THE EFFECT OF PETROLEUM PRICE FLUCTUATIONS ON PROFITABILITY RATIOS OF COMPOSITE SECTOR

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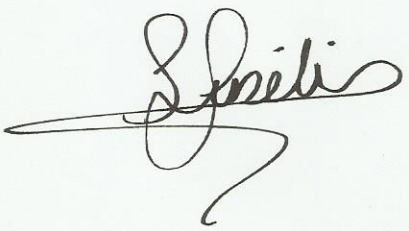

ABSTRACT

Composite industry mainly depends on chemical additives, polymer or metal matrix, and reinforcement materials. Those inputs forces industry to be highly depended to petroleum products and side products, that are crucial raw materials for composite industry. Therefore, any fluctuating variable in petrochemical sector cause a direct influence on price of resins. In this study the impact of fluctiations of oil price on composite industry is investigated by applying Non-parametric Mann Whitney and Wilcoxon tests at the points where oil price break occur. Results show that, the impact will eventually reaches to composite industry by affecting its cruical raw materials so that, the sector will response by changing demand on particular resin type, price on final product and research and development studies for product differentiation or exploration of new substitute materials.

Key Words: Composite, Oil Price, Mann-Whitney, Wilcoxon

ÖZET

Kompozit sektörünün temel bileşenleri kimyasal katkı maddelerine, polimer veya metal matrisine ve takviye malzemelerine dayanır. Bu girdiler sanayiyi, kompozit endüstrisi için çok önemli hammadde olan petrol ürünlerine ve yan ürünlere büyük ölçüde bağımlı olmaya zorlamaktadır. Bu nedenle, petrokimya sektöründe dalgalanan herhangi bir değişken, reçinelerin fiyatı üzerinde doğrudan bir etkiye neden olmaktadır. Bu çalışmada, petrol fiyatlarındaki dalgalanmaların kompozit sanayi üzerindeki etkisi, parametrik olmayan Mann Whitney ve Wilcoxon testleri uygulanarak, petrol fiyatlarındaki düşüşün gerçekleştiği noktalarda incelenmiştir. Sonuçlar; etkinin nihayetinde kompozit endüstrisinin, belirli reçine tipindeki talebin değişmesi, nihai üründeki fiyat ve ürün farklılaştırılması veya yeni ikame malzemelerin araştırılması bu gibi durumlar için araştırma ve geliştirme çalışmaları ile yanıt verebileceğini göstermektedir.

Key Words: Kompozit, Petrol fiyatı, Mann-Whitney, Wilcoxon

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1. INTRODUCTION

Composite materials are the combination of two or more materials with different physical or chemical properties in a way that remaining separate and distinct without dissolving one another, however with the chemical bond occurred between materials, final material exhibits distinct properties which are inherited from combined materials. (Callister, 2011) Basic inputs of composite sector polymer or metal matrix, additive chemicals (such as fillers, stabilizators, promoters) and reinforcement materials (i.e. fiberglass, carbon fiber), so that, inputs of composite industry makes it highly dependent on chemical and plastic industry and textile industry outputs.

Composite products can readily be used in prominent areas from basic daily life items to complex scientific materials. Main usage areas can be defined as marine, automotive, aerospace, defense industries; transportation technologies, sports and surgical equipment and those materials can be also used in amusement sector such as waterslides.

Composite Industry is considered as a major issue that has a growing potential across the World. To illustrate, in 2016, the U.S. composite materials market grew by 3.7 percent to reach $8 billion in value. It is expected to reach $10.6 billion by 2022. (Mazumdar, 2017) In Turkey, with 200,000 units of production reaches $1.15 billion in value with approximately 850-1000 production facilities. (Bulut, 2014) In the previous years, the enlargement of composite sector in Turkey is in 8-12%, the predicted growth value in 2017 will be approximately 6%. (Plasfed, 2017)

Due to the dependence to chemical and plastic industry and textile industry outputs, the sectoral volatilities also have an influence on composite sector. Moreover, those financial fluctuations are mainly resulted from the core input of chemical and plastic industry which is petroleum. In other words, most of the chemical and plastic commodity are either main petroleum products or produced as a side products from related resulting reactions.

1.1.Purpose of the Study

The purpose of this thesis is to define a breakdown for Brent petroleum price, considering the years from 2000 to 2018, annually. The time period indicates the fluctuations and breakdowns belong to Great Recession and if there is any other points that have strong breakage among compared to previous years until 2018.

Profitability ratios of 11 Chemical and Plastic Industry Companies will be discussed after the identification of breakdowns. In accordance with this purpose, necessary financial statement elements of the related companies are taken from Public Disclosure Platform (KAP), so that; before and after breakdown point, data are analyzed separately for each company by Non-Parametric Wilcoxon T-test. Overall sectoral situation at breakpoints will also be analyzed via Mann Whitney U-Test.

1.2. Importance of the Study

Composite industry, considered as currently developing sector, mainly dependent on the materials such as chemical additives, polymer or metal matrix, and reinforcement. Therefore, those inputs force industry to be highly related to petroleum products and side products.

To illustrate; unsaturated polyester and epoxy resins are crucial raw materials for composite industry; manufacturing process of those resins includes raw materials which are petroleum derivatives. Therefore, any fluctuating variable in petrochemical sector may cause a direct influence on price of resins. The impact may eventually reaches to composite industry which may react as decreasing demand on particular resin type, price on final product, import-export balance and research and development activities for product differentiation or to explore compatible substitutes.

1.3. Limitations

Due to the relevance of composite industry raw materials, companies which are studying composite material are taken to consideration. For this purpose, 11 companies are selected from chemical and plastic sector in Turkey.

2000-2018 timeline is studied in this thesis in order to analyze breakdown points. Related data is taken from Public Disclosure Platform (KAP). However KAP does not include data before 2009, for this reason, preliminary data obtained from Borsa İstanbul website.

Public Disclosure Platform (KAP) includes two companies related with composite reinforcement material. Therefore, in order to eliminate indirect results, textile sector is completely neglected in the study.

Due to the lack of chemical and plastic sector financial report data and limited number of companies to be studied on, research may be expanded by adjusting timeline as analyzing 2000-2018 financial report data quarterly.

2. LITERATURE REVIEW

In order to clarify the dynamic environment and determinants of petroleum price fluctuations, decision of evaluation test methodology; literature has been reviewed. Lack of literature resources on financial information of composite industry had been restored by searching relationship of relevant parameters with the industry.
Akgün (2006) investigated the volatile petroleum prices and their impact of 7 chosen variables on MKB-100 index by using panel data method. According to results; it is summarized that among the chosen variables, only international petroleum prices changes has an impact on MKB-100 index. However, this impact is not effecting the direction of impact by itself. (Akgun, 2006)

Due to the lack of analysis about the relation between energy prices and economical activities. Therefore, Ipek (2008) includes impacts of petroleum prices on two major effects as inflation and economic growth in Turkey, both theoretically and empirically. For that purpose for 1987- 2005 period is chosen and monthly data collection is done to apply VAR modelling. According to Granger causality analysis obtained from VAR Model, it is found that petroleum prices and economic growth has bi-directional causality relation as well as petroleum prices and inflation do. According to analysis, petroleum prices and inflation has a negative impact on economic growth. (Ipek, 2008)

In this study, impact of volatile petroleum prices on index receipts regarding 2001-2007 period is studied by Gurkan (2009) Independent variable is set as Brent petroleum prices. The daily closing price indices that are using oil in the production process or activities and traded on the Istanbul Stock Exchange chosen as dependent variable. The impact of crude oil prices on index has been analyzed by using GARCH economic modelling technique. Results of the studies shows that, the positive change in oil prices positively affected the index yields but this effect was limited and the highest effect observed on the ISE Defense Index. (Gurkan, 2009)

The relationship of petroleum prices on industry in Turkey in long run discussed by Korkmaz (2016); examines the effects of world oil prices on the industry and emphasizes on the fact that a positive but not statistically significant relationship between oil price growth and industrial production index was found. However, there is a negative but statistically significant relationship between real interest rate and industrial production index in the long term. That is, as oil prices rise, industrial

production index is increasing. As a result, inversely related relationship between the growth rate in oil prices and the real interest rate is discovered. (Korkmaz, 2016)

Apaydin (2016) studied the changes occurred on energy market ratios before and after the global crisis. Study also includes reaction of ratios against crisis and impact of crisis on global production activities. For this reason, the energy prices of the energy products of the year 2007 and the following years, the fluctuations in energy demand, supply and price in the upstream and downstream markets and the factors affecting the formation of oil prices is intended to be explained.

The liquidity crisis emerged with global crisis, affected Turkey in a macroeconomic way. Petroleum consumption has experienced a limited contraction with respect to pre-crisis period. However, the rapid fluctuations in crude oil prices have led to higher price risks and additional costs on companies with obligatory oil stock obligations, energy investments were suspended. Mark-up pricing emerged due to the high tax ratios on pump prices. So that, even though the international price of oil has a close relationship with the pump prices, the decrease has not been reflected to the consumer at the same rate. On the other hand, most oil importers benefited from the decrease in oil prices over the current account balance during the crisis. However, the improvement in the current account balance resulted from the production shrinkage in the sectors using imported energy products. Therefore, the price decreases in this period have not turned into an opportunity to reduce the import of energy products. As well as take or pay agreements have been obstacles to the realization of the desired effect without sufficient storage facilities in Turkey. As a result, the opportunity posed by oil price movements during the crisis and the tightening of financing investments in Turkey are not considered significant because of the fundamental economic characteristics of Turkey. The rapid price increases occurred immediately after the petroleum crisis has led to a further deepening of structural problems in Turkey. (Apaydin, 2016)

Production stages of composite materials, the sectors that have interest on composite material, composite production methods were explained and supported with statistical data by Bulut (2014). Moreover, problems encountered in composite industry are also mentioned such as foreign dependency raw material input, high energy cost, lack of standards and price consistency and high sectoral rivalry, low profitability, no distinctive sectoral strategic planning. (Bulut, 2014)

Karatas et.al. used diamond model to detect the competitive position of Turkey. Foreign dependency on raw material and high levels of energy cost are major challenges in the sector. The establishment of new petrochemical plants which can meet the needs of the sector and reduce the dependence on foreign sources in raw materials is vital for the sector. On the other hand, energy costs should be reduced to at least the OECD average. In the model, the government, which is assumed to have indirect effects, has a negative impact on the sector due to high tax rates and control deficiencies. (Eraslan, 2007)

In the study conducted by Demircan (2010), the bond between oil prices and inflation has investigated the case of Turkey. It has been seen that countries produce energy policy that will focus on their internal resources to reduce their external dependencies. Kun Sek et al. (2015) emphasizes the influence of oil dependency on domestic inflation and production costs of oil exporter countries.

Breitenfeliner et al. investigated short-term determinants of crude oil prices over 1983-2008 period which also confirms the idea of series of fundamental factors trigger and dominate price trends. Consumer price inflation is the main influencer on supplier side on price fluctuations. Saudi Arabia's production quota in 1990 and European demands for oil refining capacities are given as the prominence influences on crude oil price fluctuations by affecting the market structure or both supply and demand relationships. Speculation case is also considered as one of the influencers, because of the power of market participants, investment strategies etc... Although this idea is not easy to prove; it cannot be excluded out of equation for short and medium terms. (Breitenfeliner,2017)

Relationship between crude oil prices and gross domestic product (GDP) in 2000-2015 period is investigated by Khan et al. for Pakistan economy. Empirical analysis shows that rise in crude oil prices results decrease in GDP. Because of the direct influence on cost of production caused by oil prices, adversely affect production level and circumstances eventually affect economy of a country. The study supports the idea of fiscal policies of the governments also have impact on oil prices and economical state of a country, indirectly. (Khan, 2017)

2.1.Energy Sector and Conceptual Framework

2.1.1. Definition of energy

Concept of thermodynamics states that, "Energy neither be created nor destroyed." Concepts of energy conservation also adds that, "It only changes forms

physically or chemically.” So that, basic terms of thermodynamic concepts such as heat, work, energy and internal energy, heat transactions etc… occurred; which gives people the opportunity of using electricity for daily life, heat energy , mechanical and magnetic power by changing energy forms from one to another. Energy also defined as capacity to do the work by a matter or a system. (Yerebakan, 2010)

Energy originates with the four fundamental forces of physics; which are gravity, electromagnetism, weak and strong nuclear forces. These four concepts generate commercial energy in six forms: mechanical energy which associated with gravitational movements and temperature differentials such as dams, wind turbines, even human and animal power which are empowered by chemical reactions of food. Chemical energy is favoured when chemical bonds were linked or broken as in the case of combustion of fossil fuels. Thermal energy is the transaction of heat, caused by the vibration of molecules, such as geothermal energy. Radiant energy, which is mostly obtained from Sun. Nuclear energy from fusion and fission and also from the strong nuclear force. Finally, electrical energy is the electromagnetic force caused by the movement of electrons, can be transferred as in the case of alternative current and direct current. (Dahl, 2004)

Energy is and has been a fundamental component of universe since Big Bang. Only a small portion of resources have been used by pre-historic beings. However, increasing population, basic needs and concern of bringing prosperity to society are driving forces to generate more energy in different forms. Because of involving concepts of economy, engineering, forecast statistics and simulations, mathematical optimization tools; the understanding of economical use of energy is an interdisciplinary subject. (Dahl, 2004)

Growing population increase in developing countries and industrial requirements result with increase in demand of energy, which is the primary indicator of social and economic improvement of the country. In addition, energy consumption has a direct proportion with economic development and increase in welfare. (Koç, 2013)

2.1.2. Historical development of energy sector

The first energy era was started 300,000 years ago when human species started to differentiate from Homo sapiens to Homo erectus. In this era, sun was the only energy source, which provided light and heat to beings. Then lightening started fires, once people learned how to use it via flints, it became the first energy source they could control. Sun and wood provide them energy for a long time then they used wind to

move one place to another. Wind energy was the first source used in transportation. About 2,500 years ago people started to use windmills and water wheels for grinding tools. Early Egyptians collected oil from the surface of the rivers, and used as light source. (Later on, Great Britain will have the patent of oil extraction from oil shale). Afterwards Native Americans burned coal to bake clay. To acquire salt, ancient Chinese people used natural gas by heating sea water via piping gas from wells. About the same time people started to use geothermal energy, they piped hot water from wells to use in household. (NEED Project, 2017)

The Late Middle Ages and the early modern era, (during 11th century) gunpowder was discovered by China. Late 13th century Chinese cast their first guns, but Europeans were only a few decades behind. In 1600's, superior European weapon designs transformed the medieval art of war on land and gave an offensive superiority to large sail ships. Especially better weapon-making skills were depend on major medieval advances in ore-mining and metal-smelting techniques. (Smill,2004)

Discovery of steam engine had started a new era of Industrial Revolution in mid-1700's. It was also the era of coal, which had begun to replace biomass as the primary source of energy, which completely changed the world operation. Moreover, the use of coal for machinery power and electric power generation resulted increase in demand for coal; additionally, rise of population and rising energy consumption are the outputs of industrialization. (Bithas, 2016)

After industrialization, importance of steam can run the machinery and also true potential of industrial countries was revealed. In early 1800s, first steam boats and locomotives were produced. Kerosene was extracted from coal, therefore, in 1870 Rockefeller began to refine oil into kerosene in Cleveland. Volta discovered the first battery. Faraday build a generator to produce electricity from electromagnetic force. Becquerel developed first fuel cell. In Bibi-Aybul, first oil well was drilled by Russia and first North American oil well drilled Canada. Furthermore, 15 simple U.S. refineries were operational. In 1861, first global warming suggestion was mentioned. Electric bulb, intertnal combustion engines and first automobile (Daimler and Benz) were introduced to society. 40 years after discovery of oil in Pennsylvania in U.S. (while searching for a substitute for coal), mass production of automobiles has begun. Finally for this century; diesel engine invented for factories and ships, first hydro power plants were constructed in U.K. and U.S. (Dahl, 2004). Those are the significant milestones of industry and indicators speed of revolution within a century.

In early 1900s first airplane of Wright brothers powered by internal combustion engine. Inventions and productions like airplane and automobile have brought importance to petroleum. People were canalized to discover new refining and mining techniques and tools such as invention of seismograph, thermal cracking and draglines introduced for surface coal mining. (Dahl, 2004) By the way national and international governments have discovered the necessity and significance of electricity as a part of daily life. After 1930 with rising industrialization lead demands which could not be satisfied, so that, government sponsored electricity generation plants were established in order to provide electricity. (Çamcı,2005)

20th century wars were mainly depended on high explosives delivered by tanks and newly invented machine guns, missiles, torpedoes. After the development of nuclear weapons, concept of strategy and global balance of power changed completely. (Smill,2003) Since 1940, the United States had been working on developing an atomic weapon. On August 6, 1945, U.S. dropped a nuclear bomb over the Japanese city of Hiroshima. Three days later, another bomb was dropped on the city of Nagasaki. As a result of this attack, Japan announced its surrender. Moreover, in this century, energy crisis arose from Arab oil embargo, meaning the oil shipments from Middle East to U.S. and Netherlands were suspended as a revenge for U.S. and Dutch, supporting Israel during the Yom Kippur War. The historical significance of this war is being the first oil supply suspension and led price rises and worldwide energy crisis; therefore, U.S. and Western Europe countries had to revise their dependence on Middle East in terms of oil requirement; also it canalized U.S to improve its domestic oil production efficiency. (Bhattacharyya, 2011) After those incidents and strategic decisions; forecasts shown depletion of resources will arise, therefore, world started to canalize alternative resources to prevent possible energy crises.

2.1.3. Status of energy sector in the World

From the big bang to human ages, energy had an expanding influence on the evolution of Universe. In the future energy will provide a portion of needs such as light, heat, transportation, communication, mechanical power and so on. Therefore, forecasters predict the price and required energy, so that, producers will have available capacity, governments design appropriate policies, banks finance the technologies and investments will be made on suitable capital stock.

Essentially, rise in population casus more energy requirement and also results increase consumption. Figure 1 shows global population data in 2018. Global energy production leader is China followed by United States, Russia and Saudi Arabia.

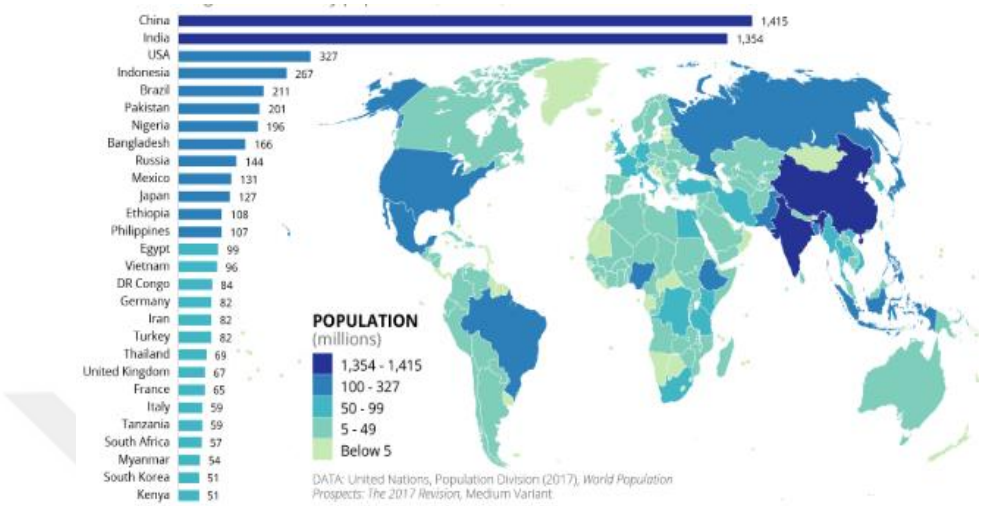

Figure 1: World population in 2018. Source: United Nations Population Division. *Note:* Energy Information Agency. (2018). https://www.eia.gov/energyexplained/index.php?page=about_home

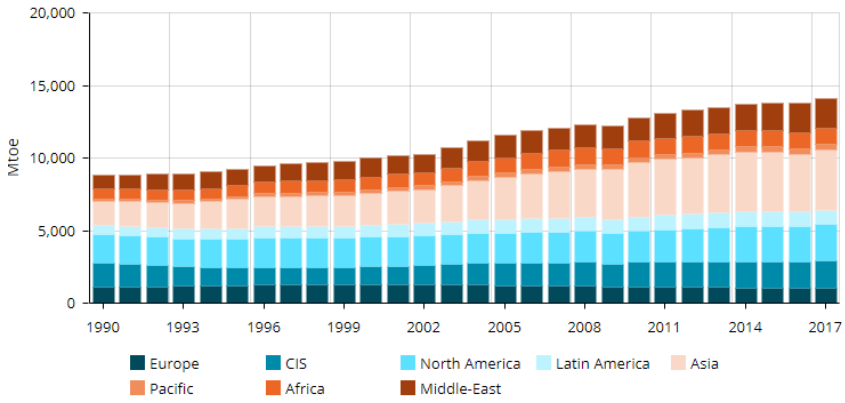

Figure 2: Global energy production between 1990-2017 years.

Note: Organization of Petroleum Exporting Countries. (2018). *Annual Statistical Bulletin*, 52nd ed. https://www.opec.org/opec_web/en/publications/4769.htm .

Table 1: First twelve leaders of global energy production.

Country	MToe
China	2,499
United States	2,018
Russia	1,418
Saudi Arabia	652
India	596
Canada	504
Indonesia	429
Iran	401
Australia	386
Brazil	293
Nigeria	250
United Arab Emirates	229

Note: United Nations Population Division (2017). https://unstats.un.org/unsd/energy/edbase.htm

Considering Figure 2 and Table 1, China is the main contributor to the increase in global energy production, as its coal output grew for the first time after three years of reduction. Higher global energy prices spurred oil and gas production in the United States, after the decrease in 2016. Energy production continued to decline in the European Union, caused by moderate growth in energy consumption, lower primary electricity production (nuclear and hydro) the depletion of oil and gas resources and the climate policy that eventually implies the exit of coal. Large oil and gas exporting countries (Russia, Iran after the end of international sanctions, Canada or Nigeria to a lesser extent) as well as the fast-developing countries (India, Indonesia, Turkey and Brazil) have been the main contributors to the energy production increase in 2017. On the other hand, Saudi Arabia's energy production was affected by the OPEC production cut agreement. (Global Energy Statistical Yearbook, 2018)

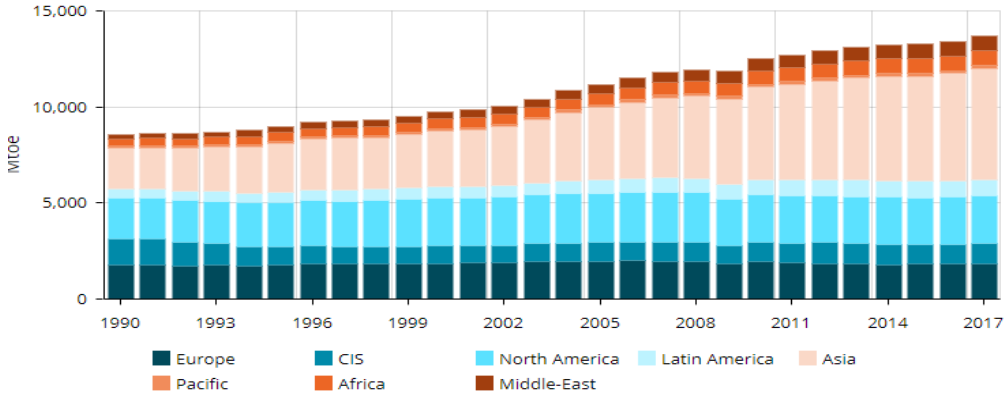

Figure 3: Global energy consumption in 2018. *Note:* United Nations Population Division (2018) https://unstats.un.org/unsd/energy/edbase.htm

Chinese energy consumption rose twice as fast as in 2016, which is the largest energy consumer in the world since 2009, because of the strong industrial demand on energy sensitive sectors, such as iron, crude steel and non-ferrous metals. (BP, 2018) It increased for the first time since 2013 in Japan, driven by the economic growth which also raised energy consumption in Europe such as Germany, France, Italy and Turkey. However; it has decreased in U.K., Canada, and Russia.
Energy consumption remained stable in the United States for the second year in a row, partly due to a lower electricity demand and energy efficiency improvements. It recovered from two years of contraction in Brazil but declined in Mexico and Argentina. (Global Energy Statistical Yearbook, 2018)

Among fossil fuels, the greatest increase belongs to natural gas which is followed by coal and oil. Biofuels and waste slightly increased their share of the world energy production in 2016. For the next year, oil reserves decreased slightly mostly because of the reduction in some OPEC countries who are the biggest reserves holders, which corresponds to 72% of world's total. World oil production remained nearly at the same level between 2016 and 2015. United States and Canada showed the biggest increase in non OPEC area. Reduction in OPEC's production due to cuts policy and Venezuela's crisis, even if Libya doubled its production and Iran continued to increase.

According to annual reports of IEA, hydro sharply increased in 2016, due to comparatively bad weather conditions in some regions for the first time in global production since 1989. Nevertheless, hydro provided 2.5% of global production in 2016. Other renewable sources such as solar PV, wind, solar thermal, geothermal, kept on expanding at a fast pace but still accounted for less than 2% of global primary energy production together. Finally, nuclear kept constant in 2016 compared to 2015, both in terms of its share of energy production and growth. According to Figure 4, China and India require more oil per unit of GDP because they are generally in a stage of the economy featured by their massive manufacturing.

Considering Figure 4 and Figure 5, with the increasing global energy demand, oil and fossil fuel reserves will sharply decrease and this situation will lead world producers head towards nuclear energy and renewable energy sources.

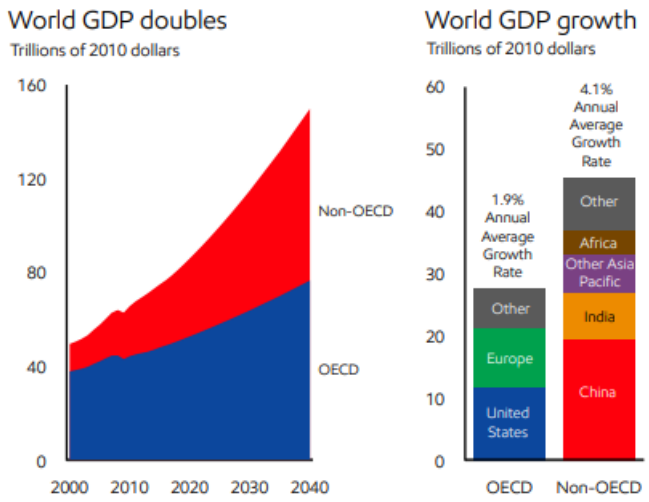

Figure 4: World GDP growth based on OECD and non-OECD countries. *Note:* BP. (June 2018). *Statistical Review of World Energy*. 67th Ed.

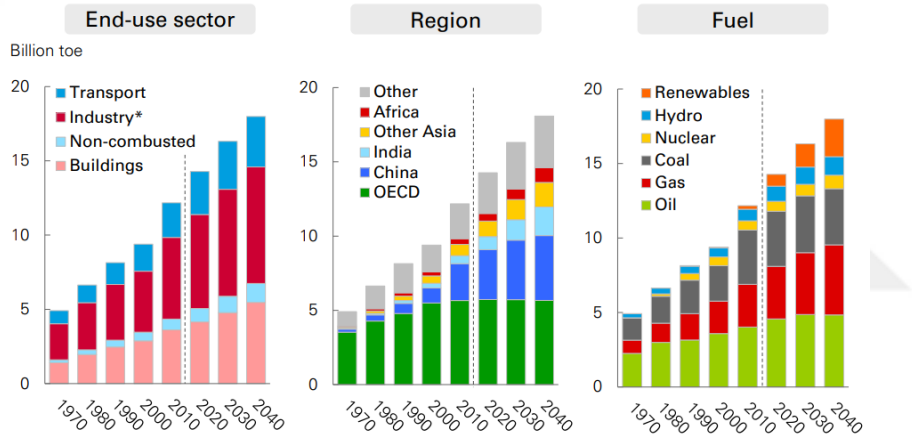

Figure 5: Regional primary energy demand forecasts. *Note:* BP. (June 2018). *Statistical Review of World Energy*. 67th Ed.

2.1.4. Status of energy sector in Turkey

Turkey is dependent on outside energy sources, due to the fact that it does not possess enough fossil reserves. In that case, Turkey has to turn towards alternative and renewable energy sources.

Energy consumption in terms of primary energy sources; coal, petroleum and natural gas sources represents the 87% of total energy sources. Although share of coal and petroleum are higher than other sources, their portion among primary resources are slightly decreased throughout the years of 2000-2016. The result is the consumption of natural source is strictly increase in 16 years. Moreover, according to

Ministry of Energy and Natural Sources of Turkey, alternative energy sources have increased their share by 14%.

According to Turkey Statistical Institution database, industrial energy consumption is around 91 million TEO. Amount of energy consumed for electricity production is reported as 46 million TEO, in addition, the biggest contribution electricity generation is provided by natural gas which is reported as 17.5 million TEO. As it mentioned before, energy consumption of natural gas is almost 32.5 million TEO, which corresponds to the most consumed energy source among primary sources. (TUİK, 2016)

In 2017, 37% of electricity generation has been provided by natural gas, 33% by coal, 20% by hydraulic energy, %6 from wind and finally, %4 of energy has been obtained from geothermal and other sources. (Ministry of Energy and Natural Sources, 2018)

Considering Ministry of Energy and Natural Resources database, amount of crude oil production in Turkey was more than 12 million barrels in 2017, 75% of this production is provided by Batman, 24% from Adıyaman and 1% is supplied from Thrace region. Daily production amount is reported as 33.784 barrels/day. It also mentioned that, priority is given on domestic petroleum and natural gas researches; for that purpose two seismic detection ship and one drilling ship will be procured.

Ministry of Energy and Natural Resources database includes that, demand of natural gas peaks in winter seasons, so that, it is possible that delays may be occurred which causes supply-demand inequalities. In order to overcome this drawback, studies are in progress to increase the capacity of storage facility in Silivri. Furthermore, Salt Lake Underground Storage Facility is also launched and further studies include its daily capacity to increase 80 million S/m^3.

2.2.Classification of Energy Sources

Energy is classified into several subdivisions according to sources and methodologies such as; chemical, nuclear, mechanical, thermal, geothermal, hydraulic, sun, wind and electrical energy. Those energy types are able to transform each other.

Considering application areas, energy sources are divided into two groups; non-renewable and renewable energy sources. Furthermore, according to convertabilities, energy sources can be grouped as primary and secondary. Mostly primary energy sources are used in the world, those sources include petroleum, natural gas, tidal, sun,

wind energies which can be used directly without converting another form. (Üçgül, 2016) On the other hand, secondary energy sources are obtained by converting primary energy sources in a different form. For instance electrical energy, fuel, LPG, coking coal, lignite are classified as secondary energies. (Koç, 2013)

2.2.1. Non-Renewable Energy Sources

Non-renewable resources are mostly occurred as a result of successive trapped carbon layers that were treated with high temperature and pressure conditions underground over 300 millions of years. As a result of this treatment, formed structure is called fossil fuel, is the base of petroleum, coal and natural gas since its carbon nature. Some of non-renewable energy sources are; petroleum, natural gas, coal, lignite, hydroelectric and nuclear energy. Non-renewable energy sources take their name from their short life span and can be depleted, according to near future projections. (Bhattacharyya, 2011)

1.2.1.1. Petroleum

Petroleum is a hydrocarbon mixture formed from plant and animal remains that lived millions of years ago. Over time the organic material underground is subjected to enormous heat and pressure and chemically breaks down into carbon atoms which forms hydrocarbon layers. Underground rock formation that blocks the movement of petroleum and causes it to accumulate in a reservoir that can be exploited. The oil is accompanied always by water and often by natural gas; all are confined in a reservoir rock, usually composed of sedimentary rock, is impermeable such as sandstones, arkoses, fissured limestones and dolomites, which prevents the upward or lateral escape of the petroleum. (Brittanica, 2018) That part of the trap actually occupied by the oil and gas is called the petroleum reservoir. A number of alternative search methods were developed in order to identify, locate and extract the fields. Geographical studies, geophysical and seismic surveys and exploratory drilling are some of the ways to fulfil the purpose, however, exploration remains a trial-error system that involves risks and significant costs. The cost of exploration increases with the sophistication of extraction. As a new reserve found, oil flows to the surface with its own pressure and also with the assistance of ground pressure below it. Due to the declines of natural pressure over the years, pressure should be sustained by means of artificially. One way to do it is pumping water into the reserve, such as ARAMCO (Saudi Arabian National Oil Company). Therefore, they are able to extract oil by injecting twice the volume of water in to the field. The amount of injected water

generally depends on the age of reservoir. The rate of extraction is also have a significance. Because if the water is extracted with a rate that is too high, water may flow pass some amount of oil and make them remain unrecoverable. The process is called secondary recovery. The resulted, extracted content is a mixture of natural gas, oil and water which will be separated into its contents before being transported or converted into commodity. (Bhattacharyya, 2011)

Among fossil fuels, petroleum receives the most attention in terms of exploratory activities. The existence of a global market is for oil and its desirable characteristics such as high heat content and various forms make oil a preferred choice for explorers.

Once the reserve is identified, crude oil is classified into various types based on physical and chemical properties. Based on gravity, crude oil is divided into two groups; light and heavy crude. Lighter crude yields lighter products to be sold at premium in marketplace where lighter crude is preferred over heavier crude. Another classification is based on the sulphur content; lower sulphur content is called sweet crude, higher sulphur content is called sour crude. Because of corrosive ability of sulphur, when burned it yields acid deposition, therefore, sour crude requires special and expensive treatment before use. Accordingly, sweet crude is sold at the market. (Bhattacharyya, 2011)

Demand for crude comes from mainly two sectors: transportation and industry which cover approximately 85 % of global requirements such as; residential, commercial, electric power generation and heating… etc. To be more precise, history with long periods of low fuel prices have led the biggest industries like transportation, infrastructure and industry, to be built around oil products. In the industrial sector, oil is mainly used for power generation or heating purposes. Raw materials are also used for manufacturing products such as plastics, industrial chemicals and asphalt. (Gyagri, 2017)

Global demand for oil in terms of usage areas as follows; 50.21% for highway constructions, 14.26% for pharmaceutical purposes, 8.94% for residential commercial and agricultural implications, 7.45 for aviation, 3.4% for marine bunkers, 2.55% for electricity generation, 1.7% for rail and domestic waterways, rest of it demanded for other industrial application. (EIA)

1.2.1.2. Natural gas

Natural Gas is firstly used by U.S in energy sector, and can be found separately from oil or in association with oil. Due to the light density, it occupies the top of the

trap and is underlain by the oil and then the water. So that, gas exploration normally follows the same methods and techniques used for oil and often gas is found while searching for oil. Therefore, gas can be described such as associated and non-associated. Secondly, natural gas can be grouped according to its dryness. Natural gas containing large amounts of condensable hydrocarbon is called wet gas. After removing the hydrocarbon contents it is called dry gas. High sulphur gas is called sour gas and low sulphur gas is called sweet gas. (Bhattacharyya, 2011)

Beside of commercial usage of natural gas; there are also industrial use such as waste treatment, preheating metal sector and also as a feedstock for manufacturing chemicals and products.

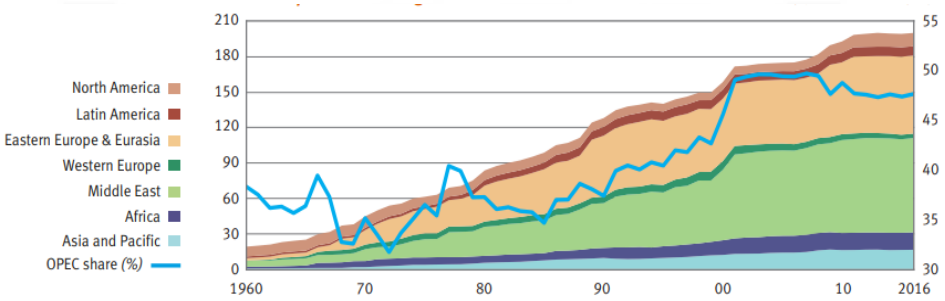

Figure 6: Global proven natural gas reserves in 2017. *Note:* BP. (June 2018). *Statistical Review of World Energy*. 67th Ed.

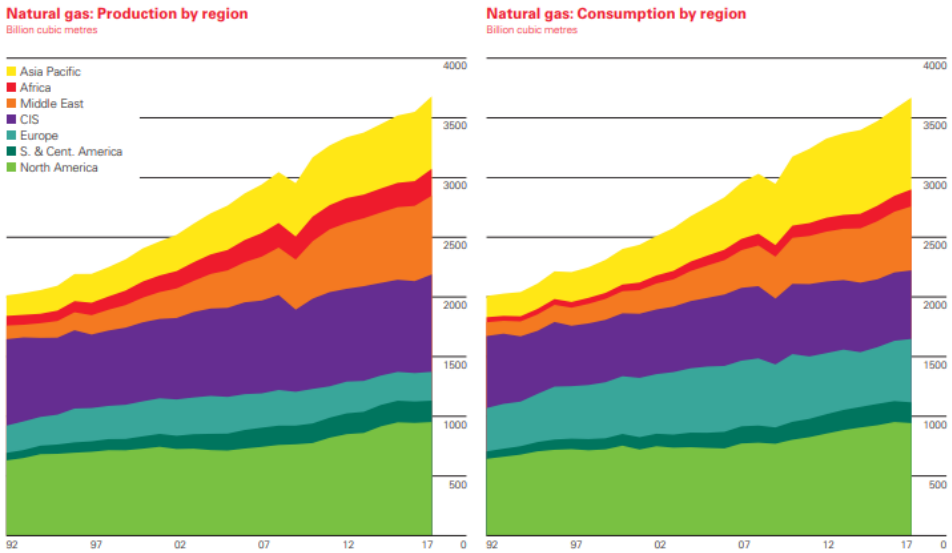

Figure 7: Global production and consumption of natural gas. Source: BP *Note:* BP. (June 2018). *Statistical Review of World Energy*. 67th Ed.

In Figure 7, natural gas production in North America and CIS regions have dominating effect on globe since 90's; additionally, because of the increasing industrial enhancements in Asia Pacific region, production requirement of natural gas also increased for the last ten years.

1.2.1.3. Coal and lignite

Coal is a black/brown coloured, heterogeneous, flammable, solid, (fossil) organic mass. That is, usually occurs in swans and contains high amount of carbon element and slightly inorganic materials such as hydrogen, oxygen, sulphur, and nitrogen elements. According to data of IEA, 25% of energy requirement of the world is provided by coal. In addition, considering global coal reserves, remaining coal in the reserves, only be enough for another 60 years. (EIA)

Exploration of coal is not widespread and coal deposits have been found while exploring other materials. Number of coal types found in literature, and there is no universal classification for coal. Depending on the fixed carbon content; coal is classified as anthracite which has lower carbon content, bituminous with dark brown to black physical appearance and lignite that has not been completely coalified. Secondly, coal may be classified into ash content and sulphur content, accordingly. High ash coals require more complex pollution control equipment which makes it less demandable for consumers. (Arık, 2016) According to Ministry of Energy and Natural Sources hard coal sectoral report, largest hard coal production belongs to Asia-Pacific Region (China and Australia).

Thermal hard coal and lignite are usually used in thermal power plants, central electricity units and industries for heating purposes. Global production of thermal hard coal had increased in late 1970, however, the production has tended to decrease after 2013 up to now. (Ministry of Energy and Natural Sources, 2018)

Among lignite producers, one of the main contributors is Turkey, which increased its lignite production to 74.1 Mt outperforming the United States, Poland and Australia, and ranking as the third largest lignite producer, given in Table 2. Greece experienced the largest increase, so that, it became the tenth largest producer in 2017. (IEA)

Table 2: Data of global lignite production.

	2015	2016	2017p
Germany	177.0	171.0	171.4
Turkey	56.7	68.0	71.7
Russian Federation	72.2	69.4	70.3
United States	67.9	67.2	64.3
Poland	63.0	60.4	61.2
Australia	65.4	61.5	57.3
India	42.2	45.2	47.5
Serbia	38.4	39.0	40.2
Czech Republic	37.8	38.2	37.7
Greece	44.3	34.2	37.7
Other	*151.7*	*159.2*	*161.2*
World	**816.6**	**813.5**	**820.5**

Data for Australia and India are provided on a fiscal basis.

Note: International Energy Agency. *World Energy Balances Overwiew*. (2018). https://www.iea.org/newsroom/events/statistics-world-energy-balances-2018-overview.html

1.2.1.4. Nuclear Energy

The nucleus of certain large atoms will split into two smaller nuclei after collusion with a neutron. In this case, the nucleus is considered to be "fissile" and the reaction is referred to as "fission". As particles with no electric charge, neutrons can gather positive charge slightly, without being repelled by the electric forces. In this manner, they are able to collide with the nucleus to split it into two parts, called fission products, which are most often radioactive. The only natural fissile nucleus is uranium-235. After fission, it releases a large amount of energy which is transformed into heat. In a nuclear reactor, this heat is recovered to generate electricity. (French Alternative Energies and Atomic Energy Commission, 2016)

Debates are still ongoing about the requirement of nuclear energy. Some countries support nuclear programs such as U.S.A., Japan, France, Canada, Czech Republic, Hungary and Republic of Korea. Some of those countries conducting nuclear programs and utilities state owned, like Korea. Some of them supports private sector to conduct reactors. Each country has its own nuclear policy. Countries like Finland, Mexico, the Netherlands, Spain, Switzerland and United Kingdom are neutral to nuclear energy and aim to hide nuclear energy as back-up plan. For example, Finnish Government treats nuclear energy like any other energy source and leaves decisions to the utilities. The Netherlands Government revised, the previous government's plan to close down the country's only operating nuclear power reactor. Countries like Belgium and Germany have set a lifespan for their reactors (40 years and 32 years) in order to collect enough power before closing them. Turkey has just made an investment on Akkuyu Nuclear Power Plant, in 2015. On the contrary, some

countries do not lean towards nuclear energy. For instance. Australia, Austria, Denmark, Greece, Iceland, Ireland, Italy, Luxembourg, Norway and Portugal do not have any nuclear power plant option. (NEA, 2004)

Those debates are mainly because of nuclear power plants are expensive to build; uranium is used as raw material, in the fusion process, which is unstable, water runs through the reactor core for cooling the nuclear fusion chamber, therefore, any fuel leakage will contaminate the which is transported to the rest of system; radioactive by products and leaks. However they are relatively cheap to run. Moreover, waste disposal and decommissioning costs are usually included in the operating expenses. Furthermore; by taking into account the social, health and environmental costs of fossil fuels the competitiveness of nuclear power is improved because of the lack of greenhouse gas emissions. (World Nuclear Association, 2018)

2.2.2. Renewable energy sources

Renewable energy sources can be defined as the resources which have longer lifespan than fossil fuels and also have the advantage of renewability.

According to IEA 2018 Outlook, due to the non-commercial use in developing countries such as, residential heating and cooking, solid biofuels are the largest renewable energy source, which represents 62.4% of global renewables supply.

1.2.2.1. Solar Energy

Solar power can be generated by two ways, one of them is photovoltaics (PV) can also be called solar cells, that mostly panels, installed on the buildings or embedded on small devices such as digital watches or calculators. The cost of manufacturing solar panels has vertically decreased in the ten years, so that it is not only affordable but also the cheapest form of electricity, having a life span of approximately 30 years. Concentrated solar power (CSP) uses mirrors to concentrate solar rays to heat the fluid (generally an oil with a high thermal capacity), so that, a steam is created through a turbine to generate electricity. CSP is commonly used to generate electricity in large-scale power plants. One of the main advantages of a CSP power plant is that it can be equipped with molten salts which heat can be stored in, allowing electricity to be generated after the sun set. (IRENA,2018)

According to T.R. Ministry of Energy and Natural Sources, geographical location of Turkey provides 2,741 hours of sunshine duration, annually. Total annual amount of solar energy is given as 1,527 kWh/m^2. Turkey will have unlicensed 4,703 MW

and 23 MW licensed, totally 4,726 MW photovoltaic cell resources, by the year of June 2018.

1.2.2.2. Wind Energy

Wind turbines first emerged after the invention of the electric generator in the 1830s, engineers started attempting to produce wind energy to produce electricity. Wind power generation took place in the United Kingdom and the United States in 1887 and 1888, but modern wind power plants has been developed first time in Denmark, where horizontal-axis wind turbines were also built in 1891 and a 22.8-meter wind turbine began operation in 1897. (IRENA, 2018)

In order to produce electricity, wind is used to convert the kinetic energy created via air in motion. Kinetic energy is transformed into electrical energy by air hitting blades cause it to rotate turbine which leads to rotational energy via moving shaft. That is connected to a generator. Therefore, electrical energy is produced by electromagnetism. The amount of generated power mainly depends on the size of the turbine and the blades. Output is proportional to the dimensions of the rotor and to the cube of wind speed. Theoretically when wind speed increases two times, therefore, the wind power potential increases by a factor of eight. (Tong, 2010)

T.R. Energy and Natural Sources Ministry states that installed wind power of Turkey will reach 6,671 MW, by the end of June 2018. Global net additions of offshore and onshore installed capacity of wind turbines are given in Figure 8. (IRENA, 2018)

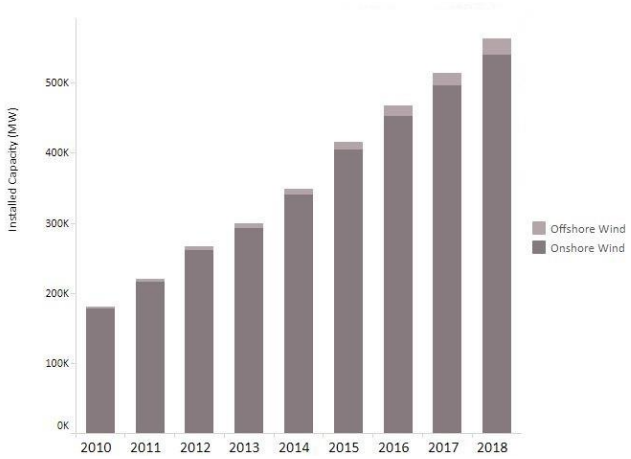

Figure 8: Global net additions of installed wind turbines from 2000 to 2017.
Note: IRENA, International Renewable Energy Agency. *(2018)* http://www.irena.org/wind

1.2.2.3. Biomass energy

Bioenergy is an energy obtained from organic matter (biomass), such as all materials of biological origin that is not occurred by geological formations (fossilised). The World Energy Council defines bioenergy to include traditional biomass (example forestry and agricultural residues), modern biomass and biofuels. It represents the transformation of organic matter into a source of energy, whether it is collected from natural surroundings or specifically grown for the purpose.

Biomass is a versatile energy source, comparing other energy sources, biomass can be converted into solid, liquid and gaseous fuels which can be used in all sectors of society. For example it is used to produce electricity, transportation, to provide heating and cooling and to maintain industrial processes. Moreover it also corresponds to largest energy source among renewables. Major drive forces of biofuel energy development are climate change and energy independency. It is considered as the most viable and sustainable option in replacing oil independency. (World Energy Council, 2016)

Biomass waste capacity of Turkey is stated as 5.6 MToe and the maximum production capacity is presumed as approximately 1.5-2 MToe by Energy and Natural Sources Ministry.

1.2.2.4. Hydrogen Energy

Hydrogen energy is an ideal carrier produced from hydrocarbons. Due to the facts that, it can be produced from and converted into electricity at high efficiencies, its raw material is water, completely renewable, can be stored in multiple forms such as, liquid and gaseous phase and metal hydrates, can be transported through pipelines or by tankers, can be converted into other energy forms with a higher efficiency. (Veziroğlu, 2003)

Turkish Republic Ministry of Energy and Natural Sources mentions that, hydrogen energy is clean, can be used easily and 33% more efficient than petroleum fuels. Moreover, by products of the system is only water and steam. Therefore, there is no environmentally toxic and harmful chemical gas is emitted. However, this energy source is three times more expensive than other fuels, the widespread of hydrogen energy depends on cost-effective economic developments and ideas in terms of production expenses.

The study of Edward and colleagues also supports that hydrogen proposes a potential for catalysing the transition of todays' carbon-based economy to a sustainable structure without emissions and climate change. (Edward, 2007)

1.2.2.5. Geothermal Energy

Geothermal energy is generated within the earth and can be used directly for heating or transformed into electricity. An advantage of geothermal energy comparing other renewable energy sources is the availability year-long and can be found around the globe. On the other hand, for electricity generation, medium- to high-temperature resources, that are usually located close to volcanic regions, are required. (IRENA, 2017) This energy is used for different purposes such as electricity generation, house heating, agriculture, fishing and so on. (Koç, 2013)

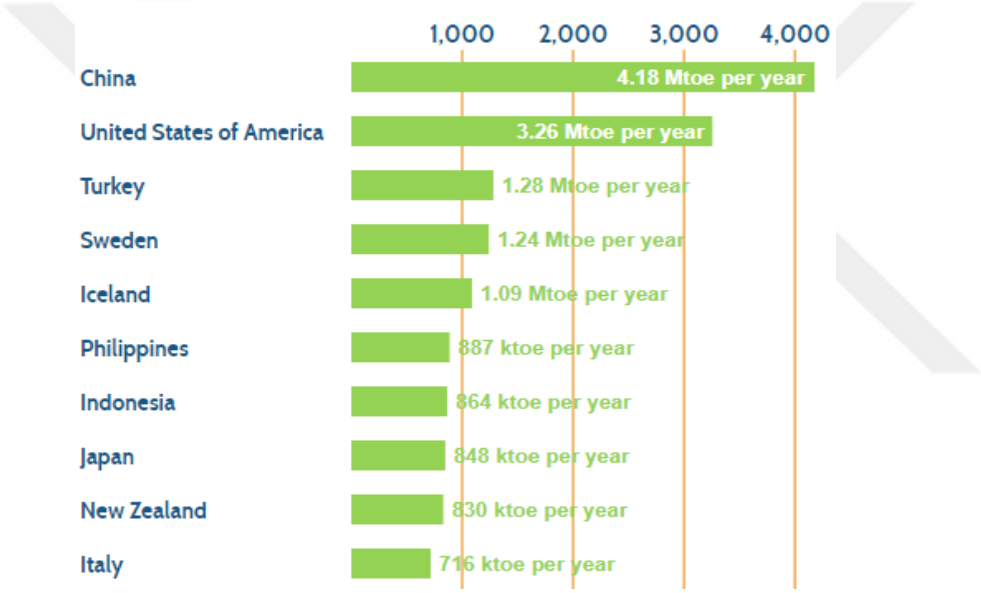

Figure 9: Top geothermal energy producers in 2016. *Note:* World Energy Organization. (2018). https://www.worldenergy.org/data/resources/resource/geothermal/

Turkey is the third biggest geothermal energy producer in the world, producing 1.28 Mtoe per year, after China and U.S.A, according to data of WOE Renewables information Overview 2018.

1.2.2.6. Hydroelectric energy

Hydro power is obtained by taking advantage of conversion of potential energy into kinetic energy. Working principle of hydro plants depends on the water cycle which occurs by solar energy cause evaporation by heating the surface of lakes and rivers, evaporated water rises and condenses in clouds then falls as rain and snow, that are collected in streams and rivers and the cycle goes on. Hydroelectric plants are

usually built near or on water source. The elevation of water changes by falling one point to another. Flowing water carries energy and pushes blades in a turbine, so that, the generator produces energy. (EIA)

Hydroelectric energy is the widest and cheapest energy source in the world. As other energy sources, it also has advantages and drawbacks. For instance, large scale applications results with loss of biodiversity, water-cut of free falling streams, re-location of settlements are some of the problems that hydro plants cause. On the other hand, hydro power does not emit greenhouse gases directly. U.S.A., China, Canada, Brazil are primary hydro power producers. (Önal, 2010) Total global shares of renewable supplies data was taken from International Energy Agency.

2.3. Petroleum Industry

2.3.1. Definition of petroleum

Petroleum has formed as early as life (nearly half a billion years ago), which is called Precambrian Period. From the Precambrian to Devonian Period, mostly marine organisms (algae, phytoplankton and bacteria) served as source of petroleum. The decay of organisms were prevented by anaerobic conditions. As the piled sediment subjected to bacterial actions that caused kerogen formation. Eventually pressure and approximately 60-120℃ of temperature allowed oil formation and 120-225℃ of temperature allowed gas formation. The gas and oil leak through interconnected porous rocks until come across to an impermeable rock in which they accumulate. (Dahl,2004) World's largest oil fields and age of reservoirs are given in the Table 3 below.

Table 3: World's 5 largest oilfields and ages.

Field	Country	Age of Reservoir	Primary Reserves (BillionBarrels)
Ghawar	Suudi Arabia	Jurassic	88
Burgan Field	Kuwait	Cretaceous	72
Ahvaz Field	Iran	Oligocene-Miocene-Cretaceous	65 25 Recoverable
Gach Saran	Iran	Oligocene-Miocene-Cretaceous	66 21 Recoverable
Upper Zakkum Oil Field	Abu Dhabi	Cretaceous	50

Note: Dahl, C.A. (2004). *International Energy Markets*. Colorado School of Mines: PennWell Corporation.

In 2017, proven oil reserves were detected as nearly 1.7 billion barrels. 47.6% of oil reserves belongs to Middle East, 19.5 %South and Middle America, and 13.3% of oil reserves present in North America. Crude oil provides 33.7% of global energy demand in 2017. (World Energy Council, 2016) 70% of global oil and natural gas reserves are positioned close to Turkey, geographically and Turkey also takes place and supports significant projects with Middle Asia, Middle East and Caspian Region to be a natural "Energy Centre" among consumer markets in Europe. Furthermore, the demand in primary resource that will be increased up to 40%, will be provided by this geographic area is forecasted up to 2030. (Ministry of Energy and Natural Sources, 2018)

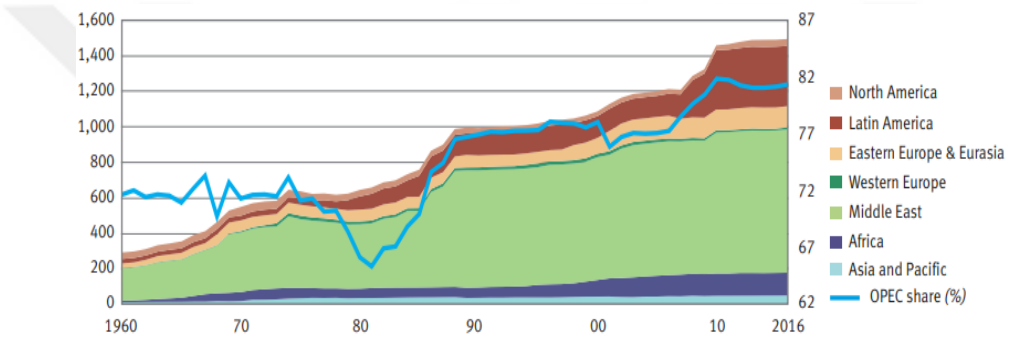

Figure 10: World's proven oil reserves in terms of billion barrels. *Note:* Organization of Petroleum Exporting Countries. (2018). *Annual Statistical Bulletin*, 52nd ed. https://www.opec.org/opec_web/en/publications/4769.htm .

2.3.2. History of petroleum

According to articles of Cevat E. Taşman who is the first geologist of Turkish Republic; although first petroleum reserve was discovered by Colonel Drake in Titusuille in 1859, there are evidences that asphalt and derivatives were used in the eye holes of statue of Sumerian Emperor which is sculptured in 3000 B.C. and currently exhibited in İstanbul Museum. Moreover, the bricks of bridge on Fırat River, which was built by King of Babylon Nebusadnezzar, contains asphalt sealant. Furthermore, it is also discovered that the tunnel under Fırat River, built by Semiramis who was the Queen of Babylon, also mortared by Bitumen. (Taşman)

With the invention of lightbulb, electric industry created and gained importance, while oil industry lost its fundamental market. The invention and mass production of automobile industry has changed the fate of oil derivatives. Although, early models were powered by steam and electricity, it was found out that gasoline-powered

engines were the most practical design. With the construction of gasoline filling stations, the consistent supply of fuel was also provided. Eventually, gasoline-powered automobiles captured the market.

Oil industry also change the course of WW1, at first horses were used and caused logistical and food stock problems. Motorized transport began to dramatically change the nature of war and the development of the airplane and the tank, which were used at the Battle of the Somme in 1918 first time, provided both mobility and power.

In WW1 period, giant petroleum companies, called Seven Sisters, were established and rule the oil sector which were made of seven American and British firms. British Petroleum, London headquartered Royal Dutch Shell, Gulf Oil of which became part of British Petroleum and the other parts joined to Chevron, Standard Oil Company of California which is today's Chevron, Texaco, part of which merged with Chevron, Exxon and Mobil merged to form Exxon-Mobil. Those companies controlled 85% of the global oil reserves, because they were well-funded and well-organized and also operated effectively.

This situation has shifted dramatically away from the Seven Sisters Oil Companies over to a combination of the OPEC oil cartel nations as well as several state controlled gas and oil companies in the emerging world economies.

2.3.3. Main petroleum products

Petroleum products are fuels obtained from crude oil and other mixtures of hydrocarbons contained in natural gas. Petroleum products can also be obtained from coal, biomass and natural gas. After crude oil is removed from the ground, it is sent to a refinery where different parts of the crude oil are distillated into useable petroleum products, shown in Figure 11. These petroleum products include ethane, LPG, gasoline, naphtha, bitumen, white spirit, diesel fuel and heating oil, jet fuel, petrochemical feedstocks, lubricating oils, waxes, and asphalt. The commodities produced from petroleum products can be counted as detergents, fertilizers, synthetic fibers, plastics, candles and band-aids. (Parkash, 2010) Light (lower density) and sweet (low sulphur content) crude oils usually priced higher, mainly because of gasoline and diesel fuel, selling significantly premium to residual fuel oil and other types of "bottom barrel" products which are produced easier and cheaper by using light and sweet crude oil. Furthermore, light and sweet crude oil is more demandable, due to the less complicated energy intensive processes. (World Energy Council, 2016)

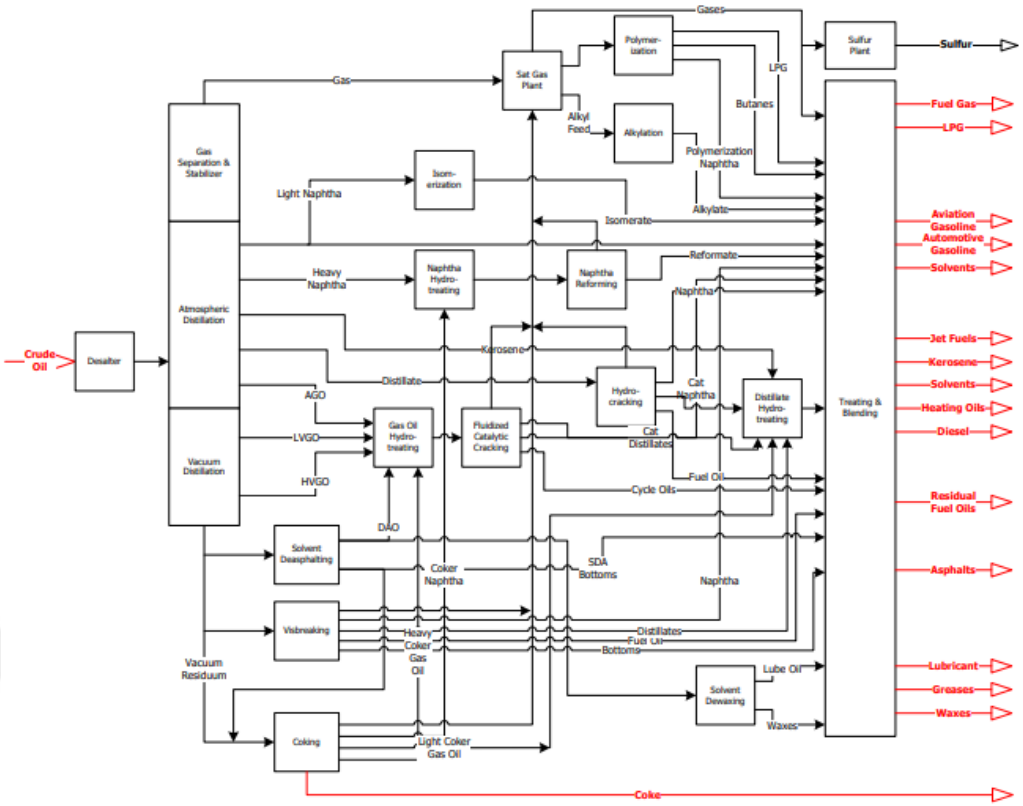

Figure 11: Crude oil distillation diagram and examples of some of the petroleum products. *Note:* Jechura, J. (2017). *Refinery Feedstocks: Products, Properties and Specifications.* Colorado School of Mines and Engineering.

Currently, PETKİM is producing petrochemical derivatives in Turkey. Thermoplastics, raw materials for fibers, olefins (ethylene and propylene), aromatic solvents (i.e. toluene, benzene and para-xylene etc…) and other carbon mixtures are among their products. Those products are essential elements for production mechanism of chemistry and plastic sectors and as well as composite industry who will use them as input/ raw material in their production.

2.3.4. Status of Petroleum Industry in the World

1.3.4.1. Petroleum production in the World

OPEC 2017 Outlook data show that, world crude oil production slightly increased to 0.35mb/day or 0.5 per cent, as compared to 2015. The majority of non-OPEC countries registered substantial declines according to 2016 average crude production, compared to 2015. The biggest declines were for the United States, (–5.7 per cent) and China (–7.2 per cent). In 2016, the top three crude oil producing countries were Saudi Arabia (10.46 Mb/d), Russia (10.29 Mb/d) and the United States (8.88 Mb/d). (OPEC, 2017)

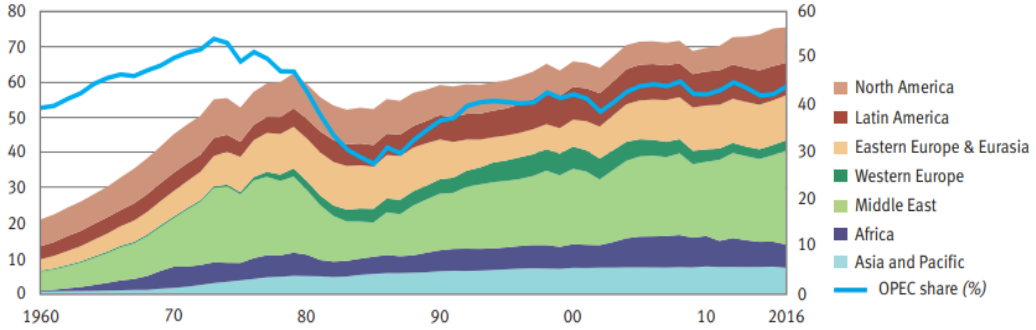

Figure 12: Global crude oil production in terms of billion barrels. *Note:* Organization of Petroleum Exporting Countries. (2018). *Annual Statistical Bulletin*, 52nd ed. https://www.opec.org/opec_web/en/publications/4769.htm .

In 2017, world oil production, slightly increased to 95.3 Mb/d considering 2016 data (95.1 Mb/d). Production increased to 2.6% in the OECD. At the country level, OECD growth in 2017 was mainly driven by large production increases in the United States +4.2 and Canada +8.1% which outweighed declines in Mexico -9.6%. On the contrary, the significant decline happened in Saudi Arabia -4.0%, Venezuela -12.2%. Libya and Iran increased their production percentages to +102.8 and +7.3. According to IEA 2018 Outlook, The United States was the world's top producer once again (620 Mt) followed by Saudi Arabia (560 Mt), the Russian Federation (548 Mt), Canada (242 Mt) and Iran (229 Mt) who has overtaken Iraq as the fifth largest producer. (IEA, 2018)

1.3.4.2. Petroleum Consumption in the World

Petroleum consumption generally depends on economic functions of countries rather than their population and region. Because of that reason countries that are economically active and have developed industries generally direct the oil consumption values. U.S., France, Italy, Canada, England, Germany, Russia and Japan (the G-7 countries) have biggest pace on global oil consumption. (BP, 2018) According to BP Outlook, in 2015, global oil consumption has given as 94 Mb/day, this value was increased to 98 Mb/day in 2017. Considering given data in BP Outlook, Asia Pacific and Africa have shown great increase in consumption.

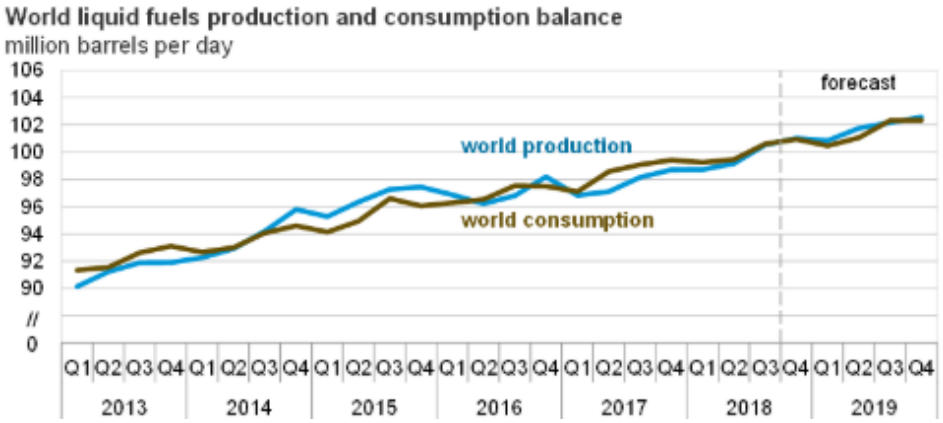

Figure 13: Global oil production and consumption balance.
Note: Energy Information Agency. (2018).
https://www.eia.gov/energyexplained/index.php?page=about_home

2.3.5. History and Progress of Petroleum Sector in Turkey

Petroleum exploration issued in Turkey with the initiatives of İsmet İnönü in 1930's that led to establish of Petroleum Exploration Department which was combined with mineral exploration and resulted to establish of Mineral Research and Exploration Institute. The exploration of Raman-1 reserve in Batman gain the title of first petroleum exploration in Turkish Republic in 1940 and started to operate in 1945. In 1954 Petroleum Market Law was introduced by Geologist Max Ball which supports the national and foreign investments that led to establish of Turkish Petroleum Corporation. Due to the issued new law daily production of Turkey reached 70,000 barrels between 1954 and 1973. However, in 1974 Petroleum Reform Law had been restricted that restriction led many foreign investors to slide their investments to other countries. In 1984 through 1991 liberal regulations gave speed to petroleum productions, again. In a short time, petroleum production had its peak and reached to 4.4 Mto/year. However; in 1992 to 2008, some of the provisions of the law were cancelled or restrained by the court order. Those restrictions caused massive reduction in production of petroleum. By the end of 2001, yearly production had reduced to 2.55Mto which was providing 9% of national consumption. In 2016 the values were not different from the past. It is projected that if the tendency does not change in short run, the external dependency of Turkey will be increased. (PETFORM, 2008)

Energy and Natural Sources Ministry of Turkey states that exploration facilities in black sea and Mediterranean regions were accelerated and sea drilling activities have gained importance by means of recruiting 1 drilling ship and 2 seismic

exploration ships. According to the data given by Energy and Natural Sources Ministry of Turkey; the amount of crude oil import is given as 25 Million tonnes and imported petroleum product is 16.8 Million tonnes, whereas, the amount of exported petroleum goods were given as 10.1 Million tonnes, in 2017. (Energy and Natural Sources Ministry, 2018)

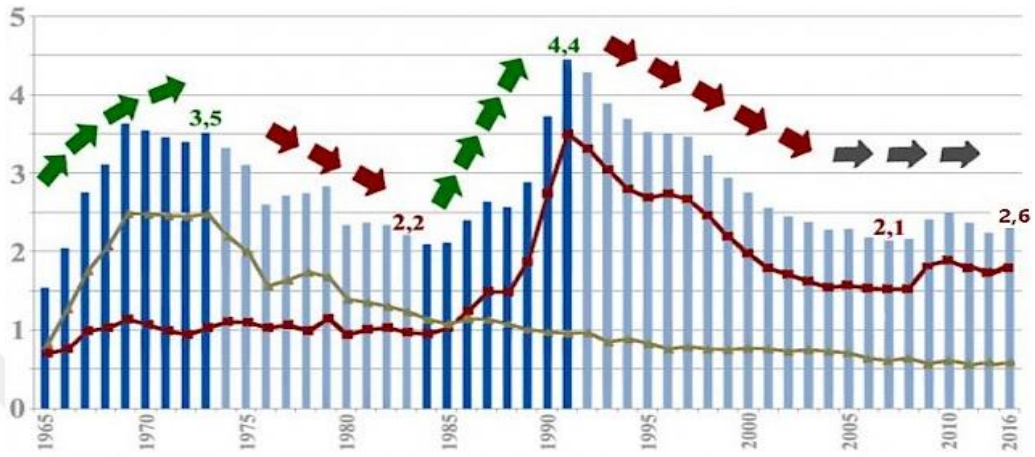

Figure 14: Petroleum production in Turkey in 1965-2016. Note: PETFORM. (2008). Retrieved from: https://www.petform.org.tr/arama-uretim-sektoru/turkiyede-petrol-uretimi/

2.3.6. Organization for Petroleum Exporting Countries (OPEC)

The Organization of the Petroleum Exporting Countries (OPEC) established at the Baghdad Conference in 1960, by Iran, Iraq, Kuwait, Saudi Arabia and Venezuela. Current headquarters is in Vienna, Austria. Other members (Qatar, Libya, U.A.E., Algeria, Nigeria, Ecuador, Angola, Gabon, Equatorial Guniea, Congo) joined to the founder members. (OPEC, 2018) Initial headquarters of OPEC was in Geneva, Switzerland in the first five years of its existence then moved to Vienna, Austria in 1965. (OPEC, 2018)

During initial phase of OPEC in 1960, it mainly focused on three issues which were production control, tax system changes and steps towards nationalization concessions. Their short term objective was maximizing surplus shares of producers by reducing the tax deductions by disallowing market allowance, expensing royalties and increasing tax reference price. Secondly, The Manifesto in 1978 help national oil companies to develop oil reserves and supported national participation by purchasing of operating concessions as well as development of relinquished ones. (Bhattacharyya, 2011)

The 1970's brought politics to the oil market and the dependence on production from Middle East materialized. (Simmons 2005) Since 1970, OPEC has gained power by the virtue of its size, controlling the half of the global crude oil production. Therefore, it had a position to influence prices through manipulation of production. Fattouh (2007) studied about constraints of OPEC oil pricing power in terms of its tendency to be influenced by market conditions and geographic area.

In 1980's oil prices had begun loosen; due to the excess of surplus, major amount of consumers had started to stay away from hydrocarbons. This situation had led to lowest revenues and economic crisis in producer countries. In 1985, non-OPEC producers filled the market. OPEC countries concentrated on rising market share, so that, price war began. (Bhattacharyya, 2011)

At the beginning of 90's safety issues and environmentally friendly materials and conditions had been started to mention. The collapse of Soviet Union and the Asian economic crisis severely affected and dampened the global oil growth due to the poor demand. During this period OPEC had worked through quota and supply adjustments which helped price stabilization in the market. Although non-OPEC producers were dominating the supply, OPEC had organized well effectively in terms of management of excess capacity phase also it increased its market share. That led to an encouragement among OPEC countries. (Bhattacharyya, 2011)

In 2000, prices showed a greater volatility and high prices, which are described as the highest values seen in the previous 15 years; except the Gulf War, were sustained. Although prices were fell sharply because of 9/11 attack; it started to rise again in 2002. At the beginning of this era, new entrants had taken place because of the attraction of high prices. In other words, cheap era was over. However, the prices were collapsed as the financial crises in the Western banking and also financial sector was damaged after the collapse of the one of the biggest Wall Street player who was Lehman Brothers. The world was having a deep recession, while injecting money into financial sector. Subsequently, oil sector, OECD economies were also entered in a deep recession, oil demand fell sharply. After the reappearing of spare capacity OPEC gained some market controlling power again.

Nowadays, the objective of OPEC is to co-ordinate and unify petroleum policies among Member Countries who produces around 43% of the total crude oil and more than 20% of the natural gas requirement globally; possess approximately 80% of the world's crude oil and 48% of the global natural gas reserves, in order to secure fair

and stable prices for petroleum producers; an efficient, economic and regular supply of petroleum to consuming nations; and a fair return on capital to those investing in the industry. (OPEC, 2018)

2.3.7. Organization for Arab Petroleum Exporting Countries (OAPEC)

OAPEC has firstly arose in public knowledge during Yom Kippur War, in 1973. War was among Arab states, Egypt and Syria versus US backboned Israel and can also be described as an extension of the Six Day War in 1963. As a result of this war Egypt and Syria had lost regions to Israel who was lack of weapon and supply that makes them depended on the west. Meanwhile Saudi Arabia was in close relations with U.S. in terms of oil venture, however, due to the war, King Faisal felt uncomfortable, so that, he gathered oil ministers and announced 5% of collective supply reduction. Furthermore, Saudi Arabia also cut 10% of their production and placed embargo on U.S. and Netherlands oil shipping hub. In addition, Saudi Arabia also increased their share to 20% of ARAMCO, as a beginning. Soon, ARAMCO will be 100% nationalized Oil Company. As a result of this embargo oil price has climbed from 4$/ barrel to 10$/barrel in a month, while other oil companies have not got the opportunity of compensating this production drop. This act caused an inelastic behaviour in oil market for the first time. The most significant outcome of this set occasions is that, from now on politic reasons and aspects have been included to the oil market and also dependence on Middle East oil production has been clearly recognized. Other oil producing countries did not have excess capacity to compensate for the production drop. This was the first time when the oil market showed its inelasticity, a feature that would continue to move prices from then on. Another reason for the strong price reaction was psychological. Market participants had to consider oil in a completely new and different way. (Simmons, 2005)

The difference between OAPEC and OPEC is that; OPEC is open for any other country who produces oil in large scale and aims to regulate the prices and maintain the stability, whereas, the OAPEC is only open for Arab oil exporting countries and aims to develop industry of member countries regarding the extraction and production of oil, and also creates investment opportunities in the member countries, because oil is as a source of national income that should help to boost the industry and economic conditions of each Arab country That is the reason why OAPEC is formed by Saudi Arabia, Libya, Iraq, Kuwait, Algeria, Qatar, Egypt, Syria, Bahrain, Tunisia, and United Arab Emirates and excludes countries such as Venezuela, Nigeria and Iran.

Headquarters of the organization is in Kuwait. Both of these organizations work independently. (Ozturk)

2.4.Petroleum Prices

2.4.1. Factors should be considered in managerial aspect

According to the study of Gyagri and colleagues in 2017, prices are indicators of supply and demand pressures on the given time frame. In order to maintain supply levels for the future purposes with the production efficiency of given time, prices adjust when the demand of petroleum products are high. High prices encourage investors and the producers, so that, supply levels increase, it is subsequently followed by lowering price of oil and the commodities.

Secondly production is also considered as a driving force for Gyagri and friends. Using the reserve effectively considering lower reserve-to-production ratio also preserve producers to deplete their reserves with respect to producers using higher rate of production. Cost of production also affected by the conditions, locations and compositions of the reserve. Some of these factors lead to differing costs of extraction. On the contrary, technologic developments have decreased the marginal cost of oil production and also increased the supply, such as horizontal drilling and deep offshore explorations. Those improvements gave the opportunity of obtaining the crude oil that was unrecoverable before.

Additionally, brokers and market speculators who are just guessing the price while having no intention to buy the product, have also impact on oil prices. According to the Chicago Mercantile Exchange (CME), the majority of futures trading is done by speculators as less than 3 % of transactions actually meet with the purchaser. Exchange value of U.S. dollar also has an impact on crude oil price because crude oil is traded globally in U.S. Dollars. If US dollar depreciates against other currencies, countries with non-dollar appreciating currencies will enjoy, on the other hand, consumers in US Dollar-pegged countries pay a higher price for the same barrel of oil. Changes in the US Dollar will therefore affect world oil demand, indirectly.

Finally, more than 90% of the world’s proved reserves are controlled by governments. Therefore, political imperatives have a major influence on the investments in exploration and production that will affect future prices, eventually. Oil investments in producer countries must strive against with a number of other priorities that are related to the welfare of the society, including social and health

programmes and other investments to diversify the economy away from dependence on oil production. Governments should also provide subsidies on petroleum products for transport, agriculture, industrial and other economic activities to control inflation. Energy policy and taxes in oil-rich countries also affect the price of oil, so that, if a government bans oil exploration in a place with proven reserves, it could lead to a reduction in oil supply. Political instability among countries especially oil producing zones, tensions may arise due to the eruption of long-standing historic rivalry among countries and tribes, religious differences and the control of power and valuable resources like petroleum.

2.4.2. Impact of petroleum price on energy markets

In 2018, maximum recorded Brent oil price was 85.83 US dollar/barrel, lowest price was identified as around 59 US dollar/barrel in the same year. The average value for Brent oil in 2018 is recorded as 73.06 US dollar/barrel.

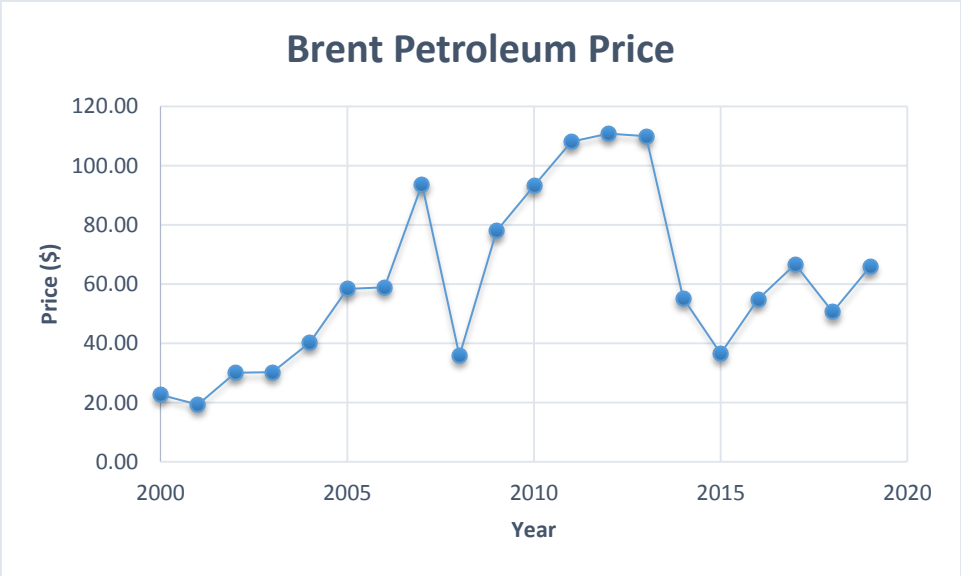

Figure 15: Historical data of Brent oil price 1976-2018. *Note:* Turkiye Is Bankasi

As a result of driving forces mentioned before, according to the data given on Figure 15, excluding small fluctuations, global petroleum market had proceeded steadily successive years until 2000. After 2008 global crisis, the fluctuations became more frequently. In 2014, oil price made its peak to 111.63$/barrel. Main drivers of this rise is caused by rapid efficiency gained in U.S shale oil production and inability of supply- demand regulations by OPEC.

According to data taken from Energy and Natural Sources Ministry, Energy Efficiency Report published in 2018, consumption of primary resources in Turkey

increased by 71.5% and reached 136Mtoe, in Turkey, and ratio of exported oil products is given as 75%. Energy intensity of primary resources of Turkey is given as 0.12Koe/2010$, which is slightly higher than OECD countries, considering their average energy intensities' is 0.11 Koe/2010$. However comparing energy intensities of EU countries (0.09 Koe/2010$), this value remains quiet higher.

Coal, petroleum and natural gas are prominent primary energy sources. During 16 years, total share of those three primary sources was 87% in 2016. Between 2000 and 2016, total share of petroleum and coal was decreased and share of natural gas was increased by 12.4%. In other words, the decrease was substituted by natural gas in 16 years. Although, alternative resources do not have much share in overall supply, it has shown the highest rise by 14.4 annually. More over among those years, electricity consumption was increased by 4%. (Energy and Natural Sources Ministry, 2018)

According to General Directorate of Energy Affairs, final total energy consumption shares in industry, residential and agriculture sectors were decreased in 2016; whereas, transportation and service sectors were increased. Insulation applications, efficient heating systems may had an effect on the decrease of energy consumption in residential industry.

According to data given by T.R. Is Bankasi, it is found that energy imports have close relationship with Brent oil prices in Turkey. Therefore, with the drop of oil price, Turkey should evaluate this chance by taking actions in order to decrease its foreign dependence.

2.4.3. Impact of Petroleum Price on Financial Markets

Due to the fluctuating prices, oil is an important source of income for the countries engaged in the trade and may be a great expense item for the importing countries. In oil importing countries, as well as increasing oil prices, inflation and input costs have been on the rise, while demand for non-oil products may also fall. Saving in government expenses, the growth slows and tax revenues decrease while budget deficits emerge. While this increases interest rates, the rise in oil prices typically results in a pressure on nominal wage levels as wages resist against the real decline. The fall in demand is increasing (at least in the short term) by adding pressure on wages. With the addition of price pressures to the fall of demand short run unemployment shows increase. The fluctuation in oil prices has played an important role in monetary policies especially in recent years. Prices are adversely affected by the lack of demand against the regular increase in demand for crude oil.

According to the study made by Ozturk in 2014 about dependence of crude oil prices and exchange rates on stock market indices using Copula approach, The fall in oil prices is a positive development for energy importing countries such as Turkey. The biggest risk in the economy is the high current account deficit. The rise in oil prices triggers low exchange rates and the dependence of the industry on imports of intermediate goods. Therefore, a fall in oil prices will close the current account deficit and accelerate growth. Falling oil prices will affect the prices of goods and services and slow down the pace of inflation.

The increase in oil prices has a negative effect on international trade balance and exchange rates. With the increase in prices, the balance of payments of the oil importing countries deteriorates and the current account deficit starts to increase. Therefore, the value of imported goods decreases and national income decreases.

Due to the increasing production costs, petroleum prices impacts inflation negatively. The negative effect of rising petroleum prices on the inflation may be prevented by decreasing national demand and taking exclusive monetary actions. In spite of the increase in oil prices, the Central Bank may increase interest rates in order to meet its annual targets. This situation causes the economic activities to shrink.

To sum up, oil price fluctuations may affect even the most powerful economies which results in world trade volume shrinkage. Developed economies go to protectionism in order not to be affected by fluctuating oil prices. In developing countries, import demands decrease, so that, country's income is restricted

2.5. Plastic and Chemical Industry

2.5.1. Histories of Plastic and Chemical Industry

History of chemical industry begins and started to develop in 12th century with the Arabic Art by alchemists. After 18th century chemical reactions and methods and application areas were discovered in England. By the 19th century England was in the leading position on producing inorganic chemical materials. Production of synthetic paint, acceleration in gaining know-how and using the knowledge caused Germany replacing England in the second half of 19th century. USA took that leading role with the production of synthetic polymer fibers in order to be used in WWII.

At the beginning of the 20th century, only a few chemical establishments which are manufacturing soap, liquor-ice extract, Vilonia extract, etc., were present within the boundaries of the Ottoman Empire. After the establishment of the Turkish Republic, corporation and production began in areas such as explosives, medicine, agricultural chemicals, detergents, printing ink and textile dyes. Among 1960 and 1980 economic policies were based on import substitution and public sector investments were canalized to petrochemicals, fertilizers and basic organic and inorganic chemicals the fields which required high investment, with low profitability. (Ministry of Economics, 2018)

TÜPRAŞ (Turkish Petroleum Refineries Corporation) is the only integrated refinery in Turkey with four refineries in Izmit, Izmir, Kırıkkale and Batman. Besides, PETKİM Petrochemical Holding Inc. which is the only integrated petrochemical complex in Turkey that operates in Petkim-Aliağa complex in which, a wide range of petrochemicals; all common plastics (HDPE, LDPE, PS, PVC, and PP), aromatics, ethylene glycol, phtallic anhydride, terephthalic acid, carbon black, synthetic rubber, acrylonitryl and caustic soda are produced. Total production of these petrochemicals meets about 30 % of domestic demand. (Ministry of Economics, 2018)

Turkey also has a superior advantage in boron chemicals which are borax decahydrate, borax pentahydrate, boric acid and sodium perborate. Eti General Directorate of Mining Operation affairs is the dominant producer of boron minerals and boron chemicals and the only exporter of boron chemicals. Turkey has developed a substantial capacity and production of sodium sulphate. In sodium sulphate production, it comes in top ranks in the world. Moreover, it is one of the most important rose oil exporters in the world market. The recent developments in textile and leather chemicals are also worth mentioning and many small and medium size

companies have recently started to operate in these two sectors. (Ministry of Economics, 2018)

The plastic sector, which has a common usage area, is used as an alternative to other materials as it is used with many substances. Nowadays, the sector is considered as one of the most important business branches of our country and with its various sub-branches, it ranks at the top of the world rankings and among the European countries.

Plastics are materials that have some structural rigidity under load and are used in general purpose applications. Polyethylene, polypropylene, poly(vinyl chloride), polystyrene, and fluorocarbons, epoxies, phenolics, and polyesters may be classified as plastics. They have wide variety of combinations of properties. Some plastics are very rigid and brittle, some are flexible, exhibiting both elastic and plastic deformations when put under stress and sometimes experiencing considerable deformation before fracture. (Callister, 2011)

In 1851, first hard rubber was discovered as a replacement of natural materials. Discovery of rubber was followed by exhibition of first man-made plastic by Alexander Parkes who also stated that the material is capable to be used as substitute of rubber with lower costs, in 1862. After a series of worldwide researches and developments on Parkes' material, nylon and plastic were discovered in 1920 and 1927. (PAGEV, 2016) Demand on plastic was accelerated in World War II and also cased to increase usage quantity and implementation areas. After war phase, development of plastic materials proceeded and earned its irreplaceable place on economic and industrial life in late phase of 20^{th} century.

On the other hand, chemical industry provides added valued inputs as a result of series of chemical production processes to the areas which may be an essential requirement as well as an input of advance technology. Eventually, 30% of the outputs are used as commodities, and the rest provides base for development of other industries and sub-chemical sectors.

Nowadays, era of chemical process is proceeding based on research and development operations with modern technology and diversified products of the industry and integrated into supply chain of national industries, especially, textiles and automotive sectors and also leading position has passed to EU Countries. (Ministry of Economics, 2018)

2.5.2. Sub-Sectors and Application Areas of Chemical Industry

Due to the raw materials of plastic sector are commonly provided from output products or semi-finished products of chemical industry; plastic sector usually mentioned as a subsector of chemical industry and they are strictly integrated. This is why the two sectors are inseparable and mentioned together. On the other hand, chemical industry has also other sub-sectors inside which are given in Table 4 below.

Table 4: Sub Sectors of Chemical Industry.

Sub- Sector	Description
Main Chemicals	Inorganic, organic main materials, chemical fertilizers, rubber, plastic raw materials and synthetic fibres
Other Chemical Materials	Paint, varnish, ink, pharmaceuticals, cosmetic products, cleaning products
Petroleum Refineries	-
Petroleum and Coal Derivatives	Fuel oil distribution, LPG filling, mineral oil preparation and blending
Rubber Products	Tyre production and Rubber products
Plastic Products	-

Note: Federation of Industrial Associations

Table 5: Contributions of Chemical Industry.

Sub- Sector	Direct Return	Indirect Return
Agricultural Drugs	Protection of grains and plants	Efficient and healthy crops
Synthetic Fertilizers	Efficient crops	Enrichment of the plant areas
Vet Drugs	Animal care	Healthy animal products
Synthetic Fibers	Fibers for textile	Alternative resource for clothing rather than animal and plant based fabrics
Detergents	Cleaning	-
Plastic Raw Materials	Addition to daily clothing materials and other items	Reduction in consumption of wood materials produced from natural environment
Pharmaceuticals	Developments on curing disease	Long life span and healthy generations
Cosmetics	Daily personal care	Shampoo, toothbrush

		production and cleaning products and their return of psychological relief
Paint, Varnish Coating Materials	Protection of materials and wares	Aesthetic issues
Leather	Leather making process ability	Ease of process stages
Construction	Added value on structural materials usage	Safe and fast construction
Textile	Characterization	Providing long life span and environmental resistance
Adhesive, Filler, Isolation materials etc…	Material development on referred sectors	Contributions on the last stages of construction

Note: Federation of Industrial Associations

According to given information on Table 5, chemical industry has wide scale of application areas and also integrated with other sectors due to the ability of providing raw materials, finished and semi-finished products to the entire sub-sectors. Energy, agriculture, health, transportation, food, construction, electronics, textile and environmental protection areas are benefited and enhanced, owing to the added-value contribution by chemical industry.

2.5.3. Inputs and Outputs of Chemical and Plastic Industry

Inputs of chemical industry mainly composed of petrochemical derivatives. As it mentioned before, large variety of chemical industry outputs are actually inputs of plastic sector. In Table 6 some of petrochemical outputs are listed, each of them exhibits unique performances and properties. Therefore, adds significant value on the progression of plastic sector.

Table 6: Inputs and outputs of Plastic Sector.

	Material Type	Characteristics	Application Area
Thermoplastics	ABS	Strength and toughness, resistance to heat distortion, good electrical properties, flammable and soluble organic solvents	Refrigerator linings, lawn and garden equipment, toys and highway safety devices
	Acrylics-PMMA	Light transmission, weathering	Lenses, transparent aircraft enclosures,

		resistance, fair mechanical properties	drafting equipment, outdoor signs, waterslides
	Fluorocarbons	Chemically inert in almost all environments, excellent electrical properties, low coefficient of friction,	
	Polyamides	Good mechanical strength, abrasion resistance and toughness; low coefficient of friction; absorbs water and some other liquids	Bearings, gears, cams, bushings, handles, and jacketing for wires and cables
	Polycarbonates	Dimensionally stable, low water absorption, transparent very good impact resistance and ductility	Safety helmets, lenses, light globes, base for photo-graphic film
	PET	Chemically resistant and electrically insulating, tough and relatively low coefficient of friction, low strength and poor resistance to weathering	Flexible bottles, toys, tumblers, battery parts, ice trays, film wrapping materials
	PP	Resistant to heat distortion, excellent electrical properties and fatigue strength, chemically inert, relatively inexpensive, poor resistance to UV light	Sterilizable bottles, packaging film, TV cabinets, luggage
	PS	Excellent electrical properties and optical clarity, good thermal and dimensional	Wall tile, battery cases, toys, indoor lighting panels, house devices

		stability, relatively inexpensive	
	Vinyls	Good low cost, general purpose materials, ordinarily rigid but may be made flexible with plasticizers, often copolymerized, subjectable to heat distortion,	Floor coverings, pipe, electrical wire insulation, garden hose, phonograph records
	Polyester	One of the toughest of plastic films, excellent fatigue and tear strength and resistance to humidity, acid greases oil and solvents	Magnetic recording tapes, clothing automotive-cords, beverages containers
Thermosets	Epoxies	Excellent combination of mechanical properties and corrosion resistance, dimensionally stable, good adhesion, relatively inexpensive, good electrical properties	Electrical moldings, sinks adhesives, protective coatings used with fiberglass laminates
	Phenolics	Excellent thermal stability to over 150C, may be compounded with a large number of resins, fillers, etc…, inexpensive	Motor housings, telephones, auto distributors, electrical fixtures
	Unsaturated Polyester	Excellent electrical properties and low cost, can be formulated for room or high temperature use, often fiber reinforced	Helmets, marine, aouto body components, chairs, fence, waterslide

Note: Callister, W.D., Rethwisch, D.,G. (2011). *Material Science and Engineering.* 8th Ed. John Wiley & Sons. 978-0-470-50586-1.

2.5.4. Developments of Plastic and Chemical Sectors

2.5.4.1. Economic situation in the World in Plastic and Chemical Industry

Generally speaking; emerging and developing economies face negative conditions and geopolitical tensions are increasing the challenges of the global economy. Three main factors that considered having on the global economy in 2018 are can be listed as; the increase in tax rates of FED, the developments in Chinese economy and fluctuations and unstable commodity prices. Considering the economic growth estimated at 5% in 2018 and the 14-year average correlation coefficient of the industry, it is estimated that the plastics industry will grow by around 5% in 2018. (PAGEV,2018)

In the first 6 months of 2018, imported goods from 10 countries has occupied 71% total quantity and 75% value-based imported goods. Share of China is nearly 28% in tonnes and 19% in value-based imports in plastic commodity production of Turkey. Besides, Germany, France, Italy and South Korea are also among the supplier countries of plastic goods. In the same period, export activities on first 10 countries holds 47% of quantity based and 45% values based total exported plastic goods. Iraq, Germany, England, Israil and France are the countries that forms the biggest export market of Turkey. (PAGEV, 2018)

In Chemical Sector; Istanbul Chemicals and Chemical Products Exporters Association (IKMIP) states that the sectoral export was 16.1 billion USD in 2017. Compared to 2016 value- based export in chemical sector has shown increase as 15.2%.

Regions that have highest exports in 2017 is given as EU (5.8 billion USD and 12.1 % increase), Near and Middle East Asia countries gained the second position with 13.8 % increase, followed by North Africa Countries and other Asian countries. Sorting the export distribution by country would be United Arab Emirates, Germany, Iraq, followed by USA, Egypt and Italy. (IKMIP,2017)

Based on 2018 projections of BASF which is a giant company in chemical society followed by Dow Chemicals; global chemical production (excluding pharmaceuticals) was expected to grow by 3.4% in 2018, roughly on a level with 2017 which was around 3.5%. Besides in the following years slightly weaker expansion rate is expected in the advanced economies as 3.7% increase in 2017. The development of the world’s largest chemical market which is China, has a significant

impact on the global growth rate. According to BASF, slightly stronger growth is expected. As a result, China will presumably once again account for almost two percentage points of global chemical growth. Growth in the E.U is projected to remain above average but in slower trend than 2017. Also domestic demand in key customer industries will probably be slightly weaker following strong industrial growth in the previous year. In addition, weaker export demand from Asia is predicted. Because of the new production capacities will reach the market in 2018, export of USA is predicted to be increased. Chemical growth is expected to be decrease in Japan after unusually strong, largely export-driven growth in 2016. In South America, BASF expects that the upturn in the chemical industry will continue in line with the overall economic recovery. (BASF, 2017)

2.5.4.2. Economic situation in Turkey in Plastic and Chemical Industry

According to data given in Plastic Sector Report of PAGEV, Turkey economy has shown 7.4% growth in the first quarter of 2018. Hence, GDP of Turkey has reached 883 Billion USD. Especially, private consumption provided the highest contribution (approximately 6%) on GDP values and followed by investment expenses (2.8 %). According to production approach, all of the sub sectors of the industry has been supported the growth. (PAGEV, 2018)

Comparing the isochronal time interval in 2017, export activities were increased by 6.3% whereas import has been increased 13.5. That margin led to a foreign trade deficit of 40.7 billion USD in the first 6 months of 2018. If the foreign trade deficits of 2017 and 2018 are compared, 31.6% increase was observed and the rate of export meeting import is reduced to 66.9 %. In this time elapse the advanced technology commodities in exported production industry was 3.2% and imported ones were found to be 13.6% (PLASFED,2018)

Despite, the increase in exchange rates in Euro and Dollar had been a challenge for domestic market of Turkey, European Union countries made a great contribution on total export goods, in this period.

In the halve of 2018, total raw material production is composed of % 31 LDPE, % 9 HDPE, % 15 PVC, % 12PP, % 10 PS and % 23 PET which corresponds 5.724 billion USD of export. Based on the trend, it is estimated that, by the end of the year values of exported goods may reach to 11.4 billion USD. In this period the biggest quantity and value based imports were based on PP and PET. Meanwhile, the record

of quantity and value-based exported raw materials are mainly acrylic polymers and polyacetals. (PAGEV,2018)

Domestic consumption of plastic goods in the first half of 2018 is found to be 4.5 million tonnes and nearly half of this weight were exported indirectly by automotive, packaging, civil engineering, and electronic sectors as final or semi-finished products. The rest was presented to consumer use directly. (PAGEV,2018)

Among the sub-groups of chemical materials and final products, plastic materials have the highest export share as 33%. Followed by mineral fuels (22%) and inorganic chemicals (8.1%). The three most exported goods are identified as elastomeric goods and chemicals, pharmaceutical products and final products as soap and detergent. (PAGEV,2018)

2.6. Composite Sector

2.6.1. Brief History of Composite Sector

Humans have been creating composite materials, without knowing it by combining various components in order to produce new material, even in 1500 B.C. Early Egyptian and Mesopotamian settlers combined mud as matrix and straw for reinforcement in order to create durable constructions. In 1200 A.D. It is a rare knowledge that Mongols were the inventors of first composite bow by combining wood, bone and animal glue as interface agent. Resulting composite bows were extremely more powerful, accurate and faster than the ordinary ones, which added value on their military troops.

Discovery of condensation polymerization in 1930 led composite materials to develop at accelerating rate. WWII was a significant place, where composite materials used in military purposes and also prove their abilities. After 1946, composite materials became a trade material under the name of advanced technology. (Turkish Composite Manufacturers Association, 2017)

Although multiphase materials such as wood, bricks made from straw reinforced clay, seashells, and even alloys such as steel had been known for millennia, recognition of this new concept of combining dissimilar materials led to the identification of composites as a new class that was separate from the familiar metals, ceramics, and polymers. Generally speaking, a composite is considered to be any multiphase materials that exhibits proportion of the properties of both constituent phases such a better combination of properties that is realized. Many composites are composed of just two phases; one is termed the matrix, which is continuous and

surrounds the other phase which is often called the dispersed phase. The properties of the composites are a function of the properties of constituent phases, phase fractions, and the geometry of the dispersed phase which is the shape, size, distribution and orientation. (Callister, 2011)

Composite usage in Turkey has begun with the production of polyester water tanks and automobile hood production under the brand of "Anadol". During successive years composites were created by the method of hand lay-up, however, with the aid of machines production method is slowly changed into thermoforming, RTM, autoclave etc. systems. Transition to machinery systems were slow, because of lower cost of the labour corresponding the necessity of high investment costs. Nowadays due to the mass production requirement and aesthetic anticipations machinery system is more preferred option. (Turkish Composite Manufacturers Association, 2017)

2.6.2. Classifications of Composites Based On Reinforcement

Inputs and outputs of composite material depends on the production technology and also sub-branches as shown in Figure 16.

2.6.2.1. Particle Reinforced Composites

Particle reinforced composites are composed of either large particles or dispersion strengthened particles. In terms of usage amounts, the most widely used reinforcement elements in the manufacture of composites include particles, ranging in size from microns to nanometres. The mechanical properties of the composite are more or less similar, due to the fact that the reinforcing phase in the main material in the particulate reinforced composites exhibits an almost uniform distribution. The strength of the structure depends on the hardness of the particles. The most common type of material used in these composites are the metal particles. Metal particles provide thermal and electrical conductivity. Metal-based and ceramic-based structures have high hardness and high temperature resistance.

2.6.2.2. Fiber Reinforced Composites (FRP)

Fibers are essential component of the composite material in terms of reinforcement. Low density, high elastic modulus and hardness and also high chemical resistance provides useful advantages to the matrix. Orientation of the fibers decides the direction of reinforcement. In other words if long fibers are oriented in parallel in the matrix, high mechanical strength (parallel forces) is obtained throughout the fibers. However, if the applied force is perpendicular to the fibers, will

yield lower mechanical strength. Therefore biaxial and homogenously dispersed discontinuous fibers are commonly used to provide strength to both directions. Moreover, length and diameter of the fibers also increases the resistance across the load. Interfacial agent and humidity on the fiber also have significance on the bonding between matrix and reinforcement. (Callister , 2011)

Glass, asbeston, boron, steel wires, carbon, aramid, silicium carbide fibers are some examples to these type of reinforcements with unique properties. Also, natural fibers such as sisal, flax, abaca; produced from animal, vegetable, or mineral sources are used in almost every sector.

2.6.2.3. Structural Composites

Structural composites includes laminates and sandwich panels whose properties depend on not only properties of constituent materials but also geometric structure and design. Providing lower cost, anti-corrosion properties low abrasive resistance and light weight with high mechanical strength compared to metal substitutes, eventually made them first option such as; plywood.

Aircraft, transportation, automotive applications of structural composites are already exists. Energy efficiency and sustainability concerns canalized people to use this material on building constructions, too. Moreover packaging sector is also usin these type of materials in honeycomb boards.

2.6.2.4. Hybrid Composites

Hybrid composites includes two or more types of reinforcements in the same composite structure. Wide variety of combinations are used, however the most common systems are carbon-glass fibres. Carbon fibres are strong however expensive materials. On the contrary, glass fibers are cheap and also lacks the stiffness of the carbon. For example; Kevlar-graphite combination may also used to get rid of low toughness of graphite and low compressive strength of Kevlar.

2.6.3. Classifications of Composites Based On Matrix

2.6.3.1. Metal Matrix Composites (MMCs)

The main materials of MMCs are various metal and metal alloy composites and the reinforcement elements are in the form of continuous fibers, particles and whiskers, which are generally in the form of oxide, carbide or nitride. In these composites, the second phase embedded in the metal-based structure can be in the form of continuous fibers or in small pieces which are homogenously distributed.

Many metals and metal alloys are fragile although they provide some properties at high temperature. However, metal-based composites reinforced with metallic fibers give high strength properties at high temperatures with the interoperation of both phases. Automobile manufacturers have already begun to use MMCs in their products such as engine components. Moreover, aerospace industry have tried MMCs on space shuttle orbiter and the Hubble Space Telescope. (Callister, 2011)

2.6.3.2. Ceramic Matrix Composites (CMCs)

Ceramic-based composite materials are generally used for parts that need to work at high temperature. Ceramic materials with hard and brittle materials show very low ductility, low toughness and resistant to thermal shocks so that they are reinforced with fibers. On the other hand, they have a very high modulus of elasticity and very high operating temperatures. Ceramic composites, which are composed of metal or non-metal materials, have a rigid and brittle structure with very good resistance to high temperatures. They also are very good at insulation properties. (Calister, 2011)

Due to their high temperature stability and corrosion resistance, they can be used both in the aerospace industry and in various industrial areas, turbine engine components, hot gas filters, turbine discs for rocket engines, heat exchanger tubes, armour, components exposed to corrosion in oil pipes, heat treatment furnaces, diesel, engine insulation and brake discs in automotive industry.

2.6.3.3. Polymer Matrix Composites (PMCs)

The main objectives of polymer and polymer composites are lightweight, resistance to high temperatures, cost and ease of fabrication. Nowadays, the automotive sector has the greatest share in the use of advanced engineering materials. While the use of various plastic materials in automobiles is around 10%, plastic composites are unique in some special applications such as buffers. Materials are searched and used according to their properties in terms of strength, flexibility, lightness, environmental conditions (such as moisture, solar temperatures, durability, impact resistance, and hardness), thermal expansion coefficients, fatigue, cracking and breaking, bending strengths and similar values are required.

It is extremely rare to find all the desired properties in a single metal, ceramic or polymer material. In various engineering applications, instead of metal, the polymer composites are used instead of metal and ceramic materials in the construction of special systems, not only because of their lightness, mechanical strength, but also in the adaptation to human tissues and in the application of special systems such as

artificial tissues and organs. The plastic used as fiber has a load-bearing feature, while the plastic used as a matrix has a resilient, shock-absorbing property. The types of plastics that can be used can also be examined in two groups.

Thermoplastic polymer matrix are such plastics soften when heated and harden when cooled, after being formed. There is no change in the microstructure of the plastic during this process. Plastics include nylon, polypropylene, polyethylene, polyetheretherketone (PEEK), polystyrene, carbonfluoride, acrylics, cellulosics and vinyls are belong to this group.

As another group, when thermoset plastics are exposed to temperature gradient, the structural recovery is no longer possible. The major plastics of this group can be given as polyesters, epoxies, alkyds, amines.

2.6.4. Economic Situation of Composite Sector

In the last 30 years, the composite industry has developed over a prolonged period based on global economic growth and the ability to penetrate key sectors (building and construction, wind energy, aerospace, automotive, etc.). According to the data of the Composite Industrialists Association, the composite material market reached a volume of 62.8 Billion Euro and 8.3 million tons worldwide. Between 2002 and 2010, the composite market grew by 4-5 percent in value and 3 percent in volume as the finished product.

Table 7: GRP production values in Europe and Turkey in kilotons.

Country	**Years**			
	2014	**2015**	**2016**	**2017**
UK/Ireland	146	150	152	153
Belgium/Netherlands/Luxembourg	43	44	45	46
Finland/Norway/Sweden/Denmark	42	39	40	40
Spain/Portugal	154	156	158	161
Italy	148	150	154	158
France	108	108	110	112
Germany	200	212	220	226
Austria/Switzerland	18	18	18	19
Eastern Europe	184	192	199	203
Turkey	245	245	265	280

Note: Witten E., (September 2017). *Composites Market Report 2017.* Carbon Composites.

Market data for Turkey shows a consistent, long term trend for the GRP market in Table 7. The sector is expected to grow by 5% to a total of 280,000 tonnes in 2017 according to the Turkish Composites Association. Turkish GRP production therefore remains higher than in any other European country. The applications differ from those in the other countries included in this report: 60 % of production volume is used in the construction sector and manufacturing pipes and tanks. Pipes and tanks produced via centrifugal casting and filament winding processes account for around 35 % of the Turkish market – nearly three times higher than European countries. The automotive and transport sectors covers approximately 20 % of the Turkish market.

The composite industry is expected to grow by 5 percent in value and 4 percent in volume over the next five years. Meanwhile, the market share of North America and Europe, which is 56 percent, will decrease to 50 percent and Asia's market share will increase from 37 percent to 43 percent. (Carbon Composites, 2017)

Table 8 shows the volume trends for significant processes/components in GRP manufacture over recent years. However, in addition to these processes, there are many other production processes/technologies which can essentially be classified under one of the areas mentioned.

Table 8: GRP production volumes in Europe according to processes/components in kilotons.

Production Method	**Years**			
	2014	**2015**	**2016**	**2017**
SMC	190	191	198	202
BMC	74	74	76	78
Hand Lay-Up	138	139	140	140
Spray-Up	94	96	97	98
RTM	132	137	141	146
Sheets	84	86	89	93
Pultrusion	48	49	50	53
Filament Wilding	79	80	80	78
Centrifugial Casting	66	68	68	67
Others	17	17	17	18
SUM	**1,043**	**1,069**	**1,096**	**1,118**

Note: Witten E., (September 2017). *Composites Market Report 2017.* Carbon Composites.

According to Carbon Composites E.V., SMC/BMC are largest segment. The next largest one continues to be “open processes” – still a segment with a greater emphasis

on manual skills and craftsmanship. Growth in the use of SMC/BMC materials has been positive over recent years – in step with the overall market trend – while the open processes of hand lay-up and spray-up techniques have generally declined. Production quantities for all other processes are virtually identical in 2017.

Composite Industrialists Association data shows that, Composite Industry had 150-200 small-medium scale companies, 700-800 companies that are partially involved in composite business. The industry provides employment for over 8000 people. Market power of composite sector is 1.225 Billion Euro and 245,000 tonnes of volume. In other words, composite industry is still proceeding and gaining power from its substitutions.

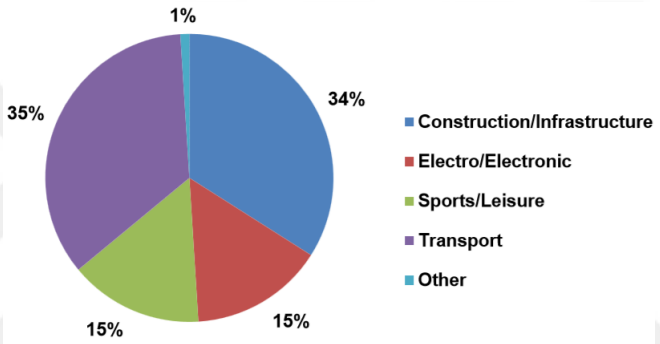

Figure 16: Shares of GRP consumption areas in Europe. Source: Carbon Composites, 2017

3. THEORETICAL MODEL AND HYPOTHESIS

3.1. Ratio Analysis

Ratio analysis are performed to understand how healthy the company is by comparing different pieces of financial information with its competitors. The ratios reflect the relationship between the different items included in the financial statements of the companies. The financial statements can be interpreted with the information provided by this relationship.

Table 9: Financial ratios and equations.

Ratio Group	Ratios	Equation
Short-Term Liquidity Ratios	Current Ratio	Current Assets/Current Liabilities
	Acid Test Ratio	(Current Assets-Inventory) / Current Liabilities
	Absolute Liquid Ratio	Absolute Liquid Assets/Current Liabilities
Financial Leverage Ratios	Total Debt Ratio	Total Liabilities/ Total Equity
	Short-term Liabilities/Liabilities	Short-term Liabilities /Liabilities
	Fixed assets/ Total Equity	Fixed assets/ Total Equity
	Interest Coverage Ratio	EBITDA / Interest Expenses
Turnover Ratios	Receivables Turnover	Sales/Accounts Receivables
	Days' Sales in Receivables	365 days / Receivables Turnover
	Inventory Turnover	Cost of Goods Sold / Inventory
	Days' Sales in Inventory	365 days / Inventory
	Payables Turnover	Cost of goods sold/ Trade Payables
	Total Asset Turnover	Sales / Total Assets
	Equity Turnover	Sales / Total Equity
	PPE Turnover	Sales /Tangible Assets
	Total Asset Turnover	Sales / Current Assets

	Days of Average Activity	Average Collection Period + Days of Inventory on Hand
Profitability Ratios	Gross Profit Margin	Gross Profit / Sales
	Operating Profit Margin	Operating Profit / Sales
	Profit Margin Ratio	Net income / Sales
	Return on Equity	Net income/ Total Equity
	Return on Assets	Net income/ Total Assets
	EBIT/TA	EBIT/Total Assets
Market Value Ratios	Price /Earnings	Price Per Share/ Earnings Per Share
	Market to Book Ratio	Market Value per Share/ Book Value per Share
	Earnings Per Share	Net Income / Number of Shares Outstanding
	Dividends Per Share	(I. divident + II. divident) / Number of Shares Outstanding

Liquidity Ratio: Liquidity ratio expresses a company's ability to repay short-term creditors out of its total cash. It is the result of dividing the total cash by short-term borrowings. It shows the number of times short-term liabilities are covered by cash. If the value is greater than 1.00, it means fully covered. Calculation methods are given in the table above. (Hillier, 2014)

Liquidity is the ability of a company of pay-off its obligations in a timely manner. These ratios compare various combinations of relatively liquid assets to the amount of current liabilities stated on an organization's most recent balance sheet. Liquidity ratios are commonly used by prospective creditors and lenders to decide whether to extend credit or debt, respectively, to companies.

Financial Structure Ratios: When analyzing the financial health and growth potential of a company, business owners and investors look to financial ratios that indicate how a company is funded and how effectively those dollars are being used. In ratio analysis, the debt to equity ratio is widely considered the best reflection of a company's capital structure. As the name implies, the debt to equity ratio compares a company's total liabilities to its total equity financing. A high debt to equity ratio indicates that a business receives a much greater proportion of its capital funding from lenders rather than shareholders. However, a large amount of debt is generally considered a sign of risky business practices; payments on that debt are required by

law regardless of business revenues. A company with a high debt to equity ratio that experiences a financial downturn must continue to make payments on its debts even if the business fails to generate enough revenue to cover them; this may quickly lead to loan default and bankruptcy. (Hillier, 2014)

Activity Ratios: It is a category of financial ratios that measure a firm's ability to convert different accounts within its balance sheets into cash or sales. Activity ratios measure the relative efficiency of a firm based on its use of its assets, leverage, or other similar balance sheet items and are important in determining whether a company's management is doing a good enough job of generating revenues and cash from its resources.

Companies typically try to turn their production into cash or sales as fast as possible because this will generally lead to higher revenues, so analysts perform fundamental analysis by using common ratios such as the activity ratio. Activity ratios measure the amount of resources invested in a company's collection and inventory management. Because businesses typically operate using materials, inventory, and debt, activity ratios determine how well an organization manages these areas.

Activity ratios gauge an organization's operational efficiency and profitability. These ratios are most useful when compared to a competitor or industry to establish whether an entity's processes are favorable or unfavorable. Activity ratios can form a basis of comparison across multiple reporting periods to determine changes over time. (Hillier, 2014)

Profitability Ratios: Measure a company's ability to generate profits within a specified context. Profitability ratios measure the overall performance of a company through profits. Profitability ratios are used to compare a company's ability to generate profits relative to its industry, or the same ratios can be compared within the same company for different periods. One ratio used to measure a company's profitability is return on equity (ROE), which measures the amount a company generates with the funds raised from shareholders' equity. It is calculated by dividing net income by shareholders' equity. (Hillier, 2014)

Market Value Ratio: Market value ratios are used to evaluate the current share price of a publicly-held company's stock. These ratios are employed by current and potential investors to determine whether a company's shares are over-priced or under-priced. These ratios are not closely watched by the managers of a business, since these

individuals are more concerned with operational issues. The main exception is the investor relations officer, who must be able to see the company's performance from the perspective of investors, and so is much more likely to track these measurements closely. Market value ratios are not applied to the shares of privately-held entities, since there is no accurate way to assign a market value to their shares. (Hillier, 2014)

3.2. Hypothesis

1st Hypothesis:

H_0: Petroleum price breakdown point did not occur in 2014.

H_1: Petroleum price breakdown point occurred in 2014.

2nd Hypothesis:

H_0: Collapsed petroleum price did not influence companies operating in Composite Sector in 2014.

H_1: Collapsed petroleum price influenced companies operating in Composite Sector in 2014.

3rd Hypothesis:

H_0: Profitability ratios of companies operating in Composite Industry are not affected by fluctuating crude oil prices.

H_1: Profitability ratios of companies operating in Composite Industry are influenced by fluctuating crude oil prices.

4. METHODOLOGY AND DATA

4.1.Definition of Variables

Table 10: Variables used in the study.

$OILPRICE_t$		Brent Petroleum Price	
PDP		Public Disclosure Platform	
Profitability Ratios	GPM_t	Gross Profit Margin	Gross Profit / Sales
	OPM_t	Operating Profit Margin	Operating Profit / Sales
	PMR_t	Profit Margin Ratio	Net income / Sales
	RoE_t	Return on Equity	Net income/ Total Equity
	RoA_t	Return on Assets	Net income/ Total Assets
	$EBITTA_t$	EBIT/TA	EBIT/Total Assets

Literature reviews demonstrate that, the fluctuations in oil prices has impacts on countries in terms of growth and inflation, supply and demand curves, prices of goods. For this reason, the effect of oil price changes on the composite sector has been studied.

Analysis were performed for 2000-2018 period, by investigating companies operating in Chemical and Plastic Industries related with Composite Sector, that are published in Public Disclosure Platform (PDP). In order to calculate profitability ratios of the companies; gross profit, net sales, operating profit, net profit, EBITTA parameters, taken from income statements; owners' equity and total asset data were collected from balance sheets listed on Public Disclosure Platform.

The profitability ratios of the companies selected from the chemical and plastic sectors were calculated by using the Ratio Analysis method. 66 profitability ratios were calculated by applying 6 profitability ratios of the 11 companies in the PDP. Brent petroleum prices were obtained from Turkiye Is Bankasi website. Descriptive analysis were performed on oil prices and oil price changes in order to show the distribution and break-points.

The SPSS program (Statistical Package for Social Sciences) for Windows 16.0 was used for analysis. The profitability ratios of the companies calculated by years, were compared with the oil prices and their relationship were estimated.

Non-parametric Mann Whitney and Wilcoxon methods were used in the study. These tests are non-parametric version of paired t-test; examines whether there is a difference between the test group and the data before and after the event. It is especially used in controlled and experimental studies to examine how the same group

behaves in different situations, can only be applied on sample groups whose size is lower than 30 elements.

The Mann-Whitney U test, applied for differences between two groups on a single, ordinal variable with no specific distribution. In contrast, the independent samples t-test, which is also a test of two groups, requires the single variable to be measured at the interval or ratio level, rather than the ordinal level, and to be normally distributed, A nonparametric test assumes no specific distribution, whereas a parametric test assumes a specific distribution. Thus, the Mann-Whitney U is conceptually similar to the t-test for determining whether two sampled groups are from a single population. If the data do not meet the parametric assumptions of the t-test, the Mann-Whitney U tends to be more appropriate.

$$U = R_1 - \frac{n_1(n_1 + 1)}{2}$$

Where, R is the sum of ranks in the sample, and n is the number of items in the sample.

Wilcoxon is also non-parametric version of t-test, can be used to test the null hypothesis that two populations have the same continuous distribution. The base assumptions necessary to employ this method of testing is that the data are from the same population and are paired, the data can be measured on at least an interval scale, and chosen randomly and independently. While comparing before and after situation of company profitability ratios separately, measurements will not be independent from each other, so that, the Mann-Whitney U-test cannot be used.

$$Z = \frac{W - m_W \pm 0.5}{\sigma_W}$$

Where, the Wilcoxon signed rank test has the null hypothesis that there is on average no difference between the two measurements, therefore mw = 0.

When oil prices are examined, it is observed that prices have breakpoints in certain years. In this study, the profitability ratios of companies in the plastic and chemical sector before and after this crisis period were calculated and their significance were discussed whether dependent ratios were subjected to a significant change with the crisis through non-parametric test methods.

To calculate with Wilcoxon Test, years of all test samples were grouped and uploaded to the program. On the other hand, in the Mann-Whitney Test the data were

uploaded to the program separately for each variable to evaluate the significance on company basis. The findings of each test were evaluated at 5% significance level.

4.2. Companies Operating in Composite Sector

The companies involved in composite sector are also involved in chemical industry and plastic sector as main area of expertise. Due to the fact that composite industry are still in emerging position, income statement and balance sheet data of the companies working on composite as core business are hard to acquire. Therefore, in this thesis, large scale companies that have composite materials in their production process and also product range are chosen for calculations.

Table 11: Companies Operating in Composite Sector.

AKSA	Aksa Acrylic Chemical Industry Inc.
ALKIM	Alkim Alkali Chemical Industry Inc.
BRKSN	Berkosan Insulation and Insulation Materials Production and Trade Inc.
BRISA	Brisa Bridgestone Sabanci Tire Industry and Trade Inc.
DYOBY	DYO Paint Factories Industry and Trade Inc.
EPLAS	Egeplast Ege Plastic Trade and Industry Inc.
PETKM	Petkim Petrochemical Holding
SASA	Sasa Polyester Industry Inc.
SEKUR	Sekuro Plastic Packaging Industry Inc.
TMPOL	Temapol Polymer Plastic and Construction Industry Trade Inc.
TUPRS	Turkey Petroleum Refineries Inc.

Data Source: Public Disclosure Platform

Thanks to the R&D developments in composite sector, emerging composite markets will be economically significant and get the deserved attraction, in terms investments and scientific knowledge.

4.3. Sizes of Assets of Companies Operating in Composite Sector

11 companies chosen that are enrolled to Public Disclosure Platform, must publish their financial information to public in specified periods. Total sizes of assets of relative companies in 2016 were obtained from Public Disclosure Platform website. (https://www.kap.org.tr/tr/Sektorler)

According to Table 12, highest size of total assets belongs to Turkey Petroleum Refineries Inc. followed by Petkim Petrochemical Holding. However, the three highest average of five years change percent belongs to Temapol Polymer Plastic and Construction Industry Trade Inc. followed by Sekuro Plastic Packaging Industry Inc. and Brisa Bridgestone Sabanci Tire Industry and Trade Inc. Based on the average growth of assets of 5 years, it can be concluded that the mentioned companies has conducted a better strategic judgement against the volatile environment.

Table 12: Size of Total Assets and 5 years of average percent changes of the related companies are given below.

Company CODE	TOTAL SIZE OF ASSETS (TL)	% Change
AKSA	2,632,970,000	69.10
ALKIM	349,490,000	31.60
BRKSN	52,220,000	64.70
BRISA	2,836,270,000	128.0
DYOBY	778,440,000	40.00
EPLAS	120,770,000	33.20
PETKM	6,268,530,000	123.9
SASA	1,032,190,000	51.00
SEKUR	62,380,000	195.7
TMPOL	72,800,000	254.4
TUPRS	13,667,060,000	-20.10

Data Source: Public Disclosure Platform

4.4. Annual production capacities of companies operating in Chemical Industry

The annual production capacity of selected companies that have composite production or provides essential raw materials for composite industry given in Table 10. Due to the fact that not all the establishments in plastic and chemical industry related with composite structures, unrelated companies were eliminated during this research.

Among focused companies, the highest annual production belongs to Turkey Petroleum Refineries Inc., followed by Bridgestone Sabanci Tire Industry and Trade

Inc. and Petkim Petrochemical Holding. In comparison with the information acquired from Table 13, Turkey Petroleum Refineries also has the highest 5 years of average asset growth. Moreover, producers with second and third largest capacities also have considerable asset growth over 5 years.

Table 13: Annual production capacities of companies.

Company Name	Annual Production Capacity (ton)
Turkey Petroleum Refineries Inc.	21,300,000
Brisa Bridgestone Sabanci Tire Industry and Trade Inc.	8,484,000
Petkim Petrochemical Holding	3,200,000
Berkosan Insulation and Insulation Materials Production and Trade Inc.	478,000
Alkim Alkali Chemical Industry Inc.	420,000
Aksa Acrylic Chemical Industry Inc.	315,000
DYO Paint Factories Industry and Trade Inc.	157,000
Sasa Polyester Industry Inc.	109,000
Egeplast Ege Plastic Trade and Industry Inc.	85,000
Sekuro Plastic Packaging Industry Inc.	14,000
Temapol Polymer Plastic and Construction Industry Trade Inc.	9,000

Source: Public Disclosure Platform

4.5. Impact of Petroleum Price on Composite Industry

Crude oil preserve its significance in daily life and also considered as one of the basic energy sources. Almost all sectors use oil directly or indirectly as input. As a result of this dependence, fluctuations in oil prices have an impact on both the country and the world economy through chain reactions.

According to Figure 18, polymer-matrix composite structures dominates the market. Furthermore, high portion of polymer matrix is composed by thermosetting resins that are highly depended to petroleum derivatives. This relationship basicly gives the idea of correlation among petroleum prices and composite products.

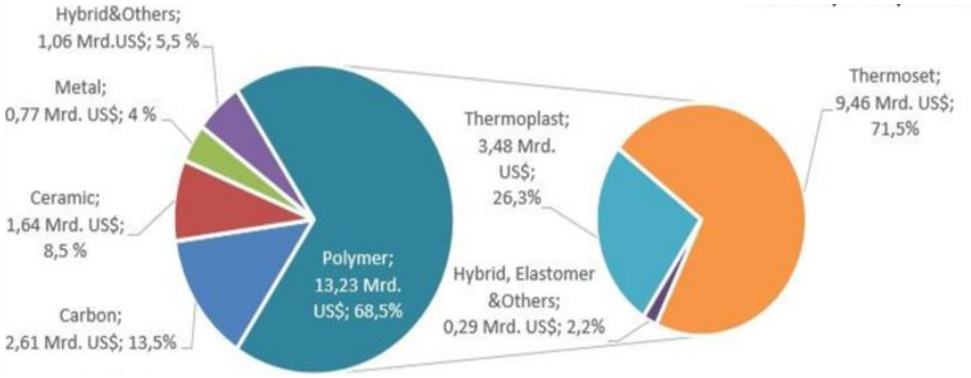

Figure 17: Distribution of the global composites market by matrix-materials. Source: Carbon-Composites

The rise in petroleum price will affect the production costs of naphtha which is a crucial input for resin market. Affected production costs leads companies to rise the product prices.

5. RESULT

5.1. Descriptive Analysis

Brent petroleum prices, given in Figure 19 were obtained from Turkiye Is Bankasi website. Data used to apply descriptive analysis in order to show the distribution and break-points.

Descriptive analysis show that, in Figure 20 and 21, oil price and its change have normal distribution and also their standard deviation values are approximately 30 and 42, respectively. In addition, Figure 19 also shows that, there are two major breakdowns, which have occurred in 2008 and 2014.

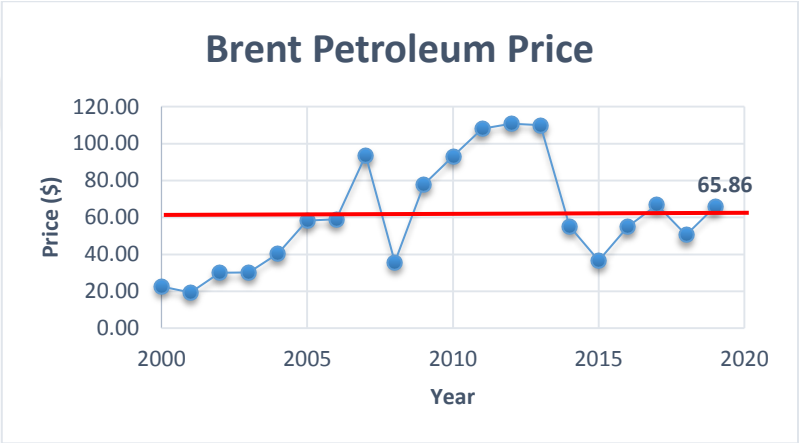

Figure 18: Brent Petroleum Price in 2000-2018. Source: Turkiye Is Bankasi

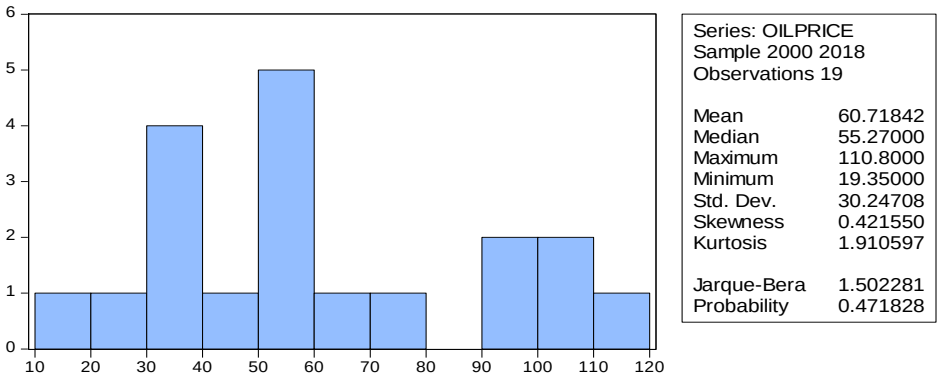

Figure 19: Distribution and standard deviation of oil price.

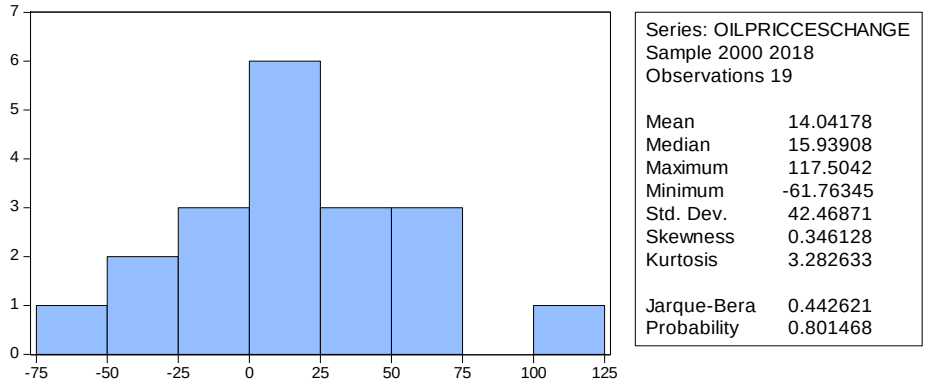

Figure 20: Distribution and standard deviation of oil price change.

Lower price levels are occurred as a result of increasing supply levels since the discovery of shale oil in U.S.A and also decreasing demand resulted by seeking alternative energy sources due to shifts in cleaner/environmentally friendly energy sources to decrease carbon emissions and cost efficient technologies driven by R&D developments in this area.

Turkey spends an average of USD 9 billion for crude oil imports, annually. Assuming oil prices between 2012 and 2014, this figure will be 20 billion dollars. In other words, the positive contribution of the decline in oil prices to the current account balance is $ 11 billion. If oil products other than oil and raw materials are taken into account, this positive contribution may be higher. (Egilmez, 2017)

5.2. Analysis of profitability ratios on composite sector via non-parametric Mann-Whitney and Wilcoxon Tests

Mann-Whitney U value analysis was applied on each ratio parameter by grouping before and after 2014 data set of whole composite sector. Results were evaluated according to significance lower than 0.05, and critical U value is taken as 30, according to two-tailed tasting Mann-Whitney U table.

Total mean profitability ratios of 11 companies were inserted SPSS separately and divided into two groups as before and after 2014 when the petroleum prices started to fall. According to results given in Table 15 obtained by SPSS Mann-Whitney U-test method, Operating Margin affected with $p<0.05$ significance. Operating margin shows amount of profit that a company makes on a dollar of sales, after paying for variable costs of production, such as wages and raw materials, before paying interest or tax. Also, RoA has a significant relationship with the fluctuating petroleum prices at 10% level of significance, the ratio shows the profitability of a

company to its total assets, relatively. Table 4.2 in Appendix shows the profitability ratios in percent of each company and each ratio element corresponding years.

Table 15: Result of profitability ratios via Mann-Whitney U Test before and after 2014 for overall industries.

Ratio	Before Mean Rank	After Mean Rank	Mann-Whitney U	Sigma
Return on Assets	9.00	14.00	33	0.071
Return on Equity	10.00	13.00	44	0.279
Gross Profit Margin	9.82	13.18	42	0.224
Operating Margin	8.09	14.91	23	0.014*
Profit Margin Ratio	9.27	13.73	36	0.108
EBIT	9.55	13.45	39	0.158

*P<0.05 significance is observed.

Secondly, profitability ratios for each company corresponding years were inserted to SPSS individually to find out significance before and after 2014 breakpoint to perform Wilcoxon Analysis. Results were given in Appendix Table 18. According to results, companies related to resin production and consumption have the most significance with the fluctuating oil price. So that, composite sector may impacted, most likely due to the demand and supply of resin medium. 8 out of 11 companies showed significance corresponding price breakdown at 2014. DYO Paint Factories Industry and Trade Inc. has the highest significance among other companies at 5% level. Petkim Petrochemical Holding has the second highest significance at 10% level. Turkey Petroleum Refineries Inc. and Aksa Acrylic Chemical Industry Inc. showed only 10% significance on gross profit margin as least affected companies, due to their weak relation with the sector.

6. RESULT AND DISCUSSION

Energy has a significant place in the enhancement and economies of countries. Turkey is also among emerging ecenomies, so that it can be considered as there is also an emerging demand in Turkey's economy which plays an important role for companies. As the energy demand increases, the supply should also increase to fill the requirement. The pace of oil in Turkey's energy imports is very high. Due to the lack amount of oil present in Turkey, the country has to import oil to provide the energy demand. Foreign dependency makes Turkey and also the companies operating in this country vulnerable against fluctuations in oil price.

The main question of this thesis is related to investigate breakdowns in oil prices. In order to answer that hypothesis descriptive analysis applied and according to results, oil price and its change have normal distribution and also their standard deviation values are approximately 30 and 42, respectively. In addition, there are two major breakdowns, which have occurred in 2008 and 2014. Due to lack of data of some companies in 2008, and also due to the obvious global crisis; this breakdown is neglected.

In this thesis, the relationship of petroleum prices and profitability of companies operating in composite sector were analyzed. By using financial data published at Public Disclosure Platform, profitability ratios were calculated. To analyze 11 companies Non-Parametric Mann-Whitney and Wilcoxon Tests were preferred due to lack of sample size, which is less than 20. The SPSS program (Statistical Package for Social Sciences) for Windows 16.0 was used for analysis. Annually calculated profitability ratios of the companies, were compared with the oil prices and their relationship were estimated.

Firstly, by using Mann-Whitney U Test, composite companies selected from Plastic and Chemical Industries were analyzed as a whole, only by dividing into two groups as before and after 2014 which had been defined as breakpoint of oil prices, found out by descriptive analysis. Comparing before and after test results, decreasing petroleum prices were increased the profitability of companies operating in composite sector.

Secondly, Wilcoxon test is applied to each profitability ratio of each company corresponding years before and after 2014. Data, inserted to SPSS individually to find out significance before and after breakpoint. According to results, resin based

composite industries and resin producers affected more relative to the companies having weaker bond with composite sector. According to results; 8 out of 11 companies showed significance corresponding price breakdown at 2014. Operation Profit Margin (EBIT), Net Profit Margin and RoA had the major tendency to react against oil price fluctuations rather than other ratio elements in before and after 2014 period. Requirement of petroleum products are mainly based on feedstock, which is produced from naphta, rather than fuel. Therefore, ratios that are related to assets and operations are mostly affected.

DYO Paint Factories Industry and Trade Inc. has the highest significance among other companies at 5% level. Petkim Petrochemical Holding has the second highest significance at 10% level. Turkey Petroleum Refineries Inc. and Aksa Acrylic Chemical Industry Inc. showed only 10% significance on gross profit margin as least affected companies, due to their weak relation with the composite sector and resin manufacturing/consumption.

In terms of managerial aspect, results show that companies with higher asset size that includes more composite elements/inputs tend to be affected more compared to companies with lower size of assets that includes weak connection between composite raw material content. Therefore, smaller scale companies are slightly affected from volatile petroleum prices.

The bond of composite sector with plastic and chemical industries is significantly tight due to the fact that manufacturing composite structures requires outputs of chemical and plastic industries. Increasing R&D developments and number of domestic and international scientific studies on composite sector shows that upcoming industrial advancements on plastic and chemical sector will also increase in 10 years, rapidly.

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4. APPENDIX

4.1. Data set used in SPSS

Table 16: Data of Plastic and Chemical Companies published in Public Disclosure Platform.

COMPANY	Year	Total Assets	Owner's Equity	Gross Profit/Loss	Operating Profit/Loss	Revenue	Pre-tax Profit/Loss	Net Profit / Loss
AKSA	2009	1,902,389,086	734,382,461		59,252,000	905,137,000	53,568,000	42,343,000
	2010	1,358,902,000	757,988,000		80,892,000	1,304,312,000	75,770,000	61,914,000
	2011	1,652,565,000	850,947,000	233,198,000	142,172,000	1,675,470,000	99,467,000	99,467,000
	2012	1,556,956,000	970,920,000	231,444,000	236,157,000	1,625,463,000	168,641,000	168,641,000
	2013	1,811,610,000	1,047,440,000	287,980,000	187,740,000	1,756,400,000	184,350,000	140,690,000
	2014	1,998,500,000	1,113,310,000	315,340,000	234,220,000	2,104,900,000	208,130,000	162,850,000
	2015	2,254,070,000	1,248,550,000	395,640,000	352,660,000	2,030,010,000	257,190,000	199,470,000
	2016	2,632,970,000	1,249,700,000	437,010,000	374,690,000	1,954,380,000	182,660,000	125,800,000
	2017	1858921000	1376119000	558569000	294971000	2761713000	36479000	294971000
	2018	2448122000	1447482000	621182000	224296000	3537548000	256575000	224296000
ALKIM	2000	-	-	-	-	-	-	-
	2001	-	-	-	-	-	-	-
	2002	-	-	-	-	-	-	-
	2003	161,131,897	21,500,000	34,300,833	15,848,447	112,716,190	15,744,804	16,953,999
	2004	163,733,973	24,725,000	28,379,923	13,019,640	104,537,814	10,255,910	13,544,853
	2005	157,998,516	107,200,401	25,559,145	9,574,072	100,728,457	10,187,104	7,930,893
	2006	162,453,044	108,563,378	31,107,803	14,136,075	119,244,537	14,562,868	11,170,067
	2007	163,471,603	114,654,786	38,205,344	24,294,891	142,463,444	23,043,505	18,230,111
	2008	175,196,124	145,125,762	41,475,098	27,089,136	147,851,194	30,586,263	24,120,776
	2009	187,621,692	157,596,216	42,002,490	24,742,764	147,908,423	27,546,516	22,134,173
	2010	213,628,661	157,111,258	35,988,526	16,468,640	162,956,649	16,468,640	13,532,853
	2011	264,099,395	172,418,513	49,938,266	25,621,004	198,701,999	25,621,004	22,677,203
	2012	265,527,158	178,576,070	47,615,503	18,463,666	209,526,859	20,565,758	16,464,838
	2013	273,820,000	169,170,000	23,630,000	20,060,000	77,000,000	22,800,000	16,370,000
	2014	247,270,000	178,800,000	22,440,000	13,040,000	86,080,000	17,920,000	13,930,000
	2015	280,790,000	193,630,000	26,200,000	20,430,000	99,350,000	14,490,000	22,760,000
	2016	349,490,000	221,030,000	25,840,000	17,250,000	102,090,000	15,630,000	11,480,000
	2017	217811530	287326493	92446464	74130422	395256839	69401567	69098554
	2018	310983354	348518341	164504572	144098891	589163482	118262974	96437725
BRKSN	2010	13,713,583	5,353,956	1,651,434	397,951	7,464,470	-241,297	- 182,086
	2011	25,605,999	17,866,378	3,578,762	451,319	15,724,220	714,788	600,052
	2012	31,696,829	18,361,881	5,101,594	266,481	24,244,681	464,276	341,728
	2013	33,070,000	15,810,000	4,350,000	-1,350,000	25,030,000	-2,770,000	- 2,540,000
	2014	38,680,000	18,330,000	7,960,000	950,000	36,520,000	80,000	950,000

	2015	47,410,000	18,730,000	10,150,000	1,930,000	41,520,000	550,000	400,000
	2016	52,220,000	23,750,000	12,360,000	2,680,000	50,280,000	950,000	520,000
	2017	30940354	25860357	11621218	3333890	46905820	1395152	1070280
	2018	34161486	26553268	12298745	6595371	53082328	710398	-255277
BRISA	2000	-	-	-	-	-	-	-
	2001	-	-	-	-	-	-	-
	2002	387,749,604	360,276,180	127,157,957	55,247,474	436,722,559	42,543,892	40,906,542
	2003	387,663,968	360,276,180	136,018,188	69,228,213	456,755,967	62,014,126	55,690,621
	2004	480,343,843	408,342,727	150,798,864	71,123,837	544,238,856	69,833,289	48,235,248
	2005	492,508,452	419,418,492	142,052,359	55,765,581	582,334,134	59,453,489	53,535,179
	2006	541,433,524	412,655,139	153,347,226	53,309,063	698,487,046	50,926,303	41,874,759
	2007	604,904,752	437,133,304	175,708,405	67,167,847	750,702,323	77,134,460	62,508,387
	2008	728,488,545	417,309,537	166,711,890	48,709,571	772,203,901	39,586,671	31,795,956
	2009	662,366,849	427,466,931	160,393,665	46,711,591	775,878,486	48,363,285	39,062,477
	2010	790,967,940	448,972,211	202,545,130	65,640,645	979,897,971	70,400,281	56,684,522
	2011	1,063,800,191	471,758,874	255,826,976	100,969,412	1,347,777,289	89,575,740	71,872,921
	2012	1,244,131,893	490,320,730	324,949,516	163,632,960	1,424,003,470	163,814,570	95,320,182
	2013	1,405,420,000	568,470,000	391,190,000	205,120,000	1,489,490,000	154,260,000	144,350,000
	2014	1,576,370,000	604,880,000	487,370,000	263,730,000	1,693,500,000	211,290,000	186,320,000
	2015	2,136,040,000	657,600,000	518,560,000	296,790,000	1,801,880,000	204,610,000	197,190,000
	2016	2,836,270,000	570,190,000	518,560,000	218,590,000	1,766,470,000	79,950,000	80,110,000
	2017	3452814275	683480020	611183133	257436942	2294135975	97306929	95203492
	2018	4557552404	920943253	766759557	429350532	2998775696	94066908	95741377
DYOBY	2000	-	-	-	-	-	-	-
	2001	54,869,730	3,440,305	26,100,102	8,106,493	81,064,251	-13,195,459	-13,080,229
	2002	175,808,697	-17,839,412	48,747,854	16,456,376	230,302,620	-26,143,136	-25,732,873
	2003	308,589,353	89,141,507	48,260,525	-11,356,123	198,291,871	-26,743,678	-32,799,233
	2004	264,729,925	56,704,941	49,472,273	4,331,745	186,002,772	-12,458,867	-17,578,866
	2005	262,523,722	49,519,426	52,649,362	3,017,656	200,204,640	-19,503,516	-22,701,258
	2006	266,710,280	38,814,343	50,481,728	-1,518,644	216,741,763	-46,352,855	-46,158,251
	2007	311,387,775	80,402,977	71,634,228	9,196,109	241,994,010	-21,616,717	-23,439,225
	2008	317,199,999	48,839,643	61,762,065	-2,327,367	222,288,267	-55,008,560	-52,419,960
	2009	307,689,981	69,444,394	61,332,459	7,718,363	212,879,900	-29,214,350	-29,308,252
	2010	307,689,981	69,444,394	61,332,459	7,718,363	212,879,900	-29,214,350	-29,308,252
	2011	545,951,313	47,556,903	95,289,556	-3,549,311	418,947,055	-58,682,093	-57,090,022
	2012	555,889,809	62,632,661	141,286,280	34,857,955	486,265,181	13,033,962	14,936,965
	2013	626,130,000	95,570,000	196,410,000	63,970,000	569,400,000	8,730,000	11,330,000
	2014	667,730,000	117,580,000	213,970,000	56,670,000	686,140,000	15,220,000	17,610,000
	2015	687,740,000	111,730,000	229,130,000	48,540,000	701,530,000	-2,200,000	2,960,000
	2016	778,440,000	119,670,000	263,610,000	71,140,000	773,250,000	9,780,000	11,530,000
	2017	523683558	148905860	256915568	56223325	923679065	-8409656	-3615419
	2018	607524545	129968146	318058905	58544198	1070851532	-40478850	-38252547
EPLAS	2000	41,016,642	6,982,465	11,097,077	4,722,646	38,414,311	-	846,656

	2001	71,384,500	-3,920,166	29,213,454	16,989,358	76,227,753	-10,415,675	-10,839,273
	2002	79,274,680	-6,057,037	14,107,404	-742,904	68,731,924	-10,438,010	-9,283,144
	2003	128,158,859	21,283,092	25,038,245	-933,894	104,269,320	-	112,291
	2004	94,614,455	7,046,630	15,204,973	-348,644	97,739,083	-	-14,066,498
	2005	88,538,461	694,407	19,005,119	2,640,564	91,357,763	-10,921,688	-11,496,888
	2006	86,541,415	-8,834,956	-	2,308,114	97,983,372	-10,303,968	-9,721,332
	2007	84,619,900	-8,226,226	-	3,225,927	93,582,054	3,753,048	923,140
	2008	82,917,500	-28,473,118	21,033,069	-557,795	98,410,817	-23,191,817	-21,148,256
	2009	84,538,017	-20,773,247	22,340,575	14,433,176	79,107,240	9,520,036	7,696,838
	2010	80,782,485	-21,325,825	18,997,495	3,838,112	103,100,793	-377,018	-538,232
	2011	90,064,695	-30,858,766	22,870,077	4,601,593	101,668,876	-11,030,043	-9,492,784
	2012	90,667,338	-33,211,139	28,618,998	6,576,927	118,230,191	-982,966	-2,354,703
	2013	97,220,000	-29,430,000	30,810,000	9,410,000	143,830,000	4,390,000	3,650,000
	2014	87,100,000	-27,510,000	25,440,000	5,640,000	135,500,000	2,780,000	1,770,000
	2015	93,620,000	-23,620,000	31,600,000	11,030,000	140,570,000	5,920,000	4,400,000
	2016	120,770,000	12,920,000	46,320,000	22,010,000	171,360,000	14,090,000	11,350,000
	2017	149664991	10834674	45586547	28011220	155379007	22128782	17596461
	2018	153634171	20542926	47943992	21461384	167080455	13737010	9574694
PETKM	2000	-	610,940,132	39,049,979	-24,736,853	497,052,242	9,666,841	-
	2001	888,545,744	659,650,287	106,195,521	12,556,877	780,183,721	13,808,452	2,887,240
	2002	1,196,566,407	848,018,057	47,599,416	-44,798,514	964,464,425	20,999,311	2,647,272
	2003	1,753,168,467	1,424,837,883	-87,553,418	-196,514,571	1,253,933,529	-174,640,741	-244,986,741
	2004	1,753,684,893	1,486,852,280	168,277,916	74,852,447	1,571,600,768	85,982,969	61,942,957
	2005	1,801,846,135	1,400,069,741	53,431,420	-34,911,301	1,344,249,050	-81,748,902	-98,546,779
	2006	1,838,952,760	1,458,055,570	205,099,888	117,544,319	2,222,333,063	51,085,519	57,985,829
	2007	1,933,536,147	1,507,485,587	204,747,632	82,319,048	2,174,849,627	67,905,574	65,958,427
	2008	1,698,292,910	1,356,592,637	-34,855,099	-131,286,670	2,320,432,985	-157,278,423	-151,258,150
	2009	2,113,202,978	1,470,262,531	113,866,414	41,498,598	2,057,459,379	64,731,190	114,035,094
	2010	2,375,893,103	1,600,347,451	229,206,840	127,141,497	2,909,391,891	139,932,200	130,084,920
	2011	2,671,127,874	1,702,688,776	174,696,649	162,942,068	3,891,322,098	117,795,725	102,341,325
	2012	2,799,356,243	1,664,317,394	76,241,921	-10,313,723	4,348,910,031	21,156,071	17,428,618
	2013	3,245,630,000	1,707,500,000	249,960,000	72,590,000	4,158,730,000	53,510,000	48,900,000
	2014	3,788,260,000	2,132,100,000	85,470,000	-60,580,000	4,132,850,000	-61,770,000	6,450,000
	2015	5,460,670,000	2,741,390,000	718,270,000	504,950,000	4,532,640,000	573,830,000	626,380,000
	2016	6,268,530,000	3,001,710,000	957,820,000	726,070,000	4,532,590,000	781,880,000	725,790,000
	2017	4208404000	3854078000	1857960000	1653848000	7363824000	1661095000	1389444000
	2018	9462822000	4134936000	1578960000	1183776000	9314717000	1003800000	836262000
SASA	2000	239,429,819	109,710,202	65,878,781	42,575,009	240,820,884	24,236,603	15,124,209
	2001	342,801,293	135,770,354	152,368,473	93,749,957	413,111,787	-2,691,866	-11,489,184
	2002	387,524,868	206,532,979	103,814,701	45,926,160	468,160,725	9,605,763	-3,842,706
	2003	961,986,000	634,560,000	-5,273,000	-55,218,000	546,139,000	-46,155,000	-25,748,000
	2004	727,435,000	431,515,000	25,246,000	-248,845,000	675,226,000	-244,905,000	-203,045,000

	2005	692,985,000	366,959,000	18,350,000	-60,848,000	620,801,000	-60,848,000	-64,556,000
	2006	519,844,000	344,114,000	34,386,000	-44,954,000	532,563,000	-44,954,000	-22,845,000
	2007	447,877,000	287,700,000	21,061,000	-41,130,000	451,189,000	-44,985,000	-43,920,000
	2008	417,316,000	237,002,000	-9,606,000	-27,069,000	354,391,000	-51,040,000	-50,698,000
	2009	390,725,000	201,852,000	15,570,000	-16,971,000	361,438,000	-35,150,000	-35,150,000
	2010	486,966,000	232,373,000	80,073,000	45,023,000	641,108,000	30,521,000	30,521,000
	2011	620,182,000	274,483,000	119,466,000	51,251,000	904,582,000	42,110,000	353112300
	2012	683,671,000	243,674,000	47,802,000	-8,006,000	999,978,000	-30,809,000	-30111156
	2013	652,040,000	249,910,000	71,030,000	32,720,000	1,090,270,000	5,060,000	6,240,000
	2014	665,540,000	320,340,000	146,210,000	86,390,000	1,209,790,000	67,090,000	71,380,000
	2015	699,560,000	391,070,000	149,860,000	105,740,000	1,111,410,000	72,110,000	70,730,000
	2016	1,032,190,000	528,120,000	187,350,000	187,260,000	1,182,910,000	157,680,000	137,050,000
	2017	2377995000	1137824000	319286000	310654000	1655205000	25029000	203566000
	2018	4151130000	1735230000	474529000	550509000	2178954000	250987000	597406000
SEKUR	2012	21,098,701	11,338,340	2,979,703	1,502,039	26,098,549	951,598	733,977
	2013	36,000,000	19,510,000	2,050,000	2,050,000	28,330,000	-50,000	-110,000
	2014	47,270,000	19,080,000	1,710,000	1,710,000	37,090,000	-710,000	-430,000
	2015	49,300,000	14,950,000	490,000	490,000	44,840,000	-4,770,000	-4,110,000
	2016	62,380,000	15,850,000	9,070,000	9,070,000	63,990,000	1,040,000	810,000
	2017	47,465,206	31,995,280	18270000	11520000	86660000	4690000	3650000
	2018	135,337,354	29,378,278	23,689,936	19,187,979	87,435,199	-3,047,306	-2,608,500
TMPOL	2012	20,540,634	4,093,587	2,862,140	2,236,868	22,816,367	948,295	734,362
	2013	32,990,000	12,760,000	4,680,000	3,360,000	23,970,000	360,000	226,091
	2014	40,990,000	15,030,000	6,330,000	4,810,000	34,860,000	2,780,000	2,270,000
	2015	55,000,000	17,100,000	9,930,000	6,340,000	47,030,000	2,910,000	2,070,000
	2016	72,800,000	17,310,000	9,570,000	5,310,000	55,860,000	-20,000	210,000
	2017	87,609,304	20,424,380	7,685,902	4,394,801	54,904,762	805,853	651,481
	2018	102,233,587	18,354,449	11,782,184	8,574,942	69,217,794	-2,608,880	-2,063,443
TUPRS	2000	1,619,282,366	624,340,909	384,699,451	319,930,569	6,357,353,828	400,131,133	242,982,184
	2001	2,185,470,851	731,814,564	371,500,257	236,953,536	10,595,788,331	286,139,887	283,505,057
	2002	3,008,239,913	1,122,266,348	303,265,761	136,854,994	14,624,325,311	228,375,845	257,545,733
	2003	4,982,690,203	2,886,465,688	668,440,082	420,735,831	22,001,453,505	708,974,175	733,610,626
	2004	5,187,880,751	3,122,441,989	977,929,725	748,020,931	21,613,209,968	919,128,376	932,825,777
	2005	5,736,825,054	3,252,513,682	1,045,275,531	810,619,179	14,844,803,951	884,543,826	658,440,381
	2006	7,026,267	3,461,599	1,154,644	836,463	20,103,086	1,013,284	822,430
	2007	9,081,879	4,111,915	1,807,192	1,269,858	22,520,083	1,612,320	1,298,039
	2008	8,636,798	3,556,264	1,899,400	1,283,502	30,404,009	549,265	439,350
	2009	10,223,304	3,779,542	1,608,196	1,015,965	20,330,633	1,015,152	815,771
	2010	13,918,037	3,901,156	1,841,983	1,034,152	26,165,954	929,142	741,358
	2011	14,757,986,000	4,405,658	2,647,311	1,983,389	40,747,047,000	1,542,183	1,244,527
	2012	17,114,140,000	4,889,584	1,997,370	1,080,003	47,033,224,000	1,371,712	1,468,039
	2013	9,764,540,000	5,093,600,000	1,473,310,000	41,190,000	41,078,430,000	13,050,000	1,197,220,000
	2014	6,991,380,000	6,156,720,000	1,262,800,000	435,740,000	39,722,710,000	183,660,000	1,458,960,000

	2015	8,742,280,000	8,305,110,000	4,126,380,000	2,751,770,000	36,893,330,000	2,225,370,000	2,550,170,000
	2016	13,667,060,000	8,088,390,000	3,649,230,000	2,357,290,000	34,854,850,000	1,944,020,000	1,793,270,000
	2017	38,162,979	10,477,661	6,213,898	4,857,459	53,948,110	4,474,038	3,840,556
	2018	40,035,727	9,945,829	9,224,323	5,736,300	88,552,170	3,724,380	3,761,445

Table 17: Profitability Ratios of Plastic and Chemical Companies published in Public Disclosure Platform.

COMPANY	Year	Gross Profit Margin Ratio	Operating Margin Ratio	Profit Margin Ratio	Return of Assets	Return of Equity	Net Profit Ratio	EBIT
AKSA	2009	17%	7%	6%	6%	2%	3%	17%
	2010	12%	6%	6%	8%	5%	6%	12%
	2011	14%	8%	6%	12%	6%	6%	14%
	2012	14%	15%	10%	17%	11%	11%	14%
	2013	16%	11%	10%	13%	8%	10%	16%
	2014	15%	11%	10%	15%	8%	10%	15%
	2015	19%	17%	13%	16%	9%	11%	19%
	2016	22%	19%	9%	10%	5%	7%	22%
	2017	20%	11%	1%	21%	16%	2%	20%
	2018	18%	6%	7%	15%	9%	10%	18%
-A-LKIM	2000	-	-	-	-	-	-	-
	2001	-	-	-	-	-	-	-
	2002	-	-	-	-	-	-	-
	2003	30%	14%	14%	79%	11%	10%	30%
	2004	27%	12%	10%	55%	8%	6%	27%
	2005	25%	10%	10%	7%	5%	6%	25%
	2006	26%	12%	12%	10%	7%	9%	26%
	2007	27%	17%	16%	16%	11%	14%	27%
	2008	28%	18%	21%	17%	14%	17%	28%
	2009	28%	17%	19%	14%	12%	15%	28%
	2010	22%	10%	10%	9%	6%	8%	22%
	2011	25%	13%	13%	13%	9%	10%	25%
	2012	23%	9%	10%	9%	6%	8%	23%
	2013	31%	26%	30%	10%	6%	8%	31%
	2014	26%	15%	21%	8%	6%	7%	26%
	2015	26%	21%	15%	12%	8%	5%	26%
	2016	25%	17%	15%	5%	3%	4%	25%
	2017	23%	19%	18%	24%	32%	32%	23%
	2018	28%	24%	20%	28%	31%	38%	28%
BRKSN	2010	22%	5%	-2%	-3%	-1%	-2%	22%
	2011	23%	3%	4%	3%	2%	3%	23%
	2012	21%	1%	1%	2%	1%	1%	21%
	2013	17%	-5%	-10%	-16%	-8%	-8%	17%
	2014	22%	3%	3%	5%	2%	0%	22%

	2015	24%	5%	1%	2%	1%	1%	24%
	2016	25%	5%	1%	2%	1%	2%	25%
	2017	25%	7%	2%	4%	3%	5%	25%
	2018	23%	12%	0%	-1%	-1%	2%	23%
BRISA	2000	-	-	-	-	-	-	-
	2001	-	-	-	-	-	-	-
	2002	29%	13%	9%	11%	11%	11%	29%
	2003	30%	15%	12%	15%	14%	16%	30%
	2004	28%	13%	9%	12%	10%	15%	28%
	2005	24%	10%	9%	13%	11%	12%	24%
	2006	22%	8%	6%	10%	8%	9%	22%
	2007	23%	9%	8%	14%	10%	13%	23%
	2008	22%	6%	4%	8%	4%	5%	22%
	2009	21%	6%	5%	9%	6%	7%	21%
	2010	21%	7%	6%	13%	7%	9%	21%
	2011	19%	7%	5%	15%	7%	8%	19%
	2012	23%	11%	7%	19%	8%	13%	23%
	2013	26%	14%	10%	25%	10%	11%	26%
	2014	29%	16%	11%	31%	12%	13%	29%
	2015	29%	16%	11%	30%	9%	10%	29%
	2016	29%	12%	5%	14%	3%	3%	29%
	2017	27%	11%	4%	14%	3%	3%	27%
	2018	26%	14%	3%	10%	2%	2%	26%
DYOBY	2000	-	-	-	-	-	-	-
	2001	32%	10%	-16%	-380%	-24%	-24%	32%
	2002	21%	7%	-11%	144%	-15%	-15%	21%
	2003	24%	-6%	-17%	-37%	-11%	-9%	24%
	2004	27%	2%	-9%	-31%	-7%	-5%	27%
	2005	26%	2%	-11%	-46%	-9%	-7%	26%
	2006	23%	-1%	-21%	-119%	-17%	-17%	23%
	2007	30%	4%	-10%	-29%	-8%	-7%	30%
	2008	28%	-1%	-24%	-107%	-17%	-17%	28%
	2009	29%	4%	-14%	-42%	-10%	-9%	29%
	2010	29%	4%	-14%	-42%	-10%	-9%	29%
	2011	23%	-1%	-14%	-120%	-10%	-11%	23%
	2012	29%	7%	3%	24%	3%	2%	29%
	2013	34%	11%	2%	12%	2%	1%	34%
	2014	31%	8%	3%	15%	3%	2%	31%
	2015	33%	7%	0%	3%	0%	0%	33%
	2016	34%	9%	1%	10%	1%	1%	34%
	2017	28%	6%	0%	-2%	-1%	-2%	28%
	2018	30%	5%	-4%	-29%	-6%	-7%	30%
EPLAS	2000	29%	12%	2%	12%	2%	-25%	29%
	2001	38%	22%	-14%	277%	-15%	-15%	38%

	2002	21%	-1%	-14%	153%	-12%	-13%	21%
	2003	24%	-1%	0%	1%	0%	2%	24%
	2004	16%	0%	-14%	-200%	-15%	-26%	16%
	2005	21%	3%	-13%	-2%	-13%	-12%	21%
	2006	20%	2%	-10%	110%	-11%	-12%	20%
	2007	21%	3%	1%	-11%	1%	4%	21%
	2008	21%	-1%	-21%	74%	-26%	-28%	21%
	2009	28%	18%	10%	-37%	9%	11%	28%
	2010	18%	4%	-1%	3%	-1%	0%	18%
	2011	22%	5%	-9%	31%	-11%	-12%	22%
	2012	24%	6%	-2%	7%	-3%	-1%	24%
	2013	21%	7%	3%	-12%	4%	5%	21%
	2014	19%	4%	1%	-6%	2%	3%	19%
	2015	22%	8%	3%	-19%	5%	6%	22%
	2016	27%	13%	7%	88%	9%	12%	27%
	2017	29%	18%	11%	162%	12%	15%	29%
	2018	29%	13%	6%	47%	6%	9%	29%
PETKM	2000	8%	-5%	1%	0%	0%	2%	8%
	2001	14%	2%	0%	0%	0%	2%	14%
	2002	5%	-5%	0%	0%	0%	2%	5%
	2003	-7%	-16%	-20%	-17%	-14%	-10%	-7%
	2004	11%	5%	4%	4%	4%	5%	11%
	2005	4%	-3%	-7%	-7%	-5%	-5%	4%
	2006	9%	5%	3%	4%	3%	3%	9%
	2007	9%	4%	3%	4%	3%	4%	9%
	2008	-2%	-6%	-7%	-11%	-9%	-9%	-2%
	2009	6%	2%	6%	8%	5%	3%	6%
	2010	8%	4%	4%	8%	5%	6%	8%
	2011	4%	4%	3%	6%	4%	4%	4%
	2012	2%	0%	0%	1%	1%	1%	2%
	2013	6%	2%	1%	3%	2%	2%	6%
	2014	2%	-1%	0%	0%	0%	-2%	2%
	2015	16%	11%	14%	23%	11%	11%	16%
	2016	21%	16%	16%	24%	12%	12%	21%
	2017	25%	22%	19%	36%	33%	39%	25%
	2018	17%	13%	9%	20%	9%	11%	17%
SASA	2000	27%	18%	6%	14%	6%	10%	27%
	2001	37%	23%	-3%	-8%	-3%	-1%	37%
	2002	22%	10%	-1%	-2%	-1%	2%	22%
	2003	-1%	-10%	-5%	-4%	-3%	-5%	-1%
	2004	4%	-37%	-30%	-47%	-28%	-34%	4%
	2005	3%	-10%	-10%	-18%	-9%	-9%	3%
	2006	6%	-8%	-4%	-7%	-4%	-9%	6%
	2007	5%	-9%	-10%	-15%	-10%	-10%	5%

	2008	-3%	-8%	-14%	-21%	-12%	-12%	-3%
	2009	4%	-5%	-10%	-17%	-9%	-9%	4%
	2010	12%	7%	5%	13%	6%	6%	12%
	2011	13%	6%	39%	-11%	-5%	7%	13%
	2012	5%	-1%	-3%	3%	1%	-5%	5%
	2013	7%	3%	1%	2%	1%	1%	7%
	2014	12%	7%	6%	22%	11%	10%	12%
	2015	13%	10%	6%	18%	10%	10%	13%
	2016	16%	16%	12%	26%	13%	15%	16%
	2017	19%	19%	12%	18%	9%	1%	19%
	2018	22%	25%	27%	34%	14%	6%	22%
SEKUR	2012	11%	6%	3%	6%	3%	5%	11%
	2013	7%	7%	0%	-1%	0%	0%	7%
	2014	11%	6%	3%	6%	3%	5%	11%
	2015	7%	7%	0%	-1%	0%	0%	7%
	2016	11%	6%	3%	6%	3%	5%	11%
	2017	7%	7%	0%	-1%	0%	0%	7%
	2018	11%	6%	3%	6%	3%	5%	11%
TMPOL	2012	13%	10%	3%	18%	4%	5%	13%
	2013	20%	14%	1%	2%	1%	1%	20%
	2014	18%	14%	7%	15%	6%	7%	18%
	2015	21%	13%	4%	12%	4%	5%	21%
	2016	17%	10%	0%	1%	0%	0%	17%
	2017	14%	8%	1%	3%	1%	1%	14%
	2018	17%	12%	-3%	-11%	-2%	-3%	17%
TUPRS	2000	6%	5%	4%	39%	15%	25%	6%
	2001	4%	2%	3%	39%	13%	13%	4%
	2002	2%	1%	2%	23%	9%	8%	2%
	2003	3%	2%	3%	25%	15%	14%	3%
	2004	5%	3%	4%	30%	18%	18%	5%
	2005	7%	5%	4%	20%	11%	15%	7%
	2006	6%	4%	4%	24%	12%	14%	6%
	2007	8%	6%	6%	32%	14%	18%	8%
	2008	6%	4%	1%	12%	5%	6%	6%
	2009	8%	5%	4%	22%	8%	10%	8%
	2010	7%	4%	3%	19%	5%	7%	7%
	2011	0%	0%	0%	28%	0%	0%	0%
	2012	0%	0%	0%	30%	0%	0%	0%
	2013	4%	0%	3%	24%	12%	0%	4%
	2014	3%	1%	4%	24%	21%	3%	3%
	2015	11%	7%	7%	31%	29%	25%	11%
	2016	10%	7%	5%	22%	13%	14%	10%
	2017	12%	9%	7%	37%	10%	12%	12%
	2018	10%	6%	4%	38%	9%	9%	10%

Table 18: z and two tailed sigma values of profitability ratios calculated via Wilcoxon Test for each company.

Company Name	Ratios	Before Mean	After Mean	z value	Sig. (2-tailed)
AKSA	**Gross Profit Margin**	0.1474	0.1892	-1.8260	0.0680
	OperatingProfit Margin	0.0929	0.1294	-1.0950	0.2730
	Net Profit Margin	0.0771	0.0810	-0.4050	0.6860
	Return on Equity	0.1128	0.1552	-1.4610	0.1440
	Return on Assets	0.0628	0.0936	1.0950	0.2730
	EBITTA	0.0708	0.0824	-0.3650	0.7150
ALKIM	**Gross Profit Margin**	0.2663	0.2581	-1.2140	0.2250
	OperatingProfit Margin	0.1435	0.1916	-2.0230	**0.0430****
	Net Profit Margin	0.1491	0.1761	-2.0230	**0.0430****
	Return on Equity	0.2169	0.1529	-0.6740	0.5000
	Return on Assets	0.0859	0.1595	-0.4050	0.6860
	EBITTA	0.1011	0.1735	-0.4050	0.6860
BRKSN	**Gross Profit Margin**	0.2083	0.2375	-1.4610	0.1440
	OperatingProfit Margin	0.0098	0.0642	-1.0950	0.2730
	Net Profit Margin	-0.0184	0.0128	-0.7300	0.4650
	Return on Equity	-0.0356	0.0254	-1.0950	0.2730
	Return on Assets	-0.0140	0.0140	-0.7300	0.4650
	EBITTA	-0.0147	0.0195	-1.0950	0.2730
BRISA	**Gross Profit Margin**	0.2395	0.2782	-1.2140	0.2250
	OperatingProfit Margin	0.0990	0.1399	-1.7530	0.0800
	Net Profit Margin	0.0755	0.0676	-1.4830	0.1380
	Return on Equity	0.1377	0.1983	-2.0230	**0.0430****
	Return on Assets	0.0883	0.0575	-1.7530	0.0800
	EBITTA	0.1083	0.0614	-1.7530	0.0800
DYOBY	**Gross Profit Margin**	0.2732	0.3109	-1.7530	0.0800
	OperatingProfit Margin	0.0324	0.0719	-1.2140	0.2250
	Net Profit Margin	-0.1195	0.0010	-2.0230	**0.0430**
	Return on Equity	-0.5952	-0.0092	-0.9440	0.3450
	Return on Assets	-0.1006	-0.0049	-2.0230	**0.0430****
	EBITTA	-0.0980	-0.0101	-2.0230	**0.0430****
EPLAS	**Gross Profit Margin**	0.2324	0.2526	-0.1350	0.8930
	OperatingProfit Margin	0.0564	0.1115	-0.6740	0.5000

	Net Profit Margin	-0.0589	0.0562	-1.7530	0.0800
	Return on Equity	0.2894	0.5436	-0.1350	0.8930
	Return on Assets	-0.0637	0.0682	-1.7530	0.0800
	EBITTA	-0.0695	0.0898	-2.0230	**0.0430****
PETKM	**Gross Profit Margin**	0.0531	0.1625	-1.4830	0.1380
	OperatingProfit Margin	-0.0008	0.1217	-1.7530	0.0800
	Net Profit Margin	-0.0069	0.1157	-1.7530	0.0800
	Return on Equity	0.0028	0.2072	-1.7530	0.0800
	Return on Assets	-0.0007	0.1301	-1.7530	0.0800
	EBITTA	0.0050	0.1429	-1.7530	0.0800
SASA	**Gross Profit Margin**	0.1013	0.1650	-0.1350	0.8930
	OperatingProfit Margin	-0.0154	0.1530	-0.6740	0.5000
	Net Profit Margin	-0.0280	0.1271	-1.7530	0.0800
	Return on Equity	-0.0848	0.2373	-2.0230	**0.0430****
	Return on Assets	-0.0500	0.1141	-2.0230	**0.0430****
	EBITTA	-0.0472	0.0855	-1.7530	0.0800
SEKUR	**Gross Profit Margin**	0.0933	0.1361	-1.3420	0.1800
	OperatingProfit Margin	0.0650	0.1102	-1.3420	0.1800
	Net Profit Margin	0.0121	-0.0157	-1.3420	0.1800
	Return on Equity	0.0295	-0.0442	-1.3420	0.1800
	Return on Assets	0.0159	-0.0044	-1.3420	0.1800
	EBITTA	0.0219	-0.0038	-1.3420	0.1800
TMPOL	**Gross Profit Margin**	0.1603	0.1749	-1.3420	0.1800
	OperatingProfit Margin	0.1191	0.1144	-0.4470	0.6550
	Net Profit Margin	0.0208	0.0190	-1.3420	0.1800
	Return on Equity	0.0986	0.0407	-0.4470	0.6550
	Return on Assets	0.0213	0.0166	-1.3420	0.1800
	EBITTA	0.0285	0.0208	-1.3420	0.1800
TPRS	**Gross Profit Margin**	0.0500	0.0935	-1.7530	0.0800
	OperatingProfit Margin	0.0360	0.0616	-1.4830	0.1380
	Net Profit Margin	0.0377	0.0542	-1.2140	0.2250
	Return on Equity	0.2893	0.3021	-0.4050	0.6860
	Return on Assets	0.1334	0.1652	-0.4050	0.6860
	EBITTA	0.1562	0.1267	-0.4050	0.6860