Erasmus University Rotterdam

MSc in Maritime Economics and Logistics

2012/2013

The Impacts of the European Union Sovereign Debt Crisis on the Maritime Transportation of Natural Gas

by

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Acknowledgements

With the accomplishment of this thesis, I can with all honesty say that all the hard work was worth it. This, because the knowledge that I gained the whole year and the providence of support by family, friends and colleagues made me do this thesis. Hence, I would like to thank some special people that really helped me this summer.

First of all, I would like to thank Dr. Koen Berden and Mr. Achim Vogt for their assistance and encouragement to undertake this project.

In addition, I would like to thank my family for their support during all the summer, since in my home country, Greece, summer is the best period of the year for enjoying the weather and the sea and without their help I would not have been able to focus on my project.

Last but not least, my friends and colleagues, who were on my side in every moment that I needed them, by discussing ideas or by supporting each other in the 'out of the office' entertainment.

It was a great year in MEL and I will never forget all the members that helped us understand that we are here for the future of shipping, by transferring us their experience, knowledge and philosophies.

Abstract

The analysis of the financial crises and their impact to several sectors has been the centre of attention for many years of several academics. The purpose of this thesis is to investigate the impacts of the European Union Sovereign Debt Crisis to the liquefied natural gas trade, or by other words the maritime trade of natural gas. Therefore, an analysis of the past financial crisis will be done in order to hypothesize the demand and supply shock that we are going to implement on the natural gas trade by sea. Furthermore, an analysis of the production, consumption, the maritime trade of natural gas, the market shares of oil, coal and natural gas will be done until 2007 and from 2008 until 2012, in order to analyse the real impacts of the European Union Sovereign Debt Crisis.

Furthermore, three scenarios of demand and supply shocks will be implemented in the Global Simulation (GSIM) model, in order to forecast the changes in the maritime trade of natural gas. More specifically, the first scenario, which is called the optimistic scenario, includes a positive change in the production and consumption of natural gas. The second scenario, which is called the neutral scenario, will include lower positive changes in the consumption and production of natural gas than the first scenario. Hence, the third scenario, or otherwise the pessimistic one, will include very low positive changes in production and consumption of natural gas in all regions, except the European that will be implemented with a negative change in both supply and demand of natural gas.

Therefore, the results of the real changes and the forecast ones will be compared in order to conclude to the probity of the scenarios'. All the above will be done for concluding to the real impacts of the European Union Sovereign debt crisis to the liquefied natural gas trade. Finally, it must be mentioned that all the above will be done by implementing the 'ceteris paribus' term, which stands for 'all the other variables remain stable'.

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List of Abbreviations

Text Abbreviations

DNV	Det Norske Veritas
ABS	American Bureau of Shipping
Bcm	Billion cubic meters
Bcf	Billion cubic feet
EU	European Union
NG	Natural Gas
GSIM	Global Simulation
US	United States
LNG	Liquefied Natural Gas
ECB	European Central Bank
ROW	Rest of the World
GDP	Gross Domestic Product
GNI	Gross National Income
UN	United Nations
S. & C.	South and Central
ECB	European Central Bank
IMF	International Monetary Fund

GSIM Abbreviations

r,s	Exporting region
v,w	Importing region

Parameters

i	Industry designation
$Q_{i,v}$	The composite good in region v
Av	An efficiency term calibrated so that the price of Q, P=1
$Y_{(i,v),r}$	The CES expenditure weight term
ρ	The CES exponent term, where the substitution elasticity is equal with

$$E_s = \frac{1}{1-\rho}$$

$E_{w,(i,v)}$ — Aggregate import demand elasticity; define for aggregate imports M(i,v) and composite price P(i,v)

$$E_{w,(i,v)} = \frac{\partial M_{(i,v)}}{\partial P_{(i,v)}} * \frac{P^*_{(i,r)}}{X_{(i,r)}}$$

Calibrated Coefficients

$N_{(i,v),(r,r)}$	Own price demand elasticity
$N_{(i,v),(r,s)}$	Cross-price elasticity
$T_{(i,v),r}$	The power of the tariff, T=1+t
$\theta_{(i,v),r}$	Demand expenditure share (at internal prices)

$$\theta_{(i,v),r} = \frac{M_{(i,v),r}T_{(i,v),r}}{\sum_s M_{(i,v),s}T_{(i,v),s}}$$

$\Phi_{(i,v),r}$	Export quantity shares
	$$\varphi_{(i,v),r} = \frac{M_{(i,v),r}}{\sum_w M_{(i,w),r}}$$

Variables

M	Imports (quantity)
X	Exports (quantity)
P	Composite domestic price
$P^*_{(i,r),v}$	World price for exports from region r
$P_{(i,r),v}$	Internal prices for goods from region r imported into region v
$T_{(i,r),v}$	Import tariffs for goods from region r imported into region v

1. Introduction

Financial crises have been affecting the economies of the world for many years. According to the journal "The Economic Times" financial crises have existed since capitalism was developed. This takes us back to the 17th and 18th centuries with the first crisis of the Dutch tulip mania and the South Sea Bubble (ETBureau, 2012). In order to be more specific, we can say that a financial crisis is a situation in an economy, in which the value of financial institutions or assets drops rapidly (Investopedia, 2013). From the above we can understand that definition of a financial crisis is quite broad and contains many types of crises in an economy, such as loan, debt and banking crises. Nowadays, the economies of the world have been affected by the European Sovereign Debt Crisis (Lane, 2012). This has been a result of the global banking crisis that started in October 2008, from which the macroeconomic imbalances affected the countries of the European Union (Lane, 2012).

Because of the fact that the European countries have signed the Kyoto protocol, which reflects to the decrease of the harmful emissions to the environment,

1.1. Scope of this Research

For the purpose of this thesis, we will examine the effects that an Economic Debt Crisis has on an economy but also to the behaviour of its producers and consumers of natural gas. More specifically, we are going to analyse the impacts of the European Union Sovereign Debt Crisis to the sea transportation of Natural Gas, which results from the changes in the demand and supply of natural gas or in other terms the behavioural changes of producers and consumers. Therefore, our main research question will be the following:

"What are the Impacts of the European Union Sovereign Debt Crisis on the Maritime Transportation of Natural Gas?"

Our analysis will have a research duration of five years, from 2007 until the current situation, 2012. First, we will go back to the start of the crisis and we will try to estimate – with the information available in 2007 – expected impact of the Global Crisis for the sea transportation of natural gas, commonly named as LNG trade. Second, we will compare our findings with the actual situation in 2012 and we will conclude if it would have been possible to predict these changes correctly. Therefore, our analysis will emphasize on the shocks that the European Sovereign Debt Crisis has caused to the production and consumption of natural gas.

In order to answer the main research question, the following sub-questions must also be answered. What are the results in Demand and Supply of Natural Gas according to past debt crisis? Is there any correlation with the current crisis? What is the current situation in production, consumption and maritime transportation of natural gas? What has happened with the imports and exports of LNG in the countries until 2007 and what between 2007 and 2012? How has our model forecast the real effects of the European Union Sovereign Debt Crisis to the LNG transportation? What is the relation

between natural gas and oil or coal in the past and what in the period of the debt crisis? Is there any substitution effect?

The above questions also define the steps of our analysis and after having gone through, we are going to be able to present the whole picture of the impacts of the European Union Sovereign Debt Crisis on the maritime transportation of natural gas. In chapter two we present literature review. This will contain the critical points' investigation of this thesis, which will be including an analysis of the financial crisis and its impact on economic growth and the energy markets, as well as the impacts of the past financial crisis on the production, consumption and maritime trade of natural gas. In chapter three we continue by looking at the production, consumption and maritime trade of natural gas from the past until the end of 2007 and in the period of the European Union Sovereign Debt Crisis that is from 2008 until 2012. Chapter four will contain our hypotheses in which our research will be based on, while chapter five will be analysing the methodology and the data that are going to be used for the Global Simulation (GSIM) model. Furthermore, in chapter six the GSIM model will be implemented, according to the scenarios that will be analysed on the previous chapter. Moreover, chapter seven will contain the results of the GSIM and their comparison with the real changes and current situation. Finally, chapter eight will contain our conclusions and ideas for further investigation.

1.2. Motivation and Uniqueness of this Research

The current financial crisis has influenced economies from all over the world and especially those of the Eurozone and the United States. In the meantime, there are a bigger and bigger percentage of people who are starting to have a more environmentally friendly approach in their energy use, which has resulted into a larger consumption of – cleaner – natural gas. Hence, this trend, in combination addition to with the Greek debt crisis haves been the core motivation reasons for this research. It is important to note that big shipping classification organizations and technology innovators, like ABS and DNV, have started projects in order to introduce the natural gas as the fuel of the future in the shipping sector, in order to make it more sustainable and eliminate the pollution of the environment.

Furthermore, the current financial crisis in the Eurozone and the growth of natural gas investigations in Greece motivated us to do this research. More specifically, in the last two years, rumours have increased that the Ionian and Aegean seas are full of natural gas reserves. This is the reason why over the last two years, research vessels arrived in Greece in order to investigate the truth of the above rumours. In addition, the energy consumption behaviour of the citizens in Greece has changed due to the price difference with the oil, and the advantage of natural gas being a more environmentally friendly source of energy.

So, all the above reasons have influenced our motivation for doing this project and conclude the effects of the current European Union financial crisis to the maritime transportation of natural gas. Moreover, except for a report for the Energy Ministers' Meeting in 2009, with the title "The Impact of the Financial and Economic Crisis on Global Energy Investment" (EIA, 2009), there has not been much research regarding the impacts of the European Debt Crisis on the maritime transportation of natural gas. Hence, this thesis is aiming to contribute to our understanding of this issue.

2. Literature Review

2.1. Economic Growth and Factors affecting it

In this section of the thesis, the literature review will be analysed. Furthermore, the academic literature behind the financial crisis will be examined and their effects on the economic growth. With the terminology "economic growth" we mean the capability of an economy to increase its production of goods and services (Investopedia, 2013) and the term also includes the capability of people to consume goods, which leads to their economic development. Over the time, various studies tried to explain the above issue using different data sets and different methodologies. Most of these studies have used real GDP and GDP growth rate as dependent variables but also other variables such as total factor productivity growth rate, capital accumulation growth rate, and private savings rate. This was a result of researchers' thoughts to try and analyse the economic cycles in order to be able and forecast their future trends. This explosive development around the economic growth, developed the empirical work on the factors that affect it (Stefan Fölster; Magnus Henrekson, 2001).

Thus, in most of the cases we express the economic growth in terms of GDP growth. The set of explanatory variables – macroeconomic indicators – that have been used, during the past studies, in order to render the studies more comprehensive, vary. Variables such as initial income per capita, educational attainment, government size, openness to trade and inflation, the level of financial intermediary development, population growth, the level of investment, terms of trade growth , fiscal balance (Schclarek, 2004), fertility rate, maintenance of the rule of law, level of political rights (Barro, 1996), public and publicly guaranteed debt as percent of GNI, interest rate, public and private investment (Shabbir, 2013) have been widely used.

Also there are other studies, more focused on the link between economic growth and the macroeconomic variables. Some of these projects are centralizing on the economic growth and its relation with government expenditure (Landau, 1983), (Niloy Bose; M. Emranul Haque; Denise R. Osborn, 2007), the results to growth effects from government expenditure and taxation (Stefan Fölster; Magnus Henrekson, 2001), the impacts of fiscal policy to economic growth (William Easterly; Sergio Rebelo, 1993), the roles of law, finance to economic growth (Ross Levine) the connection between health and economic growth (Alok Bhargava; Dean T. Jamison; Lawrence Lau; Christopher JL Murray, 2001), the effect of the legal environment, the banks to economic growth (Levine, 1997), the connection between natural resources and economic growth (Thorvaldur Gylfason; Gylfi Zoega, 2002) and finally the role of the political instability to the economic growth (Alberto Alesina; Sule Ozler; Nouriel Roubini; Phillip Swagel, 2012).

The effect of external debt on economic growth is a controversial issue. Some of the studies end up finding a negative impact on economic growth while others do not find any significant relationship between economic growth and external debt. More specifically, the results from the analysis of the connection between government expenditure and economic growth showed a negative correlation (Landau, 1983). This is attributed to the fact that open economies, which are economies that are open to private sectors, and competition have as a result to provide larger welfare than a country ruled only on government companies. It must be noted that the European Union is following the same strategy of encouraging competition and private sector in

the economies of its countries. Furthermore, in the study of Landau et. al., it has been mentioned that major private companies that are investing on energy, are playing a role of major importance to the economic growth of a country, by increasing its welfare (Landau, 1983).

Another factor that has been the centre of investigation for swaying economic growth is the level of GDP per capita, or otherwise called "income per capita", since GDP shows the income of a country. Results showed that the countries have to be divided in two categories, those of high income per capita, which mainly includes the United States and Western Europe, and those of low income per capita, which includes developing and third world countries (Landau, 1983). Hence, the conclusions of this research was that low income per capita countries have a lower rate of economic growth, in accordance with high income per capita countries, which develop their economies in high rates (Landau, 1983).

The explanation for this gap between the two groups of countries is the expenditures in education, the government consumption and their differences in the government regulation (Landau, 1983). On the one hand, countries with low GDP per capita do not invest in education while the government consumption takes the largest part of the GDP (Landau, 1983). In the meantime, each government's regulations and construction of the markets in those countries have a negative impact on the economic growth (Landau, 1983). On the other hand, high income countries invest great amounts of their yearly income in education, in accordance with the fact that education is public in most of the countries, the government consumption rises. While the structure of their markets is mainly free, which results in high competition and economic growth (Landau, 1983). More specifically, an approach regarding the government expenditure on education for the developed countries showed that it has a long-lasting effects in economic prosperity (Niloy Bose; M. Emranul Haque; Denise R. Osborn, 2007). Hence, by educating the citizens of a country, they will add value and will increase the welfare and prosperity of the economy in the long-run period.

Another investigation was made in order to research the relationship between the fiscal policy of countries and the economic growth (William Easterly; Sergio Rebelo, 1993). Fiscal policy is the government investment from its gained savings, which are the difference between taxes and expenditures (William Easterly; Sergio Rebelo, 1993). The way that governments' gain their income creates the diversification between developed and developing countries, since developing countries are relying on global tax income (William Easterly; Sergio Rebelo, 1993). Moreover, the results of a financial crisis to the tax income is huge, as well as the results that will arise. Also, fiscal policy is affected by the population, its education and its capability of adding value (William Easterly; Sergio Rebelo, 1993).

Furthermore, an additional factor that influences economic growth is the legal system of a country. The variety of the legal systems among the countries, has as a result the attraction of different companies for their settlement. Hence, countries that have a strong legal and regulatory system, which means that it allows the creditors to receive all the values from their claims, as well as the easier enforcement of contracts and stability, are being more attractive for business (Levine, 1997). Thus, this attraction of companies, which add value from the production of goods and services, will enhance the financial development of the country, in terms of employment, tax revenue, etc. and will conclude to the economic growth of the country and its citizens (Levine, 1997). The legal regulation of a country is of major importance, since in financial crisis governments are trying to attract companies and their capital inside the country, which

is accomplished by the revision of the legal system. This has to be set as first priority in order for the governments' targets to be achieved.

On the other hand, political instability plays an important role in the economic growth of a country. By this term we mean "the propensity of a government to collapse" or with other words the probability of a government to change in a small period of time, which is major of importance for the upright and safe development of a country (Alberto Alesina; Sule Ozler; Nouriel Roubini; Phillip Swagel, 2012). A research that had been done in this matter concluded that political instability impacts the economic growth and more specifically it reduces it (Alberto Alesina; Sule Ozler; Nouriel Roubini; Phillip Swagel, 2012). This happens because of the different strategies – ideologies – that each political party wants to follow in order to govern their country (Alberto Alesina; Sule Ozler; Nouriel Roubini; Phillip Swagel, 2012). Hence, by having a continuous change in the political structure of a government results to uncertainty, which the management boards of companies want to avoid.

Last but not least, the role of the dependence in natural resources of a country in the economic growth, has attracted the interest of many researchers in the past years. Studies have shown that an inverse relationship, between these two economic variables, exists (Thorvaldur Gylfason; Gylfi Zoega, 2002). This is a result of three main features, education, taxation and public policy, which affect this relationship in a large degree, as it has been mentioned above (Thorvaldur Gylfason; Gylfi Zoega, 2002). Furthermore, with these three factors to be controlled by the government and grown properly, governments can make their countries sustainable in energy production and development and not to be dependent from the trade with other countries.

Generally, the growth rate seems to be heightened by advanced initial school and life expectancy, lower inflation, better conservation of the legislation, lower government consumption and enhancements in the terms of imports and exports, which are also the factors that are most influenced from a financial crisis (Barro, 1996). In addition, it must be mentioned that due to the limitations of the theory behind the variables that have been chosen from the authors, and the widely different conclusions drawn from the above empirical and theoretical studies, all conclusions drawn from the results of these studies must be quite tentative.

2.2. Financial Crisis and Economic Growth

Any financial crisis reflects its results to the economic growth and pushes, in most cases, the economy to the downturn of its economic cycle. This does not mean necessarily that there will be a negative economic growth, but it can decelerate it. A financial crisis does not have a direct impact on the economic growth, but it affects the economic variables, which have been analysed above. Hence an indirect effect is implied in economic growth and development of a country from a financial crisis. Furthermore, we can find that financial crisis affect education, unemployment, the legal structure of a country, the taxation policy that countries follow, foreign and government investment, government expenditure and influences of the political parties' targets, which result in political instability.

The first impact of a financial crisis on a country is the capability of the government to adjust its expenditures. These government expenditures may vary from military,

health or education costs that a government has to fulfil. Hence, by reducing these budgets, many sectors that are under the jurisdiction of the public sector, are damaged (EiC, 2012). According to the New York Times, the value of education is augmented by the financial crisis (Guttenplan, 2013). This resulted from a survey, which the O.E.C.D. made, and resulted that unemployment for people with no college education was three times more than people who had a degree from a college (Guttenplan, 2013). Furthermore, unemployment rises in periods of financial crisis. The different groups of workers, young and adult, determine also their flexibility to be disposable. It has been found that young people, in periods of financial crisis, are the first to be fired, due to their lack of knowledge, working experience and skills (Verick, 2009).

Governments are really concerned about this rise in young unemployment, since it causes major problems, which embolden the downturn economic cycles (Verick, 2009). Moreover, except for the age difference, also gender plays an important role. Especially, the group that is most harmed from an economic crisis, which are young women (Verick, 2009). Also, empirical studies have shown that the period of the impact of unemployment in a country that is being affected by an economic crisis is five years (Misbah Tanveer Choudhry; Enrico Marelli; Marcello Signorelli, 2010). Hence, one solution is the update of the legal system and government strategies, by the policymakers, in order to decrease unemployment and offer a path for a country to elude the downward cycle of an economic crisis.

Even though the financial crisis does not directly impact the legislation of a country, it is changing the behaviour of the policymakers in order to reform the legislation in order to attract foreign capital to be invested in the country. In addition, barriers are being deregulated in direction to the free entrance of companies to the sectors of the country. Furthermore, changing the legal structure of the country, which concludes to a better welcome invest of these kinds of alternative reserves accelerates natural resource research and exploitation. Hence, legal structure and investment are highly connected, since with a strong legislation predictability is granted, which is one of the basic aspects that an investor is looking after for, when investing his money.

Therefore, because of the fact that investment is playing an important role in the economic growth of a country or a union, even though it is one of the main targets that is impacted by a financial crisis, it is of far greater importance to search these relationships. Banks are highly afraid to lend their capital for any type of investment in such a periods (Victoria Ivashina; David Scharfstein, 2010). More specifically, banks with less access to the type of financing through their deposits are not willing to provide loans or investment capital, compared to other banks (Victoria Ivashina; David Scharfstein, 2010). This is a result of the liquidity problem that many banks are facing in such a periods. Therefore, companies that are facing liquidity problems and where reliable to bank loans, cannot fulfil their investments that will add value and grow the economy of the country that the company is investing.

In addition, as it has been mentioned above, a financial crisis results to the remodelling of the taxation system, which has a great impact on the government expenditure. In most cases, due to the low development of the countries in such periods, taxes tend to rise. With this policy, government income rises but only for a short period and because of the high taxes and the low income of the citizens, consumption tends to decrease, which means that government does not receive as high income as before. Hence, the government does not achieve the necessary budget, for accomplishing its goals. Thus, the only solution is to borrow money that

will increase its debt, which is feasible, but with strict terms. So we can conclude that all the economic factors are reacting with each other and are greatly affected from a financial crisis, which results to the depression of the economy that also affects the energy sector.

2.3. Financial Crisis and the Energy Sector

The energy sector can be divided along the lines of the six main resources, from which energy is produced. These resources are oil, coal, natural gas, nuclear, renewables and hydroelectricity. It has been concluded from empirical studies that in financial crisis the price of oil increases in high values (Taylor, 2009). Furthermore, companies are trying to find alternative solutions, which will offer low prices to consumers. Thus, in the case of Greece in 2010, people were starting using natural gas as their main form of energy in their houses, as also for fuel for their transportation by car. In the meantime, the monetary policies that have been followed in the crisis of 2008 have resulted in negative effects in the consumption and production of oil (Taylor, 2009). Regarding the case of coal, because of its substitution effect against oil and its easiness on manipulating its price, its producers and distributors, in 2012, have decreased its price, whereas they have been having lower profits (InvestmentWatch, 2013). Moreover, regarding the nuclear, renewables and hydroelectricity resources of energy, they have not been very popular in a worldwide scale. The following figure shows us the consumption of the above resources of energy in the world from 1987 until 2012, all measured in million tons of oil equivalent.

Figure 1 - Consumption of Energy Resources in World 1987 - 2012
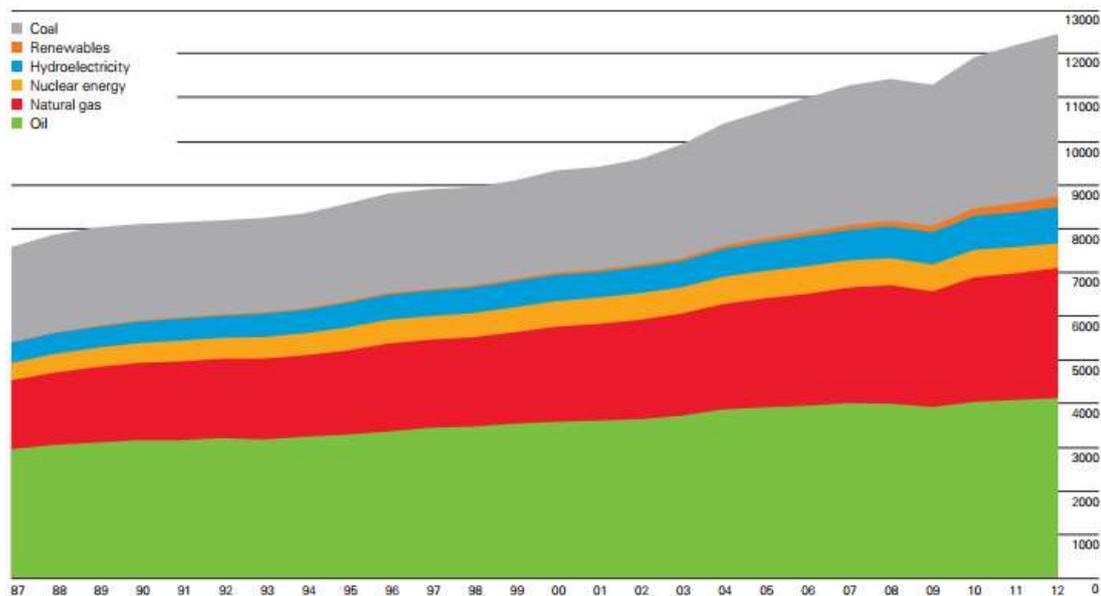
Source: BP, 2013

Therefore, we can demonstrate the above comment that the nuclear, renewables and hydroelectricity resources of energy do not play an important role in the energy market

(BP, 2013). It must be mentioned that the last two have reached, in 2012, high record shares of 6.7% and 1.9%, respectively (BP, 2013). On the other hand, oil, coal and natural gas seem to be the major players in the energy consumption market, with the first to be the leader and the two other to increase their market shares the last six years (BP, 2013). Furthermore, the below table shows us the regional consumption pattern in 2012 of the same energy resources.

Figure 2 - Consumption of Energy Resources by Region in 2012
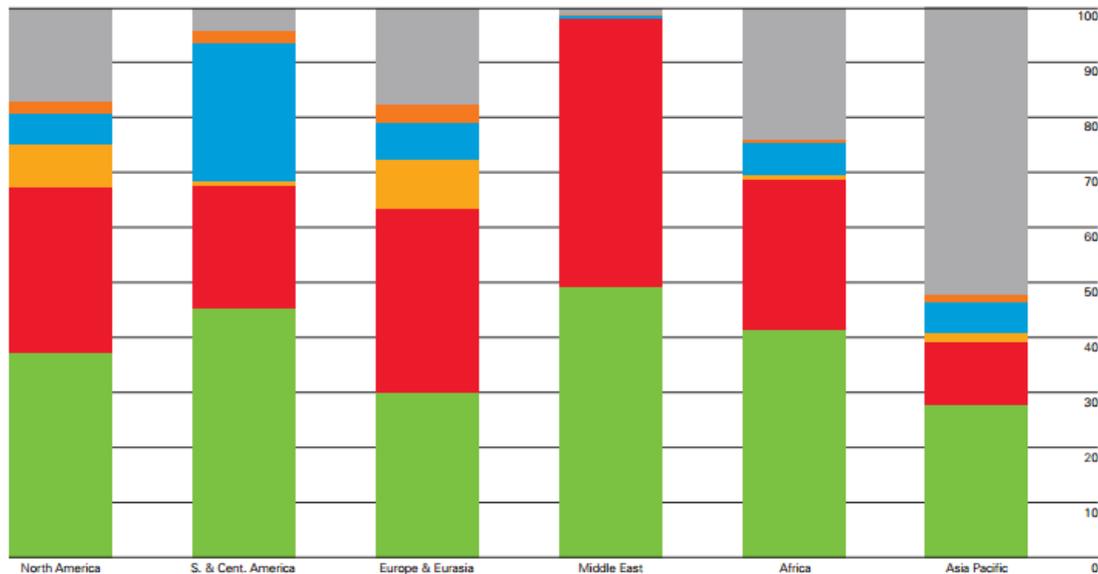
Source: BP, 2013

Hence, we can infer that Europe and Eurasia are the leaders in the introduction of new fuels for energy consumption, with natural gas having the major role in the energy consumption (BP, 2013). In contrast, coal is being mostly spread in the Asia Pacific countries with a market share of 69.9% in the global coal consumption (BP, 2013). Furthermore, oil is dominant to the other regions and especially in the Middle East, where oil and natural gas have almost the same market shares. Finally hydroelectricity is being promoted in the South and Central America, whereas the oil is the major fuel player in the consumption of energy.

On the other hand, the environmental cost of coal and oil has led to people on finding new resources of energy, in order to be eco-friendly, which also involves lower cost. The above is one of the main reasons as to why all the other resources of energy have been in the front line the past few years and in a lower percentage the years before. More specifically, the natural gas is mostly promoted, since it has an advantage, against the other, that it has lower cost in its research and development as well as in its settlement. In addition, we can infer that due to the substitution effect, the differentiation in price and the friendliness of natural gas to the environment, gives it a great advantage to be evolved. The financial crisis, in our case, are the causes for people to and companies to change their consumption and production behaviour, accordingly, in order to fulfil their new desires. Moreover, the link between economic growth and debt with demand, supply and maritime transportation of natural gas can

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be evaluated with the study of historical financial crisis and their impacts to the production and consumption of natural gas.

2.4. Impacts of Past Financial Crisis to the Natural Gas Market

According to the report of the International Energy Agency for the G8 Energy Ministers' Meeting in 2009, the financial crisis that began in 2008 has influenced the energy market. More specifically, investments that were scheduled to be made have been postponed, in accordance with the cutting back of spending in drilling, pipeline construction and power stations of oil and natural gas (EIA, 2009). The current research for the impacts of the European Union Sovereign Debt Crisis on the production and consumption of Natural Gas can be hypothesized from the results of the previous financial crises. The United States Financial Crisis of 1988, the Mexican Financial Crisis of 1995, the Asian Financial Crisis of 1997, Russian Financial Crisis of 1998 and the Argentinian Financial Crisis of 2000, from which the gas crisis of 2004 followed, are basic providers of information for structuring the hypothesis of this thesis.

The United States Financial crisis, which last from 1988 until 1991, had as an effect the increase of the growth of the production of natural gas, by 1.59% on average. More specifically, the rate of increase the first year of the crisis is 120% (EIA, 1995). This, has been caused due to the fact that the nonmajor producers of natural gas in the United States invested in their business and grew their market share from 20% to 38% (EIA, 1995). In 1991, the growth had slightly decreased by 0.63% (EIA, 2013), but it was not the case for a crisis in the natural gas production sector. On the other hand, the consumption of natural gas in the United States in the same period, had a growth increase of 3.28% (EIA, 2013). More precisely, this growth was ranged between 0.29% and 6.04% (EIA, 2013). Hence, we can conclude that natural gas was used as an alternative energy fuel.

The Mexican financial crisis, which lasted from 1994 until 1997, resulted to the behavioural change of the consumers and producers of natural gas. More specifically, its production had been increased due to the regulations that the government of Mexico issued that period. Before 1994, the production of natural gas was a monopoly, but with the above action, the entrance of private companies was able but not to the full competitiveness of the market, because the government did not want so (Juan Rosellon, Jonathan Halpern, 1999). While also, regulations were made in the whole logistics chain, in transportation, in distribution, etc. (Juan Rosellon, Jonathan Halpern, 1999). More precisely, the production had been increased by 4.87% (EIA, 2013). The production of NG had been decreased the first year of the crisis by 1.89% (EIA, 2013). On the other hand, the consumption of natural gas by the citizens of Mexico showed a growth of 4.81% (EIA, 2013). In addition, there had not been any decline in the years of the crisis, contrariwise, the minimum and maximum growths were 1.6% and 6.85% in the years 1995 and 1997, respectively (EIA, 2013).

Regarding the Asian financial crisis, which lasted from 1997 until 2001, there have been effects both in Thailand, South Korean and Indonesian Energy market. More specifically, as in the United States case, many facility construction projects were reviewed or postponed (Koichiro Nakano, Kenichiro Honda, 1999). The Indonesian group IPP had to prioritize these investments that were less expensive and more profitable. The same company in Thailand had to postpone all of the projects or

downsize them (Koichiro Nakano, Kenichiro Honda, 1999). In addition, the action to switching the main fuel of energy from coal to natural gas before the crisis failed, due to the crisis, and the coal fuel remained, because of its low price of extraction and consumption (Koichiro Nakano, Kenichiro Honda, 1999). On the other hand, the Kyoto agreement that had been signed in 1997, had played a key role for these countries to be more sustainable and promote natural gas.

Moreover, the growth of the natural gas production in the above countries had decreased in the crisis period by 1.64% (EIA, 2013). More specifically, the highest increase was in 1999 with 10.35% and the deepest decrease occurred in 2001 with 11.99% (EIA, 2013). Hence, we can conclude that the impacts of the Asian financial crisis on the production of natural gas in these countries was catastrophic. As regards the consumption of natural gas as a source of energy, between 1990 and 1996, the annual growth was on average 10% (Koichiro Nakano, Kenichiro Honda, 1999). By the start of the financial crisis in Asia, between the years 1997 to 2001, the consumption increased on average with 3.01% (EIA, 2013). During the years of 1998, 2000 and 2001, the consumption showed a decrease of 6.66%, 0.85% and 2.1%. But, this was not enough, because after the years of the financial crisis, the consumption of natural gas raised until its end with an average of 7.31% (EIA, 2013).

Russia is the largest natural gas producing country in the world. Its financial crisis lasted from 1998 until 2002 and had as the effect to lead the government to keep the public sector out of natural gas production and deal with corruption in the system (Desai, 2010). But the growth of production in natural gas the period from 1998 until 2002 has been on average 0.83% per year (EIA, 2013). Moreover, in 2000 and 2001, the production of NG had decreased 1.32% and 0.58% accordingly (EIA, 2013). In addition, the pipeline construction and the growth of exports in Russia, gave the opportunity to the monopoly company of natural gas production to grow (Gelb, 2006). In the meantime, the consumption of natural gas from the Russian citizens, in the period of1998 until 2002, has shown an increase of an average 2.01% (EIA, 2013). However, in 1999 and 2001, the NG consumption dropped by 0.17% and 1.17%, accordingly (EIA, 2013).

Finally, the economic crisis of Argentina in 2000 has caused problems in the natural gas production. The price controls of the government in 2001 has deterred investment and production with result to drive the country to rely in imports (EIA, 2012). More specifically, there was no access to external financing, there were low prices at the wellhead and the freeze on tariffs for transmission and distribution companies led to low investments and exploration / production of natural gas, which resulted to the Gas Crisis in 2004 (Honoré, 2004). Furthermore, the production of natural gas increased in the period of 2000 to 2004 by 5.55%. In accordance, the two middle years of the crisis, 2001 and 2002, the production of natural gas had been decreased by 0.72% and 2.77%, respectively (EIA, 2013). Concerning the consumption of natural gas by the people of Argentina, it had been increased on average by 3.49%. More precisely, at the first two years of the crisis, 2001 and 2002, the consumers decreased its consumption by 5.99% and 3.04% respectively (EIA, 2013). In accordance, the next years the consumption increased, with high rates of growth and more specifically by 14.24% and 9.63% for the years of 2003 and 2004.

We must mention that because we are going to calculate and use many economic variables in terms of growth, such as the debt growth or the production and consumption growth, we have to mention that the following equation will calculate our selected data in growth terms.

Equation 1: $Growth\ (t) = \dfrac{[Value\ (t) - Value\ (t-1)]}{Value\ (t-1)} * 100\%$, where, t is time.

Therefore, the above equation gives us the correlation between the value of a variable in the time "t" and one period before "t-1". Hence, by having a data table of many continuous years, we can compare their changes in terms of growth and investigate their cyclical behaviour.

The table below shows the amount of production of natural gas, in bcm, as also its growth over the years for each financial crisis, as also its growth for the years before and after each crises. It is important to know the growth of production in each region that is impacted by a financial crisis, because we are going to make our hypothesis according to the following averages for the European Union.

Table 1 - Production of Natural Gas in Financial Crisis

United States Financial Crisis	1988	1989	1990	1991	Long-run
	17,103.00	17,311.00	17,810.00	17,697.80	
	2.90%	1.22%	2.88%	-0.63%	
Growth	1.59%				0.61%

Mexican Financial Crisis	1994	1995	1996	1997	Long-run
	974.87	956.82	1,064.04	1,166.03	
	2.55%	-1.89%	10.08%	8.75%	
Growth	4.87%				1.92%

Asian Financial Crisis	1997	1998	1999	2000	2001	Long-run
	2,909.25	2,837.56	3,131.38	2,894.42	2,547.27	
	3.49%	-2.46%	10.35%	-7.57%	-11.99%	
Growth	-1.64%					4.46%

Russian Financial Crisis	1998	1999	2000	2001	2002	Long-run
	19,553.92	19,592.76	19,334.96	19,221.95	19,684.58	
	3.46%	0.20%	-1.32%	-0.58%	2.41%	
Growth	0.83%					0.39%

Argentinian Financial Crisis	2000	2001	2002	2003	2004	Long-run
	1,321.13	1,311.60	1,275.22	1,449.33	1,584.94	
	8.22%	-0.72%	-2.77%	13.65%	9.36%	
Growth	5.55%					5.57%

Source: Self, Data: EIA, 2013

As we can observe from the data of the above table, each financial crisis had a different impact on the production of natural gas. More specifically, the Asian financial crisis had as a result the worst impact on the natural gas production, where its average

growth decreased by 1.64%. On the other hand the Argentinian and Mexican financial crisis have increased the natural gas production growth by 5.55% and 4.87%. Furthermore, the Russian financial crisis has impacted positively the natural gas production growth, which resulted to be increased by 0.83%. Furthermore, regarding the long-run natural gas production average growths, we can notice from the table above that all the long term growths are positive, varying from 0.39% to 5.57%. More specifically, the Asian countries and Argentina have the highest long run growths with 4.46% and 5.57%, respectively. Furthermore, the Mexican long run growth of natural gas production is 1.92%, whereas the United States and Russian long-run average growths are 0.61% and 0.39%, respectively.

In addition, if we want to compare the long run growths of the natural gas production with these of each financial crisis periods, we can conclude that the differences are significant. More precisely, in the years of the Asian financial crisis, the natural gas production average growth differed from the long-run almost by -6%, in contrast with the years of the Mexican crisis, where the change was 3%. Regarding this alteration in the production of natural gas average growth, in the years of the Argentinian crisis, was 0.02%. Furthermore, regarding the United States and Russian financial crisis, the gap between the long-run average growths and the impacted average growths was 1.02% and 0.44%, respectively. Hence, we can conclude that each financial crisis impacted contrarily the production of natural gas.

Moreover, the following table shows us the growth in consumption of natural gas in the periods of financial crisis, in addition with the growth in the years before and after each crises. Hence, we can make results for what happened in these periods in the consumption of natural gas. Again, this will be the core for our hypothesis in the changes of consumption in the European region, which is going to be examined.

Table 2 - Consumption of Natural Gas in Financial Crisis

United States Financial Crisis	1988	1989	1990	1991	Long-run
	18,030.00	19,119.00	19,174.00	19,562.00	
	4.76%	6.04%	0.29%	2.02%	
Growth	3.28%				0.74%

Mexican Financial Crisis	1994	1995	1996	1997	Long-run
	1,026.22	1,042.64	1,102.68	1,178.21	
	5.04%	1.60%	5.76%	6.85%	
Growth	4.81%				3.79%

Asian Financial Crisis	1997	1998	1999	2000	2001	Long-run
	2,188.08	2,042.27	2,350.78	2,330.86	2,281.84	
	9.57%	-6.66%	15.11%	-0.85%	-2.10%	
Growth	3.01%					8.78%

Russian Financial Crisis	1998	1999	2000	2001	2002	Long-run
	12,603.57	12,582.38	13,058.78	12,905.51	13,564.14	
	2.48%	-0.17%	3.79%	-1.17%	5.10%	
Growth	2.01%					0.71%

Argentinian Financial Crisis	2000	2001	2002	2003	2004	Long-run
	1,172.81	1,102.53	1,068.99	1,221.19	1,338.79	
	2.63%	-5.99%	-3.04%	14.24%	9.63%	
Growth	3.49%					5.31%

Source: Self, Data: EIA, 2013

As we can observe from the data of the above table, each financial crisis had a different impact on the consumption of natural gas. More specifically, the Asian financial crisis had as a result the worst impact on the natural gas production, where its average growth decreased by 1.64%. On the other hand the Argentinian and Mexican financial crisis have increased the natural gas production growth by 5.55% and 4.87%. Furthermore, the Russian financial crisis has impacted positively the natural gas production growth, which resulted to be increased by 0.83%. In addition, regarding the long-run natural gas consumption average growths, we can notice from the table above that all the long term growths are positive, varying from 0.71% to 8.78%. More specifically, the Asian countries and Argentina have the highest long run growths with 8.78% and 5.31%, respectively. Moreover, the Mexican long run growth of natural gas production is 3.79%, whereas the United States and Russian long-run average growths are 0.74% and 0.71%, respectively.

In addition, if we want to compare the long run growths of the natural gas consumption with these of each financial crisis periods, we can conclude that the differences are significant. More precisely, in the years of the Asian financial crisis, the natural gas consumption average growth differed from the long-run almost by -5.77%, in contrast with the years of the Mexican crisis, where the change was 1.02%. Regarding this alteration in the consumption of natural gas average growth, in the years of the Argentinian crisis, was -1.83%. Furthermore, regarding the United States and Russian

financial crisis, the gap between the long-run average growths and the impacted average growths was 1.64% and 1.3%, respectively. Hence, we can conclude that each financial crisis impacted contrarily the consumption of natural gas.

Moreover, the LNG transportation during the financial crisis in the U.S., concluded to an increase (EIA, 1999). More precisely, the government of the U.S. started to build relationships with other countries, such as Australia and Algeria, in order to supply them with natural gas. This, had as an effect the increase to the peaks of LNG transportation (EIA, 1999). Moreover, the impacts of the crisis were also to the change of the regulatory framework. More specifically, the change of regulations for the natural gas trade between the U.S. and the Canada was inescapable, which led to imports and exports of natural gas increase (PLATT, 1989). Thus, this change of regulations concluded to the increase of LNG trade, since part of the imported natural gas from Canada was transferred to other countries by sea.

Regarding the impacts of the Mexican financial crisis to the transportation of natural gas was on average positive, with an average growth of 24.29% for these years (EIA, 2013). The largest decrease had been made in 1995 with 27.73% (EIA, 2013). But, after this huge decrease, the Mexican LNG trade recovered (EIA, 2013). Hence, many changes were made in the natural gas sector in Mexico during these years, which resulted to the continuous growth of LNG trade, with LNG terminals to be built and contracts to be signed, until today (EIA, 2012).

As far as concerning the impacts of the Asian financial crisis in 1997 to the LNG transportation, the South Korea, Indonesia and Thailand have mostly been affected. More specifically, the import contracts that have been signed between South Korea with Indonesia, Malaysia and Brunei, from which the first two were concerning short-term period in accordance with the last that was for a long-time period, had been postponed (Koichiro Nakano, Kenichiro Honda, 1999). At the same time, negotiations for LNG trade, which have taken place between South Korea with Abu Dhabi, Canada and Yemen, had been also deferred (Koichiro Nakano, Kenichiro Honda, 1999). Moreover, many projects for natural gas imports by sea (LNG) have been hindered, because of the crisis, between the trade relationships of Thailand with Oman, Yemen and Indonesia (Koichiro Nakano, Kenichiro Honda, 1999). Hence, the LNG trade had been decreased.

As far as is concerned the impacts of the Russian financial crisis to the LNG transportation, its average growth decreased by 1.47% (EIA, 2012). More precisely, this decrease was intense in the period of 2000 until 2002, where the imports and exports of LNG decreased on average by 5.95% (EIA, 2012). This crisis concluded Russia to be one of the key players in distribution of natural gas by sea in the whole world. The found of LNG companies, the built of terminals and progress, in terms of regulations and research, from the side of the government resulted to the today's situation. As far as concerning the Argentinian financial crisis, had as an impact the increase in the trade of LNG with an average growth of 64.57% (EIA, 2012). This happened due to the extreme results of the crisis and the huge gap between inland production and consumption.

3. Past and Current Situation

In this chapter, an analysis of the European Union Sovereign Debt Crisis will be implemented for two periods of time, past until 2007 and 2008 until 2013. In accordance, the production, consumption, maritime trade and competition of natural gas with the other energy fuels will be applied, for the same period of times as above, but separately for the European Union and non-European countries.

3.1. Past Situation

3.1.1. European Union Debt Crisis

After the collapse of the Lehman Brothers Bank in the United States, in September 2008, the German Bund had been most impacted (Santis, 2012). This resulted to its increase in October of 2008 (Santis, 2012). While also, in 2009, when the government of Ireland introduced the measures for fiscal stability, in addition with the reduction of global uncertainty in 2009, lead to an improvement of the situation (Santis, 2012). Hence, when the announcement was made from the Greek government that the budget deficit was two times higher than expected, the sovereign spread started to rise in almost all the European Union countries (Santis, 2012). Moreover, the European Monetary Union had to face the biggest challenge since its creation (Santis, 2012). The countries that did not follow this increase in spreads were the Netherlands, Germany, France, Austria and Finland (Santis, 2012). This was because all these five countries are highly connected with the German bonds, which results to following its trend (Santis, 2012).

The results of the crisis for the whole European Union have affected its growth, as also its competitiveness (Collignon, 2012). In accordance, the internal and external value of the euro, meaning inflation and exchange rate respectively, has been stable in the whole period of the crisis (Collignon, 2012). In 2011, the financial markets have been stabilized, showing positive news for the people (Collignon, 2012). Moreover, one of the causes for the start of the European Union Debt Crisis and its results, is the political structure of the European Central Bank (ECB) (Collignon, 2012). This, because the ECB does not take into account the different characteristics of each country, but it follows its main strategy, which is keeping inflation in low levels (Collignon, 2012).

The following graph shows us the European Union Sovereign Debt in percentage of the total GDP. This allows us to have a better overview of the economy of the European Union countries altogether, because GDP shows us the real production strength. Furthermore, the table shows us the yearly growth of the debt in the European Union, which has been first calculated for as the sum of central government debt for each country, and then the growth equation (Equation 1) has been applied.

Figure 3 - EU Debt (% GDP) and Debt Growth 1995 - 2007
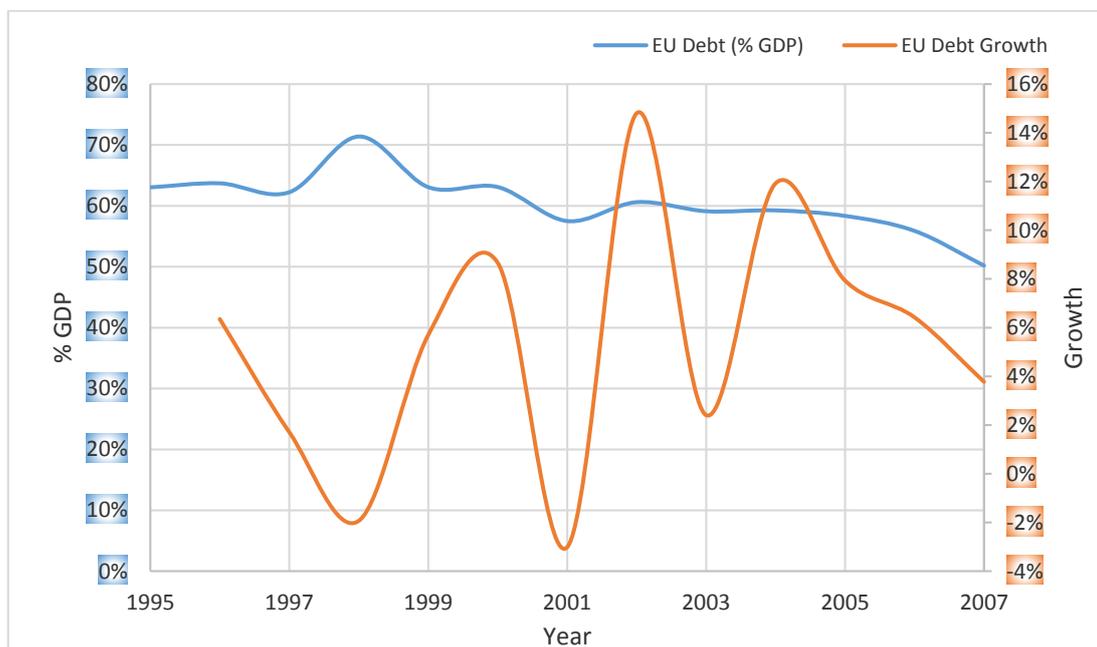
Source: Self, Data: WDB, 2013

We can observe that the total EU debt as a percentage of GDP from 1995 until 2007 decreases with a small slope. This means that the value of goods and services that the EU countries are producing in total is higher than their governments' debt. On the other hand, the EU debt growth shows us that except for 2003 when it grew for 14%, the debt growth is kept in low values, even negatives. It must be mentioned that a better analysis will follow, where each country will be presented on her own, in order to have a clear view of the situation.

The largest danger for default in the European Union are Greece and Italy. More specifically, their percentages of government debt in relation with the GDP, vary above 100% (WDB, 2013). This means that the loans that these two governments are undertaking overcome their GDP, which is the value of all final products that have been produced in the country. Hence, these two countries are the most in danger. Furthermore, the rest of the European countries, which contain the core of the European Union, such as Germany, France, Finland, Austria and the Netherlands, range between 40% and 80% (WDB, 2013).

In 2007, the countries that had the lowest percentages of central government debt in relation with the GDP, were Estonia and Czech Republic with 4.81% and 24.19%, followed by Ireland, Finland, Germany and Spain, with 28.81%, 37.37%, 40.76% and 30.09% accordingly. Furthermore, the rest of the EU countries range between the above percentages. On the other hand, Greece, Belgium and Italy remain with the highest percentages, with 125.61%, 104.25% and 82.47%, accordingly. Finally, we can conclude that the majority of the countries in the EU are having low debts, in relation with their GDP. A more detailed illustration of the EU countries debt, as a percentage of GDP, is being shown in the following figure from 1995 until 2007.

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Figure 4 - EU Countries Debt (% GDP) from 1995 until 2007
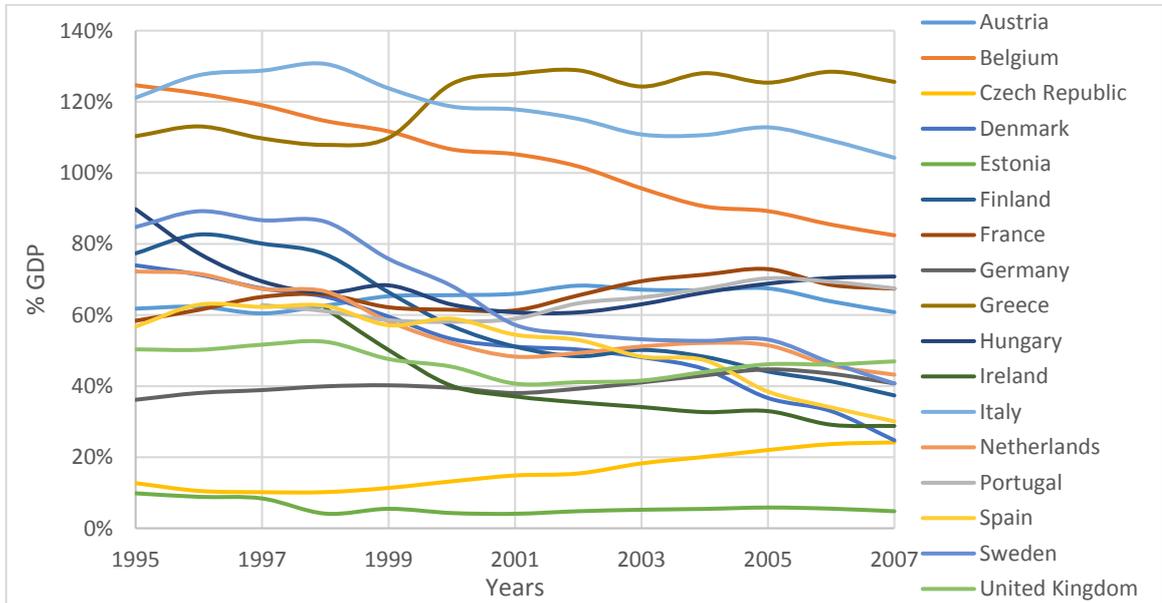
Source: Self, Data: WDB, 2013

This increase of the sovereign debt in the European Union has many effects in all industries. Moreover, because maritime trade is influenced, negatively or positively, from all the changes in the world economies. Thus, we can infer that the European Union Sovereign Debt Crisis will influence the trade of LNG and we are going to investigate this relationship and its results.

3.1.2. Production and Consumption of Natural Gas until 2007

The use of natural gas history goes back to the ancient ages, when ancient Greeks and Persians were searching its usage and its capabilities. On the other hand, the Chinese were using natural gas to heat sea water in order to obtain its salt (TNP, 2012). In the 21st century, the growth of production of natural gas has been increased on average 2.97% from 1971 until 2007. In addition the consumption of natural gas has been increased for the same period of time on average by 3.01% worldwide.

The demand and the supply of natural gas are the main economic factors that affect its transportation. In addition of exogenous factors, such as the price of competitive products, i.e. oil and coal, the economic growth of countries, the economic welfare of people, sustainability advantages of natural gas, can in total also affect its transportation. For the purpose of our project, we will assume 'ceteris paribus', so the only variables that can change will be production and consumption and we will have all the other variables remain unchanged. This is being done, because we want to distinguish the exogenous variables that affect the production, consumption and trade of LNG and focus only on the results of the European Union Debt Crisis to the LNG transportation.

Therefore, we can conclude that the LNG transportation market is being affected by various parameters, since LNG is a global industry and transfers natural gas, by sea,

from one country to another. Finally, the role of the other two basic energy production materials, oil and coal, will be examined in order to find if there are any substitution effects and how this has changed over the crisis.

Furthermore, the following two tables illustrate us the production and consumption of natural gas in bcm as well as their annual growth from 1971 until 2007.

Figure 5 - World Natural Gas Production and Annual Growth 1971 - 2007
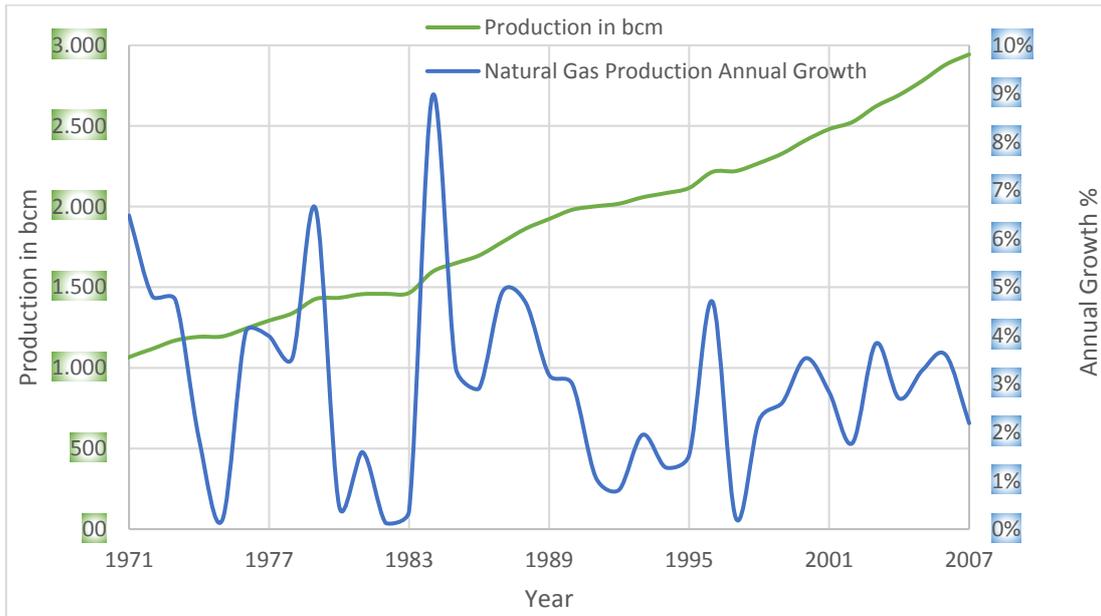
Source: Self, Data: BP, 2013

Figure 6 - World Natural Gas Production and Annual Growth 1971 - 2007
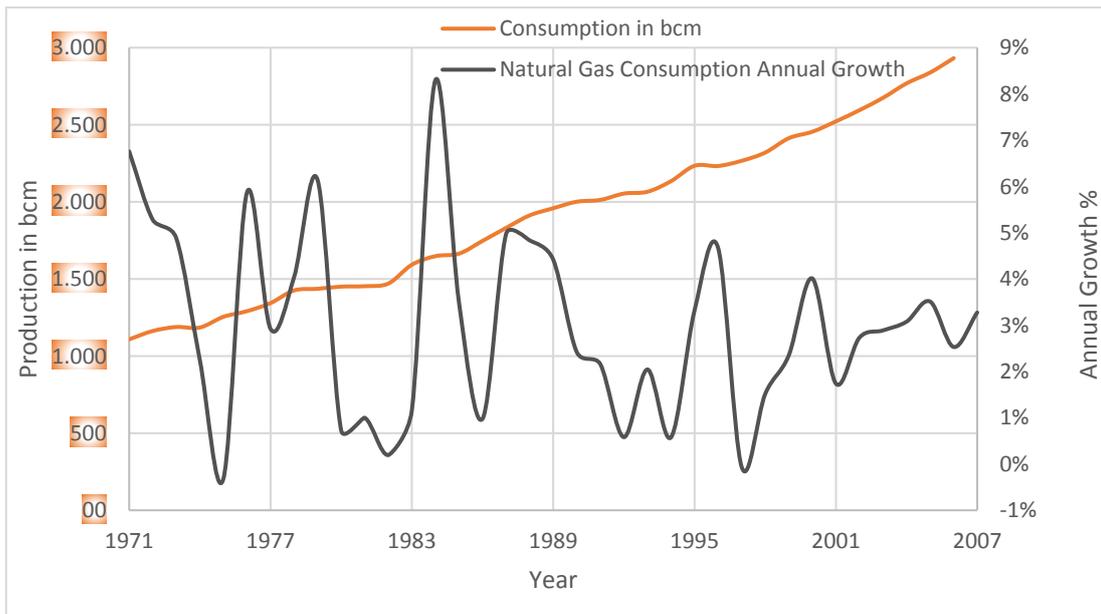
Source: Self, Data: BP, 2013

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We can easily notice that the natural gas production's and consumption's trends are almost equal. In addition, their growths are following the same slopes. That is the reason as to why the figures illustrate to us that these two measures are highly correlated, as also that they are being influenced from the same endogenous and exogenous variables. More specifically, the worldwide production of natural gas is continuously increasing, by reaching in 2007 the value of 2,943 bcm with an average annual growth, from 1971 until 2007, of 2.97%. The highest increase in the annual growth in the production of natural gas had been made in 1984 with a total growth of 8.95%, and the largest decrease was in 1982 with 0.13%. In the same time, the consumption of natural gas shows a continuous increase, with a total of 2,932.1 bcm in 2007 and an average growth of 3.01% from 1971 until 2007. Accordingly, the highest increase in the consumption of natural gas had been made in 1984, with an annual growth of 8.3%, and the largest decrease was in 1974 by 0.32%.

Furthermore, it must be noticed that the natural gas industry before the 1990's was a reserved industry, due to the fact that many consumers and producers believed that natural gas was a "premium fuel" (Stevens, 2010). This led the governments to restrict the consumption of natural gas, with the exception of some infrequent circumstances. But, in the 1980's, countries with financial crisis whose citizens could not afford the high prices of oil, were changing their energy source to natural gas (Stevens, 2010). This helped the growth of production and consumption of natural gas, as also the beginning of infrastructure projects for drilling, storing and distributing it, with the only disadvantage the long term period of completion (Stevens, 2010). Hence, the inland trade, in addition with the trade between countries, was encouraged, which will be analysed below.

In the 1990's with the evolution of technology and the extinction of the regulations that were preventing the production and consumption of natural gas, its growth increased rapidly. Countries were preferring this type of fuel for consumption (Stevens, 2010). In addition the use of economies of scale in the project that were being developed in the first decade of the 21st century, promoted natural gas to expand (Stevens, 2010). This, also had an effect to its transportation, since more and more countries were also starting to use natural gas as fuel for sustainability reasons.

A list a list of countries with production and consumption of natural gas, in 2007, can be found on Table 28 and 30 in Appendix, respectively. The production of natural gas consists the supply of natural gas to the market and the consumption entails of the demand of natural gas. As it is obvious, Russia and the United States are the largest countries in production and consumption of natural gas. More specifically, regarding the production – supply – of natural gas, Russia holds the market share of 20.12% of the total natural gas production market, followed by the United States that holds the 18.54% of the market share. The top 5 list is being completed with Canada, Iran and Norway, who all together holding the 51.71% of the whole natural gas production market. Hence, we can conclude that any economic crisis in these countries will have an impact to the world trade of natural gas. In addition, the countries of the European Union manage the 6.37% of the total production. The following table shows the natural gas production by continent.

Table 3 - Natural Gas Production by Region in 2007

Region	bcf	Market Share
Eurasia	82.79	29.07%
North America	75.65	26.57%
Asia Pacific	38.75	13.61%
Middle East	34.62	12.16%
Africa	19.75	6.94%
Europe	18.14	6.37%
Central & South America	15.06	5.29%

World	284.76

Source: Self, Data: EIA, 2012

We can notice, from the above table, that the countries of Eurasia are the major players in the production of natural gas, with 29.07% market share, followed by the countries of North America, which are obtaining the 26.57% of the market share. This result was obvious, since United States are included in the North American countries and Russia in the Eurasian. Moreover, the countries of Middle East, Asia Pacific and Africa are medium sized players, followed by Europe and C. & S. America, which have the lowest market shares. More precisely, Europe has only 6.37% of the total market share, as it has been mentioned above, which can be characterized as very low. Hence, we can end up that Europe is not a key producer of natural gas, but it is much of importance the trade that is being done from and to its countries.

Regarding the consumption – demand – of natural gas, United States and Russia are the major players, with 22.31% and 14.15% market share, respectively. In addition, the top 6 players in consumption of natural gas, which are United States, Russia, Iran, Japan, Canada and United Kingdom, hold almost 50% of the world consumption. Concerning the above, the following table shows us the consumption of natural gas by region for 2007.

Table 4 - Natural Gas Consumption by Region in 2007

Region	bcf	Market Share
North America	78.75	27.76%
Eurasia	62.28	21.95%
Europe	46.65	16.44%
Asia Pacific	44.25	15.60%
Middle East	29.34	10.34%
Central & South America	13.19	4.65%
Africa	9.23	3.25%

World	283.68

Source: Self, Data: EIA, 2012

We can easily conclude that the biggest consumer in Natural Gas is North America, in contrast with Africa, which has the lowest market share. Moreover, Eurasia is the second in the above list with 21.95% of market share, followed by Europe that holds 16.44% of the total natural gas consumption. Finally, Asia Pacific, Middle East and

Central & South America are completing the list with 15.6%, 10.34% and 4.65% accordingly. Hence, we can infer that the European Union countries play an important role in the natural gas consumption and due to the difference between production and consumption, we can redound that Europe is an importer of natural gas. Therefore, we can conclude from the above that the countries of the European Union have been dwarfed from the North America and Eurasia in the production and consumption of natural gas, but they still play a role of major importance in the natural gas market.

More specifically, the following analysis targets to the production and consumption of natural gas of non-Europe and European countries. In addition their annual growths will be presented below.

Non-European Union Countries

Regarding the non-European countries, their natural gas production and consumption in bcm, as well as their annual growths from 1971 until 2007 can be illustrated in the following two tables.

Figure 7 - Non-Europe Natural Gas Production & Annual Growth 1971 - 2007

Source: Self, Data: BP, 2013

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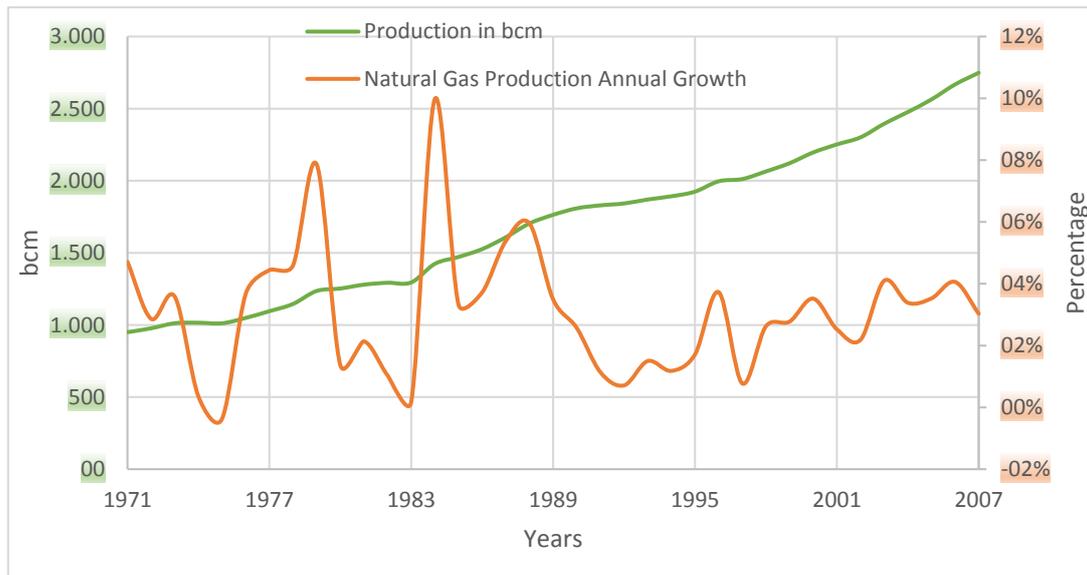
Figure 8 - Non-Europe Natural Gas Consumption & Annual Growth 1971 - 2007
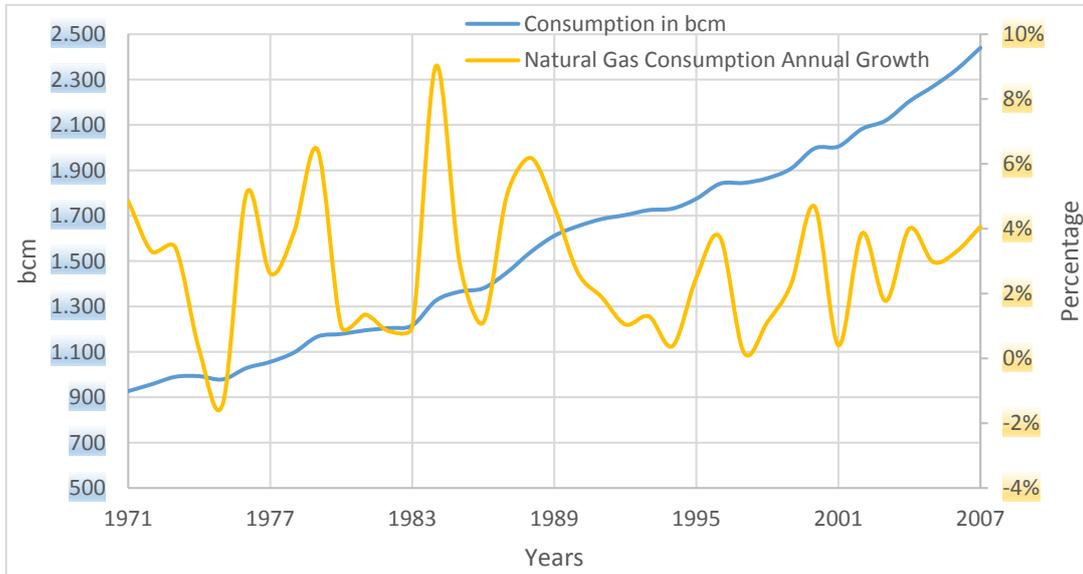
Source: Self, Data: BP, 2013

Therefore, we can conclude from the above figures that the natural gas production's and consumption's trends, in the countries that do not belong in the European Union are almost the same. In addition, their growths are following the same slopes. In addition, we can observe that difference between production and consumption in the no-European countries concludes to a surplus of natural gas reserves, which is used to be exported in Europe or stored. Furthermore, the production of natural gas is continuously increasing in the non-European countries, by reaching in 2007 2,748.1 bcm with an average annual growth, from 1971 until 2007, of 3.1% (BP, 2013). The highest increase in the annual growth in the production of natural gas had been made in 1984 with a total growth of 10%, and the largest decrease was in 1975 with 0.4% (BP, 2013). In contrast with the consumption of natural gas shows a continuous increase, with a total of 2,440 bcm in 2007, with an average growth of 2.8% from 1971 until 2007 (BP, 2013). Accordingly, the highest increase in the consumption of natural gas in the non-European countries had been done in 1984, with an annual growth of 9%, and the largest decrease was in 1971 by 1.4%.

European Countries

Regarding the European Union countries, their natural gas production and consumption in bcm, as well as their annual growths from 1971 until 2007 can be illustrated in the following two tables.

Figure 9 - European Union Natural Gas Production & Annual Growth 1971 – 2007
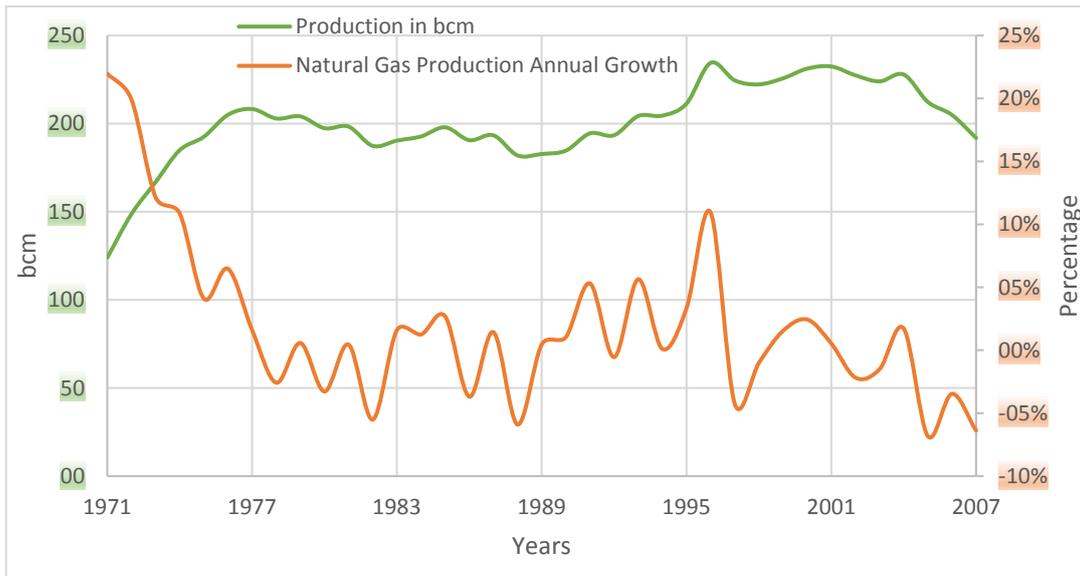
Source: Self, Data: BP, 2013

Figure 10 - European Union Natural Gas Consumption & Annual Growth 1971 – 2007
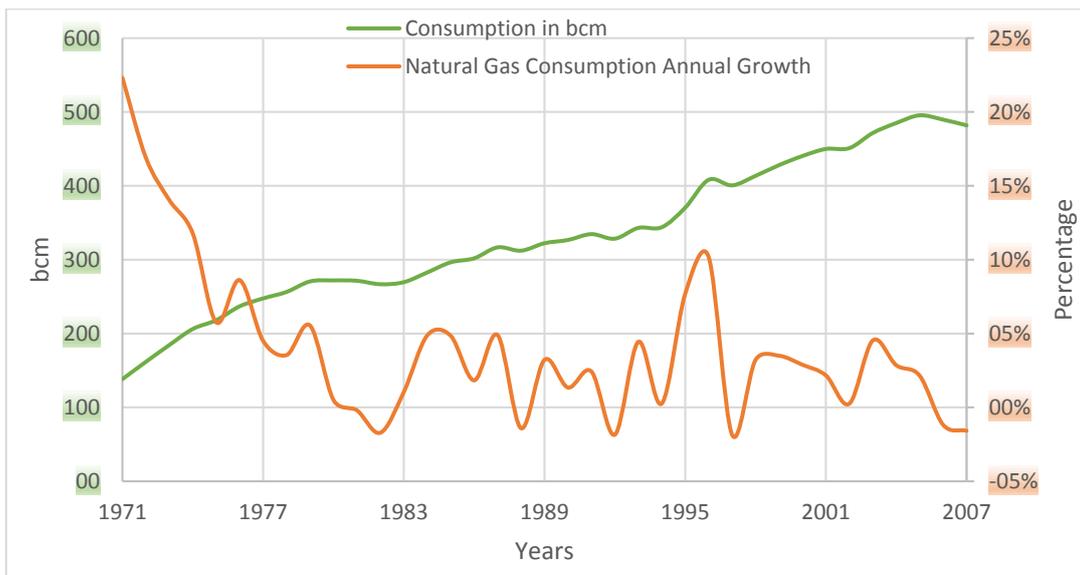
Source: Self, Data: BP, 2013

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Furthermore, whatever concerning the European region, we can conclude from the above figures that the natural gas production's and consumption's are following the same trend. In addition, their growths are following the same slopes, which shows us the high correlation between these two variables and their high interdependence. Moreover, we can observe that difference between consumption and production of natural gas in the European Union, in 2007, is around 250 bcm. This means that Europe has a deficit of 250 bcm and needs to import natural gas, in order to fulfill its citizens' desires. Furthermore, this region's production of natural gas is continuously increasing, by reaching in 2007 191.9 bcm with an average annual growth, from 1971 until 2007, of 1.9% (BP, 2013). The highest increase in the annual growth in the production of natural gas had been made in 1971 with a total growth of 22%, and the largest decrease was in 2005 by 6.8%. In addition, the consumption of natural gas shows also a continuous increase, with a total of 481.9 bcm in 2007 and an average growth of 4.1% from 1971 until 2007 (BP, 2013). Accordingly, the highest increase in the consumption of natural gas in the European Union had been done in 1971, with an annual growth of 22.3%, and the largest decrease was in 1997 by 1.8%.

3.1.3. LNG Transportation

The maritime transportation of natural gas consists of the trade of natural gas in liquefied form between countries that are entering sea. Its history goes back to 1959, when the first voyage of liquefied natural gas had been made by the ship "Methane Pioneer" (Bellver, 2012). After that, many liquefaction plants started to grow in Mediterranean and the United Kingdom, making the first trade route between Africa and Europe (Bellver, 2012). The rise of the exports and imports of natural gas continued, with result the shipbuilding of larger ships and also the built of offshore regasification terminals for servicing the LNG trade (Bellver, 2012). The following table shows us the LNG trade in bcm and its growth for the time period of 2000 until 2007.

Table 5 - LNG Trade and Annual Growth 2002 - 2007
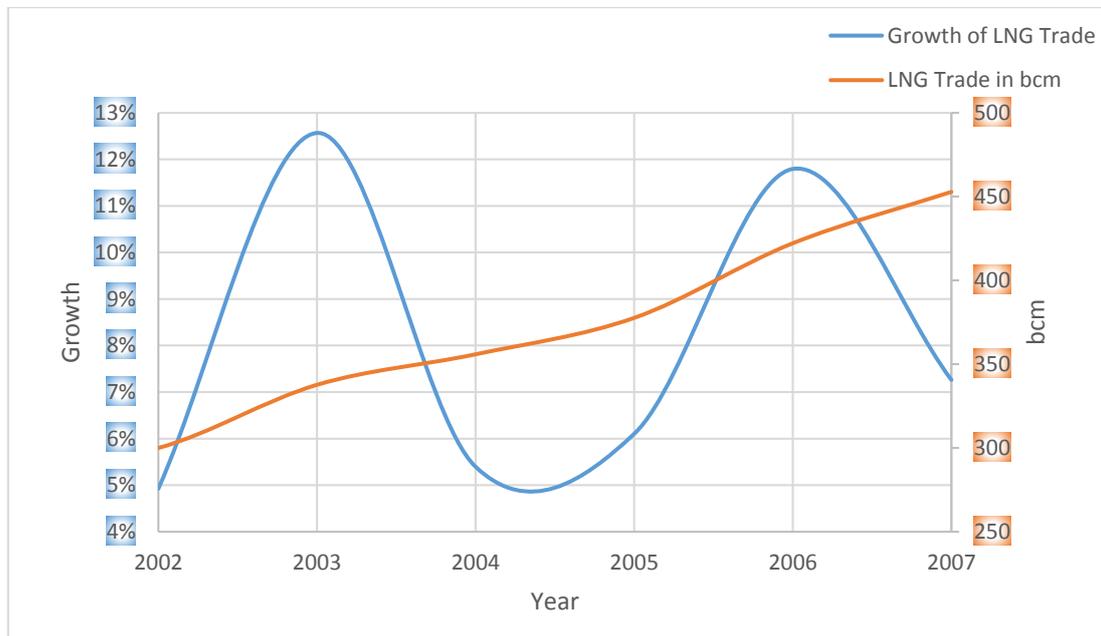
Source: Self, Data: BP Reports 2000 – 2008

As we can observe from the above table, the total world LNG trade growth follows its own economic cycle. Moreover, the total world LNG trade shows a continuous increase from the start of the 21st century. In 2007 the natural gas maritime trade showed an increase of 30.66 bcm and a growth of 7.26%.

This unbroken increase in the LNG trade is mainly because of the increase of the liquefaction capacities in the ports and the innovation in technology (Chabrelie, 2003). In addition, the difference between the price of natural gas with oil and coal, led many consumers to change their behaviour, regarding the source of energy consumption. Moreover, many countries that did not have reserves of natural gas, they had to import it, in order to consume it. The largest importer of natural gas is the United States, which is mainly serviced by sea. Therefore, the order of large ships, in order the owners to take advantage of the economies of scale, played an important role in the competition between the pipeline network and the LNG trade. As it has been mentioned above, today the pipeline networks are commonly used for the inland trade of natural gas, in contrast with the LNG trade by sea that is used for the transportation of natural gas between continents.

By the end of 2007, the world trade of LNG was 453 bcm and having an average growth of 8.62% in the four year period from 2003 until 2007 (BP, 2008). It must be noted that the largest growth in the trade of LNG was between the years 2002 – 2003 and 2005 – 2006, where a 12% increase in the transportation of natural gas by sea had been completed.

Furthermore, it is interesting to investigate the changes in the LNG trade between the regions that are going to be selected for the GSIM model. This analysis will be done directly below.

Non-European Union Countries

In order to investigate the maritime trade of natural gas in more detail, we have to divide it into exports and imports. Hence, the non-European Union countries export and import LNG in high amounts. More specifically, the trade value of the non-European Union countries exports in 2002 was 149.99 bcm. Until 2007 it increased and took the value of 226.27 bcm. This resulted to an average growth of 8% for the non-European countries exports of LNG. Furthermore, the following figure shows us the total non-European countries exports of LNG, in bcm, as also its annual growth.

Figure 11 - Non-European Countries LNG Exports and Annual Growth 2002 - 2007
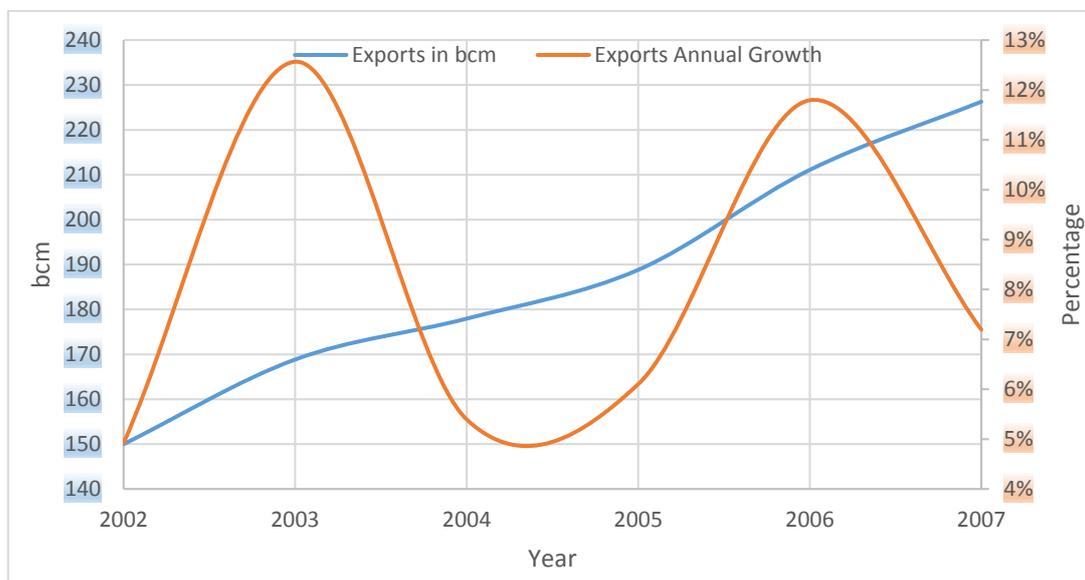
Source: Self, Data: BP Reports 2002 - 2008

The largest trade route for the non-European countries is between Indonesia and Japan, by having a value of 22.74 bcm in 2002 that decreased to 18.04 in 2007. In addition, the second largest route of LNG trade was between Malaysia and Japan, which in 2002 took a value of 15.27 bcm and in 2007 increased to 17.65 bcm. On the other hand, the smallest LNG trade was between Oman and the U.S.A that had a value of 0.05 bcm in 2002, which in 2007 did not exist. Moreover, all the other trade routes were ranging between the above prices, with Qatar, Algeria, Egypt, Oman, Australia, Indonesia and Malaysia playing the most important roles in the exportation of natural gas by sea. Last but not least, the annual growth of the non-European countries LNG exports was varying between the values of 4.92% and 12.57%, which were recorded in 2002 and 2003, respectively.

Moreover, regarding the trade value of the non-European Union countries imports, took the value of 110.91 bcm in 2002. Until 2007 it increased and took the value of 173.07 bcm. This resulted to an average growth of 8.07% for the non-European countries imports of LNG. Furthermore, the following figure shows us the total non-European countries imports of natural gas by sea, in bcm, as also its annual growth.

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Figure 12 - Non-European Countries LNG Imports and Annual Growth 2002 - 2007
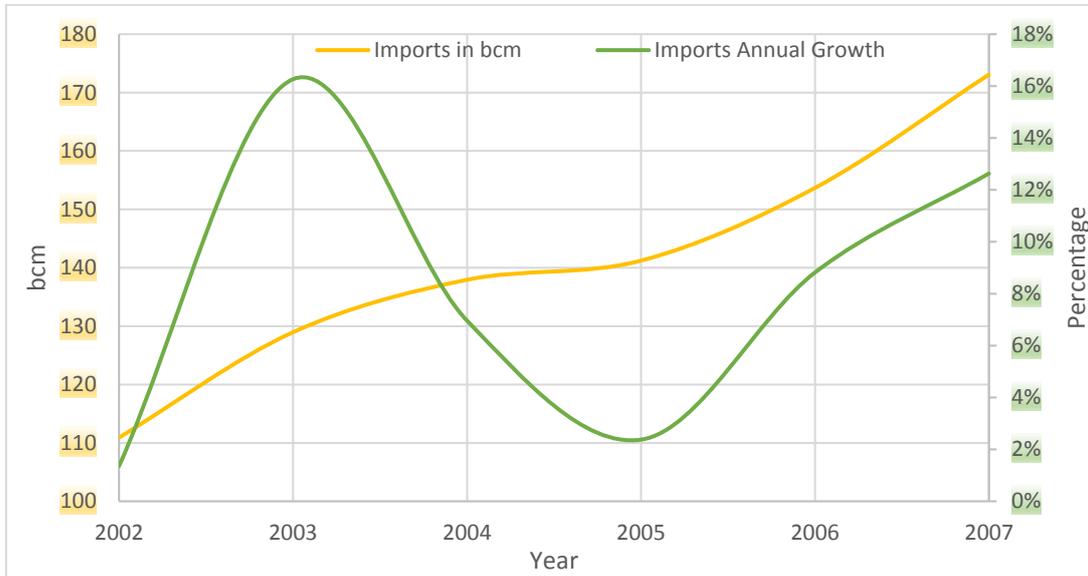
Source: Self, Data: BP Reports 2002 - 2008

Japan and South Korea play a major role in the analysis of the non-European countries LNG imports. This, because the first imported in 2007 88.2 bcm and the second one 34.39bcm. Moreover, United States imported 21.82 bcm in 2007, followed by Taiwan, which imported 10.92 bcm. The same situation existed the whole period between 2002 until 2007, making the above countries very important, in terms of LNG import, for the global maritime trade of natural gas. Finally, the annual growth of the non-European countries LNG imports was varying between the values of 1.36% and 16.27%, which were recorded in 2002 and 2003, respectively.

European LNG Trade Routes

The European region is not exporting LNG and this is the reason of a non-existence of LNG trade routes, where the exporter to be the European region. Nevertheless, it must be mentioned that in 2007 a trade route had been created for the inland transportation of LNG. More precisely, Norway exported LNG to two other European countries, France and Spain, with a total value of 0.14 bcm, which was equally divided to each import country. Thus, Europe is being considered as an importer of LNG, which is of a great importance for the results of the European Union Sovereign Debt Crisis to the European LNG production, consumption and maritime trade.

Furthermore, the total LNG imports, in bcm, and their annual growth, from 2002 until 2007, of the European Union countries can be illustrated in the following figure.

Figure 13 - European Countries LNG Imports and Annual Growth 2002 - 2007
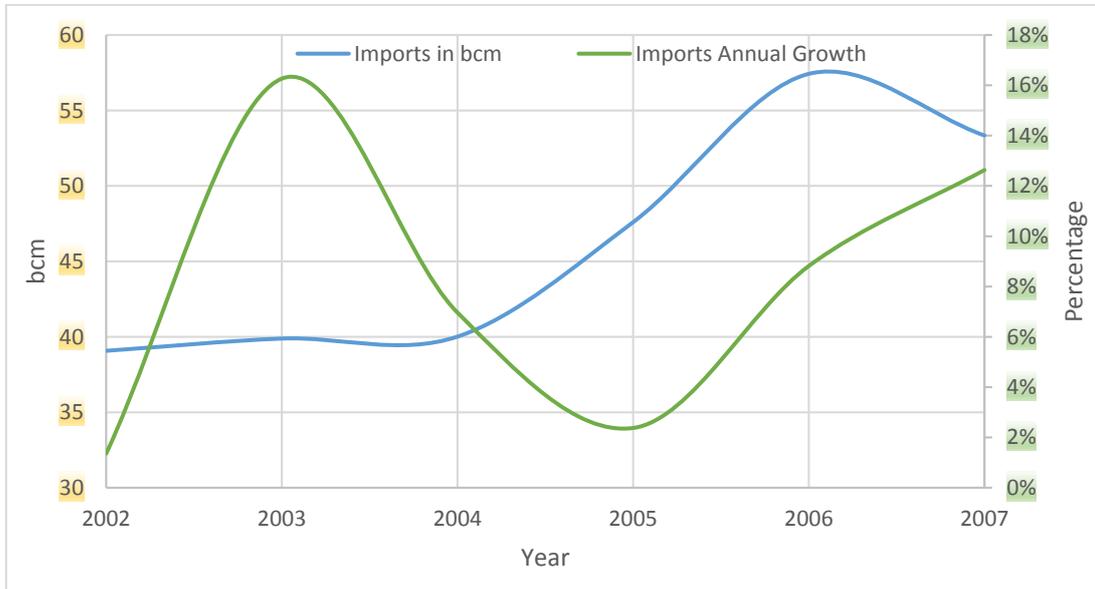
Source: Self, Data: BP Reports 2002 - 2008

The largest trade route, in 2002, for the European countries, which import natural gas by sea, was between Algeria and France, by having a value of 9.8 bcm in 2002 that decreased to 7.85 bcm in 2007 and lost the first place in the list of the largest European trade routes. Hence, the trade route between Nigeria and Spain increased from 2002, when it had the value of 1.71 bcm. In 2007 the price of this trade reached the 8.33 bcm. Furthermore all the other LNG trade routes are having values between 0.02 and 8.33 bcm from 2002 until 2007. Hence, France and Spain play the most important roles in the import of LNG, followed by Belgium, Portugal, Italy, United Kingdom and Greece. On the other hand, Europe is importing LNG from many countries, such as Trinidad and Tobago, Oman, Qatar, Algeria, Egypt, Libya and Nigeria. Hence the main suppliers of LNG, in continents, of Europe are South America, Middle East and Africa. The largest trade is between the African countries and Europe, which in 2007 took the price of 42.94 bcm. Finally, its annual growth was varying between -7.11% and 20.63%, which resulted to an average annual growth of 8.57% for the years 2002 until 2007.

Moreover, the thought of competition between pipelines and LNG carriers has been proven to be wrong, since it has been observed that the LNG trade is used for importing and exporting natural gas through countries, in accordance with pipelines, which transfer natural gas, because they are used for the inland transportation (CIEP, 2004). This has happened for a variety of reasons. The complexity of the construction of a pipeline that will be passing through many different countries, in addition with the high cost of construction, have been important for the division in the natural gas trade between the two possible ways (CIEP, 2004). In addition, technological progress and flexibility of the supply of LNG carriers, have conducted to the increase of trade by sea (CIEP, 2004). Finally, due to the incapability of countries to build pipelines with the required specifications, because of the capital intensive investment that is required, has lead them to trade natural gas via sea (CIEP, 2004).

As it has been mentioned above, the production and consumption of natural gas consist of its supply and demand, which have been rapidly increased in the last decade. The price difference between the natural gas and the oil, has led many households and energy producers to change the source of energy from oil to natural gas (CIEP, 2004). In addition, the sustainability and the small percentage of accidents have played an important role to natural gas growth. Moreover, the everyday innovation in the supply and demand models of natural gas (GASMOD) in Europe, show us two things, firstly the important role of EU to the supply chain of natural gas, and secondly the willingness of evolution of the trade between continents or countries (Franziska Holza, Christian von Hirschhausena, Claudia Kemferta, 2008).

Furthermore, the alliances and collaboration between countries in order to promote natural gas as a sustainable and economic viable source of energy, has helped to the growth of natural gas trade (Dominique Finon, Catherine Locatelli, 2008). For example, the cooperation between the EU and Russia, for constructing a unified supply chain network, in accordance with the increase of market integration, the contestability of the markets will be succeeded (Dominique Finon, Catherine Locatelli, 2008). Hence, the above will have as a result the expansion of natural gas trade.

The following figure shows us the basic worldwide trade flows of natural gas either via pipeline (red lines) or by sea (blue liens), calculated in bcm.

Figure 14 - Major Pipeline and Sea Movements of Natural Gas in 2007
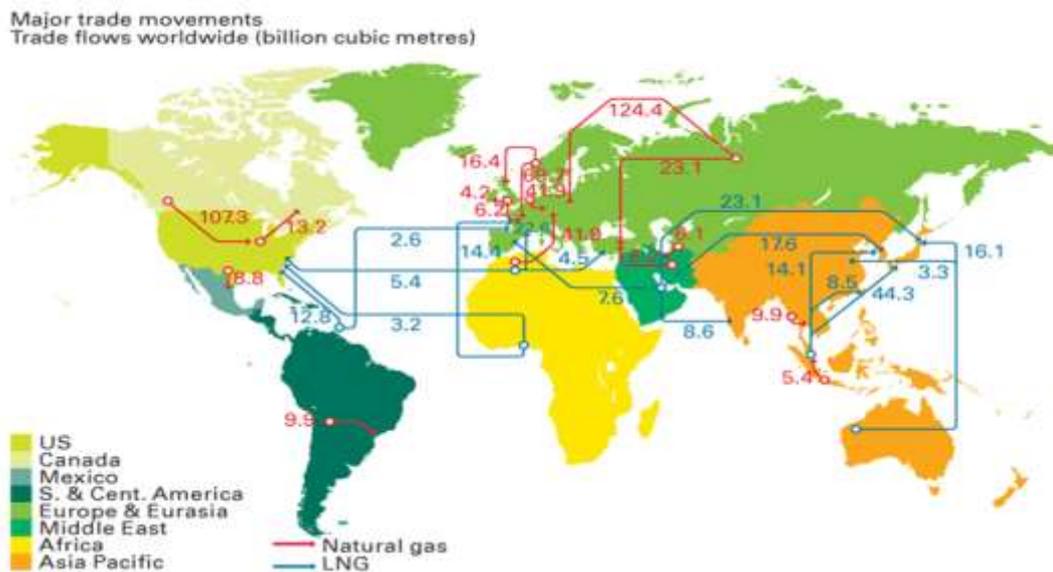
Source: BP, 2008

As we can observe, the Russia – Europe and Canada – United States trade flows are the two largest in the natural gas pipeline market. Regarding the maritime transportation of natural gas, Asia has the largest trade flows, as also the interaction between Europe and the United States play an important role. We can conclude, that Europe is mainly an importer of natural gas. Hence, with the creation of a cartel, which will include exporters of natural gas, EU has a major of importance disadvantage for its economy. Natural gas exporters' cartel can influence the market by managing the price, the contracts and or by applying fiscal policies (Wagbara, 2007). Therefore, this

policy, will have a negative impact in a competitive market, such as the LNG, and will cause many issues to the relationships between countries. The following table shows us the market share of imports per region in worldwide scale.

Table 6 - Imports Market Share per Region

	North America	S.&C. America	Europe	Asia Pacific
Total Imports Market Share	10.60%	0.49%	23.56%	65.36%

Source: Self, Data: BP, 2008

Hence, we can infer that the major importers of natural gas in the world are the countries of the Asia Pacific, from which main importers are the Dominican Republic and Puerto Rico, followed by the countries of Europe, with market shares of 65.36% and 23.56%, accordingly. Furthermore, North America and S. & C. America take the final places in the classification, with market shares of 10.6% and 0.49%. While also, the following table shows us the market share of exports per region in worldwide scale.

Table 7 - Exports Market Share per Region

	North America	S.&C. America	Europe	Middle East	Africa	Asia Pacific
Total Exports Market Share	0.52%	8.02%	0.06%	25.71%	27.22%	38.48%

Source: Self, Data: BP, 2008

From the above table we can conclude that the largest players on exporting LNG are the Asia Pacific countries, with major countries Australia, Indonesia and Malaysia, having a total market share of 38.48%. Furthermore, Middle East and African countries are also key players on exporting LNG with market shares of 25.71% and 27.22% accordingly. Finally, S. & C. America, North America and Europe are the smallest exporters of LNG.

Finally, we can conclude that Europe, whereas is not a major exporter of natural gas, is the second larger importer, which makes her a key player in the trade of LNG. Thus, the decisions of the exporters, as also the competition with oil, sustainability, natural gas price, technological innovations, and its supply – demand can cause large or small fluctuations of this percentage. Thus, the maritime trade of natural gas is a complex market, which will be tried to be forecasted by this project and the impacts of the EU Sovereign Debt Crisis.

3.1.4. Competition between Natural Gas and Other Energy Resources until 2007

Competition in the energy sector implies between the six basic forms of producing energy, oil, coal, natural gas, nuclear, hydroelectricity and renewables. Oil has been

the leader for many years in the energy production and it has rapidly expanding since 1970's, when the largest oil crisis happened. Furthermore, coal is being used as a substitution material for energy production, and it can be found commonly in developing countries. Coal is not environmentally friendly and it is not preferred to be used from countries that have signed the protocols for protecting the environment from pollution. Neither oil is an environmentally friendly fuel, but it is less harmless than coal for the environment. In the same time, prices of oil and coal make a huge difference, especially in periods of financial crisis, where the coal price is lower than the oil price, in a worldwide scale.

Therefore, natural gas combines a perfect solution for the above problems. First of all, it is an environmentally friendly fuel, which results to a greener and healthier environment. Moreover, its price is low, in accordance with oil and coal. Its disadvantage is the low infrastructure that it has been developed over the years. Only in the United States and in Japan, the infrastructure of natural gas has been industrialised, and therefore this is the reason for using natural gas as their source of energy. It must be noted that these countries are also using nuclear, hydroelectricity and renewables as sources of energy, which are not used in high scale due to danger and capital intensive reasons.

The following table illustrates us the worldwide market share of the above six main energy resources, regarding their consumption, from 1997 until 2007.

Figure 15 - Worldwide Consumption Market Share of the Selected Energy Resources 1997 - 2007

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Oil	38,68%	38,75%	38,87%	38,35%	38,32%	37,93%	37,44%	37,13%	36,53%	35,89%	35,52%
Natural Gas	22,62%	22,87%	23,00%	23,31%	23,53%	23,72%	23,59%	23,19%	23,34%	23,28%	23,45%
Coal	25,65%	25,17%	24,80%	25,08%	24,97%	25,12%	26,27%	26,85%	27,30%	27,94%	28,35%
Nuclear Power	6,07%	6,14%	6,27%	6,26%	6,38%	6,36%	6,02%	6,00%	5,85%	5,77%	5,51%
Hydroelectricity	6,52%	6,58%	6,53%	6,45%	6,23%	6,24%	6,01%	6,10%	6,18%	6,25%	6,21%
Renewables	0,46%	0,49%	0,53%	0,55%	0,57%	0,63%	0,67%	0,73%	0,79%	0,86%	0,96%
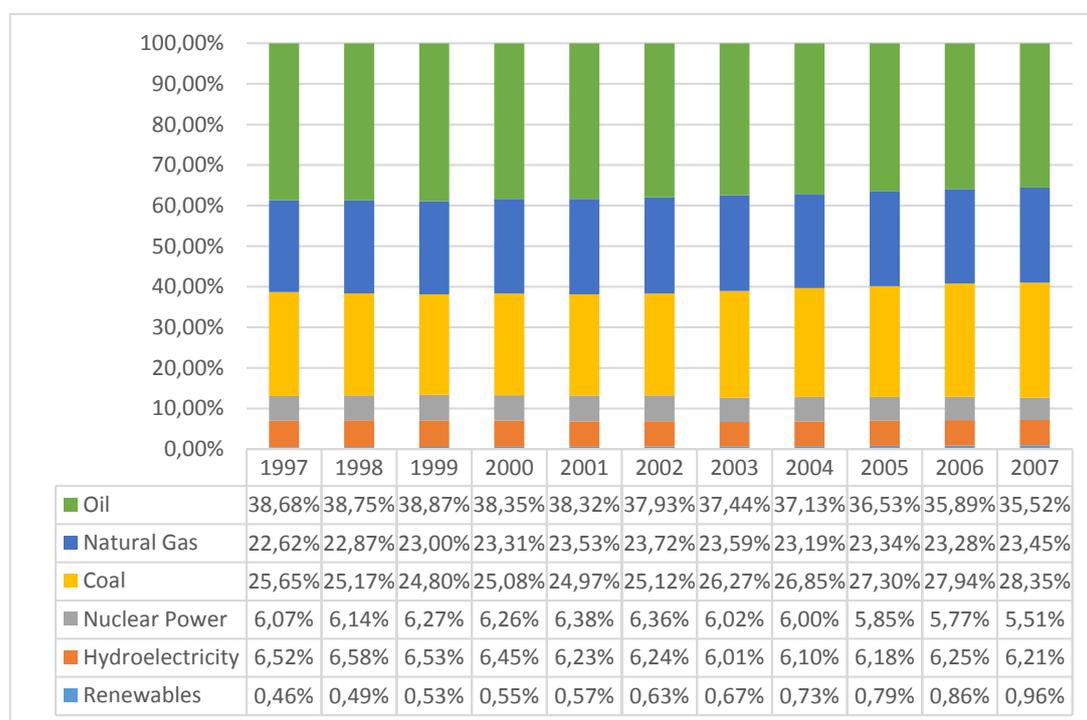
Source: Self, Data: BP, 2008

As we can observe from the above table, oil is the major consumer player in worldwide consumption of energy recources. Its market share varies between 35.52% and 38.68%. It must be noticed that its market share is declining in the researched years.

Furthermore, coal is the second most preferred resource of energy, since its consumption varies between 25.65% until 28.35%. Coal has an increase in consumption and tends to outreach 30% until 2012. Moreover, the market share of natural gas consumption shows to be increased this 10-year period, but with a lower growth than coal, since its percentages' vary from 22.62% to 23.72%. In addition, nuclear power and hydroelectricity hold lower market shares, relative to the above ones. Nuclear power shows to be decreased in the 10-year period, with its market share varying between 6.07% and 5.51%. Furthermore, hydroelectricity also has been decreased, with its market share taking values between 6.52% and 6.21%. Last but not least, renewables market share seems to be increasing, but they are holding the lowest market share in the consumption resources of energy, and its values fluctuate between 0.46% and 0.96%.

Furthermore, the following figure shows us the worldwide market share of the selected six energy resource materials, coal, oil, natural gas, nuclear, hydroelectricity and renewables production for the same 10-year period.

Figure 16 - Worldwide Production Market Share of the Selected Energy Resources 1997 - 2007

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Oil	38,91%	39,21%	38,44%	38,83%	38,14%	37,71%	37,59%	37,37%	36,62%	35,76%	35,12%
Natural Gas	22,38%	22,66%	23,19%	23,35%	23,60%	23,86%	23,82%	23,24%	23,31%	23,46%	23,62%
Coal	25,73%	25,06%	24,98%	24,53%	25,18%	25,14%	25,89%	26,61%	27,32%	27,98%	28,55%
Nuclear Power	6,04%	6,07%	6,30%	6,27%	6,33%	6,39%	6,02%	5,98%	5,82%	5,73%	5,53%
Hydroelectricity	6,49%	6,51%	6,56%	6,46%	6,18%	6,26%	6,01%	6,08%	6,15%	6,21%	6,23%
Renewable	0,46%	0,49%	0,53%	0,55%	0,57%	0,64%	0,67%	0,72%	0,79%	0,86%	0,96%
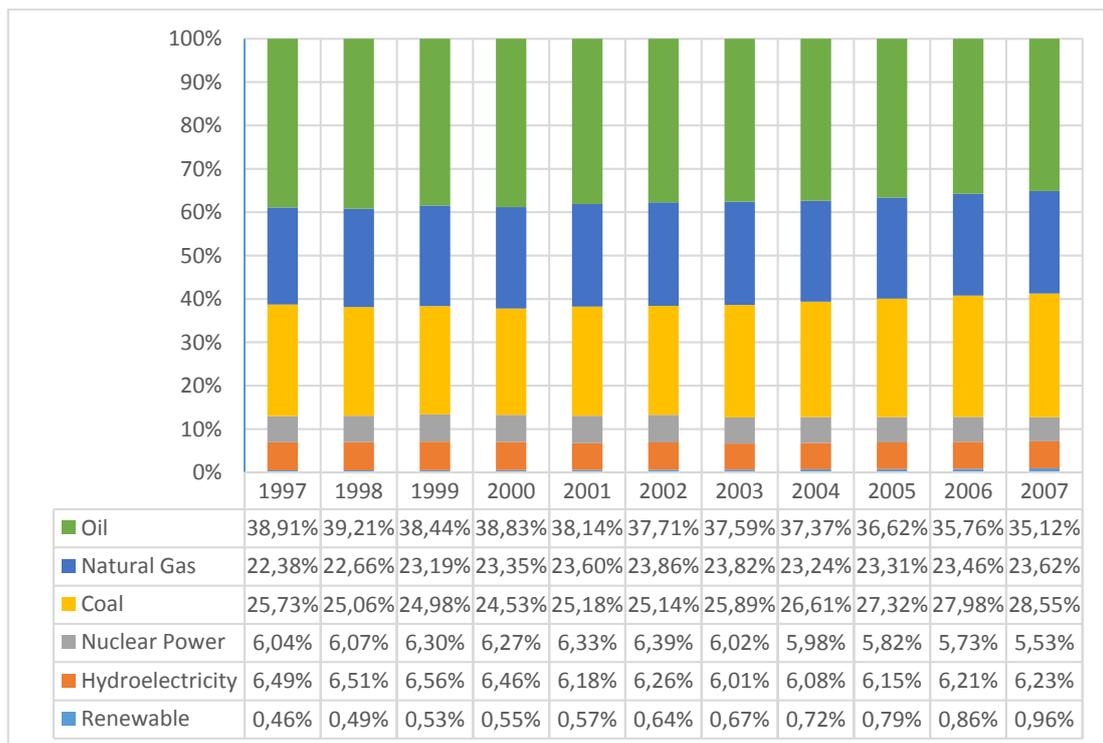
Source: Self, Data: BP, 2008

As we can observe from the above table, also in the worldwide production of energy resources, oil is the major producer player. Its market share varies between 35.12% and 38.91%. It must be noticed that its market share is declining in the researched years. Furthermore, coal is the second most preferred resource of energy, since its production varies between 25.73% and 28.55%. Coal has an increase in production and tends to outreach 30% until 2012. Moreover, the market share of natural gas production shows to be increased this 10-year period, but with a lower growth than coal, since its percentages' vary from 22.38% to 23.86%. In addition, nuclear power

and hydroelectricity hold lower market shares, relative to the above ones. Nuclear power shows to be decreased in the 10-year period, with its market share varying between 6.04% and 5.53%. Furthermore, hydroelectricity also has been decreased, with its market share taking values between 6.56% and 6.01%. Last but not least, renewables market share seems to be increasing, but they are holding the lowest market share in the production resources of energy, and its values fluctuate between 0.46% and 0.96%.

In order to have a better view of the situation in the production and consumption of the above six energy resources, we have to divide our research in two main categories of countries, these that are European and these that they are not.

Europe

The following figure is showing to us the market share of oil, natural gas, coal, nuclear power, hydroelectricity and renewables consumption in Europe for the 10-year period, 1997 until 2007.

Figure 17 - European Consumption Market Share of the Selected Energy Resources 1997 - 2007

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
■ Oil	41,05%	41,47%	41,26%	40,52%	40,34%	40,37%	39,71%	39,56%	39,76%	39,67%	39,30%
■ Natural Gas	21,34%	21,85%	22,68%	22,99%	23,14%	23,32%	23,98%	24,23%	24,67%	24,24%	24,23%
■ Coal	20,05%	19,13%	18,16%	18,47%	18,12%	18,17%	18,38%	17,88%	17,36%	17,72%	18,10%
■ Nuclear Power	12,53%	12,32%	12,53%	12,41%	12,62%	12,86%	12,71%	12,66%	12,48%	12,34%	11,83%
■ Hydroelectricity	4,51%	4,63%	4,66%	4,78%	4,86%	4,15%	3,92%	4,06%	3,84%	3,87%	3,94%
■ Renewables	0,52%	0,61%	0,70%	0,82%	0,92%	1,13%	1,30%	1,61%	1,88%	2,16%	2,60%

Source: Self, Data: BP, 2008

As we can observe from the above table, also in the European Union consumption of energy resources, oil is the major producer player. Its market share varies between

41.52% and 39.3%. It must be noticed that its market share was increasing until 2000, but afterwards started to decline. Furthermore, natural gas is the second most preferred resource of energy in Europe, since its consumption varies between 21.34% and 24.33%. It must be mentioned that natural gas consumption market share is continuously increasing, in the whole researched duration. Moreover, the market share of coal consumption shows to be decreased this 10-year period, with a low rate of growth, since its percentages' vary from 20.05% to 17.36%. In addition, nuclear power and hydroelectricity hold lower market shares, relative to the above ones. Nuclear power shows to be increasing in the first half of the researched 10-year period, but in the second one decreases, with its market share varying between 12.86% and 11.83%. Furthermore, hydroelectricity's market share follows the same trend as the nuclear power, with its market share taking values between 3.84% and 4.86%. Last but not least, renewables market share seems to be increasing, but they are holding the lowest market share in the consumption resources of energy, and its values fluctuate between 0.52% and 2.6%.

Hence, we can conclude that the decreasing trend that all the energy resources have, except natural gas, give to it the opportunity to grow and play an important role in the European Union consumption of energy resources market.

Moreover, the following figure is showing to us the market share of oil, natural gas, coal, nuclear power, hydroelectricity and renewables production in Europe for the 10-year period, 1997 until 2007.

Figure 18 - European Production Market Share of the Selected Energy Resources 1997 - 2007

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Oil	17,78%	18,70%	19,37%	18,54%	17,35%	17,86%	16,97%	15,76%	14,99%	14,06%	14,27%
Natural Gas	21,96%	22,30%	22,59%	23,35%	23,40%	23,17%	23,08%	23,45%	22,78%	22,25%	21,30%
Coal	28,07%	25,71%	24,25%	23,38%	23,17%	23,19%	23,38%	22,82%	22,85%	22,67%	22,89%
Nuclear Power	22,98%	23,35%	23,66%	23,93%	24,74%	25,35%	25,93%	26,24%	26,99%	27,55%	26,75%
Hydroelectricity	8,27%	8,78%	8,81%	9,22%	9,53%	8,19%	7,99%	8,40%	8,31%	8,64%	8,92%
Renewables	0,95%	1,16%	1,32%	1,58%	1,80%	2,23%	2,65%	3,33%	4,07%	4,83%	5,88%

Source: Self, Data: BP, 2008

As we can observe from the above table, in the non-European production of energy resources, coal is the major producer player. Its market share varies between 28.07%

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and 22.89%. It must be noticed that its market share is declining in the researched years. Furthermore, nuclear power is the second most preferred produced resource of energy, since its production varies between 22.98% and 26.75%. Moreover, the market share of natural gas production shows to be increased in the first half of this 10-year period of research, but in the second half it decreases. More specifically, its percentages' vary from 23.45% to 21.3%. In addition, oil and hydroelectricity hold lower market shares, relative to the above ones. Oil shows to be decreased in the 10-year period, with its market share varying between 18.54% and 14.27%. Furthermore, hydroelectricity has been increased, with its market share taking values between 8.19% and 8.92%. Last but not least, renewables market share seems to be increasing, but they are still holding the lowest market share in the production resources of energy, and its values fluctuate between 0.95% and 5.88%.

Therefore, we can observe in the European region are different effects in the production and consumption of the above six resources of energy. Regarding the consumption, we observe a transfer from oil to natural gas. On the other hand, in the production field, in 2012 nuclear power is the major player, with coal being decreased and natural gas fluctuating in the same values of market shares. Finally, the competition between these six energy resources is high in Europe and the European Union Sovereign Debt Crisis might change this relation between them.

Non-Europe

The following figure is showing to us the market share of oil, natural gas, coal, nuclear power, hydroelectricity and renewables consumption in non-European countries for the 10-year period, 1997 until 2007.

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Oil	38,12%	38,10%	38,32%	37,86%	37,86%	37,39%	36,94%	36,62%	35,87%	35,14%	34,81%
Natural Gas	22,92%	23,11%	23,07%	23,39%	23,62%	23,81%	23,50%	22,97%	23,07%	23,09%	23,31%
Coal	26,96%	26,59%	26,33%	26,57%	26,53%	26,66%	28,00%	28,74%	29,32%	29,96%	30,28%
Nuclear Power	4,56%	4,69%	4,83%	4,86%	4,95%	4,92%	4,56%	4,60%	4,50%	4,47%	4,32%
hydroelectricity	6,99%	7,05%	6,96%	6,83%	6,54%	6,70%	6,47%	6,53%	6,66%	6,72%	6,64%
Renewables	0,45%	0,46%	0,49%	0,49%	0,49%	0,52%	0,53%	0,54%	0,57%	0,61%	0,65%

Source: Self, Data: BP, 2008

As we can observe from the above table, also in the non-European countries consumption of energy resources, oil is the major producer player. Its market share varies between 34.81% and 38.32%. It must be noticed that its market share was increasing until 1999, but afterwards started to decline. Furthermore, coal is the second most preferred resource of energy in the non-European countries, since its consumption varies between 26.33% and 30.28%. It must be mentioned that coal consumption market share is continuously increasing since 2001. Moreover, the market share of natural gas consumption shows to be slightly increased in this 10-year period, with a low rate of growth, since its percentages' vary from 22.92% to 23.5%. In addition, nuclear power and hydr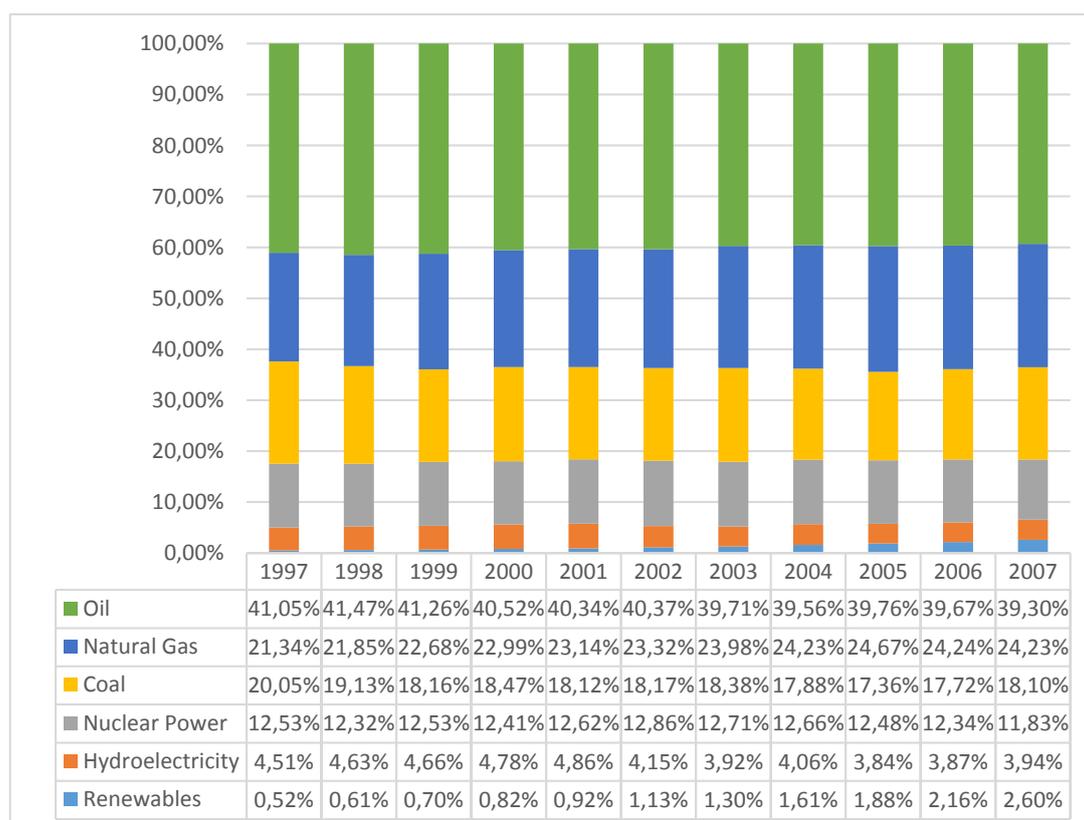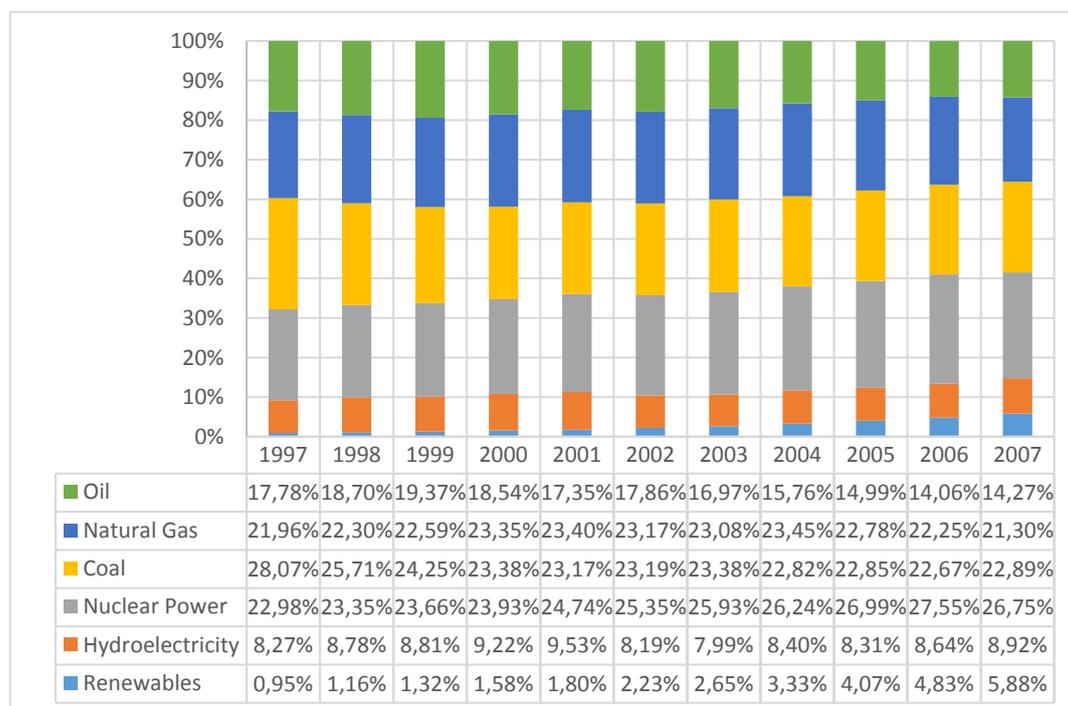oelectricity hold lower market shares, relative to the above ones. Nuclear power shows to be increasing in the first half of the researched 10-year period, but in the second one decreases, with its market share varying between 4.32% and 4.95%. Furthermore, hydroelectricity's consumption market share values varies between 6.47% and 7.05%. Last but not least, renewables market share seems to be increasing, but they are holding the lowest market share in the consumption resources of energy, and its values fluctuate between 0.45% and 0.65%.

Furthermore, the following figure is showing to us the market share of oil, natural gas, coal, nuclear power, hydroelectricity and renewables production in the non-European countries for the 10-year period, 1997 until 2007.

Figure 20 - Non-European Production Market Share of the Selected Energy Resources 1997 - 2007
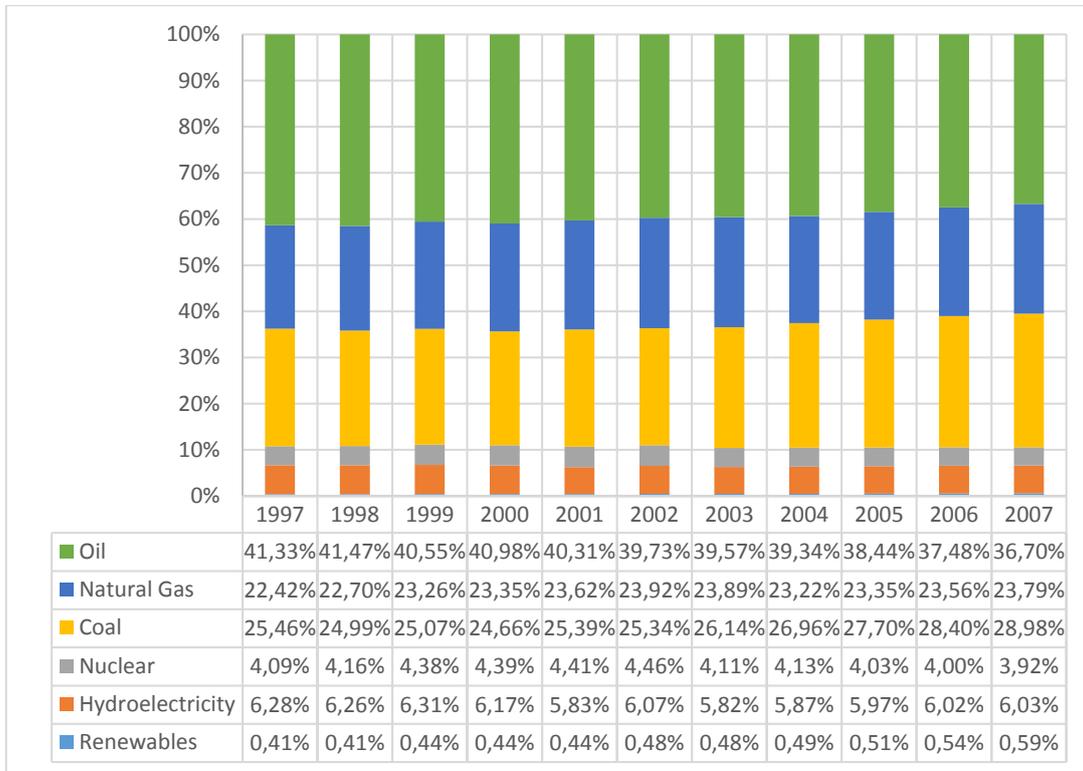
	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
■ Oil	41,33%	41,47%	40,55%	40,98%	40,31%	39,73%	39,57%	39,34%	38,44%	37,48%	36,70%
■ Natural Gas	22,42%	22,70%	23,26%	23,35%	23,62%	23,92%	23,89%	23,22%	23,35%	23,56%	23,79%
■ Coal	25,46%	24,99%	25,07%	24,66%	25,39%	25,34%	26,14%	26,96%	27,70%	28,40%	28,98%
■ Nuclear	4,09%	4,16%	4,38%	4,39%	4,41%	4,46%	4,11%	4,13%	4,03%	4,00%	3,92%
■ Hydroelectricity	6,28%	6,26%	6,31%	6,17%	5,83%	6,07%	5,82%	5,87%	5,97%	6,02%	6,03%
■ Renewables	0,41%	0,41%	0,44%	0,44%	0,44%	0,48%	0,48%	0,49%	0,51%	0,54%	0,59%

Source: Self, Data: BP, 2008

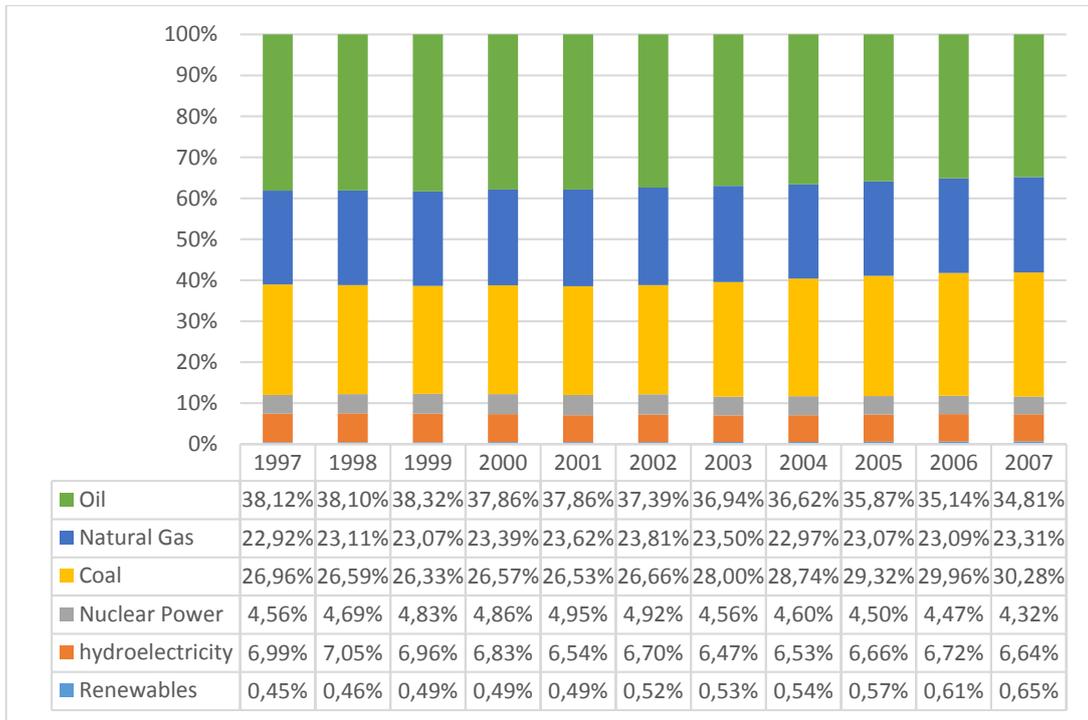As we can observe from the above table, in the non-European production of energy resources oil is the major producer player. Its market share varies between 36.7% and 41.47%. It must be noticed that its market share is declining in the researched years. Furthermore, coal is the second most preferred produced resource of energy, since its production varies between 24.66% and 28.98%. Moreover, the market share of natural gas production shows to be fluctuating between the values of 22.42% to 23.92%, the whole researched period. In addition, nuclear power and hydroelectricity hold lower market shares, relative to the above ones. Nuclear power shows to be increased in the first half and decreased on the second half of the 10-year period, with its market share varying between 3.92% and 4.46%. Furthermore, hydroelectricity has been fluctuating between the values of 5.83% and 6.31%. Last but not least, renewables market share are continuously increasing, but they are still holding the lowest market share in the production resources of energy, and its values vary between 0.41% and 0.59%.

Therefore, we can observe in the non-European countries, both in production and consumption of the above six resources of energy, oil is the major player. Moreover, coal and natural gas are getting market share from oil's loss. Furthermore, nuclear power, hydroelectricity and renewables as a resources of energy are not being very popular in the non-European countries in total.

Finally, we can conclude from the results above that the natural gas promotion and consumption differs on the region that we are referring to. All the above analysis of

the competition between the six main resources of energy will help us to conclude to the final results on the change of consumption and production behaviour.

3.2. Current Situation

3.2.1. Current Situation of the European Union Sovereign Debt Crisis

The results of the crisis can be shown in the following figure, where the red colour shows countries with high debt, which are also close to default.

Figure 21 - European Countries with Debt in 2012

Source: WDB, 2013

As it is obvious, the countries of the south, Greece (156.9%), Italy (127%) and Portugal (123.6%), with the addition of Ireland (117.6%) and Cyprus (112.6%) are those with the highest percentage of debt, followed by France (90.2%) and United Kingdom (90%) and finally by Germany (80.4%), the Netherlands (65.5%) and Spain (84.2%) (Bloomberg, 2013). Moreover, the percentages that are shown in the above figure are the Outstanding Sovereign Debt of each country divided with the annual Gross Domestic Product (Bloomberg, 2013). Therefore, we can easily compare the stability of each country or economy. Hence, we can conclude that the higher the percentage of sovereign debt is, the more resources of the economy should be saved, in order to repay its debt, rather than invest or consume them (Bloomberg, 2013). Furthermore, the European Sovereign Debt Crisis has an impact to the trade of goods among the countries of EU as also in a worldwide scale.

As it has been mentioned in the literature review, investment, government expenditure, legislation and taxation have influence the European Union Sovereign Debt Crisis. More specifically, the government expenditures have been reduced in the southern countries, which are facing the largest problem. In addition taxation changes have been made, in order for the governments to control better the tax payers and gain higher income. Furthermore, legislation is being changing for the attraction of

foreign companies and capital. Therefore, education and health expenditures have been decreased, in order governments to save their income. Unemployment is one of the most important problems that these countries are facing due to the fact that income of the citizens are influencing everything, from their consuming behaviour until the taxes that they pay. Political instability is a parameter that is being appeared in these countries, where the political parties are having different strategies, which many of them are not well structured and conclude to elections. Furthermore, low investment from the governments and companies has been a result of the crisis.

Furthermore, in two countries of the European Union, Greece and Cyprus, the International Monetary Fund (IMF) has been introduced for lending money to the countries and avoidance of a liquidity problem. In addition, the European Central Bank (ECB) is deciding for the monetary strategy that the countries will follow, in order to fulfil its basic requirements. Moreover, the countries with the largest crisis have been facing major changes, and will continue to face, in their structure in order to go through the financial crisis and develop their economies.

The following figure shows us the European Union debt as a percentage of its GDP, as well as its debt growth from 2008 until 2012.

Figure 22 - EU Debt (% GDP) and Debt Growth 2008 - 2012
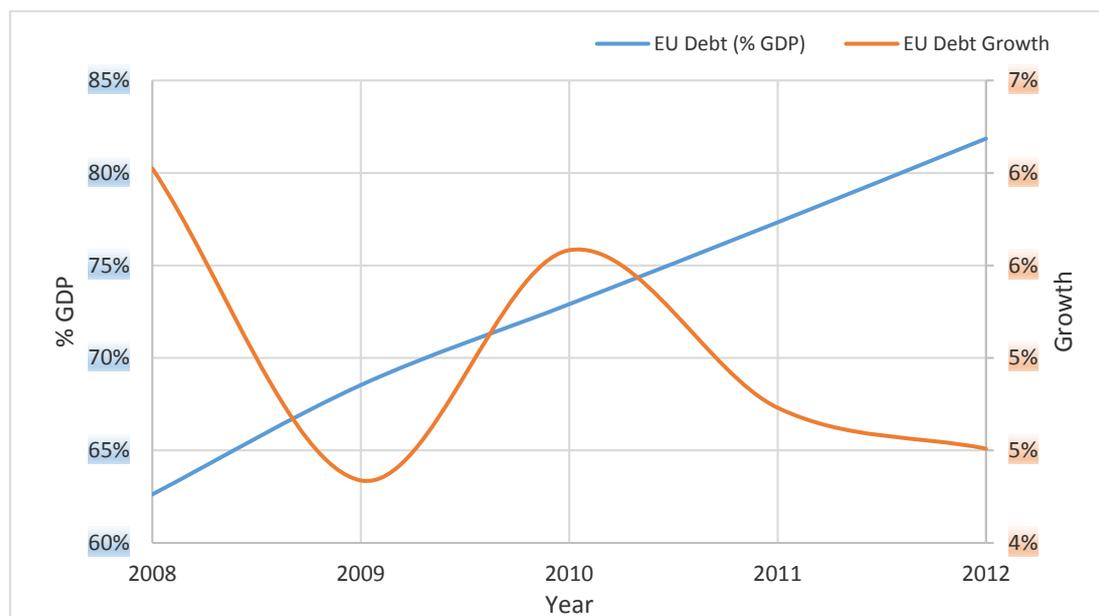
Source: Self, Data: WDB, 2013

Regarding the EU debt as a percentage of GDP from 2008 until 2012 has been increased from 62.62% to 81.86%. This shows us that the value of goods and services that the EU countries are producing in total are higher than their governments' debt. The disadvantage of this situation is that this rate grows rapidly and this is concludes us that the EU has to take the appropriate measures in order its countries to reduce their debts and start to grow economically again. Furthermore, there was a decrease in the percentage of the EU debt growth in 2009, followed by an increase in 2010 by 5.58%. Therefore, the EU debt growth is being increased, but with lower percentages, i.e. in 2012 the growth was 5%. It must be mentioned that a better analysis will follow,

where each country will be presented in her own, in order to have a clear view of the situation, for the same time period as above.
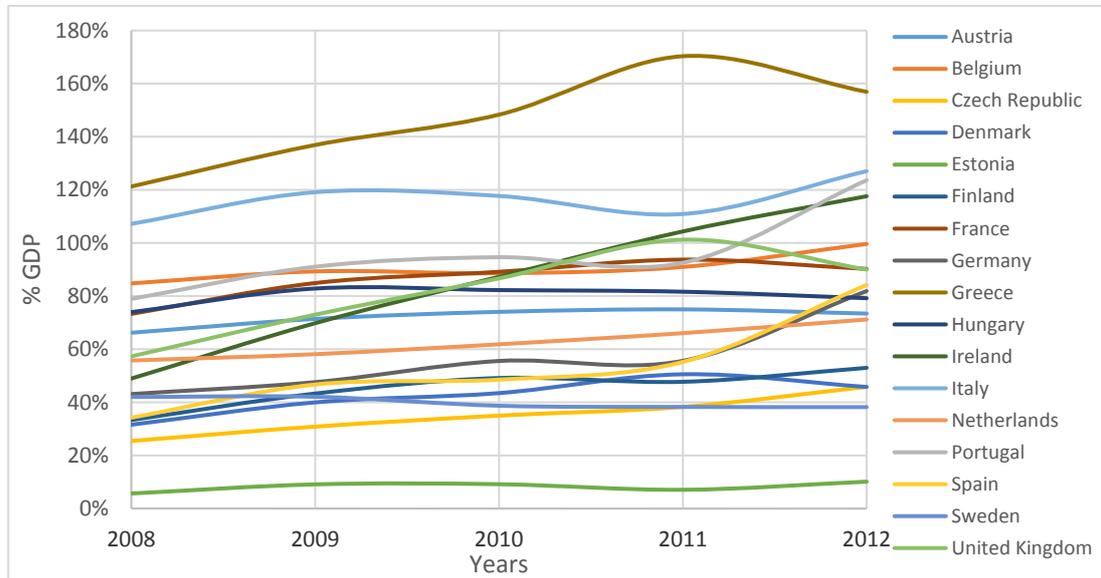
Source: Self, Data: WDB, 2013

The above figure verifies what it has been analysed in the start of this sub-chapter, about the countries that have the largest risk on default. Moreover, we can observe that there has been a change in the EU countries debt as a percentage of GDP, by meaning that many countries that were lower than 80%, in 2012 have surpassed it. Only, Estonia has remained its low percentage of debt, which in 2012 was 10.1%. Another key entity that it must be mentioned is the situation of Spain. Spain seems not to have a large problem from the EU debt crisis, since its debt as a percentage of GDP was varying between 34.2% in 2008 and 84.2% in 2012. This happens because of the high GDP value that Spain had each year. But, because of the fact that the value of the Spanish GDP is great, the debt is not being presented its real value. Furthermore, in mid-2012, the Spanish government agreed to be granted with a loan up to 100 billion euro in order to help the crisis in the bank sector (BBC, 2012). Thus, we can conclude that Spain is facing a problem in its bank sector, which is being reflected to the whole economy.

Moreover, the current situation for the production and consumption of natural gas, will be analysed below.

3.2.2. Production and Consumption of Natural Gas

The current production of natural gas, in worldwide scale, has been increased from 2008 until today with an average growth of 2.76%. In addition, the consumption of natural gas has been increased for the same period on average by 2.53% worldwide.

Moreover, the following two figures show us the production and consumption of natural gas in bcm as well as their annual growth from 1971 until 2007.

Figure 24 - World Natural Gas Production and Annual Growth 2008 - 2012
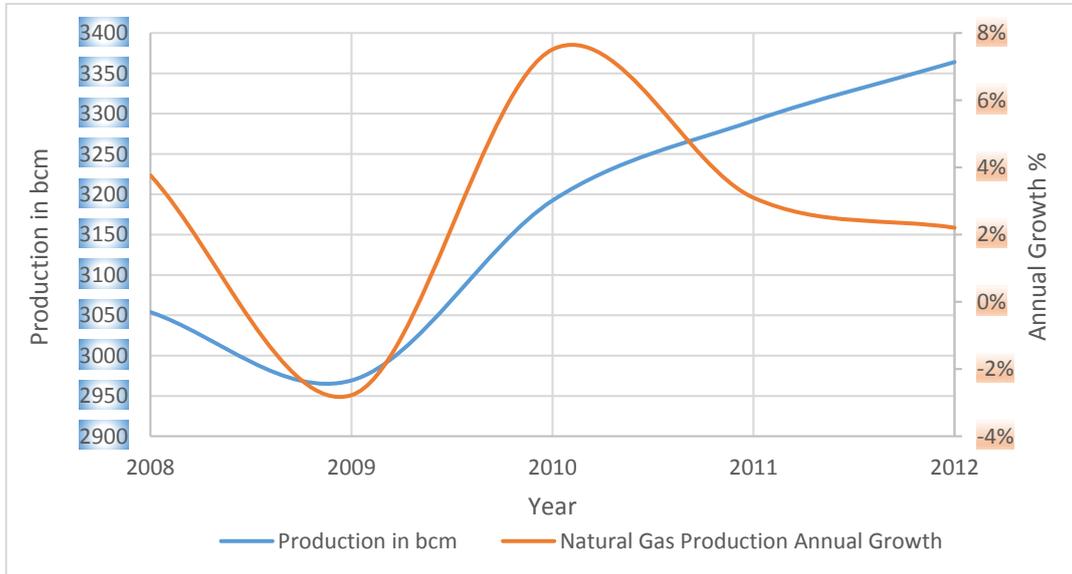
Source: Self, Data: BP, 2013

Figure 25 - World Natural Gas Production and Annual Growth 1971 - 2007
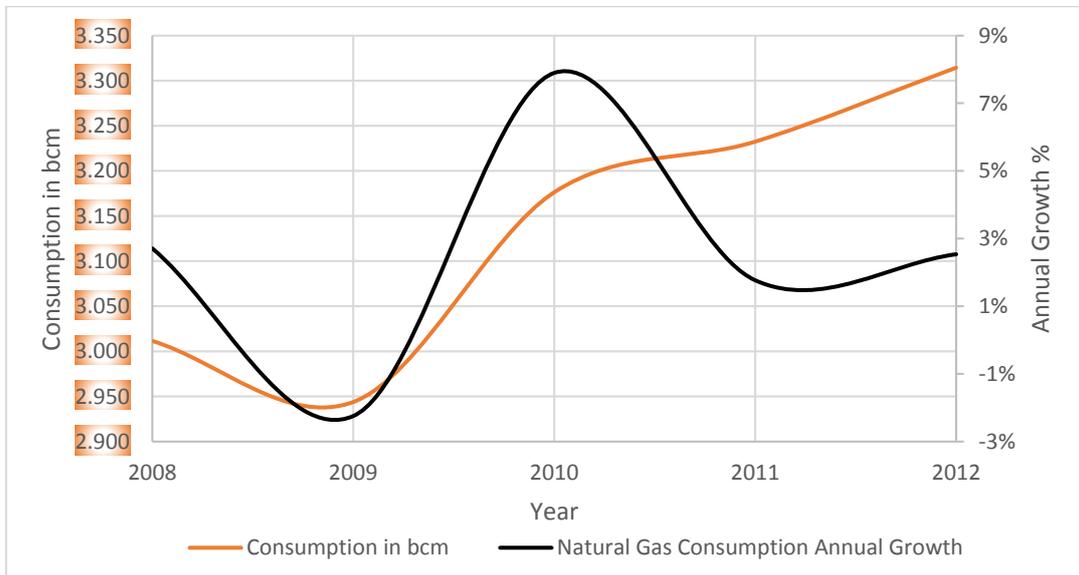
Source: Self, Data: BP, 2013

We can easily notice that the natural gas production's and consumption's trends are almost equal. In addition, their growths are following the same slopes. Hence, the figures illustrate us that these two measures are highly correlated, as also that they are being influenced from the same endogenous and exogenous variables. More specifically, the worldwide production of natural gas is decreased in 2009, by 84.7

bcm or by 2.77%. Furthermore, after 2009 it has been continuously increasing, by reaching in the end of 2012 the total consumption of 3,363.3 bcm, with an average growth of 4.27%. On the other hand, the consumption of natural gas has followed the same course. More precisely, in 2009 the natural gas consumption decreased by 67.59 bcm or by 2.24%. Therefore, after 2009 it has been continuously increased, by reaching in the end of 2012 the total consumption of 3,314.4 bcm, with an average growth of 4.07%.

Thus, we conclude that in a world scale the European Union Debt Crisis influenced the production and consumption of natural gas decreased in the period of 2008 – 2009, when the major shock of the crisis was exposed. Moreover, after 2009, they both continued their growth.

A list a list of countries with production and consumption of natural gas, at the end of 2012, can be found on Table 29 and 31 in Appendix, accordingly. The production of natural gas consists its supply to the market and the consumption its demand. As it is obvious, United States and Russia, in 2012, are the largest countries in production and consumption of natural gas. More specifically, regarding the production – supply – of natural gas, the United States hold the 20.26% of the market share, higher than 2007, followed by Russia with 17.61%. The top 5 list is being completed with Iran, Qatar and Canada with all together holding the 51.96% of the whole natural gas production market. Thus, we can conclude that in this period of 2007 – 2012, the major producer of natural gas changed from Russia to the US, as also the list of the top 5 producers. In addition, the countries of the European Union manage the 4.45% of the total production, which is lower than in 2007. Hence, this shows us that the European Union Sovereign Debt Crisis had a negative effect to the production of natural gas in Europe, via decreasing it by 20.39%. Furthermore, the following table shows the natural gas production by region.

Table 8 - Natural Gas Production by Region in 2012

Region	bcf	Market Share
North America	86.49	26.65%
Eurasia	85.46	26.33%
Middle East	52.91	16.30%
Asia Pacific	47.30	14.57%
Africa	20.86	6.43%
Europe	14.44	4.45%
Central & South America	17.11	5.27%

World	324.58

Source: Self, Data: EIA, 2012

We can notice, from the above table, that the countries of North America are the major players in the production of natural gas, with 26.65% market share, followed by the countries of Eurasia, which are obtaining the 26.33% of the market share. Hence, we can conclude that Eurasia has increased its production of natural gas in the period of 2008 until 2012. Consubstantially, this result of the first two major producers was obvious, since United States are included in the North American countries and Russia in the Eurasian. Moreover, the countries of Middle East, Asia Pacific and Africa are

medium sized players, with followed by Europe and Central & South America, which have the lowest market shares.

Regarding the consumption – demand – of natural gas, United States and Russia are the major players, with 21.79% and 12.84% market share, respectively. In addition, the top 6 players in consumption of natural gas, which are United States, Russia, Iran, Japan, China and Canada, hold more than 50% of the world consumption. Thus, we had a change in the major consumer countries, where United Kingdom has been replaced by China. The following table shows us the consumption of natural gas n bcf, as also the market share of each region.

Table 9 - Natural Gas Consumption by Region in 2012

Region	bcf	Market Share
North America	87.47	27.35%
Eurasia	61.70	19.29%
Asia Pacific	60.30	18.86%
Europe	42.83	13.39%
Middle East	39.73	12.42%
Central & South America	15.93	4.98%
Africa	11.85	3.71%

World	319.80

Source: Self, Data: EIA, 2012

We can easily conclude that the largest consumer in Natural Gas is North America, in contrast with Africa, which has the lowest market share. Moreover, Eurasia is the second in the above list with 19.29%, lower than 2007, of market share, followed by Asia Pacific that holds 18.86% of the total natural gas consumption. Hence, there was a change in the above list compared to the 2007, where Asia Pacific region increased its consumption in natural gas and replaced Europe, which now has the 13.39% of the total natural gas market share. Moreover, Middle East and Central & South America are completing the list with 12.42% and 3.71% accordingly. Finally, we can infer that the European Union countries have lost market share in the consumption of natural gas in the period of 2008 until 2013.

More specifically, regarding the European and non-European countries, the production and consumption of natural gas, in addition with their annual growth can be presented below.

Non-European

Regarding the non-European countries, their natural gas production and consumption, in bcm, as well as their annual growths from 2008 until 2012 can be illustrated in the following two tables.

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Figure 26 - Non-European Union Natural Gas Production & Annual Growth 2008 - 2012
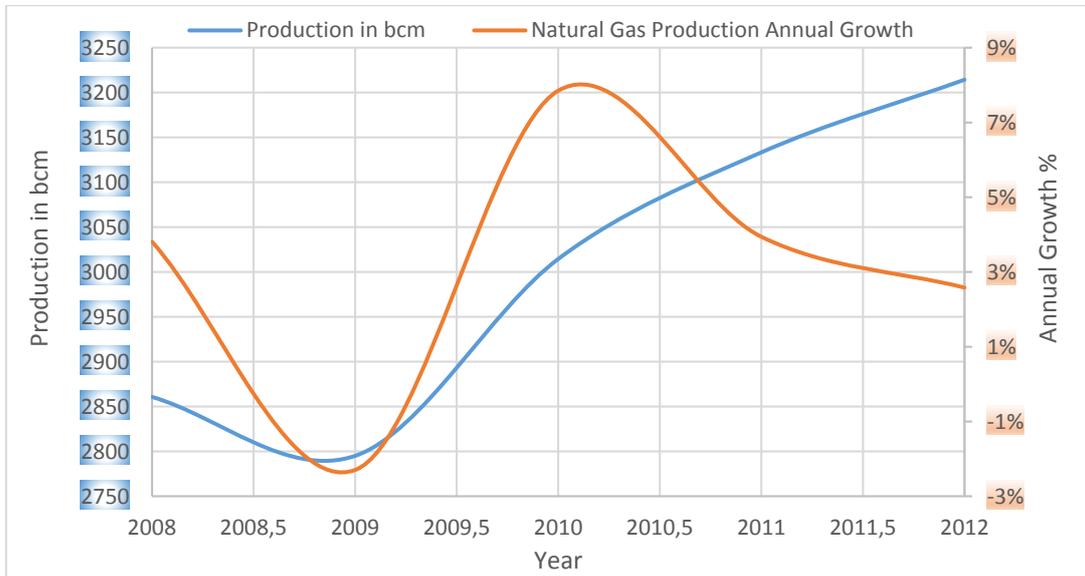
Source: Self, Data: BP, 2013

Figure 27 - Non-European Union Natural Gas Consumption & Annual Growth 2008 - 2012
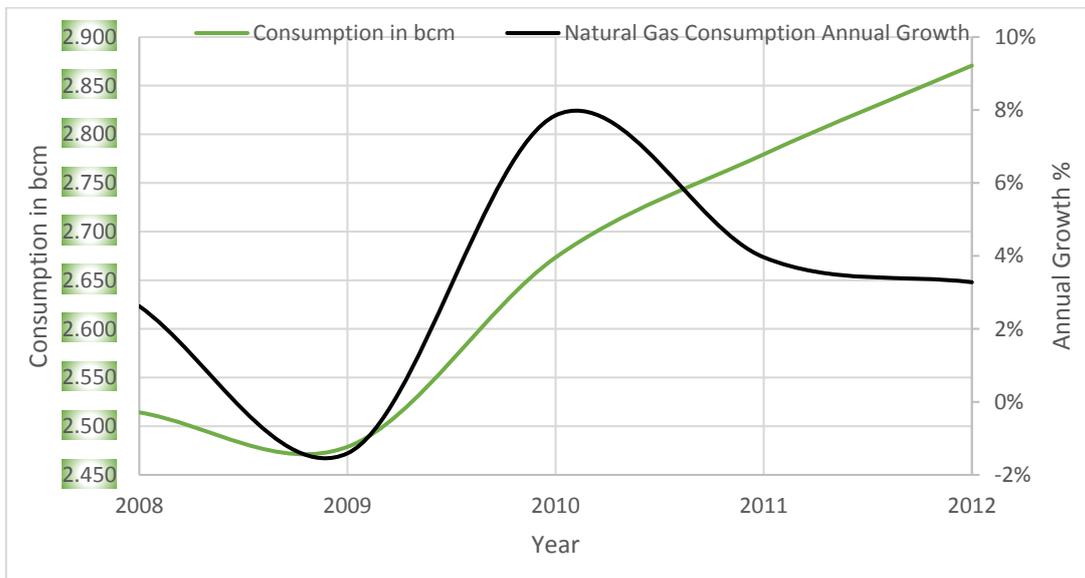
Source: Self, Data: BP, 2013

Therefore, we can conclude from the above figures that the natural gas production's and consumption's trends, in the countries that do not belong in the European Union are almost the same. In addition, their growths are following the same slopes. Moreover, we can observe that difference between production and consumption in the non-European countries concludes to a surplus of natural gas reserves, which is used to be exported in Europe or stored. Furthermore, the production of natural gas is continuously increasing in the non-European countries, by reaching in 2012

3214.27 bcm with an average annual growth, from 2008 until 2012, of 3.2% (BP, 2013). In addition, the consumption of natural gas shows a continuous increase, with a total of 2,870.53 bcm in 2012, with an average growth of 3.3% from 2008 until 2012 (BP, 2013).

Europe

Regarding the European countries, their natural gas production and consumption, in bcm, as well as their annual growths from 2008 until 2012 can be illustrated in the following two tables.

Figure 28 - European Union Natural Gas Production & Annual Growth 2008 - 2012
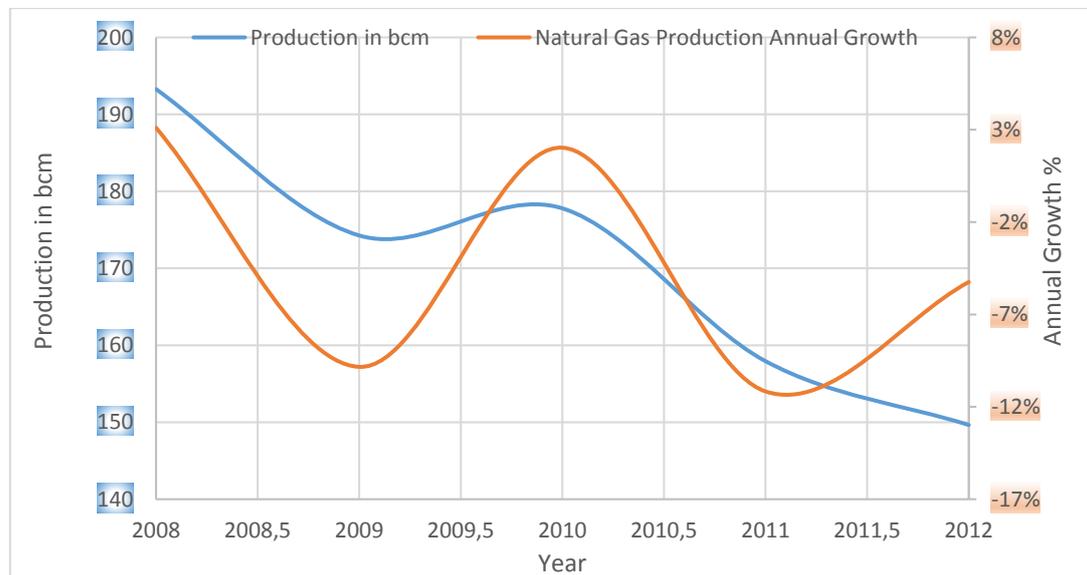
Source: Self, Data: BP, 2013
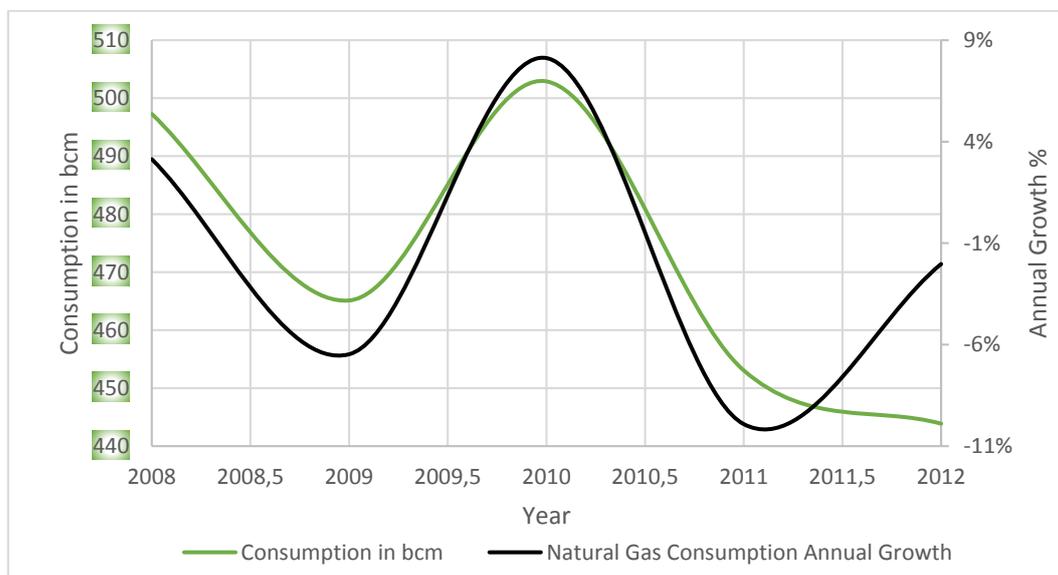
Source: Self, Data: BP, 2013

Furthermore, whatever concerning the European region, we can conclude from the above figures that the natural gas production's and consumption's are following the same trend. In addition, their growths are following the same slopes, which shows us the high correlation between these two variables and their high interdependence. Moreover, we can observe that difference between consumption and production of natural gas in the European Union, in 2012, is around 290 bcm. This means that Europe has a deficit of 290 bcm and needs to import natural gas, in order to fulfill its citizens' desires. Furthermore, this region's production of natural gas is continuously decreasing, by reaching in 2012 149.6 bcm with an average annual growth, from 2008 until 2012, of -4.2% (BP, 2013). In addition, the consumption of natural gas shows also a continuous decrease, except in 2010 when it increased,, with a total of 443.9 bcm in 2012 and an average growth of -1.4% from 2008 until 2012 (BP, 2013).

Finally, the above analysis results the impacts of the financial crisis, from the end of 2007 until 2012, to the European natural gas production and consumption that are the decrease by 22.6% and 10.7% accordingly.

3.2.3. Current Situation of Natural Gas Trade

In this section of the thesis, the current situation of the LNG trade will be analysed. In addition, the period from 2008 until 2012 will be examined in order to result to the impacts of the financial crisis to the LNG transportation.

Moreover, the following table shows us the LNG trade in bcm and its growth for the time period of 2008 until 2012.

Figure 30 - World LNG Trade & Annual Growth 2008 - 2012
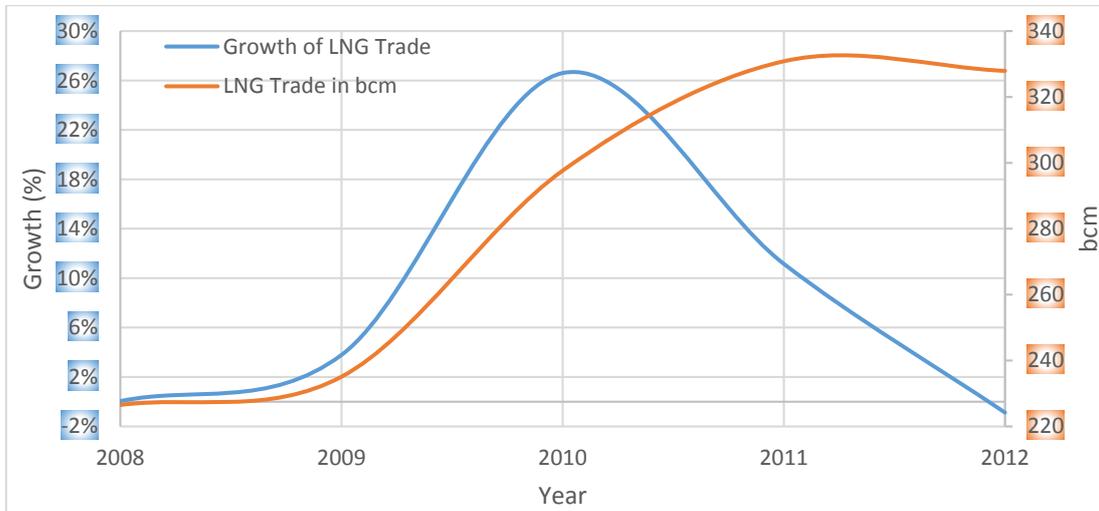
Source: Self, Data: BP Reports 2000 - 2008

As we can observe from the above table, the total world LNG trade growth shows to be steady the first year of the crisis, but then an increase of 26% takes place. After that it is being decreasing, until 2012 when it takes a negative value, -0.88%. Moreover, the total world LNG trade shows to be steady in the first year of the financial crisis. From 2009 until 2011 an increase of 40.73% takes place and after that it decreases slightly. By the end of 2012, the world trade of LNG was 327.9 bcm and having an average growth of 8.14% in the four year period from 2008 until 2012, which results to a stability in the short-run growth of LNG trade (BP, 2008). It must be noted that the largest growth in the trade of LNG was between the years 2009 – 2010 when a 26.61% increase in the transportation of natural gas by sea had been completed.

Furthermore, it is interesting to investigate the changes in the LNG imports and exports of the European and non-European countries. This analysis will be done directly below.

Non-European Union Countries

In order to investigate the maritime trade of natural gas in more detail, we have to divide it into exports and imports. Hence, the non-European Union countries export and import LNG in high amounts. More specifically, the trade value of the non-European Union countries exports in 2008 was 223.92 bcm. Until 2012 it increased and took the value of 298.02 bcm. It must be mentioned that in 2011, the exports reached the value of 325.51 bcm, but afterwards decreased. This resulted to an average growth of 6.3% for the non-European countries exports of LNG. Furthermore, the following figure shows us the total non-European countries exports of LNG, in bcm, as also its annual growth.

Figure 31 - Non-European Countries LNG Exports and Annual Growth 2008 - 2012
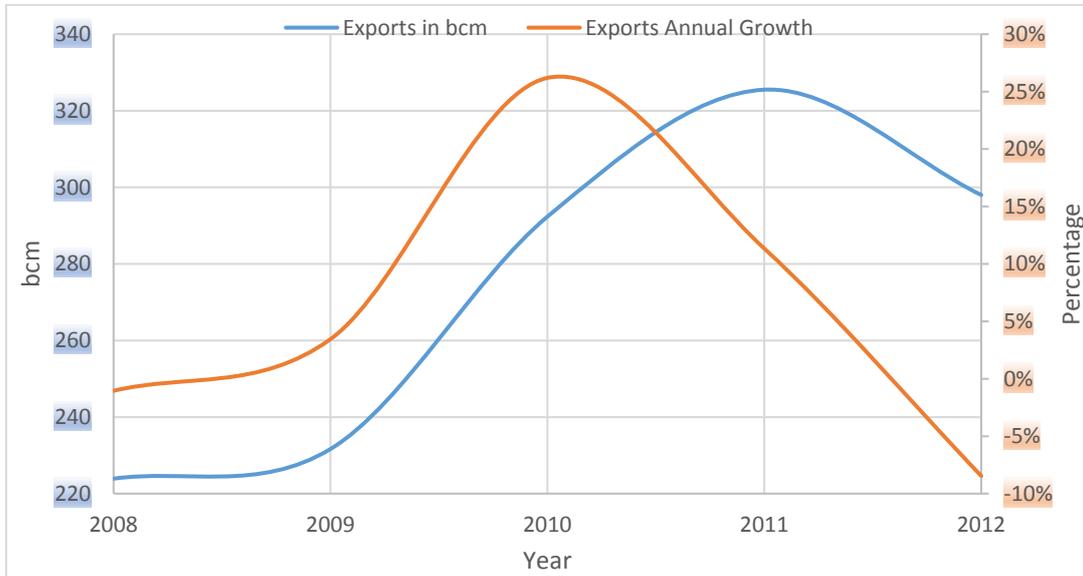
Source: Self, Data: BP Reports 2009 - 2013

The largest trade route for the non-European countries is between Australia and Japan, by having a value of 15.94 bcm in 2008 that increased to 21.06 bcm in 2012. In addition, the second largest route of LNG trade was between Qatar and Japan, which in 2008 took a value of 10.91 bcm and in 2012 increased to 21.3 bcm. Moreover, all the other trade routes were ranging between the above highest prices and 0.1 bcm, with Qatar, Algeria, Egypt, Oman, Australia, Indonesia and Malaysia having increased their LNG trade and playing the most important roles in the exportation of natural gas by sea. Last but not least, the annual growth of the non-European countries LNG exports was varying between the values of -8.45%, and 26.2%, which were recorded in 2012 and 2008, respectively.

Moreover, regarding the trade value of the non-European Union countries imports, took the value of 171.22 bcm in 2008. Until 2012 it increased and took the value of 233.12 bcm. This resulted to an average growth of 6.78% for the non-European countries imports of LNG. Furthermore, the following figure shows us the total non-European countries imports of natural gas by sea, in bcm, as also its annual growth.

Figure 32 - Non-European Countries LNG Imports and Annual Growth 2008 - 2012
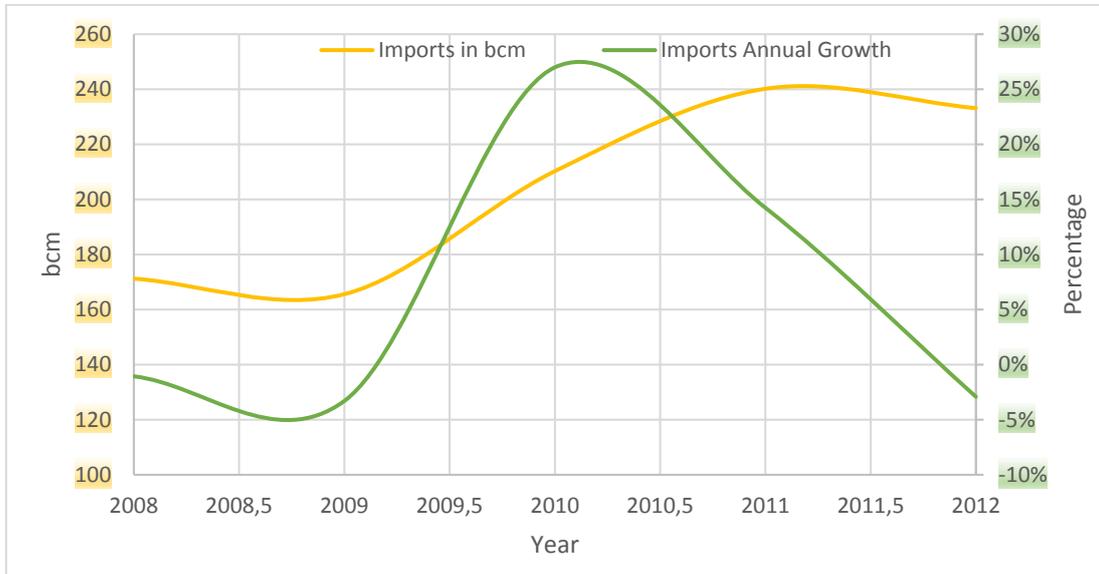
Source: Self, Data: BP Reports 2009 - 2013

Japan and South Korea play a major role in the analysis of the non-European countries LNG imports. This, because the first imported in 2012 118.8 bcm and the second one 49.7 bcm. Moreover, China and India increased their imports of natural gas, which in 2012 took the values of 20 bcm and 20.5 bcm, accordingly. The same situation existed the whole period between 2008 until 2012, making the above countries very important, in terms of LNG import, for the global maritime trade of natural gas. Finally, the annual growth of the non-European countries LNG imports was varying between the values of -3.31% and 26.98%, which were recorded in 2009 and 2010, respectively.

European LNG Trade Routes

The European region was not exporting LNG until 2007, as it has been mentioned above, which was for the purpose of inland trade. After that, between the years of 2008 until 2012, the LNG exports of Europe increased from 2.59 bcm to 4.18 bcm. It must be mentioned that until 2011 the exports were continuously increasing, when it reached the peak value of 5.32 bcm, and then decreased. Furthermore, the following figure shows us the total European countries exports of natural gas by sea, in bcm, as also its annual growth.

Figure 33 - European Countries LNG Exports and Annual Growth 2008 - 2012
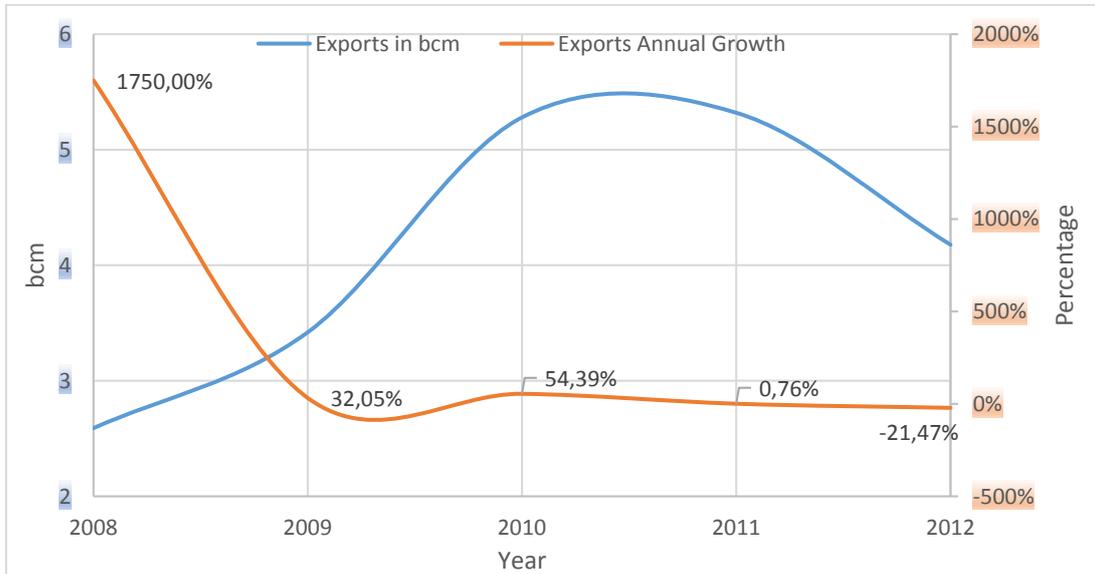
Source: Self, Data: BP Reports 2009 - 2013

The key player in the exports of LNG in Europe is Norway, which exported 4.7 bcm of LNG to other countries in 2012. The rest was exported from other European countries, but it is not such of importance. Furthermore, the largest trade route is from Norway to Spain, which in 2008 had the value of 1.05 bcm and in 2012 increased to 1.7 bcm. In addition, some of the major countries that Norway services, from exporting natural gas by sea, are Japan, United States, Argentina, France, Turkey, United Kingdom, South Korea and Taiwan. Hence, we can infer that the European exports of LNG in the period of the European Union Sovereign Debt Crisis increased its exports. Finally, the annual growth of the non-European countries LNG exports was varying between the values of –21.47% and 1750%, which were resulting to an average growth of 363.14%.

Furthermore, the total LNG imports, in bcm, and their annual growth, from 2008 until 2012, of the European Union countries can be illustrated in the following figure.

50
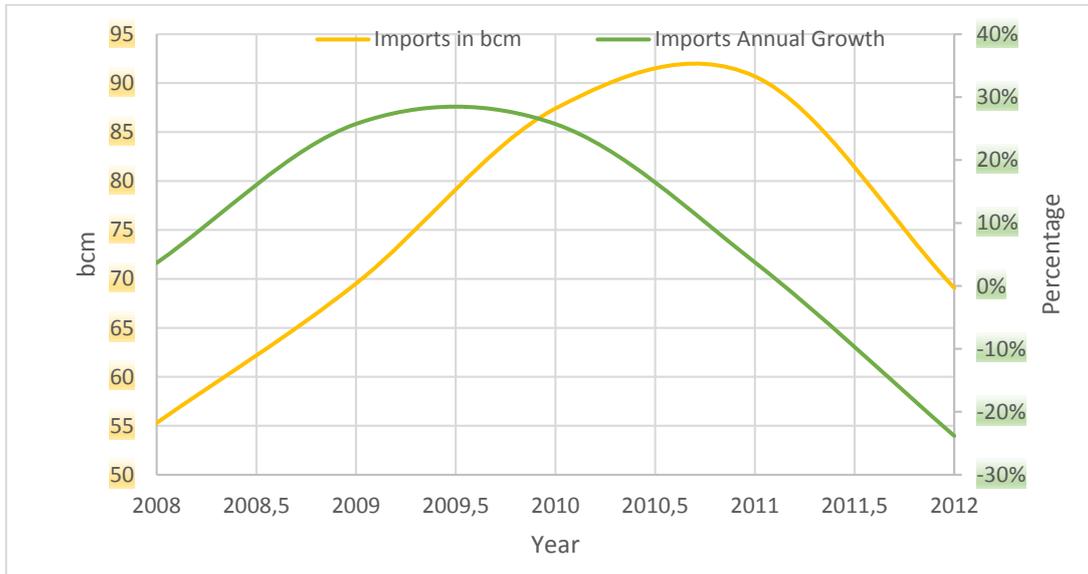
Source: Self, Data: BP Reports 2002 - 2008

The largest trade route, in 2012, for the European countries, which import natural gas by sea, was between Qatar and United Kingdom, by having a value of 0.12 bcm in 2007 that increased to 13.3 bcm in 2012. This, had as a result to leave in the second place the trade between Qatar and Italy, which in 2008 did not exist and in 2012 had a value of 5.8 bcm. Hence, the trade route between the African countries to the European increased, in addition with this between the Middle East and European countries. Moreover, France, Spain and United Kingdom play the most important roles in the import of LNG, followed by Belgium and Italy. It must be mentioned that the trade routes with recipients Greece and Portugal did not exist in 2012. On the other hand, Europe is importing LNG from many countries, such as Trinidad and Tobago, Peru, United States, Qatar, Yemen, Algeria, Egypt and Nigeria. It must be noticed that Libya in 2012 did not export LNG to Europe due to the war that is facing. Therefore, the main suppliers of LNG, in continents, of Europe are South America, Middle East and Africa. The largest trade is between the Middle East countries and Europe, which in 2012 took the price of 31.1 bcm. Finally, its annual growth was varying from -23.82% to 25.74%, with an average growth of 7.01%

Moreover, new trade routes have been created from Europe to S. & C. America, More generally, the following figure shows us the basic worldwide trade flows of natural gas either via pipeline (red lines) or by sea (blue lines), calculated in bcm.

Figure 35 - Major Pipeline and Sea Movements of Natural Gas in 2012
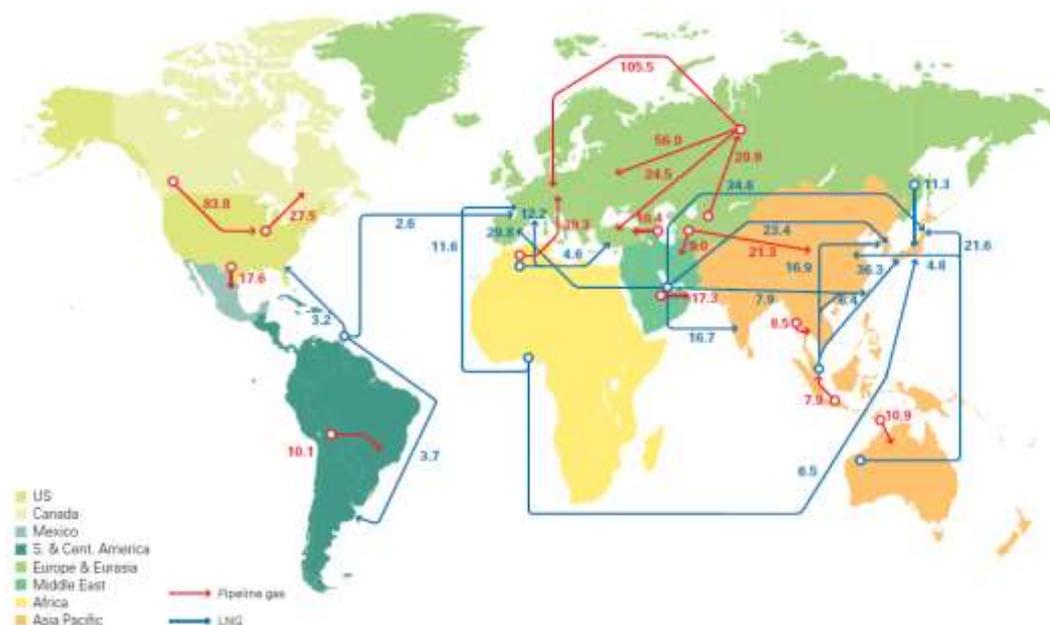
Source: BP, 2013

Regarding the trade flows between the countries, the situation has not changed a lot from 2007. Still, the Russia – Europe and Canada – United States trade flows are the two largest in the natural gas pipeline market. Regarding the LNG transportation, Asia continuous to have the largest trade flow, as also the interaction between Europe and the United States play an important role. Moreover, Middle East started to be a key player in the LNG trade, as also Africa. Furthermore, the US import LNG from S. & C. America, which is the major exporter of LNG in the American continent. We can conclude that Europe is mainly an importer of natural gas, from S. & C. America, Africa and Middle East. Taking on the analysis from above, we can conclude that these trade routes will be most influenced from the European Union Debt Crisis, which will be analysed in the end of this chapter.

Furthermore, the table below displays us the current values of the trade routes that have been analysed above.

Table 10 - LNG Trade in bcm between all Regions in 2012

Billion Cubic Meters		To				
		S. & C. America	Europe	Middle East	Africa	ROW
From	S. & C. America	10.43	5.29	0.35	-	8.87
	Europe	1.65	4.18	0.19	-	16.55
	Middle East	1.67	31.09	3.00	-	95.60
	Africa	1.22	28.53	0.99	-	23.37
	ROW	-	-	0.08	-	94.86

Source: Self, Data: BP, 2013

Moreover, the following table shows us the market share of imports per region in worldwide scale, in 2012.

Table 11 - Imports Market Share per Region in 2012

	North America	S.&C. America	Europe	Middle East	Asia Pacific
Total Imports Market Share	3.53%	4.64%	21.13%	1.40%	69.30%

Source: Self, Data: BP, 2013

Hence, we can infer that the major importers of natural gas in the world, in 2012, are again the countries of Asia Pacific, which are included to the ROW region, as it was and in 2007, with a total market share of 69.3%. Furthermore, Europe lost part of its market share from 2007, since it decreased to 21.13% from 23.56%. Moreover, North America lost 7.07% and S. & C. America gained 4.15% of their market share. Furthermore, we had the introduction of Middle East as an importer country in 2012, with a total market share of 1.4%. Thus, we can conclude that the major importers did not change in the period of financial crisis, but we had some changes in their market shares.

Table 12 - Exports Market Share per Region in 2012

	North America	S.&C. America	Europe	Middle East	Africa	Asia Pacific
Total Exports Market Share	0.24%	7.61%	6.92%	40.06%	16.50%	28.67%

Source: Self, Data: BP, 2013

Regarding the export market share of the regions, we can conclude from the above table, that Middle East is the leader exporter of LNG, in accordance with 2007, when the countries of Asia Pacific were the major exporters. Hence, the financial crisis lead to a change in the main exporters of LNG. Furthermore, Asia Pacific and African countries lost part of their market share, by having 28.67% and 16.5% of the total LNG export in 2012, accordingly. Moreover, Europe has increased its exports of LNG, which results to an increase of its market share from 2007 until 2012 by 6.86%. Similarly, North America and S. & C. America increased slightly their export market share of LNG by 0.28% and 0.41%, accordingly. Finally, we can conclude that the financial crisis had an impact on the exports of LNG, by increasing the European market share and making Middle East the major exporter.

3.2.4. *Competition between Natural Gas and Other Energy Resources*

In this sub-chapter of the thesis, an analysis of the competition between the six chosen energy recourses, natural gas, oil, coal, nuclear power, hydroelectricity and renewables, will be made, for the period from 2008 until 2012. This will be done in order to conclude if the financial crisis had an effect on their market shares worldwide, but also for the European and non-European countries. Hence, the following table

illustrates us the worldwide market share of the above six main energy resources, for their consumption, from 2008 until 2012.

Figure 36 - Worldwide Consumption Market Share of the Selected Energy Resources 2008 - 2012
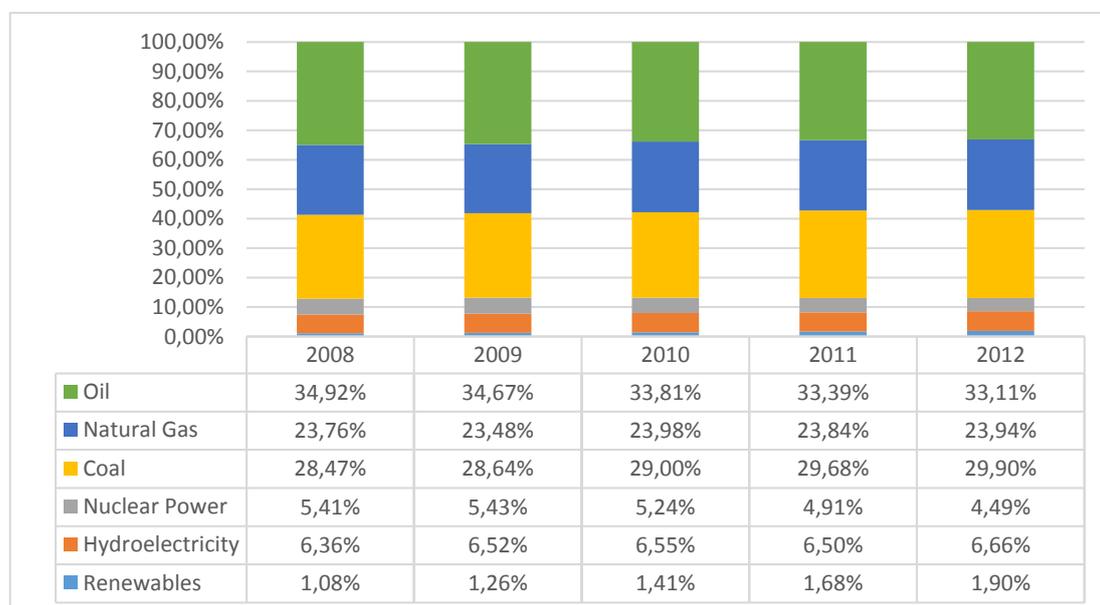
	2008	2009	2010	2011	2012
Oil	34,92%	34,67%	33,81%	33,39%	33,11%
Natural Gas	23,76%	23,48%	23,98%	23,84%	23,94%
Coal	28,47%	28,64%	29,00%	29,68%	29,90%
Nuclear Power	5,41%	5,43%	5,24%	4,91%	4,49%
Hydroelectricity	6,36%	6,52%	6,55%	6,50%	6,66%
Renewables	1,08%	1,26%	1,41%	1,68%	1,90%

Source: Self, Data: BP, 2013

From the above table, we can conclude that oil is still the major player in the consumption of energy worldwide, but it has lost the great difference that it had in the past with coal and natural gas. More precisely, oil is losing every year part of its market share, which varies between 33.11% and 34.92% in 2008 and 2012, accordingly. Furthermore, natural gas shows to be steady after its increase in 2008 by 0.26%. More specifically, we can observe small increases and decreases in its market share, with the highest value being in 2010, 23.98%, and the lowest in 2008, 28.47%. In addition, coal is gaining market share, which is most probably a result of the China's development. Coal had a market share of 28.47% in 2008, slightly higher than this of 2007. In 2012 its market share reached 29.9% and its competition with oil is in such a level than never before. Moreover, the energy resources of hydroelectricity and nuclear power remain in low levels. More specifically, nuclear power market share in the consumption field is continuously decreasing and varies between 4.49% and 5.43%, which were the rate in 2012 and 2009, accordingly. Furthermore, regarding hydroelectricity, it has been increased from 2008 until 2012, by taking the values of 6.36% and 6.66%, accordingly. Last but not least, renewables remain on having the lowest market share, but are steadily increasing, by taking values of 1.08% until 1.9% for the years of 2008 and 2012.

Moreover, the following figure shows us the worldwide production market share of the above six main energy resources for the same 5-year period.

	2008	2009	2010	2011	2012
■ Oil	34,58%	34,07%	33,21%	32,55%	32,62%
■ Natural Gas	23,88%	23,47%	24,04%	24,04%	24,02%
■ Coal	28,80%	29,38%	29,58%	30,45%	30,45%
■ Nuclear Power	5,36%	5,38%	5,23%	4,86%	4,44%
■ Hydroelectricity	6,30%	6,46%	6,53%	6,44%	6,58%
■ Renewables	1,07%	1,24%	1,41%	1,66%	1,88%
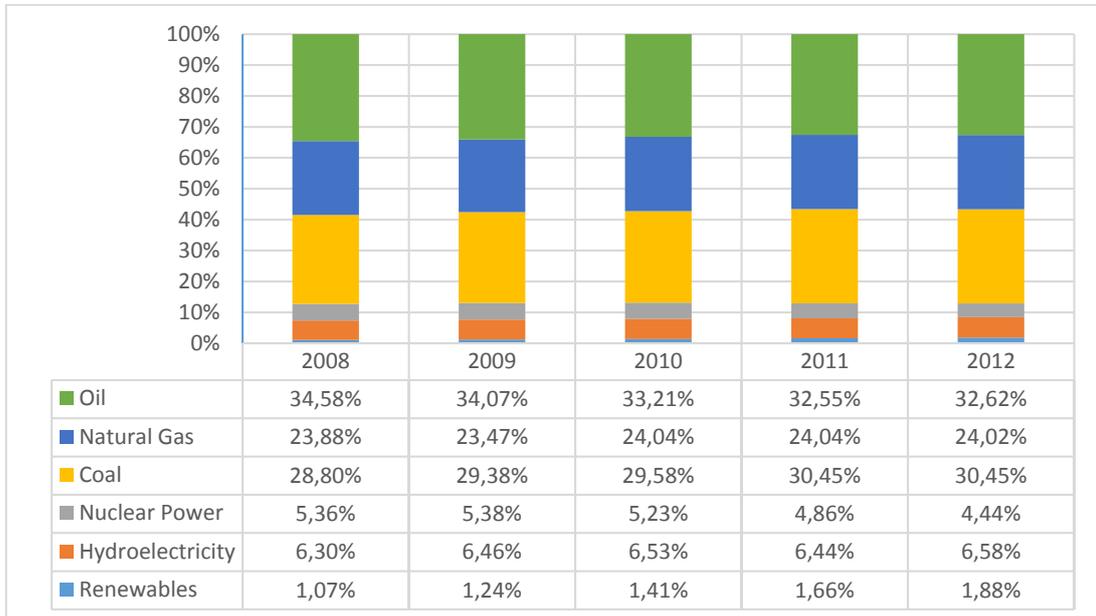
Source: Self, Data: BP, 2013

Therefore, we can conclude from the above table that oil production is still the major player in the production of resources for energy, followed by coal and natural gas. Oil has lost market share from 2008 until 2012, by 1.96%, which has been gained from coal that has in 2012 a market share of 30.45%. Hence, as in the consumption, coal is highly competing oil. On the other hand, natural gas has been stable in this period, with the highest market share value to be 24.04% in the period of 2010 until 2012 and the lowest to be 23.47% in 2009. Moreover, the same picture as in the consumption can be shown for the nuclear and hydroelectricity. Nuclear power's market share in the production has been decreased by 0.92%. In addition, hydroelectricity gained market share in the production field by 0.28%. Last but not least the renewables have been also increased by 0.81% and varying between the values of 1.07% and 1.88%.

Finally, we can observe that in a worldwide scale there is a decrease between the period of 2008 and 2009, in the production and consumption of natural gas, when Europe and the world started to face the first impacts of the debt crisis. In order to have a clearer picture of the change in competition, or substitution, we have to analyse the market shares these resources of energy for Europe and non-Europe countries for the time period of 2008 until 2013.

Europe

Furthermore, the following figure is showing to us the consumption market share the above mentioned energy resources in Europe for the 5-year period from 2008 until 2012.

Figure 38 - European Consumption Market Share of the Selected Energy Resources 2008 - 2012

	2008	2009	2010	2011	2012
Oil	39,26%	39,45%	37,61%	37,88%	36,53%
Natural Gas	25,03%	24,86%	25,93%	24,16%	23,87%
Coal	16,76%	15,70%	15,85%	16,80%	17,55%
Nuclear Power	11,88%	12,03%	11,89%	12,17%	11,94%
Hydroelectricity	4,12%	4,45%	4,81%	4,11%	4,42%
Renewables	2,95%	3,51%	3,91%	4,89%	5,68%

Source: Self, Data: BP, 2013

From the above table, we can conclude that oil is still the major player in the consumption of energy in Europe, but it has lost the great difference that it had in the past with coal and natural gas. More precisely, oil is losing every year part of its market share, which varies between 36.53% and 39.45%, which are the values in 2012 and 2009, accordingly. Furthermore, natural gas shows to be steady after and fluctuating between 23.87% and 25.93%, which are the values for the years 2012 and 2010, accordingly. In addition, coal had a market share of 16.76% in 2008, slightly higher than this of 2007. In 2012 its market share reached 17.55%. Moreover, the energy resources of hydroelectricity and nuclear power remain in low levels. More specifically, nuclear power market share in the consumption field is fluctuating between the values of 11.88% and 12.17%, which were the values of the years 2008 and 2011, accordingly. Furthermore, regarding hydroelectricity, it has been increased from 2008 until 2012, by taking the values of 4.11% and 4.81%, accordingly. It must be noted that in 2011 its market share decreased to the lowest value and afterward increased again. Last but not least, renewables remain on having the lowest market share, but are steadily increasing, by taking values of 2.95% and 5.68% for the years of 2008 and 2012.

Moreover, the following figure shows us the European production market share of the above six main energy resources for the same 5-year period.

	2008	2009	2010	2011	2012
■ Oil	13,35%	13,12%	11,97%	10,85%	9,84%
■ Natural Gas	21,97%	20,77%	20,71%	19,08%	18,16%
■ Coal	21,90%	21,55%	20,76%	22,15%	22,27%
■ Nuclear Power	26,83%	26,82%	26,86%	27,55%	26,94%
■ Hydroelectricity	9,29%	9,91%	10,85%	9,31%	9,98%
■ Renewables	6,66%	7,82%	8,84%	11,07%	12,81%

Source: Self, Data: BP, 2013

Therefore, we can conclude from the above table that nuclear power production is has been the major player in the production of resources for energy, followed by coal and natural gas. The market share of nuclear power production in the European countries has been increased from 2008 until 2012 by 0.11% with values 26.83% and 26.94%, accordingly. Moreover, coal has been increased in the whole period, from 21.9% to 22.27%, with only exception a small decrease of 0.45% in 2009. Natural gas production market share is being continuously decreased, with final value in 2012 being 18.16%. Furthermore, oil and hydroelectricity remain in low market share values. More precisely, oil is being continuously decreased from 13.35% to 9.84% for the period of 2008 until 2012. In addition, hydroelectricity's production market share has been increased from 9.29% to 9.98%, with only exception a decrease by 1.54% in 2011. Last but not least, renewables production market share has been enormously increased in the period of 2008 until 2012, when its value in 2012 took the price of 12.81%, from 6.66% that was in 2008.

Finally, we can conclude that nuclear power is being rapidly rising in the European production market, with oil and natural gas to be decreased. In accordance, coal is being slightly increased and renewables' and hydroelectricity's market shares to be increasing. On the other hand, regarding the consumption market, oil is the major player, with coal and renewables' market share to be increasing, whereas natural gas, nuclear power and hydroelectricity to be fluctuating on the same values.

Non-Europe

Furthermore, the following figure shows us the production market share of the above mentioned energy resources in non-European countries for the 5-year period from, 2008 until 2012.

Figure 40 - Non-European Production Market Share of the Selected Energy Resources 2008 - 2012

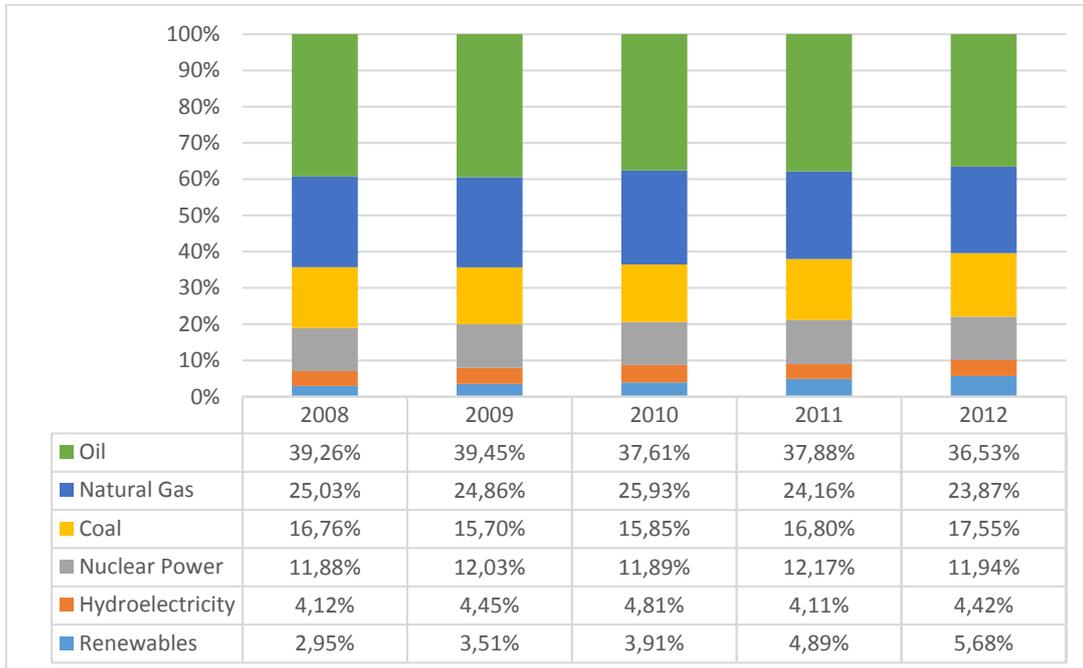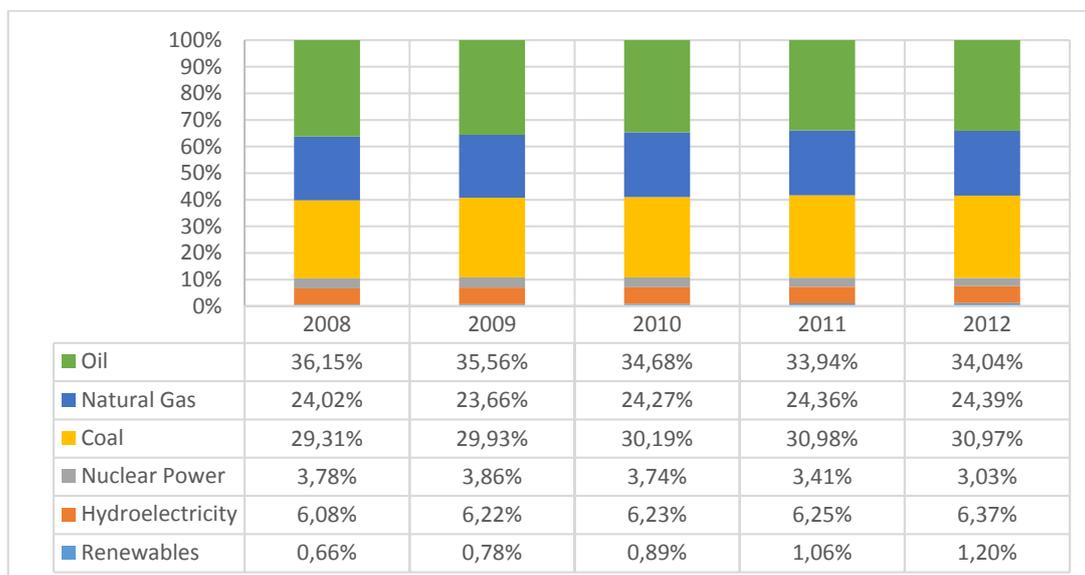|	2008	2009	2010	2011	2012
■ Oil	36,15%	35,56%	34,68%	33,94%	34,04%
■ Natural Gas	24,02%	23,66%	24,27%	24,36%	24,39%
■ Coal	29,31%	29,93%	30,19%	30,98%	30,97%
■ Nuclear Power	3,78%	3,86%	3,74%	3,41%	3,03%
■ Hydroelectricity	6,08%	6,22%	6,23%	6,25%	6,37%
■ Renewables	0,66%	0,78%	0,89%	1,06%	1,20%

Source: Self, Data: BP, 2013

Therefore, we can conclude from the above table that oil production is still the major player in the production of resources for energy, followed by coal and natural gas. Oil has lost market share from 2008 until 2012, by 2.11%, which has been gained from coal that has in 2012 a market share of 30.97%. Hence, coal is highly competing oil. On the other hand, natural gas has been stable in this period, with the highest market share value to be 24.39% in 2012 and the lowest to be 23.66% in 2009. Moreover, nuclear power and hydroelectricity's production market shares are being kept in low values. Nuclear power's market share in the production has been decreased by 0.75%. In addition, hydroelectricity gained market share in the production field by 0.29%. Last but not least the renewables have been also increased by 0.54% and varying between the values of 0.66% and 1.2%.

Moreover, the following figure illustrates us the market share consumption values of the above mentioned energy resources in non-European countries for the 5-year period from, 2008 until 2012.

	2008	2009	2010	2011	2012
🟩 Oil	34,12%	33,84%	33,16%	32,67%	32,58%
🟦 Natural Gas	23,52%	23,24%	23,65%	23,79%	23,95%
🟨 Coal	30,64%	30,90%	31,25%	31,75%	31,81%
⬜ Nuclear Power	4,21%	4,28%	4,11%	3,75%	3,34%
🟧 Hydroelectricity	6,78%	6,89%	6,85%	6,88%	7,01%
🟦 Renewables	0,73%	0,86%	0,98%	1,17%	1,32%
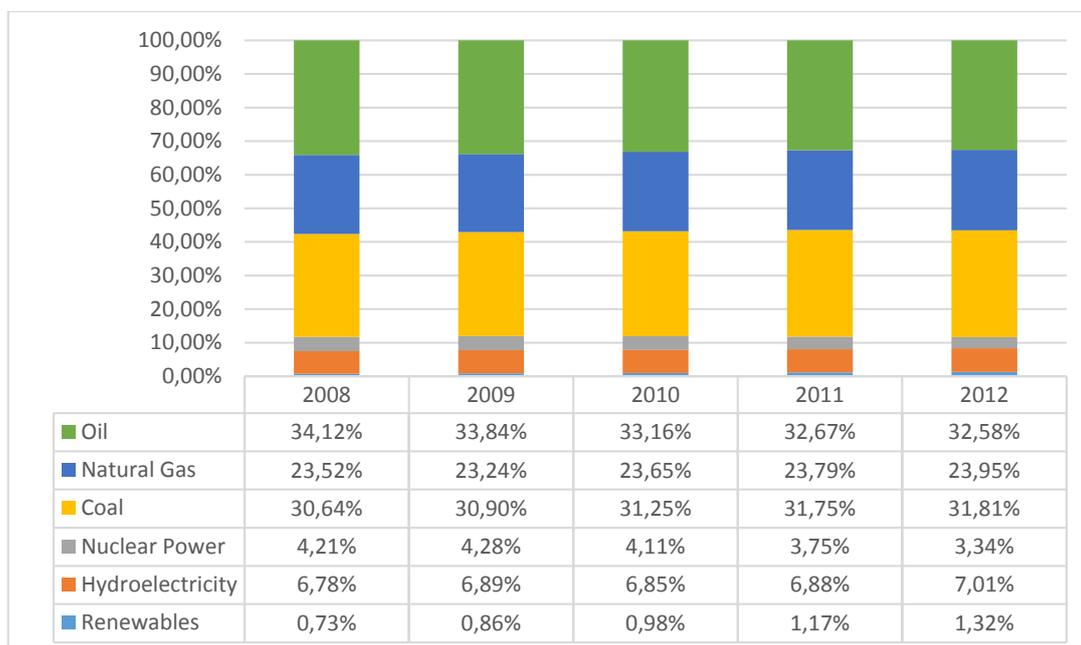
Source: Self, Data: BP, 2013

From the above table, we can conclude that oil is still the major player in the consumption of energy in the non-European countries, but it has lost the great difference that it had in the past with coal and natural gas. More precisely, oil is losing every year part of its market share, which varies between 32.58% and 34.12%, which are the values in 2012 and 2009, accordingly. Furthermore, natural gas shows to be steady and fluctuating between 23.24% and 23.95%, which are the values for the years 2012 and 2009, accordingly. In addition, coal had a market share of 30.64% in 2008, slightly higher than this of 2007. In 2012 its market share reached 31.81%. Moreover, the energy resources of hydroelectricity and nuclear power remain in low levels. More specifically, nuclear power market share in the consumption field is fluctuating between the values of 3.34% and 4.28%, which were the values of the years 2012 and 2009, accordingly. Furthermore, regarding hydroelectricity, it has been increased from 2008 until 2012, by taking the values of 6.78% and 7.01%, accordingly. Last but not least, renewables remain on having the lowest market share, but are steadily increasing, by taking values of 0.73% and 1.32% for the years of 2008 and 2012.

Finally, it must be mentioned that in all the above countries natural gas production and consumption market shares are having different results. This is because of the different behaviours of producers and consumers in each region.

4. Hypotheses

The analysis that has been done in the literature review, refers to the impacts of the past financial crisis to the production, the consumption of natural gas and LNG transportation by sea. Hence, we can summarize the above findings and structure our hypotheses, in order to proceed to our investigation for the impacts of the European Union Debt Crisis to the maritime LNG transportation.

In order to examine our project, we have first to investigate what happened to the production and consumption of the rest of the countries that were not influenced by the crisis.

Regarding the production of natural gas, we can conclude that the past financial crisis led to its increase, but the first year of the crisis a decrease had been revealed. Moreover, the consumption of natural gas had been increased in all financial crisis on average, but also a decrease can be observed, but it is not worthy that we have had decreases between the years.

In addition, the below table shows the average growth between the years of the financial crisis' in production and consumption of natural gas for the impacted countries. From this table, our hypothesis and scenarios will be presented in Chapter five.

Table 13 - Growth Production and Consumption of NG in the Impacted Countries

	Growth in Production of NG	**Growth in Consumption of NG**
United States Financial Crisis	3.48%	8.5%
Mexican Financial Crisis	19.61%	14.81%
Asian Financial Crisis	-12.44%	4.29%
Russian Financial Crisis	0.67%	7.62%
Argentinian Financial Crisis	19.97%	14.15%

Source: Self, Data: BP, 2013

According to the above table, we can observe that the impacts in the different financial crisis had a variety of results to the impacted countries. Furthermore, we can notice that in the production, the Asian Financial Crisis had as a result the decrease of the growth in production by 12.44%. In accordance, the Mexican and Argentinian Financial Crisis had as a result the increase by 19.61% and 19.97%, accordingly, of the production of natural gas. In all the other financial crisis, the percentage of growth was influenced between 0.67% and 3.48%. On the other hand, regarding the consumption of natural gas, the largest increase in terms of growth were these in the period of the Mexican and Argentinian Financial Crisis, where the growth reached 14.81% and 14.15%, accordingly. In all the other financial crisis, the growth had been

risen between 4.29% and 8.5%. Finally, we can observe that Mexico and Argentina had been influenced from their financial crisis in a large scale, by promoting the natural gas as an energy fuel, as it has been described above.

Because the above table shows us the impacts of the financial crisis to the countries that have been impacted by it, we are going to make projections about our case for the European Union Region from the above. Hence, Table 27 in Appendix shows us the growth changes in production and consumption for each region, which are caused from each financial crisis. This, has been done, in order to find the connection of each financial crisis to the rest of the regions that are trading LNG.

As we can figure out from the above table, the result to all the impacted countries from each crisis wan an increase of the consumption in natural gas. This has as a result the promotion of the natural gas in these countries and the change of the behaviour of their citizens on the resources of energy consumption. On the other hand, only the Asian financial crisis had a negative impact to the production of natural gas in Indonesia, South Korea and Taiwan. The rest of the countries, in their financial crisis, have increased the production of natural gas, which has resulted to the change of behaviour of the resource companies and also of their investing opportunities.

Hence, we are going to make an estimation of the impacts of the European Union Sovereign Debt Crisis to the LNG trade relying in three scenarios, which are going to be analysed below in the fourth chapter of this thesis. Finally, our hypothesis regarding our research question is that the European Union Sovereign Debt Crisis will increase the natural gas sea trade between the selected regions and more specifically between Europe and its suppliers.

5. Methodology and Data

In this chapter of the thesis we will analyse the methodology that is going to be followed for finding the impacts of the European Union Debt Crisis on the natural gas maritime trade. Furthermore, the countries that are going to be selected for the purpose of this project will be mentioned, as also the data and the variables, which will be the parameters that will be shocked from the debt crisis, will be analysed. The project will contain an analysis of three scenarios, an optimistic, a pessimistic and a medium scale shock scenario.

5.1. Quantitative Analysis for the Natural Gas Maritime Transportation

For the quantitative analysis of this thesis, the Generic Statistical Information Model, GSIM, has been selected. The GSIM is a global simulation model, which with the appropriate data and use, we can implement a shock in an industry and conclude the results for its future activity. This simulation model takes advantage of the available greater computational power, the stressing global market clearing conditions, and not the import markets, and finally its use as a non-linear formulation, which in many econometric software's is not being used (Joseph Francois; Keith Hall, 2009). Moreover, this simulation model, investigates the impacts of a shock in an industry, but its results can be used for the global development (Joseph Francois; Keith Hall, 2009).

The most common way of forecasting is by econometric software, such as STATA, Eviews or SPSS. The difference between these software with the GSIM is that they are using historical data in order to predict the future development. Hence, the researchers are assuming that there is a relationship between past and the future, in addition with the past shocks with the future ones. In the GSIM we do not assume that there is a relationship between the past and the future, but we are investigating the impacts in an industry by making scenarios. Furthermore, because we are going estimate the impacts of the European Union Sovereign Debt Crisis to the transportation of natural gas by sea, we will do the forecasting for a time period of five years, from 2008 until 2013. The method that we are going to follow is ideal for short-term projects.

Finally, the results of the GSIM will be in the welfare of producers, consumers, traders or governments, which will show us who is benefiting, and whose not, from the change in the trade flows of LNG. For our analysis, we will not use the tariffs or the results in the tariff surplus, since we are investigating the possible shock in the production and consumption of natural gas in the different regions, which will be analysed in detail below.

5.2. Selected Countries and the Scenarios of the Analysis

The regions that have been selected for the purpose of this thesis contain all involved countries with the LNG transportation. We have divided them in five regions, South & Central America, Europe, Middle East, Africa and the Rest of the World (ROW).

The South and Central America contains the Trinidad and Tobago as an export country of LNG and the Dominican Republic and Puerto Rico as importer countries. Furthermore, the Europe region contains Belgium, France, Greece, Italy, Portugal, Spain, Turkey and the United Kingdom as importer countries and Norway as the only exporter country of natural gas. Additionally, the Middle East region includes only countries that export LNG, and more specific they are: Oman, Qatar and United Arab Emirate. In addition, the Africa region, which includes Algeria, Egypt, Guinea Libya and Nigeria, are countries that only export natural gas by sea. Last but not least the region Rest of the World, which contains the North American countries, United States and Mexico, as well as the Asia-Oceania and Asia-Pacific countries, such as Australia, Brunei, Indonesia and Malaysia as exporters of LNG and China, India, Japan and South Korea as importer countries of LNG. We have grouped these regions in order to make the trade flows that are connected to the European LNG market, either from the imports' or exports' side of view.

The following figure shows us the percentage of market share of each region for the imports of LNG in the European market.

Figure 42 - Market Share of Regions for the European LNG Imports in 2007
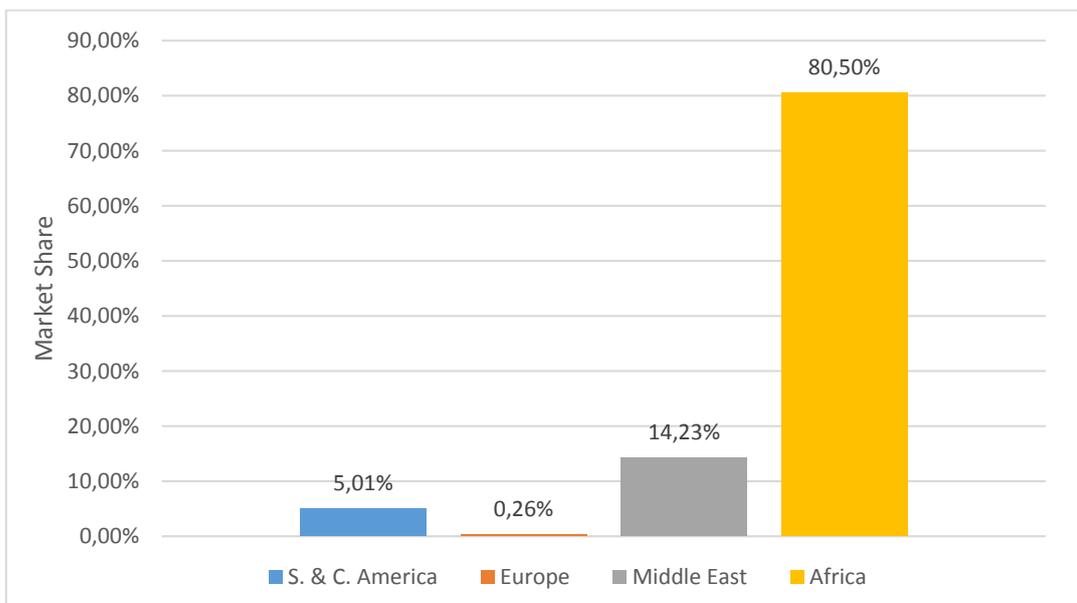
Source: Self, Data: BP, 2007

We can conclude that Europe is mostly provided with natural gas by sea from Africa, with a market share of 80.5%, followed by Middle East with 14.23%. South and Central America are supplied Europe with 2.67 bcm of natural gas in liquefied form in 2007. Finally, the inland trade of natural gas by sea has a market share of 0.26%, which result to 0.14 bcm of liquefied natural gas.

In addition, we can observe that the four countries that are facing the largest danger of default from the European Sovereign Debt Crisis, Greece, Italy, Portugal and Spain, have been taken into account for our project.

As it has been mentioned above, our project will contain the forecasting, the changes in the trade flows between the selected regions, which will be a result of the change

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in production and consumption welfare, by assuming three different scenarios. The first scenario, which is going to be the optimistic, is going to include a parallel increase in the production and consumption of natural gas in all regions. More specifically, the European Union production and consumption of natural gas will be increased by 20% and 15%, accordingly. This is a result from the Table 32 in Appendix, which shows us the growth of production and consumption in the past financial crisis on average. Regarding the S. & C. America region, an increase of 33% and 24% will be implemented in the production and consumption of natural gas, in the same order with the Middle East region that will have an increase of 37% and 29% in the production and consumption of natural gas accordingly. Furthermore, the Africa region will have an increase of 32% and 29%, and the ROW will have an increase of 16% and 15% in the production and consumption of natural gas, accordingly.

The second scenario will include an increase of 1% and 2% in the production and consumption of natural gas for the European Union region. Regarding the S. & C. America region, an increase of 17.7%, in addition with Middle East that will have an increase of 30% and 26% in the production and consumption of natural gas accordingly. Furthermore, the Africa region will have an increase of 27% and 22%, and the ROW will have an increase of 9% and 10% in the production and consumption of natural gas, accordingly.

Finally, the third scenario, which will be the pessimistic, will contain a decrease of 12% and 10% for the production and consumption of natural gas in the European Union region. Regarding the S. & C. America region, an average increase of 6% and 12%, in addition with Middle East that will have an increase of 22% and 21% in the production and consumption of natural gas will be implemented. Furthermore, the Africa region will have an increase of 19% and 12%, and the ROW will have an increase of 8% and 6% in the production and consumption of natural gas, accordingly.

All the above growth percentages are estimated to be the changes in the production and consumption of natural gas for each region for the time period between the start 2008 until the end of 2012. Furthermore, the following table shows us the above analysis of the three scenario's clustered in one table.

Table 14 - Scenarios for the Demand and Supply Change of NG

	First Scenario		Second Scenario		Third Scenario	
	Production	Consumption	Production	Consumption	Production	Consumption
Central & South America	+ 33%	+ 24%	+ 17.7%	+ 17.7%	+ 6%	+ 12%
Europe	+ 20%	+ 15%	+ 1%	+ 2%	- 12%	- 10%
Middle East	+ 37%	+ 26%	+ 30%	+ 23%	+ 22%	+ 21%
Africa	+ 32%	+ 29%	+ 27%	+ 22%	+ 19%	+ 12%
ROW	+ 16%	+ 15%	+ 9%	+ 10%	+ 8%	+ 6%

Source: Self

Therefore, we can conclude that these three scenarios defer among them in the growth percentages for each region. Therefore, in the third scenario we have included a largest decrease in the European Union production and consumption of natural gas Finally, it must be noticed that the trade between countries, which applies to the LNG

transportation also, can be influenced by the growth of many variables, such as the GDP, the employment, the prices of the product, which have not been included to our scenarios and will not be part of this thesis.

5.3. Data and Variables Collection

In this sub-chapter of the thesis, the collection of the data, from the databases and the variables will be followed up by their analysis. It must be mentioned that for the purpose of this thesis, a forecast from 2008 until 2013 will be done with the help of GSIM model. Therefore, this will be done in order to find out if it was possible to predict the impacts of the European Union Sovereign Debt Crisis to the LNG transportation back in 2008, when the crisis started. Thus, a collection of data has been done, which contains from the end of 2007 up until the end of 2012. This has been done due to the lack of data in 2013 and because the data of 2008 will contain already the first impacts of the crisis. All the above are due to the publication of the necessary data in yearly form.

Furthermore, the data that have been collected concern the production, consumption and maritime trade of natural gas. The yearly reports of BP and EIA contain all the above necessary data for this project. Moreover, regarding the prices for the imports and exports of all the regions, the database of the United Nations (UN)[1]. We can conclude from the available data of the UN's website that the world import price of LNG in the European Union is $0.42 per kg of LNG and $0.5 per kg of LNG for the exports. Hence, we are going to use for each type of trade, meaning if it is an export or import, the appropriate value. This, will be done for all the other prices of exports and imports for each region, in order to implement the data that we have found in world prices. This, will also show us, in the results, the change in the prices of the LNG trade from one region to another. Finally, the debt statistics have been gathered from the World Data Bank[2], which are in percentage of GDP that also shows us a more realistic parameter for the situation of a country.

5.3.1 Mathematical Structure of GSIM

In this section of the thesis, the mathematical structure of the GSIM model will be done, in order to understand the structure and the mathematical philosophy of the software and how it is going to give the results from our hypotheses. It has to be mentioned that the GSIM model is a software build on the Microsoft Excel, with a complex and computerised functions. Hence, all the above mathematical equations have been implemented in the Microsoft Excel file, which results to the GSIM model. Furthermore, the below mathematical description is a based on the report of (Joseph Francois; Keith Hall, 2009), who also invented the GSIM model, and the thesis of Astrid Wolkonig, who has done an analysis of the importance of container back haulage by using this software (Wolkonig, 2010). All the following equation symbols and abbreviations can be found on the list of abbreviations in the front of this thesis (page VII).

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[1] United Nations website: http://comtrade.un.org/db/dqBasicQueryResults.aspx?px=S3&cc=3431&r=97&y=2007
[2] World Data Bank Debt Statistics: http://data.worldbank.org/indicator/GC.DOD.TOTL.GD.ZS

Therefore, this simulation model is based on the demand, supply and substitution elasticities of the selected regions. Hence, in order to find these elasticities, we have to calculate the exports, imports and the industry structure of our selected regions (Joseph Francois; Keith Hall, 2009). Therefore, the first equation shows us the relationship between the import demand of a specific category of products with the industry prices and the total expenditure in the particular product category.

Equation 3:
$$\theta_{(i,v),r} = \frac{M_{(i,v),r} * T_{(i,v),r}}{\sum_S M_{(i,v),r} * T_{(i,v),r}}$$

Furthermore, the demand of the tariffs and the quantity of the imported goods are influencing the demand expenditure share (Wolkonig, 2010), which can be illustrated from the following equation:

Equation 4:
$$\varphi_{(i,v),r} = \frac{M_{(i,v),r}}{\sum_S M_{(i,v),r}}$$

The combination of equations 3 and 4 will result to the demand of imported product category (Wolkonig, 2010), from one region to another, which mathematically is the following:

Equation 5:
$$M_{(i,v),r} = f(P_{(i,v),r}, P_{(i,v),s \neq r}, Y_{i,v})$$

We can infer that the above equation is a combination of the internal, from one region to another, and external price of a category of goods, from external sources, and finally the total expenditures of a region for importing the specific category of goods (Wolkonig, 2010). Francois and Hall et al have differentiated the above equation (5) in order to define the cross-price elasticity (equation 6) and the own-price demand elasticity (equation 7). Their equations can be illustrated bellow:

Equation 6:
$$N_{(i,v),(r,s)} = \theta_{(i,v),s}(E_m, E_s)$$

Equation 7:
$$N_{(i,v),(r,s)} = \theta_{(i,v),r} E_m - \sum_{s \neq r} \theta_{(i,v),s} E_s \Leftrightarrow$$
$$\Leftrightarrow N_{(i,v),(r,s)} = \theta_{(i,v),r} E_m - (1 - \theta_{(i,v),r}) E_s$$

Moreover, equation 8 shows us the relationship between the export price that the exporter receives it and the internal price, which conclude to the demand for national

product varieties (Wolkonig, 2010). Thus, the mathematical expression is the following:

Equation 8: $\qquad P_{(i,v),r} = \left(1 + t_{(i,v),r}\right)P_{i,r}^{*} = T_{(i,v),r}P_{i,r}^{*}$

In addition, the export supply to the world markets can be demarcated as an equation that contains world prices (P*) (Wolkonig, 2010), which is the following:

Equation 9: $\qquad X_{i,r} = f(P_{i,r}^{*})$

Furthermore, the equations 5, 8 and 9 are going to be differentiated by including the elasticities in them. Hence, we have the following equations:

Equation 10: $\qquad \hat{P}_{(i,v),r} = \hat{P}_{i,r}^{*} + \hat{T}_{(i,v),r}$

Equation 11: $\qquad \hat{X}_{i,r} = E_{x(i,r)}\hat{P}_{i,r}^{*}$

Equation 12: $\qquad \widehat{M}_{(i,v),r} = N_{(i,v),(r,r)}\hat{P}_{(i,v),r} + \sum_{s \neq r} N_{(i,v),(r,s)}\hat{P}_{(i,v),s}$

If we substitute the equations 6, 7 and 10 into equation 12 and sum it over the import markets, then we have the following equation:

Equation 13: $\widehat{M}_{i,r} = \sum_{v} N_{(i,v),(r,r)}\hat{P}_{(i,v),r} + \sum_{v}\sum_{sr} N_{(i,v),(r,s)}\hat{P}_{(i,v),s} \Leftrightarrow$

$\Leftrightarrow \widehat{M}_{i,r} = \sum_{v}^{v} N_{(i,v),(r,r)}[\hat{P}_{r} + \hat{T}_{(i,v),r}] + \sum_{v}\sum_{sr} N_{(i,v),(r,s)}[P_{s}^{*} + \hat{T}_{(i,v),s}]$

In order to attain and impose the global market clearing condition, we have to equalize equation 13 with equation 11, which results to the following mathematical equation:

Equation 14: $\qquad\qquad\qquad \widehat{M}_{i,r} = \hat{X}_{i,r} \Leftrightarrow$

$\Leftrightarrow E_{x(i,r)}\hat{P}_{i,r}^{*} = \sum_{v} N_{(i,v),(r,r)}\hat{P}_{(i,v),r} + \sum_{v}\sum_{sr} N_{(i,v),(r,s)}\hat{P}_{(i,v),s} \Leftrightarrow$

$\Leftrightarrow E_{x(i,r)}\hat{P}_{i,r}^{*} = \sum_{v}^{v} N_{(i,v),(r,r)}[\hat{P}_{r} + \hat{T}_{(i,v),r}] + \sum_{v}\sum_{sr} N_{(i,v),(r,s)}[P_{s}^{*} + \hat{T}_{(i,v),s}]$

It must be noted that domestic production has not been modelled above and will not be used for the purpose of this thesis. Finally, even though the mathematical structure of the GSIM model seems to be complicated, the run of the software is much more simplified.

5.4. Demand, Supply and Substitution Elasticities

In order to run the GSIM model, we need three sorts of elasticities, the composite demand elasticity, elasticity of substitution and supply elasticity, for each of the regions that have been selected. The demand, supply and substitution elasticities, which are going to be used in our research, can be found in the following table.

Table 15 - Demand, Supply and Substitution Elasticities

	Composite Demand Elasticity	Industry Supply Elasticity	Substitution Elasticity
S. & C. America	-1.11	1.5	5
Europe	-1.11	1.5	5
Middle East	-1.23	1.5	5
Africa	-1.20	1.5	5
ROW	-1.17	1.5	5

Source: Self, Data:

Concerning the demand elasticities for the selected regions, contain the average demand ISIC-3 average elasticity for all the countries that each region contains. These ISIC-3 average elasticities have been gathered from a report of The World Data Bank, which had as a purpose to find the import demand elasticities for the main sea trading countries. (Hiau Looi Keey; Alessandro Nicitaz; Marcelo Olarreagax, 2010).

Regarding the export supply and substitution elasticities for the selected regions, they have been selected for the value of 1.5 and 5, accordingly. These values have been resulted from a project of Francois and Hall (2003) that have been used in their examples (Joseph Francois; H. Keith Hall, 2003).

6. GSIM Model

As it has been analysed above, the GSIM model is a model-software that helps us to forecast the impact of a shock to the economy trade imbalances in the future, by inserting a shock. In this research, our thesis, we will produce a shock in demand and supply for natural gas driven by two phenomena: the Eurozone debt crisis and the desire of consumers to switch to more green forms of energy, in natural gas, shock in order to change the behaviour of producers and consumers due to the European Union Economic Crisis.

Hence, the GSIM model will predict – based on 2007 and 2008 information at the time – impacts in the transportation of natural gas by sea, production, prices, and welfare will be figured and examined. Furthermore, as specified in the previous chapter, we have divided our analysis research in into three scenarios: an optimistic, a pessimistic and a neutral scenario, which will be underlying the GSIM runs and analysis implemented below. Moreover, the following table shows us the trade of LNG, in million kg, between the regions that have been selected.

Table 16 - LNG Trade in 2007 in million kg of LNG

In million kg LNG		To				
		S. & C. America	Europe	Middle East	Africa	ROW
From	S. & C. America	1,010.25	2,452.16	0.00	0.00	12,288.34
	Europe	0.00	128.58	0.00	0.00	0.00
	Middle East	0.00	6,970.74	0.00	0.00	477.57
	Africa	0.00	39,436.58	0.00	0.00	9,266.77
	ROW	0.00	0.00	0.00	0.00	135,906.49

Source: Self, Data: BP, 2008

We can notice from the above table that the largest movement of LNG in monetary base, is from the Rest of the World to its countries, with a total of 147.98 bcm (BP, 2008). This trade is mostly relies on the trade between the countries of the ROW, which have been mentioned above, and Japan. Japan is the largest importer of LNG in Asia. It conquers the 68.34% of this specific trade. On the other hand, the trade of LNG between Middle East and the ROW is the smallest one, with 0.52 bcm. Regarding the trade of LNG in Europe, the largest imports come from Africa with a total of 128.58 million kg of LNG or 42.94 bcm (BP, 2008). Furthermore, Europe does not have an export activity of natural gas, but only an inland trade with producer Norway and receptors France and Spain (BP, 2008). In addition, Middle East and S. & C. America are exporting LNG in Europe with 7.59 and 2.67 bcm, or 6,970.74 and 2.452.16 kg of LNG, accordingly.

Hence, Europe is highly depended from the other regions for fulfilling the consumption desires of its citizens in natural gas. This happens, because of the deficit in natural gas between its production and consumption in Europe and the surplus of them in the other regions. Moreover, the import of natural gas via the pipelines from Asia is not

enough in order to accomplish this gap between production and consumption of natural gas.

The above data have been recalculated to USD by converting the bcm in kg with the following formula (BP, 2008):

Equation 2:   1 bcm of LNG = 0.92*1000 kg of LNG

Furthermore, because the data for the trade of LNG should be inputted in the GSIM model in monetary values, by finding the total trade of LNG in kg we can create the following table of total trade of LNG in million USD.

Table 17 - LNG Trade in million USD in 2007

In million USD		To				
		S. & C. America	Europe	Middle East	Africa	ROW
From	S. & C. America	$464.72	$1,029.91	$0.00	$0.00	$3,440.74
	Europe	$0.00	$64.29	$0.00	$0.00	$0.00
	Middle East	$0.00	$2,370.05	$0.00	$0.00	$162.38
	Africa	$0.00	$13,802.80	$0.00	$0.00	$3,243.37
	ROW	$0.00	$0.00	$0.00	$0.00	$48,926.34

Source: Self, Data: (UN, 2013), (BP, 2008)

As it can be derived from the above table, the amount of USD that are being handled in the trade of LNG is billions of dollars. More specifically, the total trade of LNG had cost in 2007, 72.43 billion USD (BP, 2008). The total monetary flow between Europe and its exporters in 2007 was a total of 17.27 billion USD, but the highest in the whole trade was that of ROW with a total of 48.93 billion USD. The following figure shows us the market share of the regions that import and export LNG, which has been constructed from the above table with the total trade in USD.

Figure 43 - Market Share of Imports and Exports per Region of LNG Trade
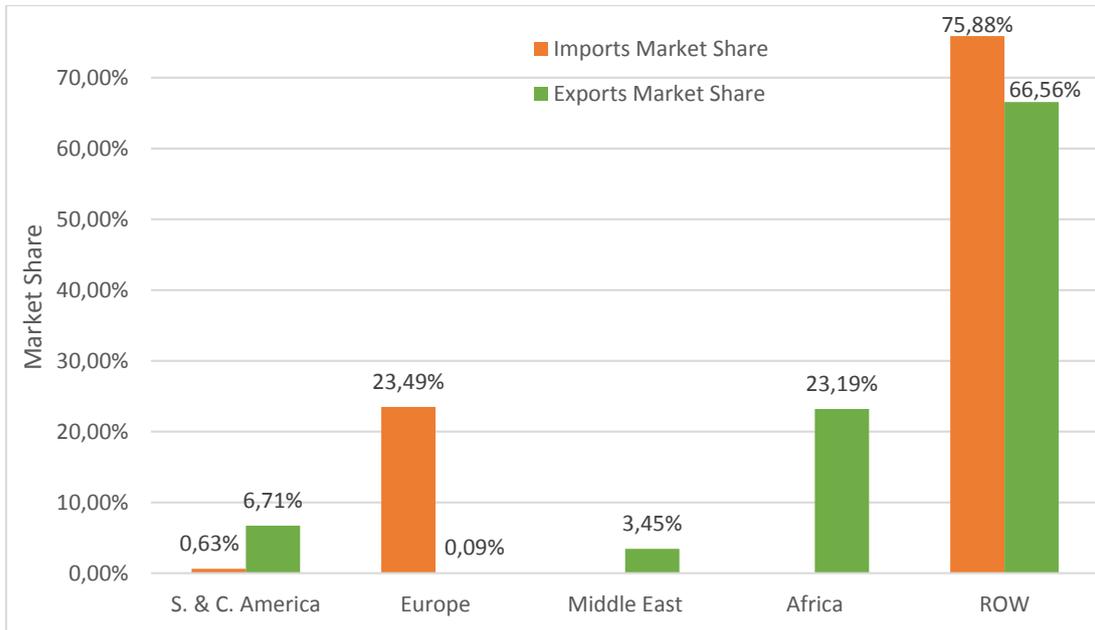
Source: Self, Data: BP, 2008

As we can figure the region ROW has the highest market share in the value of the LNG import and export trade with a total of 75.88% and 66.56% accordingly. Europe takes the second place in the import market share with a total share of 23.49%, followed by S. & C. America, which completes the list of imported regions with a total market share of 0.63%. It must be mentioned that Middle East and Africa are not included in the above figure, regarding the import part, since they do not have imports of LNG. Furthermore, concerning the market share of exports, Africa takes the second place, with a percentage of 23.19%, followed by S. & C. America, which has a market share of exports 6.71%. Last but not least, Middle East is the smaller player on exporting LNG, with a total market share of 3.45%.

Therefore, we can conclude that the price of LNG does not have a large difference between regions, since both the table of the trade flow in kg and that with the value of the traded LNG do not change our results. More precisely, the world price of LNG trade varies between $0.28 and $0.5 per kg of LNG.

6.1. Scenarios Implementation and Results Analysis

In this sub-chapter of our thesis, the implementation of the above three scenarios will be made, by running our data and hypothesised growths of production and consumption of natural gas on the GSIM model. In the meantime, the results that will be gained from the GSIM model will be analysed.

The first scenario is related to the optimistic view of the European Union Sovereign Debt Crisis, where the production and consumption of natural gas is increased for all regions in high rates. Hence this scenario is actually indifferent of the crisis and continues the growth of natural gas. Thus, two explanations for this can be figured out. First, the EU debt crisis does not seem to be huge and its impacts will be minimal. Second, the industry of natural gas is not being affected by the crisis, which will results to this growth situation.

Furthermore, the results on the LNG trade changes between the regions of the GSIM model, regarding the first scenario, can be presented in the following table.

Table 18 - Percentage Change of the LNG Trade between Regions (Scenario 1)

	S. & C. America	Europe	Middle East	Africa	ROW	Average Exports
S. & C. America	28.29%	8.56%	-	-	17.63%	16.94%
Europe	-	-15.23%	-	-	-	-15.23%
Middle East	-	15.19%	-	-	24.52%	23.30%
Africa	-	26.38%	-	-	36.13%	29.33%
ROW	-	-	-	-	16.55%	16.55%
Average Imports	28.29%	23.78%	-	-	21.11%	

Total Change:	21.15%

Source: GSIM outcome, Edited by the author

We can also transform the above table into bcm values, in order to show the real changes of this Scenario to the LNG trade between the selected regions. This transformation's results are being illustrated at the following table.

Table 19 - New Values in bcm of LNG Trade between the Regions (Scenario 1)

	S. & C. America	Europe	Middle East	Africa	ROW	Average Exports
S. & C. America	1.41	2.90	-	-	16.92	21.22
Europe	-	0.12	-	-	-	0.12
Middle East	-	8.74	-	-	63.02	71.76
Africa	-	54.27	-	-	25.43	79.70
ROW	-	-	-	-	102.92	102.92
Average Imports	1.41	66.03	-	-	208.28	

Total:	274.31

Source: Self

As we can observe from the above tables, all the trade between the regions have been increased, except the intra-Europe LNG trade. More specifically, the largest increase was that between Africa and the ROW with a total increase of 36.13%, with a final value of 25.43 bcm, followed by the trades between the countries of S. & C. America and between Africa and the European region, with 28.29% and 26.38% increase, accordingly. These trades' final values are 1.41 bcm and 54.27 bcm, accordingly. The rest of the LNG trades, except the intra-European, were increased between 8.56% and 24.52%, or otherwise between 2.9 bcm and 63.02 bcm. On the other hand, the trade between the countries of the European Union are predicted to have a decrease of 15.23%, with a final value of 0.12 bcm. This happens due to the crisis that the EU countries are facing the forecast period.

Regarding the total exports and imports of the regions, we can find out that the GSIM model forecasted an increase to all of them, except the exports of Europe, which have been decreased for the same reason as it has been analysed above. Furthermore, the imports of Europe and ROW have been increased by 23.78% and 21.11%, which results for these imports to take the values of 66.03 bcm and 208.28 bcm, accordingly. On the other hand the African region has increased its exports on LNG by 29.33%, S. & C. America by 16.94% and Middle East by 23.3%. Hence, these routes extended their trade to 79.7 bcm, 21.22 bcm and 71.76 bcm, accordingly. The ROW region remains the trade route with the highest imports and exports.

Thus, we can observe a total increase in exports and imports of the regions, as a result of the European Union Sovereign Debt Crisis, with only exception the exports of LNG of Europe that have been decreased. Finally, we can observe a total increase in the total trade of LNG by 21.15% and reaching the 274.31 bcm.

2nd Scenario

The second scenario is related to the neutral effects of the European Union Sovereign Debt Crisis to the LNG trade, where the production and consumption of natural gas has been increased in medium rates in all regions except Europe, in which we implemented a small increase. Hence this scenario is facing the crisis, as its effect is strong, but not enough to decrease the above variables, which results to the continuous of the natural gas growth, but in a lower percentage. Thus, the EU debt crisis seems to impact the natural gas market.

Furthermore, the results on the LNG trade changes between the regions of the GSIM model, regarding the second scenario, can be presented in the following table.

Table 20 - Percentage Change of the LNG Trade between Regions (Scenario 2)

	S. & C. America	Europe	Middle East	Africa	ROW	Average Exports
S. & C. America	18.54%	-0.13%	-	-	17.52%	14.99%
Europe	-	-9.03%	-	-	-	-9.03%
Middle East	-	9.14%	-	-	38.01%	34.24%
Africa	-	11.89%	-	-	40.57%	20.59%
ROW	-	-	-	-	9.18%	9.18%
Average Imports	18.54%	10.85%	-	-	21.77%	
					Total Change:	18.60%

Source: GSIM outcome, Edited by the author

In addition, we can transform the above table into bcm values, in order to show the real changes of this Scenario to the LNG trade between the selected regions. This transformation's results are being illustrated to the following table.

Table 21 - New Values in bcm of LNG Trade between the Regions (Scenario 2)

	S. & C. America	Europe	Middle East	Africa	ROW	Average Exports
S. & C. America	1.30	2.67	-	-	16.90	20.87
Europe	-	0.13	-	-	-	0.13
Middle East	-	8.28	-	-	69.85	78.13
Africa	-	48.05	-	-	26.26	74.30
ROW	-	-	-	-	96.40	96.40
Average Imports	1.30	59.13	-	-	209.41	
					Total:	268.53

Source: Self

As we can infer from the above tables, all the trades between the regions have been increased, except the intra-Europe and S. & C. America to the European region LNG trade. More specifically, the largest increase was that between Africa and the ROW with a total increase of 40.57%, with a final value of 26.26 bcm, followed by the trades between Middle East and ROW with a total increase of 38.01% and a final value of 69.85 bcm. Furthermore, the inland trade in S. & C. America has faced a continuous increase in the period of the EU debt crisis by 18.54% and a total trade of 1.3 bcm. While also the trade line between Africa and Europe has resulted to a growth of 11.89% and a final value of 48.05 bcm, followed by all the other trades, which had a growth effect between 9.14% and 17.52% and LNG trade values between 8.28 bcm and 26.26 bcm.

On the other hand, in this scenario we had two results of decrease in the LNG trade. More precisely, the LNG trade market of inland Europe has faced a decrease in its

growth by 9.03% and the total LNG trade took a value of 0.13 bcm. Likewise, the LNG trade between S. & C. America and the European region has been decreased by 0.13%, which resulted to a total trade of 2.67 bcm. Hence, we can observe that by exploiting the production and consumption of natural gas, the trade of European LNG is facing reductions in its growth, compared to the optimistic scenario.

Regarding the total imports of the regions, we can find out that the GSIM model forecasted an increase to all of them. More specifically, the imports of Europe and ROW have been increased by 10.85% and 21.77% and they reached 59.13 bcm and 209.41 bcm, accordingly. On the other hand, regarding the total exports of LNG, most regions have faced an increase, except the European region, which has been decreased by 9.03% and reached a value of 0.13 bcm. In contrast, Africa has increased its exports of LNG by 20.59%, S. & C. America by 14.99% and Middle East by 34.24%. This concludes that the above regions' imports will take the values of 74.3 bcm, 20.87 bcm and 78.13 bcm. In addition, the trade of LNG between the countries of ROW remains the largest with a total value of 96.4 bcm. Finally, in this scenario implementation, the impact of the European Union Sovereign Debt Crisis to the LNG trade has been resulted to higher decreases and lower increases in the growth of trade between the regions, in accordance with the first scenario.

In total, the neutral scenario has resulted to the increase of the LNG trade between the regions on an average of 18.6% and the total trade has been forecasted to take a value of 268.53 bcm.

3rd Scenario

The third scenario is related to the pessimistic effects of the European Union Sovereign Debt Crisis to the LNG trade, where the production and consumption of natural gas have been increased in low rates in all regions except Europe, in which we implemented a large decrease. This has happened in order to cover all the possible reactions of the effects. Hence this scenario is facing the crisis as its effect is strong, enough to decrease the above variables, which results to the continuous of the natural gas growth in lower percentages and regarding the Europe it will result to a total decrease of the LNG trade. Thus, the EU debt crisis seems to have a strong impact to the natural gas market.

Furthermore, the results on the LNG trade changes between the regions of the GSIM model, regarding the second scenario, can be presented in the following table.

Table 22 - Percentage Change of the LNG Trade between Regions (Scenario 3)

	S. & C. America	Europe	Middle East	Africa	ROW	Average Exports
S. & C. America	9.17%	-28.82%	-	-	16.53%	9.41%
Europe	-	0.75%	-	-	-	0.75%
Middle East	-	2.55%	-	-	42.71%	37.47%
Africa	-	-3.12%	-	-	37.98%	9.34%
ROW	-	-	-	-	6.95%	6.95%
Average Imports	9.17%	-3.59%	-	-	21.64%	
					Total Change:	**15.11%**

Source: GSIM outcome, Edited by the author

We can also transform the above table into bcm values, in order to show the real changes of this Scenario to the LNG trade between the selected regions. This transformation's results are being illustrated to the following table.

Table 23 - New Values in bcm of LNG Trade between the Regions (Scenario 3)

	S. & C. America	Europe	Middle East	Africa	ROW	Average Exports
S. & C. America	1.20	1.90	-	-	16.76	19.86
Europe	-	0.14	-	-	-	0.14
Middle East	-	7.78	-	-	72.22	80.01
Africa	-	41.60	-	-	25.77	67.37
ROW	-	-	-	-	94.44	94.44
Average Imports	1.20	51.42	-	-	209.19	
					Total:	**260.62**

Source: Self

As we can conclude from the above tables, all the trades between the regions have been increased, except the trade routes from S. & C. America to Europe and Africa to Europe. More precisely, the largest increase was that between Middle East and ROW with a total increase of 42.71%, with a value of 72.22 bcm, followed by the trade between Africa and the ROW, which resulted to a total increase of 37.91% and a total value of 72.22 bcm. Furthermore, the inland trade in S. & C. America has faced a continuous increase in the forecasted period by 9.17%. Likewise, the trade route between S. & C. America and ROW ensued to an increase of 16.53%, which concludes to a trade value of 16.76 bcm, and the inland trade of ROW has stemmed to an increase of 6.95% and a total trade of 24.44 bcm. At the same time, the inland

trade in Europe and from Middle East to the European region resulted to an increase of 0.75% and 2.55%, with final values of 0.14 bcm and 7.78 bcm.

On the other hand, in this scenario we had two results of decrease in the LNG trade, which both included Europe as their destination. More specifically, the LNG trade route between S. & C. America and Europe has faced a decrease in its growth by 28.82%, which results to a value traded of 1.9 bcm. Similarly, the LNG trade line between Africa and Europe has decreased by 3.12%, with a trade value of 41.6 bcm in 2012. Hence we can observe that by implementing a decrease in the production and consumption of natural gas, some LNG trades with recipient the European region are facing negative growths, which concludes to be a negative impact of the European Union Debt Crisis to the LNG trade.

Regarding the total exports of the regions, we can find out that the GSIM model forecasted different results in this pessimistic scenario, in accordance with the other two. More precisely, all the exports of the regions have has as a result their increase. Thus, the imports of S. & C. America, in LNG terms, have been increased by 9.41%, as well as the imports of Middle East LNG imports by 37.47% and the African by 9.34%, with final values of 19.86 bcm, 80.01 bcm and 67.37 bcm. On the other hand, the total imports of LNG have faced in most regions an increase, except the imports of Europe, which have been decreased by 3.59% and its trade value reached 51.42 bcm. In contrast, ROW has increased its imports in LNG by 21.64%, which results to a trade value of 209.19 bcm. Therefore, in this scenario implementation, the impact of the European Union Sovereign Debt Crisis to the LNG trade has been resulted to even lower increases in the average growth of exports and imports, likewise with the decrease in the total European imports of LNG. Regarding the rest of the regions, we can observe lower increases in the LNG trade. In total, the pessimistic scenario has resulted to the increase of the LNG trade between the regions on an average of 15.11% and a total traded amount of 260.62 bcm.

Finally, we are waiting the European Union Sovereign Debt Crisis to have impacted the LNG trade between the above results of GSIM model, for each route. This can be found in chapter 8, where the comparison between the above findings and the current situation is analysed.

7. Impacts of the European Union Sovereign Debt Crisis to Natural Gas

7.1. Real Impacts

From the analysis that have been done in chapter 3, we can conclude to several results regarding the impacts of the European Union Sovereign Debt crisis to the production, consumption, trade via sea, and market shares of production and consumption of natural gas.

Hence, we can observe that the European Union Sovereign Debt Crisis has impacted the world production and consumption of natural gas that results from the period 2008 – 2009, when they have both decreased. More specifically, regarding each region, we can observe that S. & C. America's and ROW's production and consumption of natural gas decreased in the period 2008 – 2009, in contrast with Middle East's, where there has been a total increase in the two sectors, but with a small decrease in the growth of production and consumption. Furthermore, the European region has been impacted the most, since the crisis has come from its continent. Hence, its production and consumption of natural gas have highly decreased in the years of 2009 and 2010, by resulting in the total decrease for the period of 2008 – 2012. Additionally, the African region had a large decrease in the production of natural gas, in the years of 2009 and 2010, which were most probably due to the fact that the major exports of Africa have as a recipient Europe. Therefore, the consumption of natural gas in the African region has faced a small decrease in 2009, whereas in total it has been increased.

Furthermore, the worldwide trade of LNG has been increased until 2011, but after, a slight decrease has been observed. More specifically, in S. & C. America, the total exports have been increased and explicitly, the exports to Europe have decreased. Regarding Europe, the total trade of LNG has increased, and especially the inland trade, in corresponding with the creation of two new trade routes of exports to Middle East and to S. & C. Europe, which are results of the European Union crisis due to the surplus of natural gas. Concerning the Middle East, there has been a total increase in the natural gas trade by sea, which introduced two new routes, to Middle East and to S. & C. America. In addition, the trade route to Europe has been increased until 2011, but afterwards in slightly decreased. About the exports of the African region, a total decrease has been observed, similar with its exports to Europe, which had been decreased, but with a lower rate. Furthermore, the ROW region's LNG trade has increased until 2011, but afterwards a huge decrease came. Therefore, it must be mentioned that all the new trade routes to Middle East from all regions have been created, because of the highly demand of natural gas in that region.

Regarding the worldwide consumption market share of natural gas, we can conclude that it remained untouched, in accordance with oil that it decreased and coal that increased. In addition, the worldwide production market share of natural gas increased together with coal, compared to oil, which decreased. More specifically, in S. & C. America and Africa both market shares of natural gas have been increased, similar with coal and in accordance with oil that decreased in the period of 2008 – 2010. In Europe, the consumption and production market share of natural gas and coal have been increased in a low rate, in contrast with oil that decreased. In addition, in Middle East the natural gas production and consumption market shares have been increased in a large scale due to the expansion of the natural gas industry, in

accordance with oil that lost part of its market shares. Concerning the ROW region, the natural gas market shares remained in the same levels as before 2008, similar with the increase of coal, because of the development of China, and the decrease of oil. Thus, we can conclude that in general natural gas gains a small part of the total market share, coal is gaining the largest part and oil loses its competition attitude due to its high prices.

Finally, we can conclude that the European Union Debt Crisis has influenced the market of natural gas. More specifically, regarding the European market, its impacts were the decrease of production, consumption and market share of natural gas, in contrast with the increase of the inland and outland trade and the establishment of two new trade routes. Moreover, there has been a total positive impact on the imports LNG trade, which has been increased in a high rate from the imports of Middle East and less from S. & C. America and the inland trade, in contrast with the decrease, in a low rate, from the imports of the African region. Hence, this influenced the exports of the above countries, since they had to realign their production. Hence, the decrease in production of natural gas in the African region is a result of the EU crisis, in addition with the increases in Middle East and S & C. America regions, where it increased. It must be mentioned that in the case of Middle East, the inland consumption growth and LNG trade played also an important role. Moreover, regarding the ROW region, because it did not have any connection with Europe, we think its changes in the natural gas market may had a small relation with the EU crisis, but not in a high level.

7.2. Comparison of the Scenarios' Results and Current Situation

In this section of the thesis, we are going to compare the results that have been found from the analysis of the GSIM model and the real impacts of the European Union Debt Crisis on the LNG trade. Hence, we have to divide our comparison in two parts, first regarding the contrast between production and consumption changes that we hypothesized with the real and second the evaluation of the between the trade results of the GSIM model with these that happened. Subsequently, the following table shows us the real changes and the scenarios undertaken in the production of natural gas by region.

Table 24 - Real & Scenarios' Changes in Natural Gas Production 2007 - 2012

	Real Production Change	Hypothesized Production Change		
		Scenario 1	Scenario 2	Scenario 3
S. & C. America	13.90%	33%	17.7%	6%
Europe	-4.30%	20%	1%	-12%
Middle East	53.30%	37%	30%	22%
Africa	5.90%	32%	27%	19%
ROW	10.80%	16%	9%	8%

Source: Self

Thus, we can conclude from the above table that the production changes in the S. & C. America, Europe and ROW regions have been successfully estimated. More

specifically, the production changes of the S. & C. America and European region have been projected to be between the 2nd and 3rd scenarios. Moreover, the ROW region's production of natural gas change has been assessed to be between the 1st and 2nd scenarios. On the other hand, the Middle East and African regions' production of natural gas change have not been estimated correctly. More specifically, Middle East production change has been increased more than the projection of the 1st scenario and the African one has been increased lower than the assessment of the 3rd scenario.

Regarding the real changes and the scenarios undertaken in the consumption of natural gas by region, can be shown in the following table.

Table 25 - Real & Scenarios' Changes in Natural Gas Consumption 2007 - 2012

	Real Consumption Change	Hypothesized Consumption Change		
		Scenario 1	Scenario 2	Scenario 3
S. & C. America	21.10%	24%	17.7%	12%
Europe	-9.25%	15%	2%	-10%
Middle East	35.80%	26%	23%	21%
Africa	28.72%	29%	22%	12%
ROW	14.50%	15%	10%	6%

Source: Self

Therefore, we can result from the above table that the consumption changes in the S. & C. America, European, African and ROW regions have been successfully estimated. More specifically, the production changes of the S. & C. America, African and ROW regions have been projected to be between the 1st and 2nd scenarios. Moreover, the European region consumption of natural gas change has been assessed to be between the 2nd and 3rd scenarios. On the other hand, the Middle East region's consumption of natural gas change has not been estimated correctly. More precisely, it has been increased more than the projection of the 1st scenario.

As a final point, we can conclude that we have mostly projected the changes of the production and consumption of natural gas, except of some, which will probably conclude to problems in the outcomes of the GSIM model, which will be analysed directly below.

A disadvantage of the GSIM model is the incapability to predict trade values in new routes. Thus, our comparison will be done for the existing LNG trade routes of 2007. Therefore, concerning the changes in these trade routes between the regions in the period of the financial crisis, 2008 - 2012, are being illustrated in the following table.

Table 26 - Real Changes in LNG Trades between Regions 2008 - 2012

	S. & C. America	Europe	Middle East	Africa	ROW	Exports
S. & C. America	58.06%	21.02%	-	-	-7.69%	6.45%
Europe	-	234.94%	-	-	-	234.94%
Middle East	-	46.02%	-	-	14.55%	18.00%
Africa	-	-7.44%	-	-	17.48%	-2.47%
ROW	-	-	-	-	2.11%	2.11%
Imports	58.06%	6.99%	-	-	5.80%	
					Total	**6.44%**

Source: Self

By comparing them with the scenarios tables that have been illustrated in chapter 6, we can result in several conclusions. Although the GSIM model could not predict the changes in the LNG trades between the regions precisely, it has mostly forecast the positive or negative trend that the amounts of these routes will have. More precise, except the trade routes between the countries of Europe and from S. & C. America to the ROW region, which have been decreased and the GSIM model has predicted to be increased, all the other routes' trends have been successfully estimated.

Finally, we can conclude that whereas we can predict the demand and supply shock of the regions, it is not possible to forecast the accurate values of the trade due to the external variables that affect the LNG trade. On the other hand, it is promising that we can predict the trends between the most regions, which will be very helpful for further research.

8. Conclusions

The impacts of the financial crisis to the society are of high importance due to the element that economists want to predict them and provide their results to the necessary parties. This in order for the parties to know how to react and try to outreach future financial crisis with the minimum cost in welfare. Hence, this thesis analysis had as a scope two major targets, first to try and forecast the impacts of the European Union Debt Crisis to the LNG trade and, secondly, to research the period of the EU crisis in concluding to the real impacts. Thus, the demand and supply shocks have been implemented and researched in order to conclude, by keeping the rest of the variables that influence the LNG trade 'ceteris paribus'.

Summarize of the Impacts

Therefore, we concluded that the European Union Sovereign Debt Crisis did impact negatively the natural gas production and consumption of all regions, and especially the European one. Therefore, the gaps that have been raised in the European consumption and production of natural gas, in this period, resulted in the increase of the imports and exports of LNG. In addition, there have also been noticed decreases in the LNG trade between some routes, which was probably due to the readjustment of the trade routes. In addition, new trade routes from Europe have been established, in order to provide other countries with natural gas. Moreover, it is our belief that the Middle East's and ROW regions increase of the trade and consumption of natural gas does not have a direct relation with the EU crisis, but their increase in exports of LNG to Europe should be related to the crisis.

GSIM Model Results

On the other hand, we did not succeed in predicting the accurate trade values between the regions that we have selected, through the implementation of the GSIM model. But, we have forecast most of the trends that each route, negative or positive, would be undertaken in the period of the European Union Sovereign Debt Crisis. This is of major importance due to the fact that there has never been such a project or a scientific research for the impacts of a financial crisis to the LNG trade. Our conclusions may not be precise, but they give a great picture of the results of a financial crisis to the LNG trade between all the regions of the world.

Areas for Supplementary Research

Regarding ideas for further investigation about the impacts of the European Union Sovereign Debt Crisis to the LNG trade, the investigation between all the countries separately, and not in regions, may conclude to more trustful results of the GSIM model. Furthermore, the use of a software that would be able to contain the creation of new trade routes between countries, may be useful, since we resulted in this. Finally, a larger variety of scenarios, with the inclusion of price changes of oil, coal and natural gas and their results to the freight rates of LNG trade in period of financial crisis, would be a good idea for further investigation.

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Appendix

Table 27 - Total World Consumption and Production of Natural Gas, in bcm, & Growth 1970 - 2012

Consumption				Production		
Year	**in bcf**	**Growth**		**Year**	**in bcf**	**Growth**
1970	95.4	-		**1970**	96.9	-
1971	101.8	6.76%		**1971**	103.2	6.48%
1972	106.9	4.99%		**1972**	107.9	4.53%
1973	112.5	5.17%		**1973**	113.3	5.01%
1974	115.0	2.25%		**1974**	115.4	1.87%
1975	114.6	-0.32%		**1975**	115.6	0.19%
1976	121.0	5.58%		**1976**	120.0	3.79%
1977	124.9	3.21%		**1977**	125.1	4.27%
1978	130.0	4.04%		**1978**	129.5	3.54%
1979	137.9	6.14%		**1979**	138.1	6.62%
1980	138.6	0.45%		**1980**	138.4	0.21%
1981	140.3	1.28%		**1981**	141.0	1.87%
1982	140.6	0.19%		**1982**	141.2	0.13%
1983	142.2	1.16%		**1983**	141.7	0.38%
1984	153.6	8.01%		**1984**	153.9	8.66%
1985	159.4	3.78%		**1985**	159.5	3.62%
1986	161.0	0.98%		**1986**	164.2	2.91%
1987	169.0	4.98%		**1987**	172.2	4.91%
1988	176.7	4.55%		**1988**	179.8	4.39%
1989	185.0	4.71%		**1989**	186.0	3.47%
1990	189.5	2.42%		**1990**	191.6	2.99%
1991	193.6	2.16%		**1991**	193.6	1.07%
1992	194.2	0.31%		**1992**	194.7	0.54%
1993	198.7	2.33%		**1993**	199.0	2.23%
1994	199.9	0.58%		**1994**	201.6	1.27%
1995	206.5	3.32%		**1995**	204.6	1.53%
1996	215.6	4.39%		**1996**	213.7	4.42%
1997	216.0	0.21%		**1997**	214.8	0.51%
1998	219.3	1.52%		**1998**	219.6	2.25%
1999	224.5	2.35%		**1999**	225.4	2.62%
2000	232.8	3.73%		**2000**	232.7	3.25%
2001	237.5	2.02%		**2001**	239.9	3.12%
2002	244.0	2.73%		**2002**	244.2	1.78%
2003	251.1	2.89%		**2003**	253.6	3.84%
2004	258.1	2.80%		**2004**	259.7	2.42%
2005	267.9	3.80%		**2005**	269.0	3.57%
2006	274.7	2.53%		**2006**	278.7	3.60%
2007	283.7	3.28%		**2007**	284.8	2.19%
2008	290.6	2.43%		**2008**	294.7	3.48%
2009	284.8	-1.98%		**2009**	287.3	-2.51%
2010	307.3	7.90%		**2010**	308.9	7.51%
2011	312.7	1.77%		**2011**	318.4	3.10%
2012	319.8	2.26%		**2012**	324.6	1.93%

Source: Self, Data: BP, 2013

Table 28 - List of Countries with Production of Natural Gas in 2007

Rank	Country	bcf in 2007	Market Share in 2007
1	**Russian Federation**	57.3	20.12%
2	**US**	52.8	18.54%
3	**Canada**	17.7	6.21%
4	**Iran**	10.8	3.80%
5	**Norway**	8.7	3.05%
6	**Algeria**	8.2	2.88%
7	**Saudi Arabia**	7.2	2.53%
8	**United Kingdom**	7.0	2.45%
9	**China**	6.7	2.35%
10	**Indonesia**	6.5	2.30%
11	**Turkmenistan**	6.3	2.22%
12	**Malaysia**	6.2	2.19%
13	**Qatar**	6.1	2.15%
14	**Netherlands**	5.9	2.06%
15	**Uzbekistan**	5.7	2.01%
16	**Egypt**	5.4	1.89%
17	**Mexico**	5.2	1.82%
18	**United Arab Emirates**	4.9	1.71%
19	**Argentina**	4.3	1.52%
20	**Trinidad & Tobago**	4.1	1.43%
21	**Australia**	3.9	1.36%
22	**Pakistan**	3.6	1.25%
23	**Nigeria**	3.5	1.22%
24	**India**	2.9	1.02%
25	**Venezuela**	2.9	1.00%
26	**Thailand**	2.5	0.88%
27	**Oman**	2.3	0.82%
28	**Ukraine**	1.8	0.64%
29	**Kazakhstan**	1.6	0.57%
30	**Bangladesh**	1.5	0.54%
31	**Libya**	1.5	0.52%
32	**Germany**	1.4	0.49%
33	**Bolivia**	1.3	0.47%
34	**Myanmar**	1.3	0.46%
35	**Brunei**	1.2	0.42%
36	**Kuwait**	1.2	0.41%
37	**Bahrain**	1.1	0.40%
38	**Romania**	1.1	0.39%
39	**Brazil**	1.1	0.38%
40	**Azerbaijan**	0.9	0.33%
41	**Denmark**	0.9	0.31%
42	**Italy**	0.9	0.30%
43	**Colombia**	0.7	0.26%
44	**Vietnam**	0.7	0.24%
45	**Syria**	0.5	0.19%
46	**Poland**	0.4	0.15%
47	**Peru**	0.3	0.09%
48	**Iraq**	0.1	0.05%
49	**Yemen**	0.0	0.00%

Source: Self, Data: EIA, 2012

Table 29 - List of Countries with Production of Natural Gas in 2012

Rank	Country	bcf in 2012	Market Share in 2012
1	**US**	65.7	20.26%
2	**Russian Federation**	57.1	17.61%
3	**Iran**	15.5	4.77%
4	**Qatar**	15.2	4.67%
5	**Canada**	15.1	4.65%
6	**Norway**	11.1	3.42%
7	**China**	10.3	3.19%
8	**Saudi Arabia**	9.9	3.06%
9	**Algeria**	7.9	2.42%
10	**Indonesia**	6.9	2.11%
11	**Malaysia**	6.3	1.94%
12	**Turkmenistan**	6.2	1.91%
13	**Netherlands**	6.2	1.90%
14	**Egypt**	5.9	1.81%
15	**Mexico**	5.6	1.74%
16	**Uzbekistan**	5.5	1.69%
17	**United Arab Emirates**	5.0	1.54%
18	**Australia**	4.7	1.46%
19	**Nigeria**	4.2	1.28%
20	**Trinidad & Tobago**	4.1	1.26%
21	**Pakistan**	4.0	1.23%
22	**Thailand**	4.0	1.23%
23	**United Kingdom**	4.0	1.22%
24	**India**	3.9	1.20%
25	**Argentina**	3.6	1.12%
26	**Venezuela**	3.2	0.98%
27	**Oman**	2.8	0.86%
28	**Bangladesh**	2.1	0.65%
29	**Kazakhstan**	1.9	0.59%
30	**Bolivia**	1.8	0.56%
31	**Ukraine**	1.8	0.55%
32	**Brazil**	1.7	0.52%
33	**Azerbaijan**	1.5	0.46%
34	**Kuwait**	1.4	0.43%
35	**Bahrain**	1.4	0.42%
36	**Peru**	1.2	0.38%
37	**Myanmar**	1.2	0.38%
38	**Brunei**	1.2	0.37%
39	**Libya**	1.2	0.36%
40	**Colombia**	1.2	0.36%
41	**Romania**	1.1	0.33%
42	**Vietnam**	0.9	0.28%
43	**Germany**	0.9	0.27%
44	**Italy**	0.8	0.23%
45	**Syria**	0.7	0.23%
46	**Yemen**	0.7	0.23%
47	**Denmark**	0.6	0.19%
48	**Poland**	0.4	0.13%
49	**Iraq**	0.1	0.02%

Source: Self, Data: EIA, 2012

Table 30 - List of Countries with Consumption of Natural Gas in 2007

Rank	Country	bcf in 2007	Market Share in 2007
1	US	63.3	22.31%
2	Russian Federation	40.2	14.15%
3	Iran	10.5	3.71%
4	Canada	9.3	3.28%
5	Japan	8.7	3.08%
6	United Kingdom	8.7	3.07%
7	Germany	8.4	2.97%
8	Italy	7.5	2.64%
9	Saudi Arabia	7.1	2.51%
10	China	6.8	2.41%
11	Ukraine	6.5	2.28%
12	Mexico	6.1	2.17%
13	France	4.3	1.50%
14	Argentina	4.2	1.50%
15	United Arab Emirates	4.2	1.48%
16	Uzbekistan	4.1	1.43%
17	India	3.9	1.37%
18	Egypt	3.7	1.31%
19	Netherlands	3.7	1.30%
20	Pakistan	3.6	1.26%
21	Thailand	3.4	1.21%
22	South Korea	3.4	1.18%
23	Spain	3.3	1.15%
24	Malaysia	3.2	1.14%
25	Indonesia	3.0	1.07%
26	Turkey	3.0	1.04%
27	Venezuela	2.9	1.01%
28	Australia	2.6	0.91%
29	Algeria	2.4	0.83%
30	Trinidad & Tobago	2.1	0.75%
31	Brazil	2.1	0.72%
32	Qatar	1.9	0.67%
33	Belarus	1.8	0.65%
34	Turkmenistan	1.8	0.63%
35	Romania	1.8	0.62%
36	Belgium	1.6	0.57%
37	Bangladesh	1.5	0.54%
38	Poland	1.3	0.47%
39	Hungary	1.2	0.43%
40	Kuwait	1.2	0.43%
41	Taiwan	1.0	0.36%
42	Kazakhstan	1.0	0.34%
43	Austria	0.9	0.32%
44	Czech Republic	0.9	0.32%
45	Azerbaijan	0.9	0.31%
46	Singapore	0.8	0.29%
47	Colombia	0.7	0.25%
48	Vietnam	0.7	0.24%
49	Slovakia	0.6	0.20%
50	Denmark	0.5	0.17%
51	Chile	0.4	0.16%
52	Republic of Ireland	0.4	0.15%
53	Norway	0.4	0.15%

54	Finland	0.4	0.14%
55	Portugal	0.4	0.14%
56	New Zealand	0.4	0.14%
57	South Africa	0.3	0.12%
58	Philippines	0.3	0.11%
59	Lithuania	0.3	0.11%
60	Bulgaria	0.3	0.11%
61	Greece	0.3	0.11%
62	Switzerland	0.3	0.10%
63	China Hong Kong SAR	0.3	0.09%
64	Peru	0.3	0.09%
65	Israel	0.2	0.08%
66	Ecuador	0.1	0.04%
67	Sweden	0.1	0.03%

Source: Self, Data: EIA, 2012

Table 31 - List of Countries with Consumption of Natural Gas in 2012

Rank	Country	bcf in 2012	Market Share in 2012
1	US	**69.7**	21.79%
2	Russian Federation	41.1	12.84%
3	Iran	14.9	4.64%
4	China	**13.9**	4.34%
5	Japan	**11.3**	3.52%
6	Canada	**9.7**	3.04%
7	Saudi Arabia	8.9	2.79%
8	Mexico	**8.1**	2.52%
9	United Kingdom	8.0	2.50%
10	Germany	7.2	2.25%
11	Italy	6.9	2.16%
12	United Arab Emirates	6.0	1.89%
13	India	**5.3**	1.65%
14	Ukraine	5.2	1.62%
15	Egypt	**5.1**	1.59%
16	Thailand	**4.9**	1.55%
17	South Korea	**4.8**	1.51%
18	Uzbekistan	4.8	1.49%
19	Argentina	**4.6**	1.43%
20	Turkey	4.4	1.38%
21	Pakistan	**4.0**	1.25%
22	France	4.0	1.24%
23	Netherlands	3.7	1.15%
24	Indonesia	**3.5**	1.08%
25	Venezuela	**3.4**	1.05%
26	Malaysia	**3.2**	1.01%
27	Spain	3.1	0.97%
28	Algeria	**3.0**	0.93%
29	Brazil	**2.8**	0.88%
30	Australia	**2.5**	0.77%
31	Turkmenistan	2.4	0.76%
32	Qatar	2.1	0.66%
33	Bangladesh	**2.1**	0.66%
34	Trinidad & Tobago	**2.1**	0.66%
35	Belarus	1.8	0.55%
36	Kuwait	1.6	0.51%
37	Belgium	1.6	0.50%
38	Taiwan	**1.6**	0.49%
39	Poland	1.5	0.48%
40	Romania	1.3	0.42%
41	Hungary	1.0	0.31%
42	Colombia	**0.9**	0.30%
43	Austria	0.9	0.29%
44	Vietnam	**0.9**	0.28%
45	Kazakhstan	0.9	0.28%
46	Czech Republic	0.8	0.25%
47	Singapore	**0.8**	0.25%
48	Azerbaijan	0.8	0.25%
49	Peru	**0.7**	0.23%
50	Chile	**0.6**	0.18%
51	Portugal	0.5	0.16%
52	Slovakia	0.5	0.16%
53	Israel	0.5	0.15%

54	Republic of Ireland	0.4	0.14%
55	Greece	0.4	0.14%
56	Norway	0.4	0.13%
57	New Zealand	**0.4**	0.13%
58	Denmark	0.4	0.13%
59	South Africa	**0.4**	0.11%
60	Finland	0.3	0.10%
61	Philippines	**0.3**	0.10%
62	Lithuania	0.3	0.10%
63	Switzerland	0.3	0.09%
64	Bulgaria	0.3	0.09%
65	China Hong Kong SAR	**0.3**	0.08%
66	Sweden	0.1	0.04%
67	Ecuador	**0.1**	0.02%

Source: Self, Data: EIA, 2012

Table 32 - Average Growth of Natural Gas Production and Consumption by Region in Past Financial Crises

Regions	Growth	United States Financial Crisis	Mexican Financial Crisis	Asian Financial Crisis	Russian Financial Crisis	Argentinian Financial Crisis
Central & South America	Production Growth	14.38%	27.85%	6.52%	17.63%	32.37%
	Consumption Growth	14.20%	27.85%	21.08%	12.33%	23.41%
Europe	Production Growth	2.30%	10.45%	3.93%	8.72%	8.61%
	Consumption Growth	5.88%	15.86%	11.79%	11.18%	14.31%
Middle East	Production Growth	22.51%	35.75%	32.77%	33.63%	37.01%
	Consumption Growth	22.65%	37.37%	20.56%	25.86%	21.71%
Africa	Production Growth	23.63%	35.90%	31.59%	26.58%	19.11%
	Consumption Growth	13.28%	14.02%	27.71%	28.84%	29.04%
ROW	Production Growth	16.05%	5.16%	8.44%	9.65%	8.10%
	Consumption Growth	15.00%	4.26%	6.92%	13.57%	9.52%

Source: Self, Data: EIA, 2013