who is always a role model for me with his grace and wisdom. I have seen a lot of his support at each stage of my study as well as my life.

I would like to thank to Prof. Dr. Sadullah ÇELİK whom I had taken the inspiration of developing a new method in my thesis instead of only using the existing data. He always encouraged me to increase my potential in all parts of my life.

I would also like to show my appreciation to Prof. Dr. Nazım ENGİN who gives a poetic approach of a life with his joy and energy of life. His inspire will always remain in the rest of my life.

I am also grateful for my dear father, my lovely mother and my unique sister whom are always with me and stand behind me in the times of the big decision of my life.

I appreciate my colleagues at Piri Reis University, particularly Prof. Dr. A. Zafer ACAR and Dr. Pınar GÜROL, whom have supported me in an unlimited way during my study.

They made significant contribution to my life with their sincere support for each step of my life.

ABSTRACT

International trade activities increased remarkably over the last decades thanks to the globalization. Considering that over the 80% of global trade by volume and over 70 % of global trade by value are carried by sea; freight rate which is defined as a cost charged by the carrier for the transportation of cargo from the origin to the final location becomes crucial under the area of maritime economics. Freight rates may vary with respect to the type of goods, distance, weight, size, methods, and directions of the cargo. Just like final and semi-final products; commodities are also carried by the vessels in international seas and ships are named with respect to the goods carried such as bulk-carrier, dry cargo ship and tankers. In this thesis we aim firstly to detect the main determinants of the freight rates as a cost of transportation from the microeconomics and macroeconomics point of view in the literature and using those determinants we aim to investigate, in specific, the dynamic relationship between the commodity prices and freight rates charged to carry those commodities by using time series analysis for the various types of vessels and commodities in specific routes. Hereby analyzing the strength of direction of the relationship and the lag between changes in the freight rates up to the changes in the commodity prices may be useful for the actors in international trade for future's projections.

ÖZET

Uluslararası ticaret hacmi, küreselleşme ile beraber geçtiğimiz 20 yılda oldukça güçlü bir ivme kazanmıştır. Küresel ticaretin hacim olarak %80'inin; değer olarak ise %70'inin denizyolu taşımacılığına konu olduğu hususu ele alınırsa deniz ticaretinin önemi bir kez daha anlaşılmış olacaktır. Bu kapsamda dış ticarette bir yerden başka bir yere ulaştırmak için gemiye alınan eşyanın bütünü ve taşıyıcı tarafından, gemisinde taşınacak yük için istenen ücret olarak tanımlanan ve yükün türü, taşınacak mesafe, yükün ağırlığı gibi faktörlere gore değişen navlunlar ekonomide oldukça önemli bir faktör olarak ön plana çıkmaktadır. Deniz ticaretinde yarı-mamül, nihai mamül taşımacılığı yapıldığı gibi üretimde girdi olarak kullanılan emtialar da yer almakta olup bu ürünler dökme yük gemileri, kuru yük gemileri, konteyner gemileri ve tankerler vasıtası ile taşınmaktadır. Bu tezde, öncelikli olarak deniz ticareti, denizcilik sektörleri, navlunların makro ve mikro ölçekte belirleyicilerinin yer aldığı bir literature taraması yapılmış olup sonrasında ise emtia fiyatları ve navlunlar arasındaki dinamik ilişkiyi konu alan ve zaman serisi verileri kullanılan bir analiz yapılmıştır. Bu kapsamda farklı gemi türleri ve farklı emtialara konu fiyat ve navlun arasındaki ilişkinin doğrultusu, nedenselliği ve değişkenin etkisini göstermedeki gecikmeye yönelik bulgulara ulaşılması amaçlanmıştır.

LIST OF FIGURES

Figure 1: Economies By Size Of Merchandise Trade, 2016

Figure 2: World Merchandise Trade By Major Product Grouping, 2006-2016 (US$ Billion)

Figure 3: Exports Within Regional Trade Agreements, 2006-2015 A (Share, %)

Figure 4: Share In World Merchandise Trade Of WTO Members, 2006-2016 (Percentage, %)

Figure 5: World Merchandise Trade Of WTO Members, 2006-2016 (US$ Billion)

Figure 6: The Share Of The Dry Bulk Commodities In The Maritime Market (%)

Figure 7: Most Used Ship Types In The Maritime Market

Figure 8: World Seaborne Trade In Cargo (Billions Of Tones-Miles)

Figure 9: World Major Dry Bulk Traders And Main Routes

Figure 10: Guide To Interpret The Model (Wavelet)

Figure 11: Coal Prices And Freight Rate

Figure 12: Iron Ore Prices And Freight Rates

Figure 13: Wheat Prices And Freight Rates

LIST OF TABLES

Table 1: Macro And Micro Determinants Of The Freight Rates

Table 2: Data Summary

LIST OF APPENDIX

Appendix 1: Coherency Analysis for Coal Price and Freight Rate

Appendix 2: Continuous Wavelet Analysis for the Coal Price and Coal Freight

Appendix 3: Cross Wavelet Analysis for the Coal Prices and Coal Freight Rate

Appendix 4: Coherence Analysis for the Iron Price and Freight Rate

Appendix 5: Continuous Wavelet Analysis for the Iron Ore Price and Iron Ore Price Rate

Appendix 6: Cross Wavelet Analysis for the Iron Ore Price and Iron Ore Freight Rate

Appendix 7: Coherence Analysis for the Wheat Price

Appendix 8: Continuous Wavelet Analysis for the Wheat Price and Wheat Freight Rate

Appendix 9: Cross Wavelet Analysis for the Wheat Price and Wheat Freight Rate

LIST OF ACRONYMS/ABBREVIATIONS

AHTS : Anchor Handling Tug Supply

ASEAN : Association of Southeast Asian Nations

CEMAC : Economic and Monetary Community of Central Africa

COMESA : The Common Market for Eastern and Southern Africa

CWT : Continuous Wavelet Transform

DWT : Deadweight Tones

ECB : European Central Bank

ECCAS : Economic Community of Central African States

ECHOWAS : Economic Community of West African States

EU : European Union

FED : Federal Reserve

GATT : General Agreement on Tariffs and Trade

GDP : Gross Domestic Product

GPG : General Policy Group

IACS : The International Association of Classification Societies

IMF : International Monetary Fund

IMO : International Maritime Organization

ISL : Institute of Shipping Economics and Logistics

LNG : Liquid Natural Gas

LPG : Liquid Petroleum Gas

MERCOSUR : Mercado Comum do Sul

NAFTA : North Atlantic Free Trade Agreement

OECD : Organization for Economic Cooperation and Development

QE : Quantitative Easing

SADC : Southern Africa Development Community

SOLAS : The International Convention for the Safety of Life at Sea

TEU : Twenty Equal Units

ULCC : Ultra Large Crude Carrier

ULOC : Ultra Large Ore Carrier

UN : United Nations

UNCTAD : United Nations Conference on Trade and Development

US : United States

VLCC : Very Large Crude Carrier

VLOC : Very Large Ore Carrier

WAEMU : West African Economic and Monetary Union

WB : World Bank

WEO : World Economic Outlook

WP : Working Parties

WTC : Wavelet Coherence

WTO : World Trade Organization

XWT : Cross Wavelet Power

CONTENT

ACKNOWLEDGEMENTS II
ABSTRACT III
ÖZET IV
LIST OF FIGURES V
LIST OF TABLES V
LIST OF APPENDIX VI
LIST OF ACRONYMS/ABBREVIATIONS VII
CONTENT IX
CHAPTER 1: INTRODUCTION 1
1.1. The Scope of the Research 1
1.2. The Objectives of the Research 1
1.3. The Methodology of the Research 2
CHAPTER 2: RECENT TRENDS IN INTERNATIONAL TRADE MOVEMENTS WITH ITS NEXUS TO THE GLOBALIZATION 3
CHAPTER 3: INTERNATIONAL SHIPPING MARKET 10
3.1. Sectors in the International Shipping Market 10
3.1.1. Tramp Transportation 11
3.1.1.1.Dry Bulk Market 14
3.1.1.2.Tanker Market 17
3.1.2. Liner Market 20
3.2.Classification Society 25
3.2.1. International Association of Classification Societies (IACS) 25
3.3. Vessel Types in Shipping Industry 26
3.3.1. With Respect to Cargo Carried and Intended Use 27
Dry Cargo 27
Bulk Carriers 27
Container ships 27
Liquid Cargo Ships 28
Passenger Ships 29
Cruise Ships 29

Ferries 29
Yachts 29
Auxiliary Vessels 29
3.3.2. With Respect To the Capacity of Vessels 30
Aframax 30
Capesize 30
Chinamax 30
Handymax/ Supramax 30
Handysize 31
Malaccamax 31
Panamax 31
Q-Max (Qatar-max) 31
Suezmax 31
VLCC and ULCC 31
CHAPTER 4: WORLD'S DRY BULK COMMODITY TRADE MOVEMENTS AND TRADE ROUTES 33
4.1. Dry Bulk Trade Outlook 33
4.2. Dynamics in the International Shipping Industry: Major Macro and Micro Determinants of the Freight Rate and Commodity Trade 37
CHAPTER 5: EMPIRICAL ANALYSIS OF THE RELATIONSHIP: FREIGHT RATES AND COMMODITY PRICES FOR SPESIFIC TYPES OF SHIPS AND COMMODITIES 44
5.1. Methodology: Wavelet Coherence 44
5.2. Data Description 49
Coal: 49
Iron Ore: 50
Grain: 51
5.3. Results 53
CHAPTER 6: DISCUSSION AND CONCLUSION 56
REFERENCES 59
APPENDIX 66

CHAPTER 1: INTRODUCTION

1.1.The Scope of the Research

International trade activities have increased in a remarkable rate within the last two decades. Considering the fact that around 80% of global trade by volume and over 70 % of global trade by value are carried by sea and are handled by ports worldwide; maritime economics and maritime transportation can be regarded as benchmarks for the international trade (UNCTAD, 2017). From this point of view, freight rate which is defined as the cost charged by the carrier for the transportation of cargo from the origin to the final location becomes crucial. Freight rates follow a similar path with economic conjuncture and has a close link with the world economic growth and international trade movements. Thus, freight rate has always been an area of interest in shipping industry. However, freight rates have highly volatile nature due partly to the uncertainty in international trade; partly to unforeseen events in international shipping industry.

1.2.The Objectives of the Research

According to the data obtained from "*Dry Bulk Trade Outlook by Clarkson Research*", world seaborne trade volume has reached to 10,047 million of tones total cargo in 2015. Around 29% of this volume has resulted from oil and gas trade; around 29% of which is due to main bulk commodity trade such as iron ore, coal, grain, bauxite and alumina and phosphate rock; whereas the remaining part of 41% is due to trade in dry cargo other than main bulk commodities. Considering the aim of this study in which analyzing the relationship between commodity prices and freight rate, the main commodity trade routes in international seas are given to visualize the commodity trade activities around the world as well. To do so, such commodities as coal, grain and iron ore are chosen to be studied. Because each type of vessels which carries different product have their own characteristics and cost structure for pricing in maritime transportation, comprehensive review of literature on the macro and micro determinants of freight rates are studied as well. Studying and understanding this raw information is crucial for the methodology

implemented in order to give the bilateral relationship between selected commodities' prices and trade volumes of which coal, grain, and iron ore; and cost of transporting this selected commodities, namely freight rates for those commodities.

Due to the volatile nature of the freight rates, actors in shipping industry to take into consideration the quantitative analysis of the freight rates in order to bring a predictable outlook to understand the dynamics of freight rate and to forecast for the future trade activities. To do so, wavelet coherence analysis is applied to find out the dynamic relationship between the freight rates and selected commodity prices.

1.3.The Methodology of the Research

The analysis shows that literature about the freight rate with its nexus to other explanatory variables have a frame of estimation in which conventional time domain approaches are dominant. However, underlying time scales are neglected. Motivation of this paper is derived from the gap in which the analysis of the freight rates on both time and frequency approaches are missing. To fill this gap, this study uses a methodology to analyze the dynamic relationship in both time and frequency domain in order to see how the bilateral relation may vary over time.

From this point of view, this study is organized to explain the recent trends in the international trade movements especially by emphasizing the commodity trade activities in the second section; international shipping industry which covers the sectors in the market as well as the vessel types is given in the third section; fourth chapter aims to focus on the world's dry bulk commodity trade movements and the trade routes; wavelet analysis which is conducted to analyze the dynamic relationship between the freight rates and commodity prices for selected types of ships and commodities on both time and frequency domains as well as causalities is explained in the fifth section; sixth section finally concludes and creates a room for discussion for furthering studies.

CHAPTER 2: RECENT TRENDS IN INTERNATIONAL TRADE MOVEMENTS WITH ITS NEXUS TO THE GLOBALIZATION[1]

In this era, globalization appears as an important concept in the economies (Mathews, 2006). Globalization is realized in the 19th century as a modern way and gained momentum in the years of 1980s (O'Rourke et al., 2000). World Bank explains the globalization as growth of interdependence of nations because of the increase in consolidation of finance, ideas, trade and people (Soubbotina, 2004). The globalization represents the trade of goods and services as well as the repositioning of idea, capital, technology and labor (Feigenbaum, 2002; Anheier&Isar, 2008).

International investment opportunities and international trade are considered as the important factors of the globalization whereas technologic improvement increases the momentum of the globalization. This fact reduces the cost of production, transportation and communication (Riain, 2000; Hesse&Rodrigue, 2004; Clift & Diehl, 2007; Rodrigue, 2007; Banyai, 2012).

The nations aim to maximize welfare and income of the society (Evans & Sewell, 2013). Thus they realize the influence of globalization so that implement the future's projections with respect to this factor. So that protectionism became less popular for the economies whereas foreign competitiveness got more popular (Skogstad, 2015). Moreover trade restrictions are lower comparing the past figures.

International Monetary Fund (IMF), World Trade Organization (WTO), General Agreements on Tariffs and Trade (GATT) are important figures of the globalization (Mansfield & Reinhardt, 2003). Since 2001, in macroeconomics view, inflation rates in the all economies was

[1] This part of the thesis is derived from the former publication of the author of the thesis with Prof.Dr.A.Zafer ACAR (Acar, A.Z. and Balakan, A. (2016) "Effects Of Transatlantıc Trade And Investment Partnershıp Agreement On Contaınerızed Cargo Flow In Transatlantıc" Journal of Management, Marketing and Logistics – (JMML), ISSN: 2148-6670 Volume:3 Issue:3).

declined because of this competition mostly based on strides in China and liberal economic policies which created a disinflation era.

International trade was influenced by many events such as economic and financial crisis, technological improvement and WTO members who support the liberal policies in last two decades (Barro 2006; Reinhart &Rogoff, 2008). Since 1990s, trade flows experienced quick growth and accelerated in the begging of the 2000s. According to WTO data, developing countries became very crucial under the world merchandise roof.

The global increase continued until the great recession in 2008 followed by a strong decline in the trade volume. However, in 2010 and 2011, international trade has experienced a strong recovery because of the monetary and fiscal policies applied by governments and central banks, especially by FED. FED did asset purchases known as quantitative easing (QE) and increased the balance sheet from 0,9 billion $ to 4 billion $ in the end of 2013 (Labonte, 2013).

This approach enabled to boost the economies and international trade to get it over the bad effect of the great recession in 2010 and 2011(WTO, 2015). According to the WTO data, the year of 2009 experienced the biggest drop in merchandise trade by 22% in terms of value and the year of 2010 experienced the highest recovery rates in trade with 14% increase in terms of value over the last 20 years.

EU's action was delayed to apply policies but better late than nothing they made bailouts to some economies such as Greece, Portugal, and Ireland (Polychroniou, 2012). Taking into account the fact that EU has a large share of the world imports with the amount of 32% WTO implies that economic conditions in the EU were getting better in early 2015 even though the high unemployment rate .

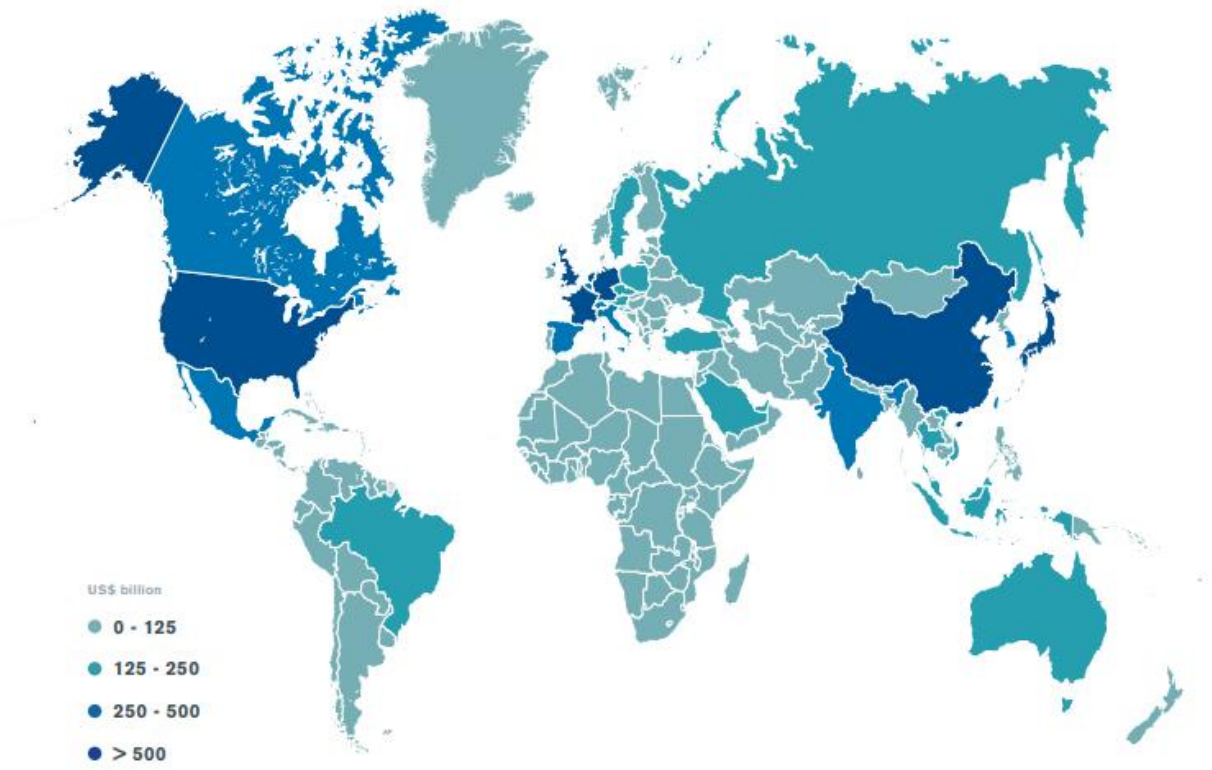
Trade volume increased from 2 trillion dollars to over 20 trillion dollars from 1970's to 2017. Trade became more important. The ratio of world trade to world GDP increased from 20% in 1995 and to 30% in 2014 (WTO, 2015).

After the last decade of the 20th century, China followed a policy to decrease the tariff and non-tariff barriers and eliminating the trade deformations caused by exchange rate regimes (Ianchovichina& Martin, 2003). In the year of 2001, China got membership of the WTO (WB, 2015). Thus, the world experienced cheaper goods and commodity prices as imported from China which makes other economies more competitive by encouraging the domestic producers to produce in a more effective way by implementing more technologies (Shafaeddin, 2002). It was the unique action for domestic producers to deal with cheap Chinese commodities (Morrison, 2001). Moreover the strong Chinese demand for natural resources created an increase of prices in oil and primary resources until the great recession.

With this respect, taking an action from the consensus that WTO is a considerable organization with it member's share on world trade, the following part of this section is mostly relied on the data taken from the WTO.

According to the WTO, merchandise exports of the WTO members totaled US$ 15.71 trillion in 2016. The top 10 traders in merchandise trade account for a little over half of the world's total trade (%53) in 2016 whereas the developing economies had a 41% share in world merchandise trade in 2016.

Figure 1: Economies by size of merchandise trade, 2016

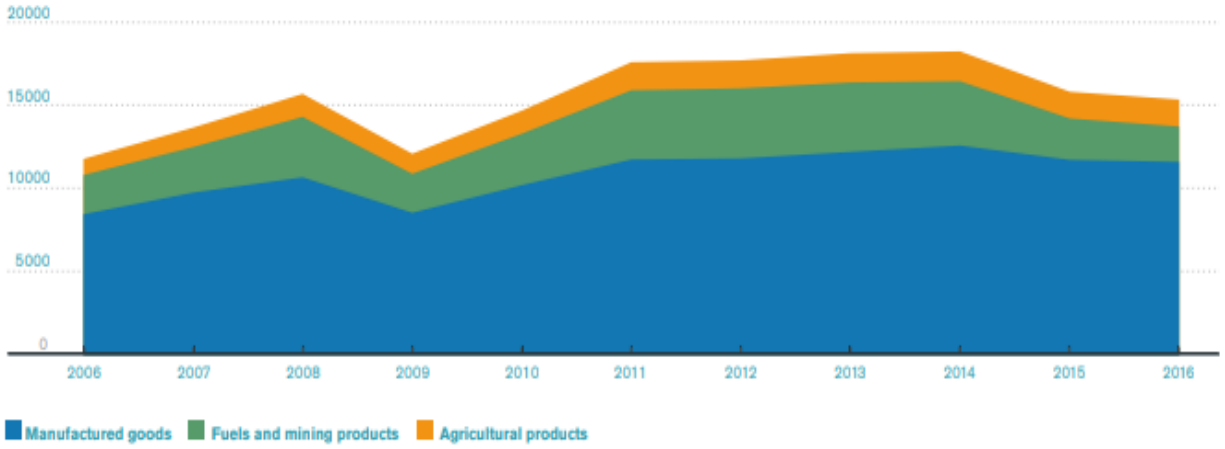


Source: World Trade Organization (WTO)

Export of the commercial services is also a strong indicator of the world trade. Thus, exports of commercial services by WTO members totaled US$ 4.73 trillion in 2016. The top 10 traders in world commercial services represent again the %53 of the world's total share whereas the developing economies accounted for 34% of total trade in commercial services in 2016.

Figure 2 below shows the world merchandise trade by major product grouping. Manufactured goods have the highest share in the merchandise trade and world exports of manufactured goods increased remarkably from US$ 8 trillion in 2006 to US$ 11 trillion in 2016. Manufactured goods are followed by fuels/ mining products and agricultural products respectively.

Figure 2: World merchandise trade by major product grouping, 2006-2016 (US$ billion)

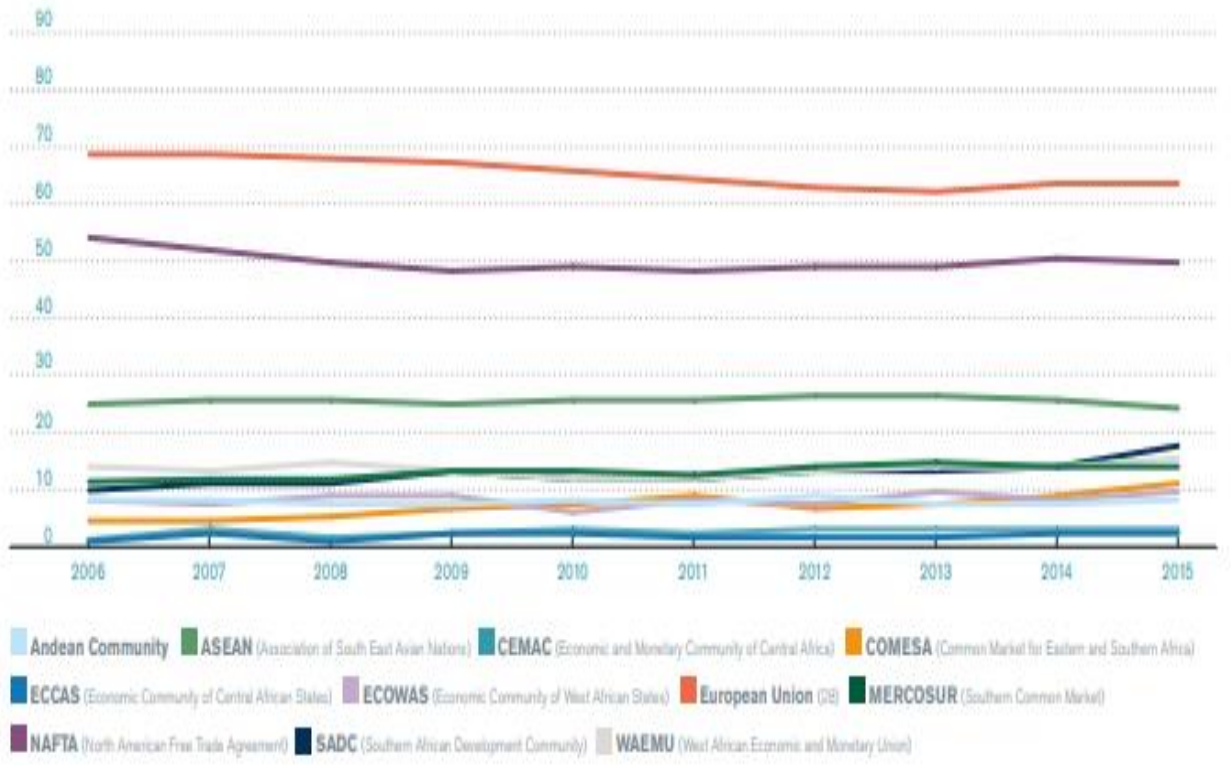


Source: World Trade Organization (WTO)

As it has been already mentioned that bilateral trade agreements became crucial actors of the world trade; regional trade movements are also important indicator to follow. The Figure 3 below shows the exports within major regional trade agreements which includes Andean Community, ASEAN, CEMAC, COMESA, ECCAS, ECHOWAS, EU, MERCOSUR, NAFTA, SADC and WAEMU.

According to the data in Figure 3, the trade within the EU represented 63% of all EU total exports in 2015. In NAFTA, ASEAN, SADC and MERCOSUR, intra-trade totalled 50%, 24%, 18% and 14% respectively.

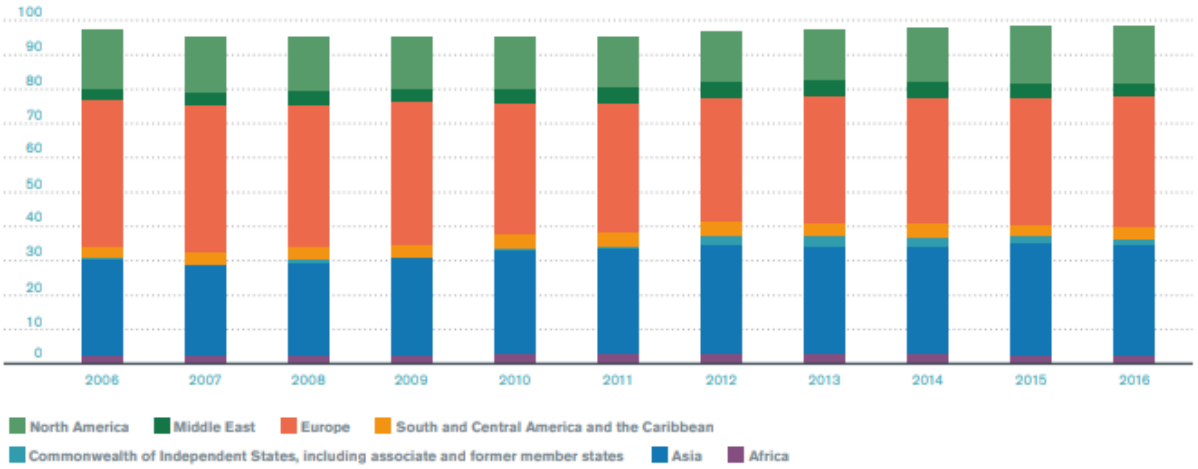
Figure 3: Exports within regional trade agreements, 2006-2015 a (Share, %)



Source: World Trade Organization (WTO)

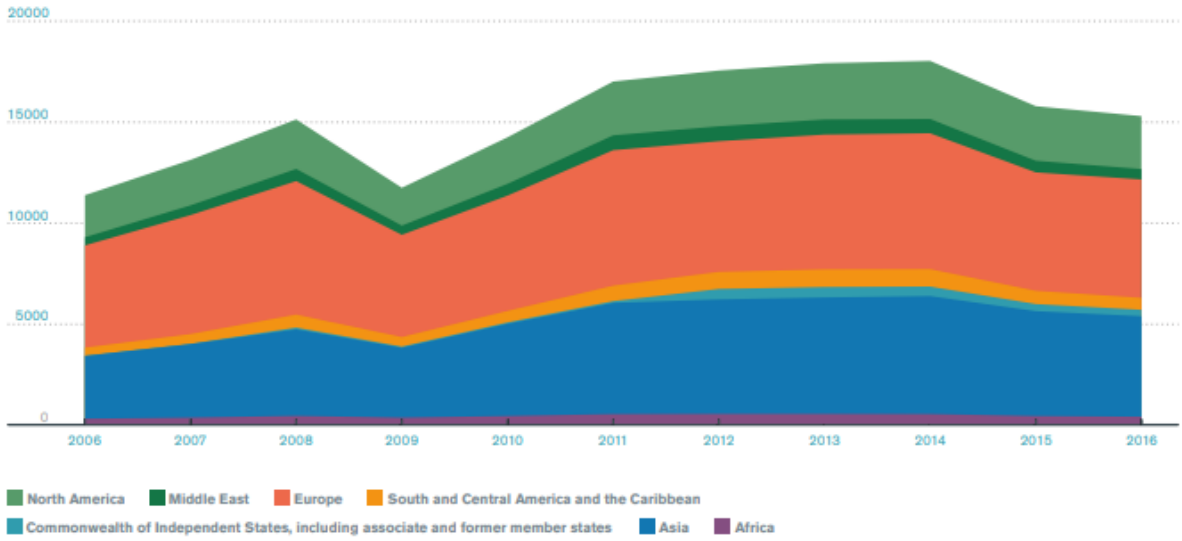
WTO members account for 98.2% of world merchandise trade. Asia, Europe and North America account for 88% of this total. Merchandise trade of WTO members has increased to US$ 15.4 trillion, up from US$ 11.7 trillion in 2006.Figure 4 and Figure 5 below show the share in world merchandise trade of WTO membersover the last decade.

Figure 4: Share in world merchandise trade of WTO members, 2006-2016 (Percentage, %)



Source: World Trade Organization (WTO)

Figure 5: World merchandise trade of WTO members, 2006-2016 (US$ billion)



Source: World Trade Organization (WTO)

CHAPTER 3: INTERNATIONAL SHIPPING MARKET

3.1. Sectors in the International Shipping Market

Maritime transportation is done by tramp and liner transportation systems and each of them have their own structure and characteristic (Başak, 1996). In the maritime trade, dry bulk transportation is also known as tramp transportation (McConville, 1999).

Even though the maritime transportation industry seems to contain several industries, it may actually be counted as a single industry (Farthing, 1993). This industry covers several markets and each of them has their own market structure. This structure is shaped with respect to feature of the each market and such factors as service supply, type of the good, number of the actors in the market, boundaries to enter / leave the market and number of the clients may affect this structure (McConville, 1999). Considering those factors, a crucial feature for one market may not be sufficient to understand another market (Farthing, 1993).

Dry bulk cargos are carried by the dry bulk carriers whereas the liquid cargos are carried by the tankers. Both dry bulk and tanker markets are perfectly competitive markets. Another market in the maritime transportation is the liner market in which containers and bulk cargos are carried. This liner market is considered to be more complex and imperfect competition is dominant (McConville, 1999). Imperfect competition level may differ with respect to conjuncture. The most extreme shape of the imperfect market may come into existence as a monopoly market whereas only one firm has a word to say in the market. But neither in the liner market nor in the dry bulk and tanker markets, monopoly market is valid in the maritime transportation industry (Farthing, 1993).

3.1.1. Tramp Transportation

Tramp transportation started in the 1850's as the first steamboat ply safely and regularly. From this date to 1914, a lot of goods such as coal, iron ore grain are carried by general purpose small ships. From one cruise to another, with different routes and different burden, those ships are called tramp steemar. After the first quarter of the 19th century, opening up of the Panama Canal, maritime transportation industry/technology experienced spectacular changes. This changes are reflected to the tramp steemers as well and technology oriented ships are adapted in the tramp transportation (Kendall, 2000).

Tramp transportation, as it is called, does not follow a particular program (Öztek, 1996). With another words, ships go to the part where they find a burden to carry to around any point of the world in this type of transportation (Sloggett, 1984).

In the nature of the tramp transportation, searching the place where the burden is cancarrying them to the ordered place are valid. So that, tramp steemers play a crucial role to carry the goods necessary for production in complex industries by showing respect to time, proper and economics (Kendall, 2000).

It is not expected that a cruise is settled with respect to the neccesity of the demander and routes. For such products as fuel and coal, shipowners may repeat the voyages and make aggrements called "consecutive voyages". Those voyages are organized with respect to the neccesity of the charterer and never called as "liner transportation" (Başak, 1996).

The main argument in the tramp transportation is the "burden" itself insted of the "service". That is why burdens are homogenous and its equal exactly to the capacity of the vessel. Ships

do not cruise before the capacity reaches to its maximum level (Öztek, 1996). Carried products are generally dry bulk commodities and has low value (Branch, 1975).

In the tramp transportation, ships are rented by signing aggrements of "charter party". Charter party is based on time and voyage (Branch, 1975). Trampsteemer owner should make different charter party agreement for each voyage. Conditions on the charter party agreement are based on the ability of the shipowner and the charterer as well as the trends in the market. It may differ from one ship to another. The conditions on the charter party can only be implemented on the forenamed ship. In this type of transportation, the burden and the ship are matched via brokers or shipping exchanges. There is no commercial or promotion (Başak, 1996). Tramp steemer owners look for burdens with high mark-up and ask help of the agencies or brokers. So that, by the help of those sources, owners may have better skill to evaluate the market and make efficient decisions(Kendall, 2000).

Freight market in the tramp steemer transportation is shaped by the demand and supply conditions (Branch, 1996). If the burden is low and number of ship is high, charterer have a better position. When it is opposite, meaning the burden is high and number of ship is low, the ship owners have a better position. The competition among the shipowners is very high and even 5% difference per tones may change the deal (Başak, 1996)

Freight rates in the tramp transportation is relativelty lower and changes as a response to the world economy. For example, if there is an abundance in the grain market, the demand for the seaborne trade get lower. As the supply and demand law suggests, ship owners lower the freight rates and try to get burden as much as possible. In 1974, war time in Soviet Union, there was a decline in the harvest and many grain producer countries increased the demand for seaborne transportation. Once the amount of the demand for ships exceeded the amount of the existed ship, freigh rates increased dramatically.

There is no competition institution on the freigh market and invisible hand works in the freight market whereas the freight rates are determined in the market (Altuğ, 1974).

Freight are highly volatile in all tramp markets (Volk, 2002). Researches show that time basis freights are more volatile than the voyage basis freight (Branch, 1996). Considering the tanker and dry bulk carriers, which are in the tramp market, freight rates for tankers are much more volatile than the dry bulk freight rates. Meanwhile, in the tanker market, bigger tankers are much mobile than the smaller tankers (Volk, 2002).

In the tramp markets, futures market enables to avoid the risks caused by volatile freight rates. Goods traded in the futures market should be standarized. That is why there are some standarts for the dry bulk commodities in the future market. However, as the freight is a price of a service, there is no standart. In order to overcome such problem, an index is settled and trade occurs via this index. This index is called Baltic Dry Index (BDI) and it contains 12 main routes to represent the freight market (Gray, 1987).

As the industralized countries will always need raw materials and the regions of the source of raw materials make it neccesary for seaborne transportation to reach industrlized countries, tramp transportation will remain its importance (Kendall, 2000).

3.1.1.1.Dry Bulk Market

Dry bulk commodities are the materials such as grains, metals, and energy materials that are transported in their raw form in order to be used as a input for the production. So that dry bulk commodity transportation refers to geographic movement of the dry bulk commodities from exporter to importer for production process of any type of goods (Farthing, 1993). Taken into account the fact that dry bulk commodities are crucial for production they can also be considered as an indicator to see the world's economic conjuncture. So that dry bulk transportation appears as an important factor in the maritime industry. For example, without the efficient transportation of the coal and iron, steel industry cannot function efficiently neither. Because energy demand of the developed countries and one of the vital point of the world economies are depend on the coal and iron.

Dry bulk commodities can be categorized under two major titles. Primary dry bulk commodities consist of iron, coal, grain, forest products, steel products, fertilizer and bauxite ore. Among those primary dry bulk commodities, iron ore and coal have the highest shares in the world dry bulk trade. On the other hand, secondary dry bulk commodities are sugar, salt, nickel, chromium, rice, sulphur, coking coal and etc.

When one glance through the evolution of the sea borne dry bulk trade, it can be seen that sea borne dry bulk commodity trade activities started in 1960's (McConville, 1999). After the World War II, Japan and West European countries became world’s dominant importers and the demand for the dry bulk commodities gained a strong momentum. That is why; sea borne dry bulk commodity transportation experienced a strong growth in the 1960's (Stopford, 1988). This growth remained up until the oil crisis in 1970's and meanwhile this growth gave way to constriction. However, after 1970's, sea borne dry bulk commodity transportation again catched a stable growth (McConville, 1999). Among the dry bulk trade, the share of the primary dry bulks is higher comparing to the secondary dry bulks. So that primary dry bulks can be considered as a propulsive force of the market. At the same time, as the primary dry bulks are used in whole world economies, dry bulk trade show parallelism with the world economic conjuncture (Stopford, 1988).

Even though the exact determination of the volume of the dry bulk trade is impossible, the figure below gives a rough commodities of the trade volume of the dry bulk trade. From this figure, it can be seen that trade volume of the dry bulk has a tendency to increase from its initial to nowadays. Given this fact, dry bulk fleet also havea tendency to increase as well.

During the 1980's and 1990's, dry bulk trade volume has experienced a growth around 2%. However, this growth has increased in the last years (Eagle Bulk Shipping Inc., online). Especially after the Asian economies opened their door to the global trade, from 2000 to 2003, as China became a member of the World Trade Organization, dry bulk trade experienced a growth of 14%. This growth is even higher than the fleet growth whereas it is around 10% for the same period. This increase in the dry bulk trade volume come true in Asian economies with a remarkable rate.Particularly, Chinese Economy which has high rates of economic growth created a significant market for the dry bulk commodity (International Association of Dry Cargo Ship-owners-Intercargo-).

In the dry bulk commodity trade, the factors which affect the size of the demand can be indicated as (Metaxas, 1971) .

- International trade volume and its structure,
- Geographic distribution of the agricultural products, finished and semi-finished goods, production and consumption regions in the world.
- Level of the demand for those goods in production and consumption in the regions

As well as those factors above, transported commodity's market is also an indicator of the dry bulk maritime market. That is why, in order to have better understanding of the dry bulk market, it should be noted that chracteristics of the commodities and market of those

commodities must be evaluated (Rogers, 2002). Motivation of this study is derived from this fact.

For example, around 70% of the dry bulk trade volume consists of the primary dry bulk commodities. Among those, iron ore and coal have the biggest share with almost 50% (Global Insight Report). So that it can be understood that dry bulk commodity transportation is mostly based on the demand of the coal and iron ore.

The figure below shows the share of the dry bulk commodities in the maritime market.

Figure 6: The share of the dry bulk commodities in the maritime market (%)

	Million Tones (2016)	% share
Five major bulks	3172	65%
Iron ore	1410	29%
Coal	1140	23%
Grain	476	10%
Bauxite/alumnia	116	2%
Phosphate rock	30	1%
Minor bulks	1716	35%
Steel	404	8%
Forest	354	7%
Total Dry Bulk	**4888**	**100%**

Source: UNCTAD, Clarkson (2017)

Grain transportation which has 10% share in the dry bulk trade is mostly depend on the climate and geographic conjuncture as well as the agriculture policy of the countries (Institute of Shipping Economics and Logistics –ISL- Online). In the grain industry, USA, Canada and Australia are considered as major exporter as those countries have large and productive lands. Major importer of the grain are England, North Europe and Med-Countries (Kendall and Buckley, 2000).

In the iron ore market, Brazil and Australia are considered as major exporter (Institute of Shipping Economics and Logistics -ISL-, Online). On the other hand, most considered importer countries are Europe and Far Eastern countries.

In the coal trade, coal transportation volume has almost similar figures as iron ore trade. In general, coal demand are categorized under two main groups. One of each is the coke coal which is used in the steel production and the other one is the thermal coal which is used in energy santral and warm up. Large part of the coke coal import is due to the demand of West Europe and Japan by creating a crucial market whereas thermal coal trade reacts against to the oil crisis. As the oil prices follow an increasing path, thermal coal trade experiences a boom period and almost racing with the oil trade (Stopford, 1988).

In the bauxit-alumnia trade, development are mostly based on the major OECD countries as this commodity is used mainly for plane construction, building construction, demistry and electricity.

3.1.1.2.Tanker Market

Tankers are playing an important role to carry the oil and petroleum products in all over the world. In this manner, tanker transportation is a crucial sector in the shipping industry. Tanker transportation corresponds to the one of third share of the world seaborne transportation. Petroleum can be carried by the pipelines and trucks as well however the volume is limited comparing the volume in the tanker vessel transportation. Thus, this is very crucial for both petroleum producers and demanders (Kumar, 2003).

Tanker transportation has also a close link to the petroluem trade, geopolitics and politic conjuncture. That is why it is important to give a brief history of the tanker industry. Petrol trade initially started in the end of the 19th century as the petrol was an important source for United States thus small scales of the petroleum vessels was constructed by the Americans (Kumar, 2003). In 1861, first voyage was organized from the US to Europe in a form of wood barrels (Newton, 2002). However, handling cost and the volume of the trade crated a necessity for developing new models for trade (Stopford, 1988). As the petrol is an important input and has a large scale of use, the petrol companies aimed to increase their share by improving the transportation facilities which has caused a revolution in the tanker industry (Newton, 2002).

Gluckauf which is the first tanker ship used by Germans was constructed in 1866. Then, sons of Alfred Nobel, Nobel Brothers created European fleets for trade with Russia in the middle of the 1880's Americans (Kumar, 2003).

The years of the 1960's can be accepted as a development period for the petrol industry which enable the tanker transportation to grow rapidly whereas the number of the fleets and the size of the vessels increased as well Americans (Newton, 2002; Kumar, 2003). With the rapid growing economies, USA, West Europe and Japan became an important demander of the petrol so that the transportation volume and cycles are required to be developed between the producers of the petrol and demanders. So that the years of 1960's and 1970's are considered as a golden years in the tanker industry.

In the year of 1965 as Egypt nationalized the Suez Cannel, freight rates increased remarkably thus the political role of the petroleum trade and tanker transportation became clearer. Up until the beginning of the 1973, the demand for petroleum increased (Valoies, 1997). However, with the effect of the Israel's occupation in Egypt in the Six Days War, Yom-Kippur War started in 1973. It caused a decline petroleum and tanker market (Kumar, 2003). Following this event, OPEC countries implemented embargo to such countries which support Israel as USA and Netherland (Şentürk, 1999). Thus first oil shock was experienced (Kumar, 2003). During these years, golden age of the tanker transportation ended. Meanwhile the crisis, credit repayments of the tanker investments was in run. Some of orders of the tanker buildings was stopped but as the building of the most of them was closed to be completed, it was needed to be delivered (Newton, 2002). However after the embargo ended, global demand for petroleum increased. Petroleum trade has close links to the industrialization. So that an increase in the industry causes an increase in the petroleum trade thus in the tanker transportation.

Today, over the sixty countries are regarded as producer of the petroleum. The petroleum export is mainly provided from the Middle East. However, those exporters are also the demanders. Some countries uses the pipeline and rode tankers in the petroleum trade; some of the countries do not involve to the petroleum trade because of its country policies. That is why all the producer countries are not engaged to the tanker trade. For example, USA has enough capacity to export petroleum but because of the policy which aims to protect the natural resources, country did not export petroleum for long-years. So that even though the USA is considered as a petroleum producer, the country did not engage to the tanker trade (Wood, 2000).

Middle East- Asia Pacific route is relatively longer so that bigger types of vessels are used in these routes.

Tanker freight market have highly volatile nature. Generally, tanker freight market have similarities to the dry bulk freight market. Even though there are similar characters, tanker freights have higher volatility. There are two main reasons for this fact. One of each is that the demand for tanker is derived demand and it is inelastic. So that it shows reaction to the seasonal changes and

international economic events.Meaning that as the demand is inelastic, it is not much sensitive to the prices in short term, it may have so much reaction to some events. The second fundamental reason is that the supply side of the market is always active. It is seen especially in the full capacity action regions. This may eliminate the flexibility of increasing the supply in the short run. Thus, spot freight market present a constant supply and irregular demand combination in the short run which creates a volatile market (McConville, 1999) .

There is a spesific tariff system in the tanker transportation because of the fact that there are many ports with different costs and each routes have has the different voyage time. To over come this issue, "Worldscale" tariff system is used. This system enables to compare the freight rates offered for different ports. World scale 100 refers to a standard number. Tariff is accepted as a cost of a voyage within the ports included among the destination and it is calculated for each line (Evans and Marlow, 1990). If the demand and supply is on balance and the defined tanker is rented, "Worldscale" rate is taken as 100% (Valoies, 1997)

The tankers in the market are divided into three categories. One of each is that crude oil tankers which contains Panamx, Aframax, Suezmax, VLCC and ULCC. The second is called petroleum products tanker which contains handymax, large and VLPC. The third one can be categorized as "others" which contains combined carriers, tank barges and wine tankers.

3.1.2. Liner Market

Liner transportation is settled due to a certain program. Thus, the voyages are organized between the particular ports with particular amount of vessel. These regular voyages are similar with the public buses which stop by on certain stations. Market conditions on liner transportation are determined for some types of burdens with respect to distance, time, and vessel type so that transportation is on regular basis. Moving from this fact, freight rate is also determined by taking those factors into account (Öztek, 1996). Those determined freight rates are announced for specific routes and the rates are generally stable (Farthing, 1993). When the liner service is settled, administrative should arrange the ship immediately for the voyage charts. Frequency of the voyages

is based on the amount of the burden however monthly organized voyages are generally applied (Başak, 1996).

Liner service is open for everybody who wants to carry burden and the ship should leave the port even though it is not embarked on full capacity. So that it is possible to say that when the economy is on the boom period, ships are embarked on its full capacity and when it is the opposite, ships may go on the voyage empty.

Considering those factors, tramp transportation is similar with the taxi whereas the liner transportation is similar with the public buses. Transportation agreement between the ship owner and the charterer is only invalid when the transportation is already done(Haralambides, 2000).

Liner transportation system requires high infrastructure investment on agencies, ships and equipment (Haralambides, 2000). And comparing the liner transportation with the tramp transportation, liner system is more expensive as it requires specific equipment for handling. Ever since the year of 1954, liner ships got larger and more complex so that purchasing and administrating those ship become more costly. So that cost per tones is higher in liner system comparing with the tramp system (Başak, 1996).

Such semi-finished and finished goods as computer, cellphone, textile and other production input are carried in liner system (Haralambides, 2000). And those cargos are usually named as "general cargo". Until the beginning of the 1960's, those cargos were carried with the small ships on barrel, pocket or boxes. Aligning those cargos into the ship was requiring high amount of labor. That's why ships were waiting for a long time at the ports in order to complete barking-embarking process. So that port traffic was a chronic problem of the seaborne trade and it was increasing the transportation cost. Moreover, those delays at the ports were making the trade activity irregular and unpredictable in which encourage the producers and sellers for good storage. Thus, storage and

handling cost was added to the transportation cost, resulting the final good to be more expensive. This situation was putting barrier on world trade.

However, containerization in 1960's was a remarkable turning point for the world trade. It initially started on the route between the US and Europe then spreaded to the whole world. Until the containerization, liner ships companies mostly cared about the appearance of the ships and aligning cargos neatly. Even though the way of packing the cargos is also important for the cargo owner, considering the feature of the cargo, client had no word to say regarding handling process. After this revolution in 1960's, general cargos are carried within the standardized boxes called container (Haralambides, 2000).

After these changes, port costs declined dramatically as well as the time passed on the ports. All those development increased the productivity of the ships and ports whereas ship owner took advantage of the economies of scale (Haralambides, 2004) . Ever since this time, container ships got larger and reached almost level of 21,000 TEU. Moreover, in order to deal with the technological developments in containers, there was also a flow of investment on ports.

Another point of liner transportation is that the value of the cargo is much more important than the tonnage of the cargo (McConville, 1999) . It can be said that the value of the cargos in liner transportation is higher than the one in tramp transportation (Başak, 1996). So that carrying more valued product requires higher freight rates as it is in liner system. That is why the income of the liner sector is the highest comparing the dry bulk and tanker sectors (McConville, 1999).

Another crucial feature of the liner system is that freight rates are determined in such a system called conference system. A significant part of the firms in liner transportation are the member of the conference system which gives an oligopolistic structure to the liner sector (Altuğ, 1974). According to the conference system, two or more transportation companies engages with

the aim of decreasing competition, hedging themselves against the market risks, regulate the voyages and determine the freights (Haralambides, 2004).

The first conference in the history of liner system was arranged between the England and Calcutta, which is a port city in India, in 1875. Later on, in 1979, ship owners in Japan and China have decided on a common freight rate (Alderton, 1995) In the initial period of the conference system, steam ships were common and opening up the Suez Canal has accelerated the spreading of the conference system. After the Suez Canal, the distance between the England and India has declined almost by 50% and exceed tonnage has occurred in the route. This situation leaded the conference system to be more common. Thus, conference system was accepted as a supply regulated system by ship owners (Alderton, 1995; Stopford, 1988)

One of the other important features of the liner system is that the industry has constant and high level of expense. For the ships to follow the pre-determined calendar, they should take the voyage without considering whether the ship is full of burden or not. That is why expenses are independent from the cargo and they are constant.

For example, when the ship is not in the full capacity just before the voyages, if an unexpected client come and give order, ship administrator should accept the cargo with a freight rate as cheapest as possible. Because whether the ship take the cargo or not, it should continue to the voyage. If they accept the cargo, the cost per unit decreases.

Consider a situation that all ship owners apply to this method which give freight rates the tendency to decline, so that liner system cannot survive in the long-run as the competition reaches to such level that ship operates in the cost-price boundaries with no mark-up. This is another factor for the necessity of the conference system (Haralambides, 2000) The main arguments in the conference system are determining the freight rate and splitting the market. In addition to those,

conference system also enables to avoid the competition and sustain freight rate stability as well as serving a safe voyage (Branch, 1975).

In the conference system, members can only compete on the quality of the service instead of the price. That is why even though the market seems to be monopoly, it is actually not. Because the actors do not have mark-up as high as monopoly market. As the price is constant, only way to increase the profit is about the service quality (Haralambides, 2000) Conference system has disadvantages as well. Ship related to the conference may lose the bargaining power and they cannot benefit the tramp transportation facilities for higher tonnage burdens (Alderton, 1995).

Conferences can be divided into two categories namely as opened and closed conferences. In the closed system, the number of the members is limited and some of them, income and expenses can be shared out. The main aims of the closed system are to put boundary on the entrance of the new ships into the market and to avoid to decrease the share. Closed systems have semi-monopoly characteristics.

Opened conference system on the other hand does not require membership. Every ship owner can join to the conference and it is used mainly by the USA for Atlantic and Pacific Routes (Stopford, 1988).

3.2.Classification Society[2]

Classification society is considered as a non-governmental organization in the shipping industry. The society has a right to establish and maintain technical standards in the field of the construct and operate the ships.

Considering its role in which categorizing and corroborating the designg and standarts the vessel, the society has an important impact on the industry as it demands some technical standarts moreover controling the standarts implemented in some certain periods. Classification societies are accredited by flag states to control and classify vessels and give certificates on this regard.

Its labour power includes mechanical, material, piping and electrical engineers as well as the ship surveyors.

Today there are more than fifty classification societies in the world.

3.2.1. International Association of Classification Societies (IACS)

Thirteen largest marine classification societies in the world are the members of the International Association of Classification Societies (IACS). IACS was founded in Hamburg, Germany on September 11, 1968. The classification standards set by the thirteen member societies of IACS are covering more than 90% of the world's cargo carrying ships' tonnage. Origins of the IACS are coming from the International Load Line Convention of 1930 and its recommendations.

Following the Convention, RINA hosted the first conference of major societies in 1939 - attended by ABS, BV, DNV, GL, LR and NK - which agreed on further cooperation between the societies.

[2] The information in this section is summarized from the website: http://maritime-connector.com/wiki/ship-sizes/

Another important meeting was in 1955, which resulted to the creation of working parties on specific topics and, in 1968, to the formation of IACS by seven leading societies. IACS was given consultative status by the IMO in 1969. This organization give a guide and technical support.

IACS is consultative actor in IMO, and continuously the only non-governmental organization with status as the observer which also develops and applies technical rules that are reflective of the aims embodied within IMO conventions.

Every classification society can apply for membership as long as they satisfy the liabilities whereas the members of IACS have to show continued compliance with quality standards as determined by periodic audits.

To promote maritime safety and clean seas, IACS and its individuals carry out research and development on marine-related topics, providing technical support and verifying compliance with published standards.

3.3. Vessel Types in Shipping Industry[3]

Vessel types can be categorized under two topics mainly with respect to the type of the cargo carried and with respect to the capacity of the vessel. From this point of view, this part of the study aims to explain the specific types of the vessels to have deeper understanding and insight for the data used in the empirical analysis.

[3] The information in this section is completely taken from the website: http://maritime-connector.com/wiki/ship-sizes/ as the notions of the ship types in the shipping industry are by definition.

3.3.1. With Respect to Cargo Carried and Intended Use

There are 10 types of vessels in the shipping industry for their use of intendance which are dry cargo, bulk carriers, container ships, liquid cargo, passenger, ocean liners, cruises, ferries, yachts and auxiliary purpose .

Dry Cargo

This type of the vessels are used to carry solid dry goods such as metal ores, coal, steel products, forest products, and grains. It mainly includes bulk carriers and container ships. Bulk carriers are used for transportation of unpackaged bulk cargo, such as metal ores, coal, cement, tin, steel, and grains in its cargo holds. Container ships are considered for the transportation of non-bulk cargo, generally manufactured goods, in truck-size intermodal containers.

Bulk Carriers

Bulk carrier is considered in carrying unpackaged bulk cargo items such as metal ores, coal, cement, grains and other similar cargo. It can be categorized under six topics (with respect to DWT capacity) These consist of Handysize, Handymax, Panamax, Capesize and Very Large.

Container ships

Container ships are considered for the transportation of non-bulk cargo, generally manufactured goods, in truck-size intermodal containers. They can be divided into several categories according to their cargo carrying capacity. Main categories of container ships include Feeder, Feedermax, Panamax, New Panamax, and Ultra Large.

Liquid Cargo Ships

Liquid cargo vessels are ships which carry cargo in liquid form. Possible cargoes are crude oil, oil products like gasoline, vegetable oil, wine, orange juice, acids, chemical substances, gas under ambient temperatures and atmospheric pressure and etc.

An oil tanker, also known as a petroleum tanker, is a merchant ship designed for the bulk transport of oil. There are two basic types of oil tankers: crude tankers and product tankers.

Liquid cargo vessels can be categorized under two main types in which product tankers and chemical tankers.Crude tankers move large quantities of unrefined crude oil from its point of extraction to refineries (Hayler and Keever, 2003).

- **Product Tankers** carries the refined products of refineries and petrochemical industry. There are higher number of tanks/holds available than by the crude oil carriers. Possible cargoes for these type of vessels are: gasoline, kerosene, diesel oil, lubricating oil etc.

- **Chemical Tankers:** Possible cargoes for these vessels are acids, alkaline, alcohol, monomers, chlorinated alkenes, other chemical substances.

- **LNG/LPG Carrier:** These are the gas carrier vessels. The gas cargo is pressurized or brought under low temperatures so that it becomes liquid, which increases the transported quantity.

Passenger Ships

Passenger ships are considered for carrying passengers. It consists of ferries, yachts, ocean liners, and cruise ships.

Cruise Ships

Cruise ships are large passenger ships offering pleasure trips adventure seeking people.

Ferries

Ferries are boats or small-sized ships that are used for day or overnight short sea trips sailing close to the coast between two or more ports.

Yachts

They are small boats or ships primarily used for recreational purposes.

Auxiliary Vessels

Specialized vessels are those vessels that have onboard machinery and equipments to perform various tasks related to marine industry.

Anchor Handling Tug Supply Vessels are designed and equipped for anchor handling and towing operations. They are also used for rescue purposes in emergency cases. **Cable Laying Vessels** defined to lay cables on the bed of ocean floors for telecommunications, power transmissions and other purposes. **Drilling Vessel is** used for offshore drilling purposes **Fire Fighting Vessels** used for extinguishing fire on ships. **Ice Breaking Vessels** designed to move and navigate through ice-covered water and are used to make way for other marine vessels. **Pipe laying vessel** is used to lay pipes on the sea. **Seismic Vessels are designed** for the purpose of seismic studies deep inside oceans. The ship is used as a survey vessel to explore and locate best potential areas for oil drilling in the oceans. **Tugboat is** a boat that moves ships by towing or pushing them. **Well Intervention Vessels** are used for subsea well intervention purposes. These interventions are commonly executed from light/medium intervention vessels.

3.3.2. With Respect To the Capacity of Vessels[4]

Cargo ships or vessels come in different types and sizes to meet the various demands of marine cargo transportation. Cargo ships arecategorized partly by capacity and partly by dimensions (often related to the different canals and canal locks they are traveling through). Sizes of cargo vessels range from a modest handysize carriers(10,000 - 30,000 DWT) to mammoth VLCC and ULCC super tankers with a capacity to carry cargoes of more than 200,000 DWT. Aframax and Panamax are mid-sized cargo vessels.

Aframax

AFRA stands for Average Freight Rate Assessment. Aframax are medium-sized oil tankers with a dead weight tonnage (DWT) between 80,000 and 119,999.

Capesize

They are very large and ultra large cargo vessels with a capacity over 150,000 DWT. They are categorized under VLCC, ULCC, VLOC and ULOC. They are primarily used for transporting coal and iron ore.

Chinamax

Chinamax ships are very large bulk carrier which can't be longer than 360m (1,180 ft), wider than 65 m (213 ft) and her draft can't be more than 24 m (79 ft). The deadweight tonnage of these vessels is 380,000–400,000 DWT.

Handymax/ Supramax

Handymax are small-sized cargo ships with a size less than 60,000 DWT. Supramax vessels have capacity between 50,000 to 60,000 DWT.

[4] The information in this section is completely taken from the website: http://www.thormarinetrading.com as the notions of the ship types in the shipping industry are by definition.

Handysize

Handysize are small-sized ships with a capacity ranging between 15,000 and 35,000 DWT. They are mainly used in transporting finished petroleum products and for bulk cargo.

Malaccamax

These ships are the largest ships that can pass through the Strait of Malacca which is 25 m (82 ft) deep.

Panamax

Panamax and New Panamax ships are travelling through the Panama Canal. It is not allowed to be longer than 294,13 m (965 ft), wider than 32,31 m (106 ft) and her draught can't be more than 12,04 m (39.5 ft). These vessels have an average capacity of 65,000 DWT, and are primarily used in transporting coal, crude oil and petroleum products.

Q-Max (Qatar-max)

Q-Max's are largest LNG carriers that can dock at the LNG terminals in Qatar.Q-Max ship is 345 metres (1,132 ft) long, 53.8 metres (177 ft) wide and 34.7 metres (114 ft) high, with a draught of approximately 12 metres (39 ft). It has a capacity of 266,000 cubic metres (9,400,000 cu ft), equal to 161,994,000 cubic metres (5.7208×109 cu ft) of natural gas.

Suezmax

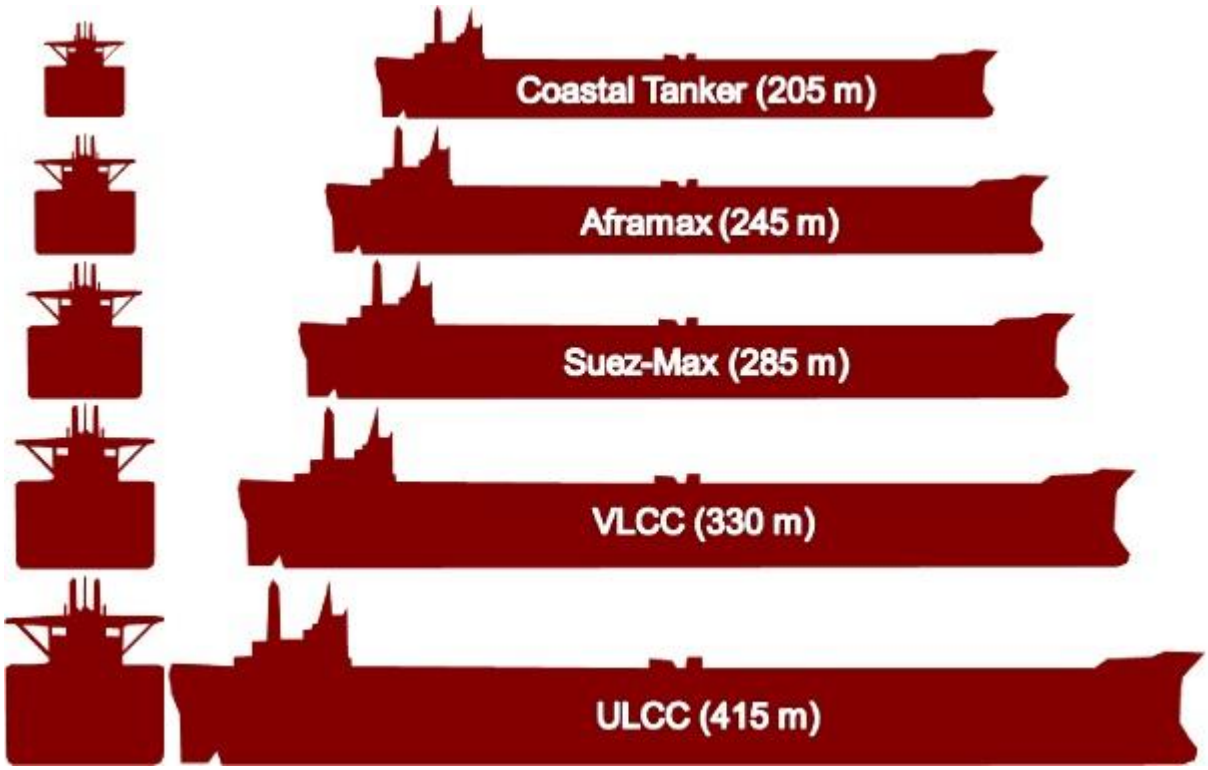
It is mid-sized cargo vessels with a capacity ranging between 120,000 to 200,000 DWT. They are designed to pass through the most of the ports in the world.

VLCC and ULCC

VLCC stands for Very Large Crude Carriers. They have a size ranging between 180,000 to 320,000 DWT. VLCCs are used extensively around the North Sea, Mediterranean and West Africa.

ULCC or Ultra Large Crude Carriers are the largest shipping vessels in the world with a size more than 320,000 DWT. Called Super Tankers, ULCCs are used for long-haul oil crude transportation from Middle East to Europe, Asia, and North America.

Figure 7: Most used ship types in the maritime market



CHAPTER 4: WORLD'S DRY BULK COMMODITY TRADE MOVEMENTS AND TRADE ROUTES[5]

In order to have better understanding of the dynamic relationship between the selected commodity prices and the freight rates, it is firstly necessary to give an outlook of the dry bulk commodity trade and world's main trade routes as the freight rates are determined with respect to type of the cargo and the distance. So that this section focuses on the dry bulk trade outlook as well as the dynamics in the international shipping industry by lighting the macro and micro determinants of the freight rates in the literature.

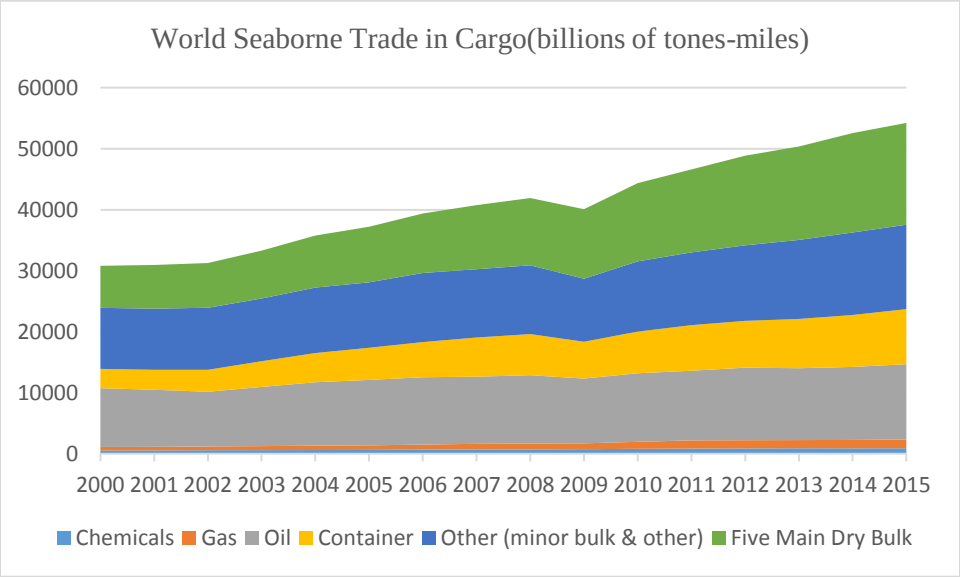
4.1. Dry Bulk Trade Outlook

Over the last two decades, international trade has been affected by many factors including financial crisis, improvement in technology and increased number of states membership of WTO (Barro 2006; Reinhart &Rogoff, 2008). According to the WTO data world exports of merchandise was 5.168 billion $ in 1995 whereas it is 19.002 billion $ in 2014. Trade has been increasing its role in GDP in terms of the ratio of trade in GDP as well. WTO reaches to the ratio of world trade to world GDP and this ratio was 20% in 1995 and 30% in 2014 (WTO, 2015). Considering those trade activities, UNCTAD (2014) implies that around 80% of global trade by volume and over 70 % of global trade by value are carried by sea, thus maritime economics and transportation industry appears as breathtaking fields in the literature.

Maritime transportation industry can be classified into three different sub-industry with respect to cargo which are dry bulk market, liner shipping market and tanker market. Breakdown and evaluation of the maritime transportation with respect to type of cargo over 15 years from 2000 to 2015 is given below in terms of billions of tones-miles.

[5] This part of the thesis is also presented and published as a proceeding in the 1st International Economic Research and Financial Market (IERFM) Congress, University of Trakya, Edirne, 12-13 May 2017 by the advisor of the thesis Erhan ASLANOĞLU

Figure 8: World seaborne trade in cargo (billions of tones-miles)



Source: UNCTAD (2015) secretariat, based on data from Clarksons Research

According to the Figure 8 above, five main dry bulks has the largest share in the global maritime transportation industry. It is followed by other types of cargo, which includes minor bulks, and oil trade. ISL shipping market review statistics shows that bulk carries dominates the world merchant fleet as well with a share of 41.5% dwt segment; of 56.8% in order books; and of 60% world's delivery.

In the context of this study, dry bulk commodity trade is being analyzed as dry bulk commodities includes such materials that function as raw material inputs to the production of intermediate or finished goods. That's why dynamics in this market can be seen as an efficient economic indicator of future economic growth and production. These dry bulks can be divided into major and minor bulks. Major bulks stands for the largest group of dry bulk cargoes and usually include iron ore, coal, and grain. Minor bulks are made up of steel products, forest products, bauxite

or alumina and cement, and fertilizers. Major bulk transportation represent the 70% of the dry bulk trade (30% of iron ore; 30% of coal; 10% of grain; and remaining 30% of minor).

Emerging developing economics such as China and India play important roles as importers and can be considered as main drivers in dry bulk trade. In 2015, maritime dry bulk transportation grew by 5% which is above the worlds GDP growth for the same year. This growth is driven mainly by the strong increase of the iron ore trade by 12.4% whereas grain transportation has increased by11.1%. Despite, coal trade experienced a slight increase of 2.8%. To have a better understanding of the world dry bulk trade, it is important to mention the main importers and exporters of the dry bulk.

Australia is the leading the iron ore exporter with a dominant share of 54% and it is followed by Brazil with a share of 25%. Demand side, on the other hand, includes such countries as China, Japan and Europe with a share of 68%, 10% and 9% respectively. Even though the China's steel production has slowed down in the past years, countries' import remained high due to the lower iron ore prices caused by extreme production of Australia. In the following years, China's steel industry and iron ore demand should be monitored as the country is the main demander; however India's import demand may bring a momentum as the country aims to boost the steel industry.

Indonesia and Australia are the main exporters of the coal with a share of 34% and 31% respectively whereas China, Europe and India are the main importers of the coal. China, again in this industry as well, is the major driver of the world coal demand. However, China's import has slowed down comparing to the previous years due to the facts as China's regulation on saleable coal use, slowing down in the steel production, coal import taxes and quality limits, hydroelectric power production and initiatives to reduce air pollution.

Grain industry's leading exporters are the United States and European Union with a share of 26% and 14% respectively. Thickly populated regions of Asia and Africa are the main importers

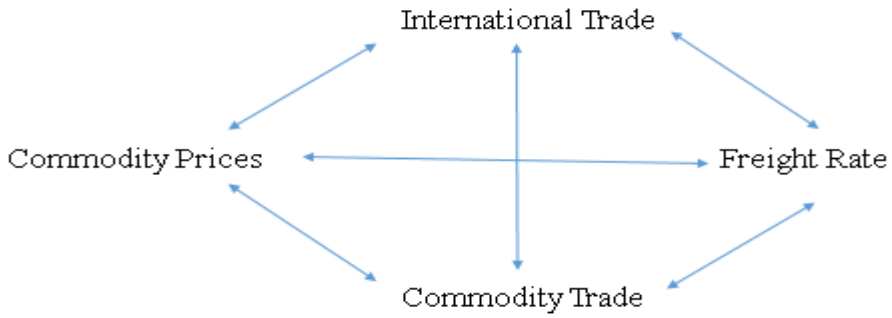
of the grain. Improved weather conditions and recovery in the main exporters and favorable exchange rate played important role for the increase in the grain transportation around the world whereas it is supported by the strong increase in the demand of the China for soybean by 16.4%. So that main exporters and importers of the major dry bulk and main routes are summarized in the following Figure 9.

Figure 9: World Major Dry Bulk Traders and Main Routes

	Exporters		Importers	
Iron Ore	Australia	54%	China	68%
	Brazil	25%	Japan	10%
	Others	21%	Europe	9%
			Others	13%
Coal	Indonesia	34%	China	20%
	Australia	31%	Europe	19%
	Russian Federation	9%	India	18%
	Columbia	6%	Japan	15%
	Others	20%	Others	28%
Grain	United States	26%	Asia	33%
	European Union	14%	Africa	21%
	Ukraine	10%	Developing America	20%
	Canada	9%	Western Asia	19%
	Argentina	8%	Europe	5%
	Russian Federation	8%	Transition Economies	2%
	Others	25%		

Source: UNCTAD (2015)

In the international shipping industry, different classes of the ships are used depending on volume, trade routes, and the geographical limitations of ports. For the largest ports, Capesize (110,000 to 119,999 dwt) are used primarily for the iron ore or coal trade on long-haul routes. Panamax vessels (60,000 to 79,999 dwt), which is able to pass through the Panama Canal, are used to carry coal, iron ore, grains, and to a lesser extent, minor bulks. This feature of the Panamax vessels makes them more adaptable than larger ships in terms of access to different trade routes. Handymax or Supramax vessels (40,000 to 59,999 dwt in capacity) are smaller types of vessel comparing to the Capesize and Panamax and are used in a larger number of global trade routes to carry primarily grains and minor bulks.



Giving this snapshot for the dry bulk industry, major determinants of the dry bulk freight rates in the literature are being analyzed in the next section. So that implementation of the methodology to understand the chain between commodity prices and freight rates becomes smoother. Such chain carries the idea that change in the commodity prices directly affect the world's economy as those are used as input. This change in the economic conjuncture is affecting the international trade, so does maritime trade. Change in the volumes of shipped commodities may have an effect on the freight rates. After revealing all of those topics in the literature, missing parts are pointed out in which the non-existence of the studies about the relationship in time and frequency domain nexus.

4.2. Dynamics in the International Shipping Industry: Major Macro and Micro Determinants of the Freight Rate and Commodity Trade

International shipping industry has a close link with the international trade activity in such a fact that major parts of the international trade movements are carried by the maritime mode of transportation (UNCTAD, 2014). International shipping industry can be categorized under the four major industry which are new building ship market, the sale and purchase market, demolition market and freight market. (Stopford, 1997) New building ship market consists of ship owners and ship builders; and the conditions on this market are determined on the ship specification, delivery date, finance and stage payments. The sale and purchase market, which is also named as second hand market, is the market in which second hand ships are sold and bought. This market is affected mainly by the freight rate in the market, inflation, age and condition of the ship and expectations regarding the future activities. The third market in the international shipping industry is the

demolition market that ships are sold for scrap and the size of this market is associated with the price of the steel and the other raw materials used to construct the ship. The fourth and last market, which is the main topic of this study, is the freight market. The freight rate is a price of a certain cargo delivered from one point to another point and mainly depends on the mode of transportation, weight of cargo and distance as it is defined earlier. Freight is paid to the ship owner by the charter for the use of voyage charterer. Even though each route and type of cargo and ship have its own freight rate such indexes as Baltic Dry Index which measures the cost for shipping goods such as iron ore and grain can give an idea about the freight market. (Stopford, 1997)

Just like in the economy, there is a supply and demand relationship in the shipping industry as well. When there is oversupply of ships, it may give charterer the perception of easiness to find a ship to carry their product and decrease the willingness to pay higher freight. From this point of view, it is important to emphasize that international trade activities is mostly associated with the world's economic conjuncture. Whereby, freight rates follow a similar path with economic conjuncture and directly related with the economic situation. For example, just like cyclical effect in the economy, when economy recovers itself and experience a boom period, freight rate is expected to increase as a response to increase in trade. Since there may not be enough ship to meet this demand, ship owners order new ships to cover the demand coming from charterer and results the increased number of new orders in the world's list of ship order. However, it takes at least two to three years, depending on the technology and size of the ship, for the ship to be ready to use. Thus, it results a shortage of the ships which makes difficult to find ships for charterer to carry those cargo. This fact may lead them to pay higher freight resulting the freight markets to increase. However, these higher rates in the freight market may cause a signal instruction problem in which causes over-new-orders in the ship building industry by the ship owners who aims to increase their share in the market. It is the basic dynamics of the freight market in the economic boom periods. As the economy reaches to the top level, so do the freight rates as well. After a while, as the cyclical effect claims in the economy, trade activities may drop. This decline in the economic activity leads ship owners to sell their ships as there is not enough trade activity to carry those cargos because of the oversupply experience in the boom periods. Because of this fact, second hand market starts to increase up until the point that freight rates and trade activities are still desirable to stay in the

market. Main determinants of those are the freight rate in the market, inflation, age and condition of the ship and expectations regarding the future activities. This dynamics work until the freight rates gofurtherly down and it becomes costly and un-economic to operate the ships and thus managers in the shipping industry may sell the ships for their scrap value and increase the activities in the demolition market.

It is of course not as simple as it sounds to understand the dynamics in the freight market as it is an integrated industry with its many sub-sectors and has a complex shape. In reality, there are many other determinants which affect the freight market. The geographic and political conjuncture as well as economic conjuncture, number of ships in the market, price of the ships in the market, fixed and variable costs of the operating the ships are also important factors which should be taken into account to comment on the freight market (Stopford, 1997).

This study aims to analyze the dry bulk market which consists of coal, grain and iron ore as it is defined earlier. In the dry-bulk market, factors which affect the size of the demand are the volume and the structure of the international trade as they are used as input and raw materials for production; geographical distribution of raw materials, agricultural and industrial materials, and semi-and-final products. This demand level can be covered both regions of production and consumption. That is why distance between the regions in which dry bulk commodities are supplied and demanded becomes one of the major factors in determining the freight rate.

Talley and Alizadeh (2011a) investigated the microeconomic determinants of the freight rates in dry bulk shipping market by making use of the dry-bulk charter contracts for the period between 2004 and 2009. They also investigated the differences in the freight rates around major dry bulk shipping routes, geographical distribution of shipping activities and duration of the laycan period. Their analysis found that laycan period and dry bulk freight rates are interrelated and determined simultaneously. They also found that age and deadweight of the ship and voyage routes can be considered as the determinants of the freight rates. Talley and Alizadeh (2011b) strength

their analysis and conclude that vessel's hull type, fixture deadweight utilization ratio, vessel age and voyage routes are important factors of the freight rates.

Binkley and Harrer (1981) find that ship size and trade volume also play important roles in the determination of the freight rates. Carrying on this idea, using larger ships may reduce the sea cost thereby the role of distance. They also find that such policies to improve shipping technology and to boost trade volumes may cause a decline in the freight rates. This fact directly reduces the geographic distance and increase the competitiveness in the market. However, larger ships may have negative impact as well in such a view that it incurs higher port costs which basically point out that efficient port facilities are required for a scale economies.

With this regards, liner shipping connectivity and port infrastructure are pointed out as determinants of the freight rates in the literature. Wilmsmeier and Hoffmann (2008) analyzed the effect of the port infrastructure and liner shipping connectivity on intra-Caribbean freight rates. By making use of such empirical analysis as principal component analysis and ordinary least square regressions, it is found that structure of the liner.

Carrying the same aim, Micco and Perez (2011) made an analysis in a frame of transportation cost. Their study investigate the determinants of shipping costs to the U. S. for Latin American countries with a large database of more than 300,000 observations per year. They find that efficiency of ports is an important determinant of shipping costs. Because inefficient ports also increase handling costs, which are one of the components of shipping costs. They also contributed to the literature with a finding of improving port efficiency from the 25th to the 75th percentile reduces shipping costs by 12 percent. In addition to those, policies to improve shipping technology and increase trade volume can lead to lower rates, reduce geographic differences among exporters, and thus lead to more competitive markets.

In line with the fact that increase in the trade volume can lead to lower rates, Zarzoso and Burguet (2005) studies to determine the relationship between the international trade and transportation cost. Moving further from the previous studies in which transportation cost is taken as exogenous variable, they analyzed the causal relationship between trade and transport costs which can be operating in both direction with the idea that expanding volume of trade also reduces the unit cost of transport. They applied gravity model to investigate the endogeneity of the trade and transport cost variables by estimating simultaneously both equations. According to their findings; the higher the distance and the poorer importer's infrastructure, the higher the transport costs. Oppositely, a higher volume of trade lowers the transport costs.

According to the studies in the literature, macro end micro determinants of the freight rates can be summarized as the Table 1 below.

Table 1: Macro and Micro Determinants of the Freight Rates

Micro	Distance	The higher the distance, the higher the freight rate
	Ship Size	The larger the ship, the lower the freight rate
	Port Infrastructure	Efficient port infrastructure decreases the freight rate
	Number of Ships	The more the number of ship, the lower the freight rate
	Weight Of Cargo	The weightier the cargo, the higher the freight rate
	Technology	The higher the technology, the lower the freight rate
Macro	World Growth	Depending on the economic cycle
	Trade Volume	The higher the trade volume, the lower the freight rate
	Political Conjuncture	Depends on the bilateral relations

As it is seen in the literature, freight rate has always been an area of interest in the shipping industry. With this regards, quantitative analysis implemented on the freight rate becomes important in the economic literature. Thus, there is such analysis implemented to understand the freight market and international shipping industry by making use of the macro and micro determinants discussed above. Those analysis shows that literature has such studies focuses on the analysis in the nexus of freight rate and those determinants. But conventional time domain approaches are dominant in that analysis. Moreover, underlying time scales are neglected. In addition to this fact, freight rates have highly volatile nature due partly to the uncertainty in international trade; partly to unforeseen events in international shipping industry. Thus, rates mostly follow a non-linear path. Motivation of this paper is derived from the gap in which the analysis of the freight rates on both time and frequency approaches are missing. To fill this gap, this study uses a methodology to analyze the dynamic relationship which enables the researcher to see the evaluation of the relationship of two time series in different frequencies. Thanks to this methodology, this study contributes to the literature by enabling to comment how strong the relationship in different frequencies. Moreover it also allows to comment which variable is leading or lagging.

Change in the commodity prices effects the economic growth and international trade movement as dry bulk commodities is used as both input and final product, commodity trade can be taken as indicator to analyze the economic growth and international trade. As seaborne trade is associated with the international trade and economic growth; seaborne trade volume is also affected from this change, so does the freight rates. With this regard, it is important to understand the effect of the changes in commodity prices on seaborne trade volume and freight rates.

One study is conducted to aim to find out the determinants of the Baltic Dry Index (BDI) which is published by the Baltic Exchange in the period of 2003-2016 by amultiple OLS regression analysis. For this purpose, the most important factors thatare considered to have an impact on BDI, are analysed by the help of E-views 9.0program thereby establishing optimum model. Empirical findings indicate thatphosphate rock and barley have the highest impact on BDI. Additionally, the results ofthe analysis also showed that, while crude oil prices which is the core cost factor

haspositive effect on the BDI, cement and maize prices have significant but negativeeffects (Yıldız and Bucak, 2017). By making use of the data obtained from the official sources, the dynamic relationship between the commodity prices and freight rates are studied using wavelet methodology as a new contribution to the literature by commenting on how significant and in which direction is the relationship between commodity prices and freight rates in both time and frequency domain.

So that before moving further to the results, it is important to point out the evaluation of the models and studies from the sole time domain and correlation coefficients approaches to the three dimensional analysis on both time and frequency domain are reviewed in the following section.

CHAPTER 5: EMPIRICAL ANALYSIS OF THE RELATIONSHIP: FREIGHT RATES AND COMMODITY PRICES FOR SPESIFIC TYPES OF SHIPS AND COMMODITIES

Up until here in this study, trends in the international trade movements, overview of the international shipping market, world's dry-bulk commodity trade movements and main trade routes are softly explained to provide a basis the importance of the relationship between the commodity prices and freight rates. Thus, this section gives a closer view for the dynamic relationship between commodity prices and freight rates on both time and frequency domains as well as giving the causalities.

Within this framework, the methodology, the data used and the result of the analysis is given in this section.

5.1. Methodology: Wavelet Coherence

Studies in the literature suggest that co-movement has link with the time domain also known as correlation coefficient. As a complementary tool to time domain, Fourier analysis enables to examine the relationships between variables at frequency level as well as the time domain. Moreover, carrying on this study, Croux et al. (2001) contributed a new methodology to economic literature to study dynamic correlation which enables the researchers who aims to explore the co-movement between two series at each individual frequency in a range from -1 to 1. Nevertheless, dynamic correlation model introduced by Croux et al. (2001) ignore the time-varying features of the co-movement and gives only the snapshot at the frequency level.

Fourier method, on the other hand, uses such set of trigonometric components as sine and cosine functions which have infinite energy and finite power. However, because of the fact that Fourier transform does not allow for any time dependence of signal, it cannot be obtained any information related to the time evolution of its spectral case (Rua, 2010). To overcome this problem

and eliminate limitations; short-time or windowed Fourier transform appeared in the economic literature. Moreover, there is an emphases in the literature that this transform does not allow a sufficient resolution for all frequencies since the signal is examined under a fixed time-frequency window with constant intervals in the time and frequency domain. However, wavelet-transform solves all these problems and eliminates limitations by making use of local base function which can be translated with a flexible resolution in both time and frequency domains. It is actually a method used for numerous studies in geophysics but can be converted to use in economics as well. The wavelet-transform decomposes a time series in terms of some elementary functions, which are derived from a time-localized mother wavelet by translation and dilation. Wavelets have finite energy, and compact support means that they grow and decay in a limited time period (see, for example, Rua (2010) for further details). In this frame, it gives the co-movement a different quantified shape, so that enables the researcher to comment which time periods and frequencies have the higher co-movement among variables. With this respect, wavelet analysis makes it possible to take into account jointly both the time and the frequency domain to examine the co-movement between the variables. Thanks to this fact, analyzing the change in the strength of the co-movement over time becomes possible.

Bilateral dynamic relationship between the freight rates and those determinants may vary over the different frequencies and some crucial relations may exist at different frequencies. With this regard, an implementation of the analysis done by the Torrence and Compo (1998) is used in this study for analyzing the relationship between the freight rates and such determinants of which in the economic literature. Implementation of this model in economics is done by Dar, Bhanja and Tiwari (2014). This model is introduced to the literature to determine which set of time series are lagging or leading as well as it gives how strong the relationship is in different frequencies. This approaches contains such components as cross wavelet power, cross wavelet coherency and phase difference. First one of those allows the researchers to study the interactions between two time series at different frequencies and how they vary over time by making use of the cross wavelet tool. On the other hand, single wavelet power spectrum make it clear the evolution of the variance of a time series at different frequencies. With another words, cross wavelet power of two time series shows the confined covariance between time series. Correlation coefficient in the time and

frequency space is named as the wavelet coherency. Phase difference used in the following parts gives information regarding on the delay or synchronization between oscillations of the two time series whereas phase stand for the term in which position in the pseudo-cycle of the series as a function of frequency as it is explained by the Aguiar and Conraria et al. (2008).

This methodology is used by many researchers. Grinsted et al. (2004) also studied the wavelet with different transformation and complex methodology by deriving and running the Continuous Wavelet Transform (CWT), the Cross Wavelet Power (XWT) and Wavelet Coherence (WTC) as Torrence and Compo (1998) did. Similar implementation of the methodology for economics is implemented to analyze the inflation and industrial growth. (see, for example: Dar, Bhanja and Tiwari (2014) for further details and mathematically application.)

Torrence and Compo (1998), Grinsted et al. (2004) and Dar, Bhanja and Tiwari (2014) explains the mathematical background of the methodology in details. Those studies in the literature show that this methodology is tried and proved and becoming widespread. In the context of this study, it is important to interpret the results rather than discussing the mathematically correctness. To do so, a guide to interpret the results is given as below.

Continuous Wavelet Power Spectrum gives the wavelet power spectra which indicates the scale specific variance linked with the time series. The color code of the wavelet power spectra varies from blue for low power to yellow for high power. It is also necessary to comment on the significance level. Area within the thick black contour shows the 5% significance level estimated from the Monte Carlo simulation. Y -axis measures frequencies or scale and X-axis represent the time period studied. The cone of influence, which indicates the region affected by edge effects, is shown with a lighter shade black line. Thanks to this component, we can analyze how strong is the wavelet power spectra for individual sets in different frequencies.

Another concept, called Cross Wavelet Power Spectrum, tests the relationship between two time series. The cross wavelet analysis is similar with the covariance and tells about the co movement between variables. Confidence interval of 95% is again shown by the thick black

contour estimated from the Monte Carlo simulation. Y -axis measures frequencies or scale and X-axis represent the time period studied. The cone of influence, which indicates the region affected by edge effects, is shown with a lighter shade black line. Additional figure of arrows in here indicate the relative phase relationship between the series. Pointing right means that series are in phase (positive) whereas to left (negative) indicates that series are in anti-phase. Arrows pointing to down represents that first series is leading the second series; and to up means that first series is lagging the second series.

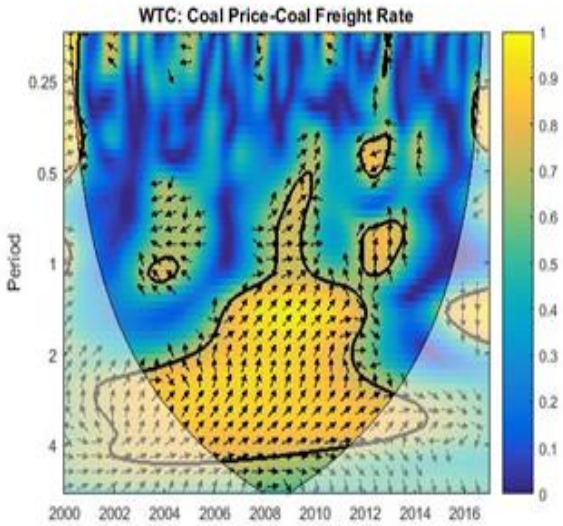
Another and last concept is the wavelet coherency which can give better chance to cross-check the result given in the cross wavelet power spectrum. It is defined as "the ratio of the cross spectrum to the product of the spectrum of each series and can be taken into account as the local correlation in both time and frequency domain between two time series" by the Aguiar and Conraria et al. (2008, p.2872). Wavelet coherency enables the researchers to identify both frequency bands and time interval that is two time series set are correlated. Significance level and cone of influence are derived similar to the cross wavelet power spectrum. Level of the coherency is determined by the color code which is blue standing for the low coherency and the yellow standing for the high coherency. Also the guide for the arrows are the same as given above.

Figure 10: Guide to Interpret the Model (Wavelet)

Guide to Interpret the Model

- The color code of the wavelet power spectra varies from blue for low power to yellow for high power.
- Area within **the thick black contour** shows the 5% significance level estimated from the Monte Carlo simulation.
- **Y -axis** measures frequencies or scale and **X-axis** represent the time period studied.
- **Arrows:**

To Right	series are in phase (positive)
To Left	series are not in phase (negative)
To Up	first series is lagging
To Down	first series is leading



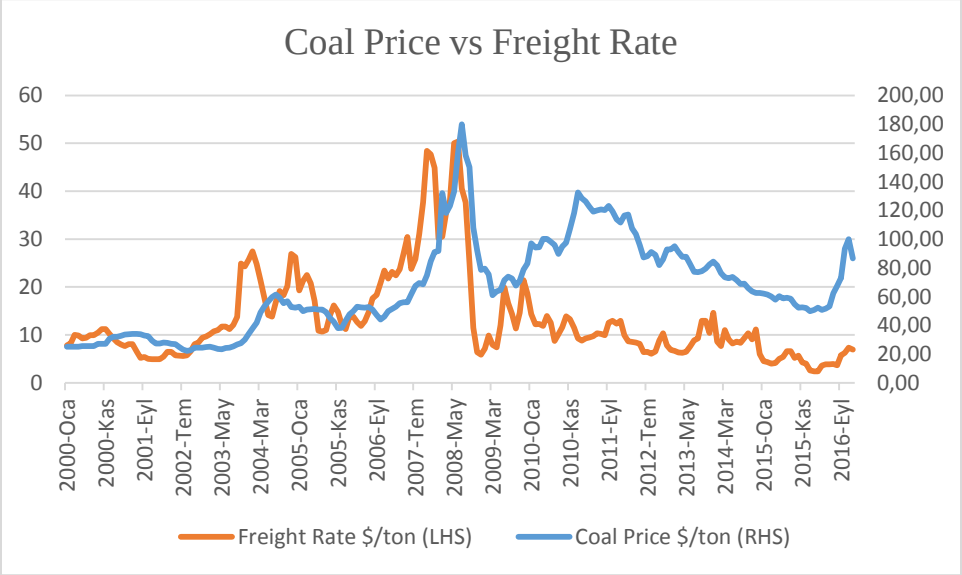
5.2. Data Description

Coal:

In order to determine the dynamic relationship between the coal prices and freight rate; coal prices are obtained from the Clarkson Research in monthly basis. To do so, prices are taken with respect to Thermal Coal Price, FOB Australia in terms of $/tones. Data cover the period between January 2000 and December 2016 which makes 204 observations.

Freight rates, on the other hand, is again taken from the Clarkson Research for the route from Richards Bay to Rotterdam as it is one of the main coal routes in the world and supply tremendous amount of coal to Europe. Daily freight rates are adapted to a monthly basis (which makes 204 observations). Freight rates is estimated in terms of US dollar/tones. Figure 17 below gives the coal prices and freight rate for this route.

Figure 11: Coal Prices and Freight Rate



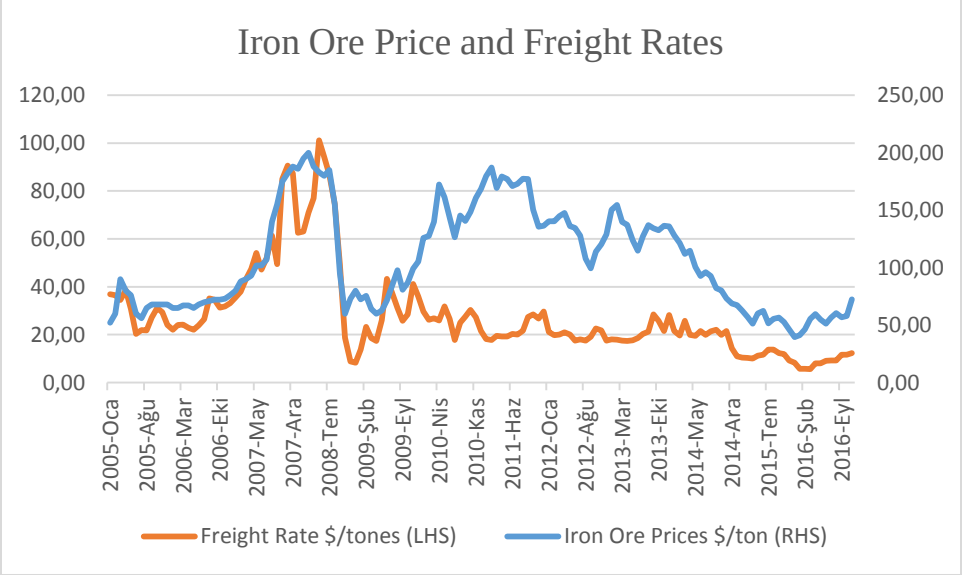
Source: Clarkson Database, 2017

Iron Ore:

In order to find the dynamic relationship between the iron ore prices and freight rate; Iron Ore Spot Price CFR N China is used for the period between January 2005 and November 2016. Frequency of the data of iron ore price (US Dollar/tones) is in monthly basis which makes 144 observation.

The data for the freight rates is taken with respect to route from TubaraotoQingdao. This route is chosen as it is one of the main iron ore trade route whereas the freight rates are taken in terms of $/tones for the same time period of January 2005-November 2016 with 144 monthly observation.

Figure 12: Iron Ore Prices and Freight Rates



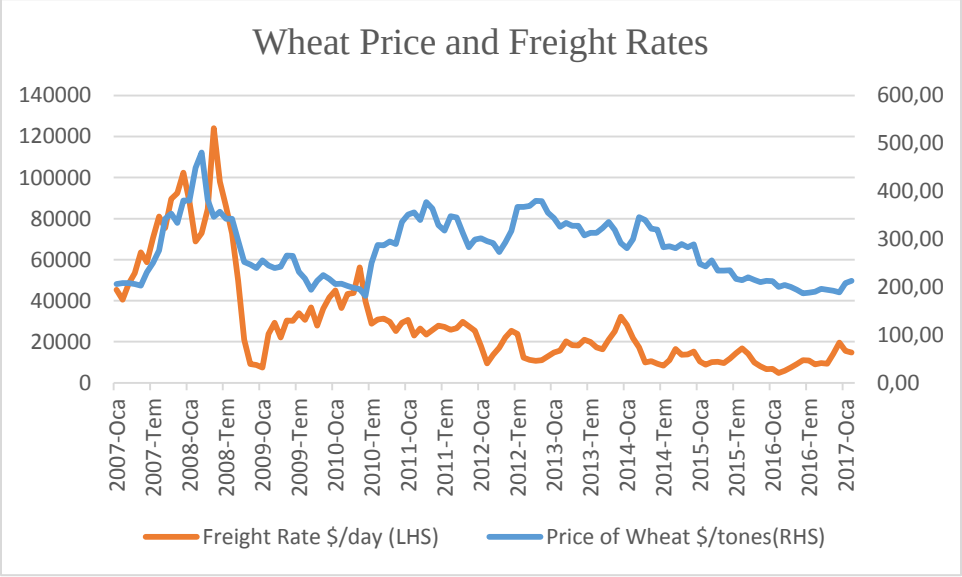
Source: Clarkson Database, 2017

Grain:

In order to find the dynamic relationship between the grain prices and freight rate; wheat prices is used as a proxy for grain. Frequency of the wheat prices is monthly and the data is obtained from the Clarkson Research for the US Gulf Wheat Price for the period between January, 2007 and February 2017 (therefore number of observation is 122). Wheat prices are described in US Dollars/tones.

Determination of the freight rate used in this analysis with respect to the routes in which has the highest volume. In this regard, BSI4a: US Gulf to Skaw – Passero is chosen. Duration of this route is about 30 days and Baltic Supramax type of vessels are used. Freights are taken as US dollars/day for the use of the ship.

Figure 13: Wheat Prices and Freight Rates



Source: Clarkson Database, 2017

After describing the data, next step is to run the wavelet coherence model to find out the dynamic relationship between the price of three main dry bulk commodity and dry bulk freight rates with respect to representative routes.

Table 2: Data Summary

DATA	Period	Route	Number of Observation	Freight Terms	Commodity Terms	Frequency
Coal	Jan. 2000-Dec. 2016	Richards Bay to Rotterdam	204	$/ton	$/ton	Monthly
Iron Ore	Jan. 2005-Nov. 2016	Tubarao to Qingdao	144	$/ton	$/ton	Monthly
Grain	Jan. 2007-Feb. 2017	US Gulf to Skaw – Passero	122	$/day	$/ton	Monthly

Source: Clarkson Database, 2016

5.3. Results

Implementation of the wavelet coherence analysis shows that commodity prices and freight rates has similar pictures and dynamics in general whereas there is a high coherence in the medium and long terms between the series and this relation is valid in 5% significant level.

In specific, for the coal prices and coal freight rates, the series are generally in phase, meaning positive direction, and this significant relationship is clearly seen for the periods between 2002 and 2014 for the frequency from fifteen days to four months. An interesting note in here is that freights are leading the coal prices in the same direction which means an increase/decrease in the freight rates may lead an increase/decrease in the coal prices. This might be due to the fact that coal is a low value added product and transportation costs play an important role for the coal trade. Thus, from the exporter view, a decrease in the freight rates decreases the trade cost whereas increase the profitability of the producers as the Porter's value chain theory (1985) suggest that increasing profitability is possible by either decreasing the cost or increasing the price. However, as the coal is a low-value-added product and used as a input, it is not so easy to increase the price. Thus, coal exporter may enjoy the decline in the transportation cost up until a point in which the lag between the declines in the cost of the transportation is realized as a decline in the commodity prices just like competitive market requires.

From the other side, as the freight rates increases, the cost of the trade also increase therefore leads an increase in the coal prices. This lag is between 15 days and four months as it is seen in the Appendix . This relationship is valid for the short term in the begging of the 2000's as well. However, in the end of 2016 and begging of the 2017, coal prices is leading the freight rates in the frequency from one to two months and the series are not in phase, meaning negative direction.

This dynamics of the commodity prices and freight rates can be explained in two ways. One of each is related to the field of economics. In this point of view, for example, as the commodity price declines, demand theory suggest that demand to the commodity increases. This increased

demand leads an increase in the trade volumes, thus seaborne trade movements. As explained in the third section, increased volume in the shipping industry may have an effect on the freight rates to go up. Thus, commodity prices is lagging the freight rates in the opposite direction. It can secondly be explained with respect to administrative view. In this regards, for example, an increase in the commodity prices may increase the production cost as those are used as input. This may lead the producer for different pursuit in which they may prefer lower quality commodity and gravitate towards the closer resources. Thereby, the demand for the maritime transportation may decrease as other mode of transportations such as rail transports are chosen. This fact causes the ship owner to reduce the prices to remain the ship economically desirable. Therefore, again, commodity prices are lagging the freight rates in the opposite direction.

For the iron ore, there is again similar dynamics. Iron ore prices and freight rates are in phase whereas iron ore prices is lagging the freight rates as well. This relationship is significant in 5% significant level on the frequency from one month to four month. Appendix show the wavelet coherence analysis for the iron ore price and iron ore freight rate. However what can surely be said is that the series are in phase however leading/leading series are not as clearest as it is for wheat and coal.

The same dynamics are valid for the wheat prices, chosen as proxy for the commodity grain. One point in here is that wheat prices and freight rates are not in a phase (negative relation) and wheat prices is leading the freight rates in the short run from one week to two weeks in 2008, 2010 and 2014. However, after two months, the series in phase with freight rates are leading the wheat prices.

Another important thing to be mentioned here is that output gap also a crucial for the time being studied in the thesis. Even though there is a debate for the definition of the output gap in the literature in such a way that there is no certain way to measure the potential level of the economy's output, it is clear that there is a decline in both demand and production of the commodities after the 2008 crisis. Because there was a strong demand for the commodities just before the crisis period

however a decline in the demand was experienced in the post crisis period. So that crisis period is a variant period for the explanation of the data.

Very up-to-date study conducted Tsioumas and Papadimitriou (2018) which aims to investigate empirically the relationship between the dry bulk freight markets and the prices of ‘major bulks.The elements of their analysis consist of representative prices of coal, iron ore, and wheat, and Baltic Exchange indices that correspond to the most widely used vessel size for each commodity. In particular, They focus on the lead–lag relationship between each pair of variables, employing cointegration analysis, Granger Causality tests, and Impulse Response analysis. Their results imply the existence of a bidirectional relationship in the cases of iron ore and coal, while they indicate that wheat price leads the Baltic Panamax Index but the opposite is not true which has the similar argument of this thesis as well.

These findings can support decision making in both dry bulk chartering and commodity trading.

CHAPTER 6: DISCUSSION AND CONCLUSION

With the help of the globalization, international trade activities gained new dynamics and increased in remarkable rates over the last two decades. In line with this fact, seaborne trade volumes also experienced a strong momentum as the maritime transportation stands for a considerable ratio of the world trade. Therefore, cost of seaborne transportation, namely freight rates, became an interesting field in the literature because it is thought that economic activities have reflections on the freight rate as well. Dry bulk commodities includes such materials that function as raw material inputs to the production of intermediate or finished goods whereas dynamics in this market can be seen as an efficient economic indicator of future economic growth and production. With this respect, dry bulk commodities such as coal, iron ore and grain are analyzed in this study. Literature has studies on the freight rates and its main determinants however conventional time domain approaches are dominant in those studies. As the underlying time scales are neglected in the literature, motivation of this paper is derived from the gap in which the analysis of the freight rates on both time and frequency approaches are missing.

There is also a consensus that linear models are not sufficient enough to explain the models so that there is a need for non-linear models to explain the relationship. To contribute to the literature, this study uses a methodology to analyze the dynamic relationship between the commodity prices and freight rates in both time and frequency domain in order to see how the bilateral relation may vary over time, how strong the coherence is and which series is leading in what frequency.

With this respect, rather than implementing a multivariable indicator included models, the wavelet analysis is implemented to give the direct and bilateral relationship between the commodity prices and freight rate.Changing commodity prices can influence the timing and quantity of imports and exports and, by extension, the volume of seaborne trade. In this context, many maritime practitioners tend to monitor the levels of commodity prices in order to obtain insights into the anticipated demand for bulk carriers.

So that this thesis contributes to the literature in such a manner that direct, non-linear, three dimensional model is used to explain the bilateral relation of the commodity prices and freight rate as it fits better than the existing linear models.

According to the wavelet coherence analysis, commodity prices and freight rates has similar pictures and dynamics in general whereas there is a high coherence in the medium and long terms between the series and this relation is valid in 5% significant level. It is seen that two series are in phase and freight rates are generally leading the commodity prices. This situation is explained by Porter's value chain. On the other side, for the periods, in which the series are not in-phase and commodity prices are leading, is explained jointly by the demand theory and administrative approaches. By the use of this methodology, a strong and significant results are proven. It also enables the researcher to comment in what lag the change in the commodity prices is affecting the freight rate market.

However, this study has some limitations. First of all, it analyzes the three main commodities' relation with the freight rates. If this implementation is done for other commodities, such as oil, results may vary. On the other hand, commodity prices were highly volatile in the study period as the sensitivity to the economic conjuncture is high. Moreover, it also ignore such data as the commodity trade volumes, industrial production data, and economic growth; and directly focuses on the relation between the commodity prices and freight rate. Therefore, for further studies, this analysis can be evaluated by taking into account those factors as well and this result should be considered as tentative results. From the view of transportation economics, if the trade volumes are in very low levels, freight rates might have tendency to increase in order to cover the operational cost due to the low trade volume. Up until a point in which the volume covers the operational cost, freight rates decreases as the volume increases. After a while, with the motion of the profit and increased trade volume, freight rates may go up and resulting a J-Shape curve. Authors also work on such analysis and focuses on the relation by taking into account the industrial growth, trade

volume and economic growth to have better understanding whereas also compares the results by making use of other methodologies such as Granger Causality Tests.

DISCUSSION ON FINDINGS

This study analysis the economic figures for the period in which there is a output gap in the commodity market. However, transportation sector does not function with respect to output gap whereas if the demand increases, freight rates also increases as opposed to the commodity market whereas output gap does not results an increase in the commodity prices due to the increase in the demand for the commodities.

Since the early of the 2000's, the economic growth increased the capacity utilization. In the post-crisis period. In the period this study analysis production rises without any increase in the cost for the commodity market due to the output gap.

This study analyzes only such commodities as grain, iron ore and coal. If this analysis is implemented on the oil or other commodities, the figure could be different. Moreover, this study does not take into account the other factors which may affect the freight rates and commodity prices. Such factors as economic growth, international trade volume, supplied and demanded amount of the commodities, output gap and transportation costs are excluded in this study. This study can be expanded via taking into account other factors that might affect the commodity prices and freight rates by building regression models. Another suggestion is that the data can be analyzed with micro-oriented view especially for the crisis period.

REFERENCES

Acar, A.Z. and Balakan, A. (2016) "Effects Of Transatlantıc Trade And Investment Partnershıp Agreement On Contaınerızed Cargo Flow In Transatlantıc" Journal of Management, Marketing and Logistics – (JMML), ISSN: 2148-6670 Volume:3 Issue:3

Aguiar-Conraria, L., Azevedo, N. and Soares, M. J., (2008)."Using Wavelets to Decompose the Time-Frequency Effects of Monetary Policy".Physica A: Statistical Mechanics and its Applications 387: 2863-2878

Alderton P.M. (1995), "Sea Transport (Operation and Economics)", 4. bs., UK., Thomas Reed Publication, 1995, s.199.

Alizadeh, A.H. and Talley, W.K., (2011a), "Microeconomic determinants of dry bulk shipping freight rates and contract times" Transportation, Volume: 38, Issue:3, pp 561-579.

Alizadeh, A.H. and Talley, W.K., (2011b), "Vessel and voyage determinants of tanker freight rates and contract times", Transport Policy, Volume: 18, Issue: 5, pp. 665-675

Altuğ O. (1974) Deniz Taşıt İşletmelerinde Maliyetler ve Maliyetlerin Yönetim Yönünde İncelenmesi", İstanbul İktisadiveTicariİlimlerAkademisi, YayınlanmışDoktoraTezi, İstanbul Matbaası, 1974., s.7.

Anheier, H. K. &Isar, Y. R. (2008), "Cultures and Globalization: The Cultural Economy", The Cultures and Globalization Series SAGE Publications Ltd.

Banyai, Á. (2012), "Intermodal optimization with harmony search", Advanced Logistic Systems, 6(1), 57-62.

Barro, R.J. (2006), "Rare disasters and asset markets in the twentieth century", The Quarterly Journal of Economics, 121(3), 823-866.

Barro, R.J. (2006), "Rare disasters and asset markets in the twentieth century", The Quarterly Journal of Economics, 121(3), 823-866.

Başak (1996), "Tramp GemiİşletmeciliğindeTalep v eMaliyet Analizi", İTÜ, YayınlanmamışYüksekLisansTezi, 1996., P.40

Binkley, J.K. and Harrer, B., (1981), " Major Determinants of Ocean Freight Rates for Grains: An Econometric Analysis", American Journal of Agricultural Economics, 63(1):47-57.

Branch A.E., (1975) "The Elements of Shipping", 3.bs., London, Chapman & Hall Ltd, 1975, s.33.

Branch A.E.,(1996) "Economics of Shipping Practice and Management", 2.bs., London, New York, Chapman&Hall, 1996, s.133

CEPR. (2013), "Reducing transatlantic barriers to trade and investment: An economic assessment. Final Project Report", Centre for Economic Policy Research, London, March 2013.

Cheetham, R. (1998), "Asia Crisis. Paper presented at conference, U.S.-ASEAN-Japan policy Dialogue", School of Advanced International Studies of Johns Hopkins University, 7–9 June, Washington, D.C

Clift, J. & Diehl, E. (2007), "Financial globalization", IMF Report, Washington: IMF.

Croux, C., Forni, M. and Reichlin, L., (2001)."A measure of comovement for economic variables: theory and empirics", Review of Economics and Statistics, 83, 232–241.

Dar, A.B., Bhanja, N., and Tiwari, A.K., (2014) "Inflation-Industrial Growth Nexus In India – A Revisit Through Continuous Wavelet Transform" Central Bank Review Vol. 14 (May 2014), pp.1-11

Dry Bulk Trade Outlook (2015). ClarksonsResearch, May.

Eagle Bulk Shipping Inc., USA, (ONLINE),

Ernst, D. & Kimb, L. (2002), "Global production networks, knowledge diffusion, and local capability formation", Research Policy, 31(8–9), 1417–1429.

Evans J. and Marlow P., (1990) "Quantitive Methods in Maritime Economics", 2.bs.,London, Fairplay Publications, 1990, p.61

Evans, P., & Sewell, W. H. (2013), "The Neoliberal Era: Ideology, Policy, and Social Effects", See Hall & Lamont.

Farthing B. (1993)," International Shipping: An Introduction to the Policies, Politics and Institutions of the Maritime World", London, Lloyd's of London Press Ltd., 1993, p.11.

Feigenbaum, H. B. (2002), "Globalization and cultural diplomacy", Center for Arts and Culture, Art, Culture and the National Agenda Issue Paper.

Gray J., (1987) "Futures and Options for Shipping, London, Lloyds London Press, 1987, p.17

Grinsted, A., J. C. Moore and Jevrejeva, S., (2004), Application of the cross wavelet transform and wavelet coherence to geophysical time series, Nonlin.Process.Geophys., 11, 561566

Haralambides E. (2000), "Liner Shipping Economics", Center for Maritime Economics & Logistics (MEL), Erasmus University, Rotterdam, 2000, s.1.

Haralambides E. (2004), ""Determinants of Price and Price Stability in Liner Shipping", Workshopon "The Industrial Organization of Shipping and Ports", National University of Singapore, Singapore, 5-6 March, 2004, s.6.

Hayler B.H., Keever M.K. and Seiller P.M., (2003) "American Merchant Seaman's Manual 7TH ED" Bluewater Books & Charts

Hesse, M., & Rodrigue, J. P. (2004), "The transport geography of logistics and freight distribution", Journal of Transport Geography, 12(3), 171-184.

Hitt, A. M., Ireland, R. D., &Hoskisson, R. E. (2014), "Strategic Management: Competitiveness and Globalization- Concepts and Cases" (11th ed.). South-Western College Pub.

Huber J.C., (2001) "A new method for analyzing scientific productivity" journal of the association for information science and technology, Vol.52, Issue:13

Ianchovichina, E., & Martin, W. (2003), Economic impacts of China's accession to the World Trade Organization, World Bank Policy Research Working Paper 3053, May 2003.

Institute of Shipping Economics and Logistics (ISL) , (2005), "Dry Bulk Market Developments", ISL Market Analysis 2005, s.5., (ONLİNE)

International Association of Dry Cargo Shipowners (Intercargo),

Kendall L. C and BUCKLEY J.J., (2000) "The Business of Shipping", 7.bs., Centreville, Maryland, Cornel Maritime Press, P.7

Kumar S.H., (2003), ”Tanker Transportation”, Encyclopedia of Energy, Ed. Clevelan Cutler, Maine Maritime Academy, Elsevier, 2003, p.2.

Labonte, M. (2013), “Federal Reserve: Unconventional monetary policy options”, Congressional Research Service, 7-7500.

Mansfield, E. D., & Reinhardt, E. (2003), “Multilateral determinants of regionalism: The effects of GATT/WTO on the formation of preferential trading arrangements”, International Organization, 57(04), 829-862.

Mathews, J. A. (2006), “Dragon multinationals: New players in 21st century globalization”, Asia Pacific Journal of Management, 23(1), 5-27.

McConville J. (1999), “Economics of Maritime Transport”, 1.bs., London, Witherby& Co Ltd, 1999, s.149

McConville J., (1999) “Economics of Maritime Transport”, 1.bs., London, Witherby& Co Ltd, 1999, p.280.

Metaxas B.N. , (1971), “The Economics of Tramp Shipping”, London, the Athlone Press, 1971, p.31

Micco, A. and Perez, N., (2011), “Determinants of Maritime Transport Cost” , IDB working paper No. 371

Mishra, P., Moriyama, K., N'Diaye, P., & Nguyen, L..(2014), “Impact of Fed tapering announcements on emerging markets”, IMF Working Paper 14/109.

Morgan, G., Kristensen, P. H., & Whitley, R. (2003), “The Multinational Firm: Organizing Across Institutional and National Divides”, Oxford University Press.

Morrison, W.M. (2001), “China and the World Trade Organization”, CRS Report for Congress, November 19, 2001.

Newton J., (2002) “A Century of Tankers: the Tanker Story”, Intertanko, 2002, p.15.

O'Rourke, K.H. & Williamson, J. G. (2000), “When did globalization begin?” NBER Working Paper No. 7632.

ÖztekM.Y., (1996) " İşletmecilerİçin DenizTaşımacılığı El Kitabı", y.y., t.y., s.33 1996

Polychroniou, C. J. (2012), "Greece's bailouts and the economics of social disaster", Levy Economics Institute of Bard College.

Porter, M. E., and Millar, V. E. (1985). How information gives you competitive advantage.ISO 690

Reinhart, C.M., &Rogoff, K.S. (2014), "This time is different: A panoramic view of eight centuries of financial crises", Annals of Economics and Finance, 5(2), 1065-1188.

Reinhart, C.M., and Rogoff, K.S. (2014), "This time is different: A panoramic view of eight centuries of financial crises", Annals of Economics and Finance, 5(2), 1065-1188

Riain, S. Ó. (2000), "The flexible developmental state: globalization, information technology and the "Celtic Tiger"". Politics & Society, 28(2), 157-193.

Roberts, J. T. (2000), From Modernization to Globalization: Perspectives on Development and Social Change, Blackwell Readers in Sociology Wiley-Blackwell.

Rodrigue, J.P. (2007), "Transportation and globalization", In Robertson, R. &Scholte, J. A. (Eds) Encyclopedia of Globalization, London: Routledge.https://people.hofstra.edu/jean-paul_rodrigue/downloads/Transportation%20and%20Globalization.pdf.

Rogers P., (2002) "Understanding the Dry Bulk Market; What are the Underlying Factors Governing the Ocean Freight Market andWhat Lies Ahead for Dry Bulk Market in Particular? Transport, Storage & Logistics", Oils & Fats International, November 2002, s.1.

Rua, A., (2010). "Measuring Comovement in the Time-Frequency Space", Journal of Macroeconomics, 32(2), 685-691.

Shafaeddin, S. M, (2002), "Some implications of accession to WTO for Chinaís economy", International Journal of Development, 1(2), 93-128.

Shangquan, G. (2000), "Economic globalization: trends, risks and risk prevention", CDP Background Paper No. 1.

Skogstad, G. (2015), "The international trade regime: Liberalism and embedded liberalism", Journal of International Law and International Relations, 11(2), 147-154.

Sloggett J.E., (1984) “Shipping France” (Financing Ships and Mobile Offshore Installations),Shipping Management Series, London, Fairplay Publications Ltd., 1984, P.112

Soubbotina, T. P. (2004), “Beyond economic growth: An introduction to sustainable development”, World Bank Publications: Washington DC.

Stopford M., (1988) “ Maritime Economics”, 1.bs., Great Britain, Harper Collins Academic, 1988, s.248

Stopford, M., (1997), “Maritime Economics” , Routledge, ISBN: 0-203-44266-0

ŞentürkU.,(1999)GemiYatırımınınFinansalAçıdanİncelenmesiveMatematikselModellenmesi”, YayınlanmamışYüksekLisansTezi, İTÜ, İstanbul, 1999, p.8.

Torrence, C. and Compo, G.P., (1998)” A Practical Guide to Wavelet Analysis” Bulletin of the American Meteorological Society Vol. 79, No. 1, January 1998

Tsioumas, V. & Papadimitriou, S. Marit Econ Logist (2018) 20: 267. https://doi.org/10.1057/s41278-016-0005-0

UNCTAD, U. N. (2014), “Review of Maritime Transport 2014”, United Nations.

UNCTAD, U. N. (2014), “Review of Maritime Transport”, United Nations.

UNCTAD, U.N. (2015), “Review of Maritime Transport 2014”, United Nations.

UNCTAD, U.N. (2017), “Review of Maritime Transport 2017”, United Nations.

Valoies P., (1997) “Tankers an Introduction to the Transport of Oil by Sea”, 1.bs.,Witherby Co Ltd., London, 1997, p.4.

Volk B., (2002) “The Dynamics of Supply and Demand in Tramp Shipping”,Fachhochschule University of Applied Sciences, Launceston, April 2002, s.1

Yıldız B., Bucak, U. (2017) ”Determinants of Freight Rates: A Study on the Baltic Dry

Index, IGU J. Soc. Sci.,4 (2), Spec. Iss.Of ICEFM 2017, pp. 17-32.

Wilmsmeier, G. and Hoffmann, J., (2008), “Liner Shipping Connectivity and Port Infrastructure as Determinants of Freight Rates in the Caribbean”, Maritime Economics and Logistics, Volume: 10, Issue: 1, pp. 130-151

Wood P.J., (2000) “Tanker Chartering”, 1.bs., the Institute of Chartered Shipbrokers, London,2000, p.62.

World Bank (2015), “World Bank Economic Review”, 29(3) Oxford Press.

World Trade Organization (2015), “Press Release 2015” / Press 739: www.wto.org/english/news_e/pres15_e/pr739_e.htm.

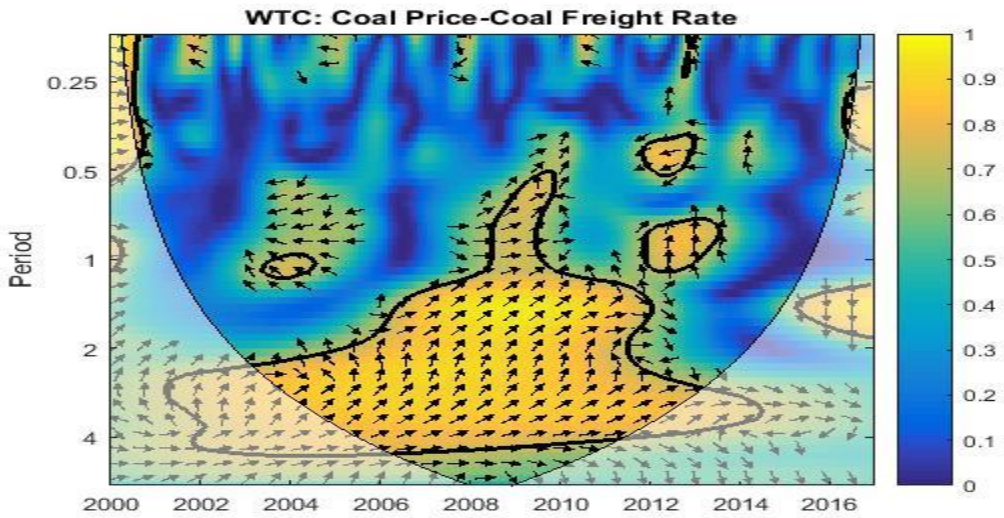
WTO (2015), “World Trade and The WTO: 1995-2014”, World Trade Organization

WTO (2015), “World Trade and The WTO: 1995-2014”, World Trade Organization

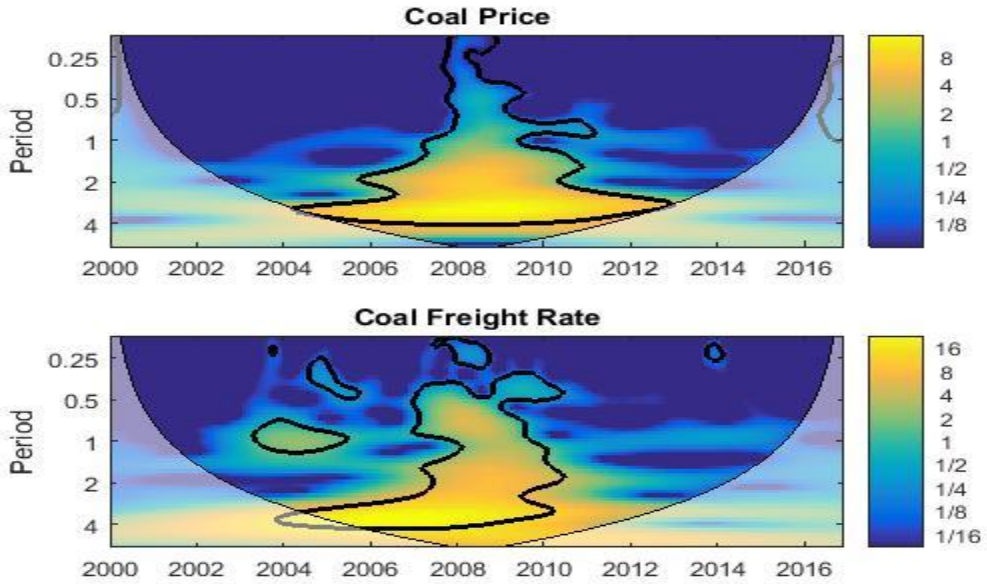
Zarzoso,I.M. and Burguet, C.S., (2005), “Transport costs and trade: Empirical evidence for Latin American imports from the European Union”, The Journal Of International Trade & Economic Development Vol. 14 , Issue. 3

APPENDIX

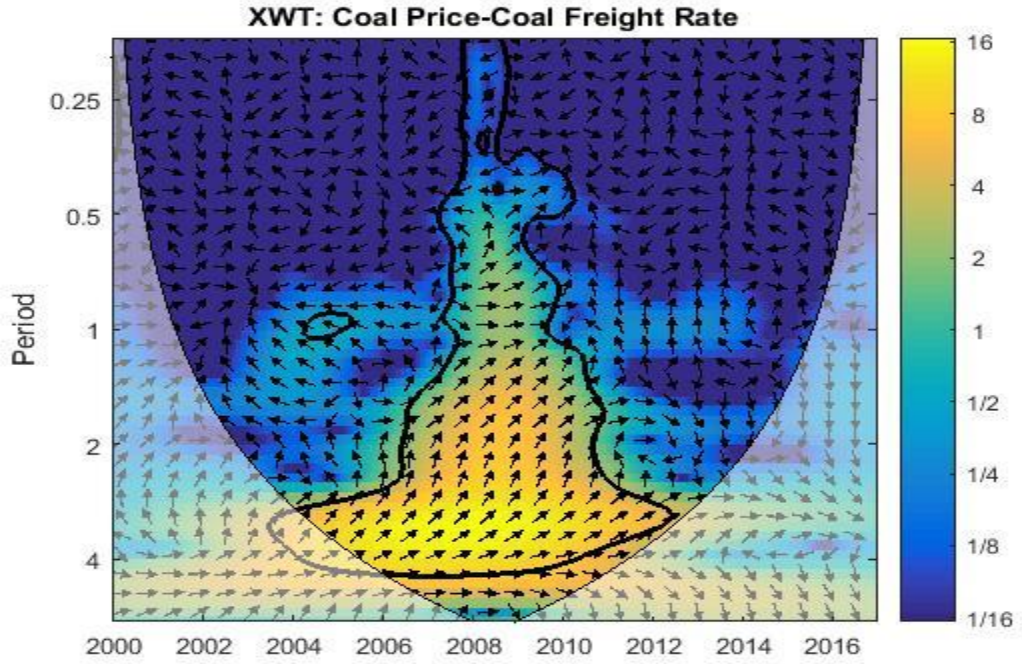
Appendix 1: Coherency Analysis for Coal Price and Freight Rate



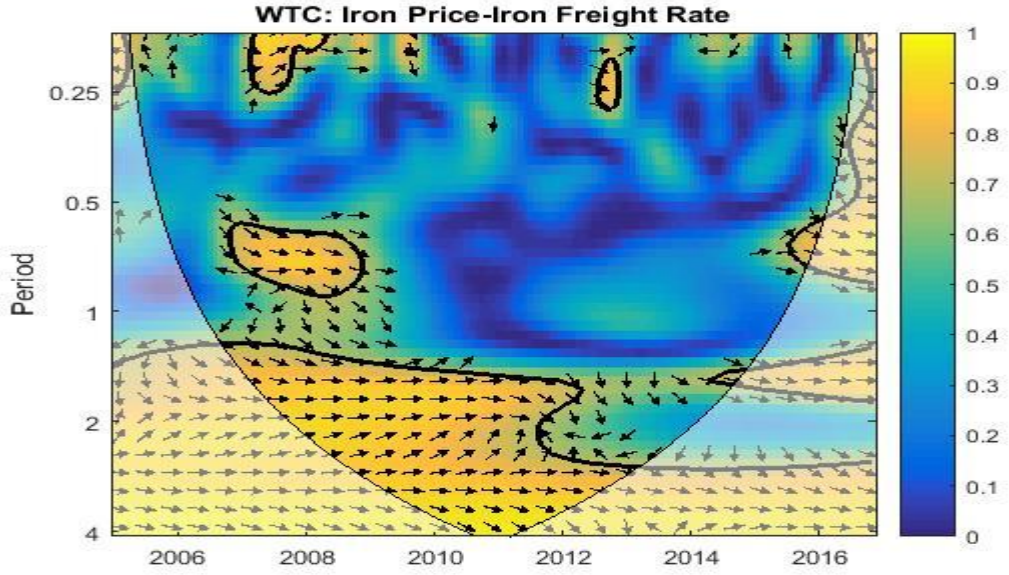
Appendix 2: Continuous Wavelet Analysis for the Coal Price and Coal Freight



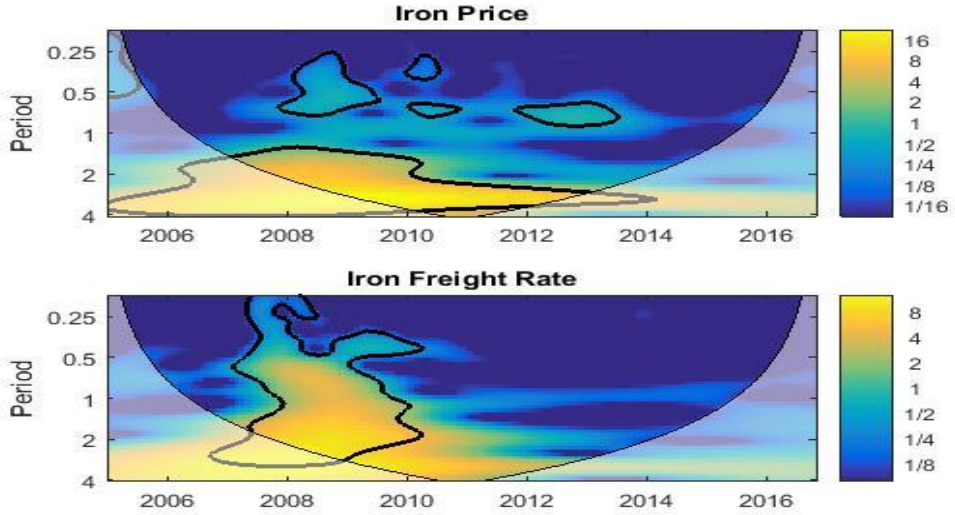
Appendix 3: Cross Wavelet Analysis for the Coal Prices and Coal Freight Rate



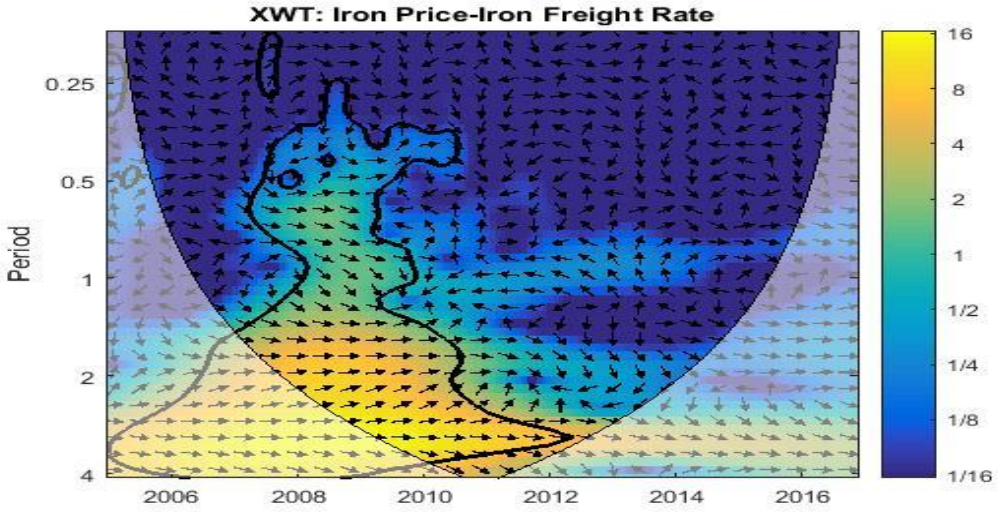
Appendix 4: Coherence Analysis for the Iron Price and Freight Rate



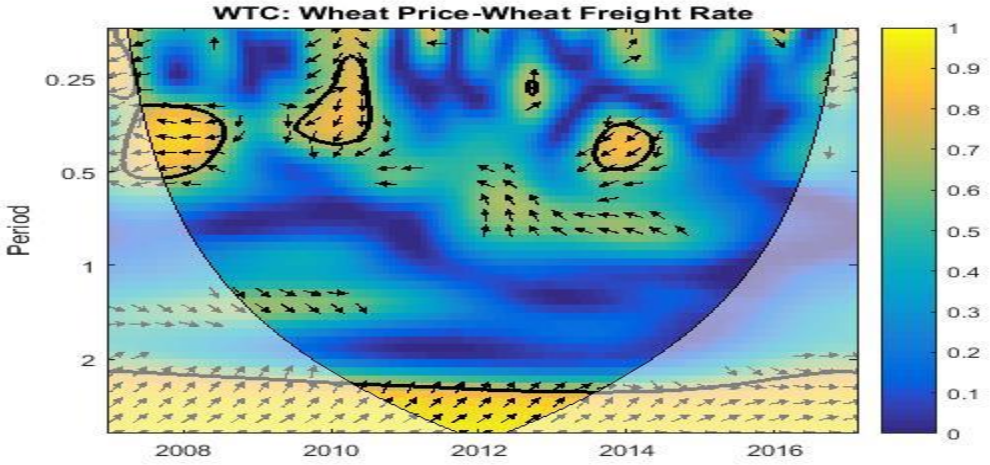
Appendix 5: Continuous Wavelet Analysis for the Iron Ore Price and Iron Ore Price Rate



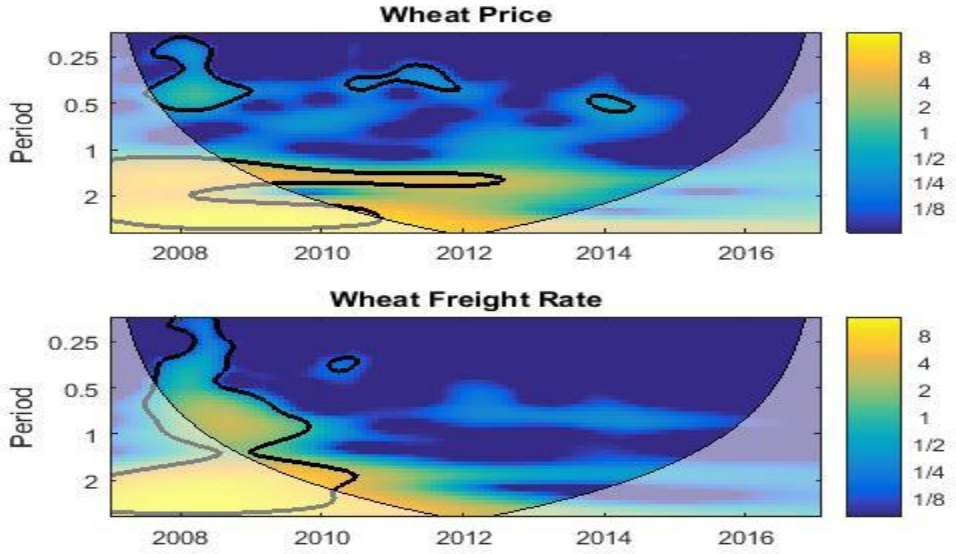
Appendix 6: Cross Wavelet Analysis for the Iron Ore Price and Iron Ore Freight Rate



Appendix 7: Coherence Analysis for the Wheat Price



Appendix 8: Continuous Wavelet Analysis for the Wheat Price and Wheat Freight Rate



Appendix 9: Cross Wavelet Analysis for the Wheat Price and Wheat Freight Rate