

**Czech University of Life Sciences Prague**

**Faculty of Economics and Management**

**Department of Economics**



**Bachelor Thesis**

**Crude oil industry. Case study of Russia.**

**Elena PUDOVA**

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# CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Faculty of Economics and Management

## BACHELOR THESIS ASSIGNMENT

Elena Pudova

Business Administration

Thesis title

**Crude oil industry. Case study of Russia.**

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### Objectives of thesis

The main goal of thesis is to evaluate the impact of crude oil price volatility on the economic performance of Russia. Based on the main goal the following tasks were identified:

- understand the key characteristics of crude oil commodity;
- define the main determinants that which drive crude oil prices;
- assess the current state of the world crude oil market;
- examine the current state of crude oil market in Russia;
- investigate the links between oil prices and GDP in Russia.

### Methodology

The Bachelor Thesis is divided into theoretical and practical parts.

The theoretical part contains comparative and descriptive methods of research.

In theoretical part beside descriptive method, statistical methods will be applied: linear regression model of relationship between price of crude oil and GDP per capita in Russia will be created and tested.

**The proposed extent of the thesis**

35-40

**Keywords**

Crude oil, economic performance, crude oil price, GDP, Russia

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Hilyard, J. The oil & gas Industry; PennWell: Tulsa, Okla., 2012, ISBN-13: 9781593702540

Speight, J. An Introduction to Petroleum Technology, Economics, and Politics; Wiley: Hoboken, 2011, ISBN: 9781118012994

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### **Declaration**

I declare that I have worked on my diploma thesis titled "Crude oil industry case study of Russia" by myself and I have used only the sources mentioned at the end of the thesis. As the author of the diploma thesis, I declare that the thesis does not break copyrights of any their person.

In Prague on 15.3.2019

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# **Crude oil industry. Case study of Russia.**

## **Abstract**

Crude oil is the most important raw material used in modern society for the reason that it provides not only raw materials for fuel manufacture and energy, but also starting materials for plastics and other products.

The economics of crude oil pricing is one of the most complex and variable mechanisms in the commodities market. A number of different factors affect it.

The oil price can determine the economic situation of the state, its budget and trade balance, impact on the government revenues and oil and gas industry and other sectors of an economy. That is why it is important to follow and predict the global oil prices.

The oil complex is a strategically important element in the economy of Russia and has great importance in the socio-economic development of the country.

Russia is one of the world's largest producers of crude oil. Russia's economy is highly dependent on its hydrocarbons, oil and natural gas revenues account for more than one-third of the federal budget revenues hence the Russian economy is now highly dependent on oil and gas.

The aim of the thesis is to understand the main determinants of crude oil price evaluate the impact of crude oil price volatility on the economic performance of Russia.

The theoretical part describes factors influencing price of crude oil and fuel from the origin of crude oil over extraction and production process to the current market situation in the world. The practical part of thesis is focusing on crude oil market in Russia, its trends and policies. Furthermore, in the practical part a linear regression model of relationship between price of crude oil and GDP per capita in Russia is tested. It is found that there is a strong relationship between GDP per capita and average price of crude oil.

**Keywords:** Crude oil, economic performance, crude oil price, GDP, Russia.

# **Petrochemický průmysl. Případová studie Ruska.**

## **Abstrakt**

Ropa je nejvýznamnější surovinou dosud používanou v moderní společnosti, neboť poskytuje nejen suroviny pro výrobu paliv a energie, ale také výchozí materiály pro plasty a další produkty. Ekonomika cen ropy je jedním z nejsložitějších a nejproměnlivějších mechanismů na trhu s komoditami. Je ovlivňována řadou různých faktorů.

Cena ropy může určovat ekonomickou situaci státu, jeho rozpočet a obchodní bilanci, dopad na vládní příjmy a ropný a plynárenský průmysl a další odvětví hospodářství. Proto je důležité sledovat a předpovídat globální ceny ropy. Ropný komplex je strategicky důležitým prvkem v ekonomice Ruska a má velký význam pro socioekonomický rozvoj země.

Rusko je jedním z největších světových výrobců surové ropy. Ekonomika Ruska je silně závislá na uhlovodících, příjmy z ropy a zemního plynu tvoří více než jednu třetinu příjmů federálního rozpočtu, a proto je ruská ekonomika v současné době silně závislá na ropě a plynu. Cílem diplomové práce je pochopit hlavní určující faktory cen ropy a zhodnotit dopad kolísání cen ropy na hospodářskou výkonnost Ruska. Na základě hlavního cíle byly stanoveny následující úkoly. V teoretické části jsou popsány faktory ovlivňující cenu ropy a paliva od původních zdrojů ropy přes těžební a výrobní proces až po současnou situaci ve světě. Praktická část práce se zaměřuje na trh s ropou v Rusku, jeho trendy a politikou. V praktické části je dále testován lineární regresní model vztahu mezi cenou ropy a HDP na obyvatele v Rusku. Bylo zjištěno, že existuje významná spojitost mezi HDP na obyvatele a průměrnou cenou ropy.

**Klíčová slova:** Ropa, hospodářský výkon, cena ropy, Rusko.

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## List of abbreviations

API-	American Petroleum Institute
b/day	-barrel per day
bbl-	blue barrel
GSE	-Government Sponsored Enterprises
Mln.	- million
mln.t.-	million tons
NOC	-National Oil Company
OPEC-	Organization of the Petroleum Exporting Countries.
RUB-	Russian ruble
USSR-	Union of Soviet Socialist Republics
US	- United States
VAT	- Value Added Tax

# **1 Introduction**

Crude oil supplies around 33 % of the global energy consumption. Gasoline, kerosene, and diesel oil provide fuel for automobiles, tractors, trucks, aircraft, and ships. Petroleum products are the basic materials used for the manufacture of synthetic fibers for clothing and in plastics, paints, fertilizers, insecticides, soaps, and synthetic rubber. Therefore crude oil plays the key role in the economy of many countries; it is the strategic energy resource, because it influences not only the economy of a separate country but a global economical and geopolitical situation as well. Politics, in its term, as well as currency exchange rate, the level of demand and supply and other factors, influence the world crude oil price and it is very important to understand the main determinants of crude oil price. Some countries have a massive part of their revenues coming from crude oil and natural gas. However, price volatility reaches those countries under a strong market dependency that gradually affect the Country GDP. One of such countries is Russia, where oil and natural gas revenues account for more than one-third of the federal budget revenues. In addition, Russia has the world's eighth-largest proven oil reserves accounting for 80 billion barrels.

In this bachelor thesis the main crude oil price determinants will be defined and the relationship between economic performance of Russia and crude oil price will be tested.

## **2 Objectives and Methodology**

### **2.1 Objectives**

The crude oil industry is one of the most important natural resource of the national economy, the strongest source of currency and one of the largest contributors to the state budget.

The main goal of this paper is to evaluate the impact of crude oil price volatility on the economic performance of Russia.

Based on the main goal the following tasks were identified:

- understand the key characteristics of crude oil commodity;
- define the main determinants that which drive crude oil prices;
- assess the current state of the world crude oil market;
- examine the current state of crude oil market in Russia;
- investigate the links between oil prices and GDP in Russia.

### **2.2 Methodology**

The Bachelor Thesis is divided into theoretical and practical parts.

The theoretical part contains comparative and descriptive methods of research.

This part describes the crude oil commodity and its characteristics as well as analyses the crude oil market, its structure and main market players. In addition the main determinants of crude oil price will be identified.

In theoretical part crude oil market in Russia will be analyzed. Beside descriptive method, statistical methods will be applied: linear regression model of relationship between price of crude oil and GDP per capita in Russia will be created and tested for parameters, goodness of fit and significance of relationship.

## **3 Literature Review**

### **3.1 Commodity overview**

In order to understand the nature of crude oil market and economy it is important to understand the nature of crude oil itself, its origin, how it is extracted and refined and what it is used for.<sup>1</sup>

#### **3.1.1 Definition of crude oil**

Crude oil is a naturally occurring, unrefined petroleum product composed of hydrocarbon deposits and other organic materials. A type of fossil fuel, crude oil can be refined to produce usable products such as gasoline, diesel and various forms of petrochemicals. It is a nonrenewable resource, which means that it can't be replaced naturally at the rate we consume it and is therefore a limited resource.

#### **3.1.2 Classification of crude oil**

All types of crude oil are hydrocarbons; however there are differences in their properties, especially variations in the molecular structure. A big range of variations may also influence the appropriateness of the different types of crude oil for particular products and the quality of the products. There are three main grades in crude oil classification. It can be classified among the oil density (Light or heavy), sulfur content (sweet or sour) and location of oil producer.

Location of oil producer shows the transportation cost to refinery - offshore production or production in countries with high level of environmental and political risks increase the costs. Crude oil with low density (light) is more desirable than heavy one, since it produces a higher yield of gasoline. Sweet oil (with low sulfur content) has fewer environmental problems and requires less refining to meet sulfur standards of consuming countries than sour oil and therefore is more desirable. Light, sweet crude oils are preferred by refiners

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<sup>1</sup>Investopedia. (2012). *Crude Oil*. [online] Available at: <https://www.investopedia.com/terms/c/crude-oil.asp> [Accessed 3 Jan. 2018].

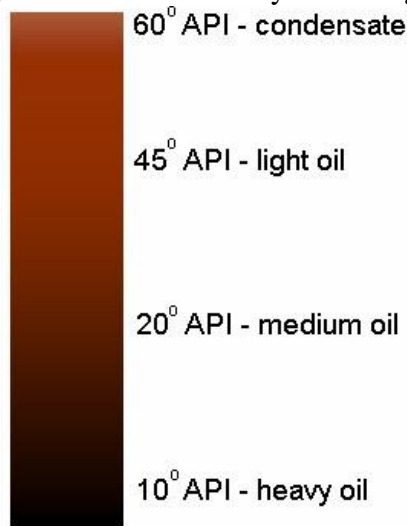
<sup>2</sup>Indexmundi.com. (2019). *Light vs Heavy Crude Oil - Commodities Glossary - IndexMundi*. [online]

because of relatively high yields of high value products such as gasoline, diesel, fuel, heating oil and jet fuel.

Crude oil density is expressed by API gravity. API stands for American Petroleum Institute. API gravity represents of how heavy or light a particular type of crude oil is in comparison to water. If the gravity is bigger than 10, it is lighter. If API gravity is less than 10, this type of crude oil is heavier than water.<sup>2</sup>

Light liquid types are considered to be very valuable, as it produce large amount of gasoline, while heavy types produce a large amount of asphalt, but only a small amount of gasoline.<sup>3</sup>

**Figure 1** Crude oil density according to American Petroleum Institute scale



Source: Fekete.com. API. [online]

Classifications are made based on the sulfur content as well. Crude oil with low content of sulfur is called 'sweet' and the presence of high content sulfur is known as 'sour'.<sup>4</sup> Sweet crude oil can be described as the type that has less than 0.42 % of sulfur. Low level of sulfur is highly demanded, it is commonly refined into gasoline. Sour crude oil has more than 0.5 % of sulfur<sup>5</sup>. The purity of crude oil depends on the sulfur content as sulfur is an

<sup>2</sup>Indexmundi.com. (2019). *Light vs Heavy Crude Oil - Commodities Glossary - IndexMundi*. [online] Available at: <https://www.indexmundi.com/commodities/glossary/light-vs-heavy-crude-oil> [Accessed 2 Feb. 2018].

<sup>3</sup>VáclavCílek: "Nejistýplamen - Průvodceropnýmsvětem." 2007. p. 22

<sup>4</sup>Fekete.com. (2015). *API*. [online] Available at: <http://www.fekete.com/SAN/TheoryAndEquations/FieldNotesTheoryAndEquations/API.htm> [Accessed 9 Oct. 2018].

<sup>5</sup>VáclavCílek: *Nejistýplamen - Průvodceropnýmsvětem.* 2007 . p. 23

acidic material, which causes corrosion and represents bad quality. Because of lower content of sulfur the sweet crude oil is also easier to refine and safer to extract and transport than sour crude.<sup>6</sup> Hence Crude oil with lower content of crude oil also known as sweet crude oil is always preferred to a sour crude oil.<sup>7</sup>

### **3.1.3 Types of crude oil**

#### **West Texas Intermediate**

The West Texas Intermediate is sweet and light crude oil. Its sulfur content is only 0.24% and its gravity is 39.6 degrees. The refining of this oil is usually done in Gulf regions as well as the United States because it is suitably located to oil reserves.

#### **Brent Blend**

Brent Blend is considered as sweet oil having 0.37% sulfur and 38.06 degrees in gravity. The term Brent Blend acquired from the geographical location where this type of oil is extracted from. It is mostly refined in Northwest Europe and is also called Brent Blend, London Brent, and Brent petroleum. The Brent field is located in the East Shetland Basin, halfway between Scotland and Norway. Brent Blend oil is typically used for making petroleum and gasoline for vehicles.

#### **Dubai Crude**

As the name puts it, the Dubai Crude oil is extracted from Dubai. The Dubai crude has a light density, having 31 degrees gravity and a sulfur content of 2%, making it 6 times more sour than Brent Crude and 8 times more sour than West Texas Intermediate Russian Export Blend

This type of oil has been the standard for Russian crude oil. Russian Export Blend Crude Oil is coming in two main qualities, Urals Blend and Siberian Light. Siberian Light has a lower sulfur content and lower viscosity than Urals Blend which is a mixture of crude oils consisting of Siberian Light with high sulfur oils produced in Russia's European

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<sup>6</sup>Petroleum.co.uk. (n.d.). *Petroleum - Classification - Sweet vs Sour*. [online] Available at: <http://www.petroleum.co.uk/sweet-vs-sour> [Accessed 15 Nov. 2018].

<sup>7</sup>mcbrokers.com. (2010). *Classifications of Crude Oil*. [online] Available at: <http://www.imcbrokers.com/blog/overview/detail/classifications-of-crude-oil> [Accessed 8 Dec. 2018].

regions. It's density is 32 degrees in gravity and sulfur content 1,8% , which makes it fall under a classification of sour crude oil with medium gravity.<sup>8</sup>

### **OPEC Reference Basket**

This is not specific crude, but rather is a weighted average of petroleum that comes from OPEC countries. There are currently 11 different oils combined into the ORB. It averages an API gravity, with the present combination, of 32.7 degrees and has a sulfur content of 1.77.

### **Minas**

Minas oil comes from the island of Sumatra. It is light, sweet crude. The API gravity is approximately 35degreesat has a sulfur content of only 0.08%.<sup>9</sup>

### **3.1.4 Conventional and Non-conventional oil**

There are two basic types of oil – conventional oil is extracted using traditional oil well method. It is preferred because it provides a much higher ratio of extracted energy used, but sources of conventional oil are running out. Non-conventional types of production include tar sands, heavy oil, oil shale, bio fuels, and thermal depolymerization of organic matter and the conversion of coal or natural gas to liquid hydrocarbons.

Non-conventional production requires more complex and expensive methods to produce the required products, it is less efficient and some types have a larger environmental impact relative to conventional oil production.

Tar sands are oil traps that are not deep enough below the surface to allow the generation of conventional oil. The oil was not heated enough to continue the process of cracking in order to get rid of high viscosity. Tar sands are found in large amounts of in many countries throughout the world, however the world's largest deposit occur in two countries: Canada and Venezuela, both of which have oil sands reserves approximately equal to the world's total reserves of conventional crude oil. Heavy crude oil is extracted in

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<sup>8</sup>HY Markets Official blog. (2010). / *HY Markets Official blog*. [online] Available at: <http://blog.hycm.com/training/the-different-types-of-crude-oil-and-how-they-are-classified.html> [Accessed 9 Jul. 2018].

<sup>9</sup>Petroleum.co.uk. (2010). *Petroleum - Classification - Benchmarks*. [online] Available at: <http://www.petroleum.co.uk/benchmarks> [Accessed 5 Jul. 2018].

extremely viscous form and therefore has to be transported with additives like steam, solvents or hot air. These processes require larger amount of water and energy than conventional oil extraction which results in higher cost of final product.<sup>10</sup>

Oil shales are source rocks that have not been exposed to heat or pressure long enough to convert their trapped hydrocarbons into crude oil. This source rock contains kerogen, from which high energy consumption technology can extract liquid hydrocarbons. Deposits of oil shales are globally estimated around 3 trillion barrels of recoverable oil. Kerogen requires more processing to use than crude oil, which increases its economic cost as a crude-oil substitute both economically and in terms of its environmental impact.<sup>11</sup>

Biofuel is a solid, liquid or gas fuel derived from relatively recent dead biological material. There are two common strategies of production of crude oil: The first one is to grow crops high in sugar (sugar cane, sugar and sweet sorghum) or starch (corn/maize), and then use yeast fermentation to produce ethyl alcohol (ethanol). The second one is to grow plants that contain high amounts of vegetable oil, such as oil palm, soybean, algae or jatropa. When these oils are heated, their viscosity is reduced, and they can be burned directly in diesel engine or chemically processed to produce fuels such as biodiesel.<sup>12</sup> Thermal depolymerization (TDP) is a process that reduces complex organic materials (usually waste products like biomass and plastic) into light crude oil. The energy production is difficult to estimate since energy output varies greatly based on feedstock.

The conversion of coal and natural gas has the potential to yield great quantities of non-conventional oil albeit at much lower net energy output. Because of the high cost of transporting natural gas, many known but remote fields are being developed. Conversion can make this energy available even under present market conditions. First transformation of coal into hydrocarbons was during 1920s in petroleum-poor but coal-rich Germany, It was used in Nazi Germany when petroleum the petroleum imports were restricted due to

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<sup>10</sup>Energy.gov.ab.ca. (n.d.). *Energy Internet*. [online] Available at: [http://www.energy.gov.ab.ca/OilSands/pdfs/RPT\\_Chops\\_app3.pdf](http://www.energy.gov.ab.ca/OilSands/pdfs/RPT_Chops_app3.pdf) [Accessed 3 Aug. 2018].

<sup>11</sup>Eia.doe.gov. (n.d.). [online] Available at: [http://www.eia.doe.gov/oiaf/archive/aeo06/pdf/0383\(2006\).pdf](http://www.eia.doe.gov/oiaf/archive/aeo06/pdf/0383(2006).pdf) [Accessed 3 Aug. 2018].

<sup>12</sup>Newworldencyclopedia.org. (2010). *Biofuel - New World Encyclopedia*. [online] Available at: <http://www.newworldencyclopedia.org/entry/Biofuel> [Accessed 3 Aug. 2018].



war. As crude oil prices increase, the cost of coal to oil conversion becomes comparatively cheaper.<sup>13</sup>

### 3.1.5 Phases of crude oil industry

All stages of the industrial activity of oil are under three main stages, upstream, midstream and downstream stages.

**Upstream** oil and gas operations identify deposits, drill wells, and recover raw materials from underground. This sector also includes related services, such as rig operations, feasibility studies, and machinery rental and extraction chemical supply. China National Offshore Oil Corporation and Schlumberger are examples of large companies that focus on upstream services. Many of the largest upstream operators are the major diversified oil and gas firms, such as Exxon-Mobil.

**Midstream** operations link the upstream and downstream entities. Midstream operations mostly include resource transportation and storage, such as pipelines and gathering systems. Kinder Morgan and Williams Companies are two examples of midstream firms.

**Downstream** operations include refineries and marketing. These services turn crude oil into usable products such as gasoline, fuel oils, and petroleum-based products. Marketing services help move the finished products from energy companies to retailers or end users. Marathon Petroleum and Phillips 66 are two noteworthy examples of downstream companies.<sup>14</sup>

### 3.1.6 Crude oil extraction process

Before learning the costs components of crude oil extraction, let's take a look at how producers extract crude oil from the ground.

First, a crude oil well is created by drilling a hole into the earth with an oil rig. A steel pipe is placed inside the oil well for structural strength. Then holes are made at the bottom

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<sup>13</sup><https://www.ucsusa.org/clean-energy/coal-and-other-fossil-fuels/shale-gas-unconventional-sources-natural-gas>

<sup>14</sup>Investopedia. (2019). *Upstream vs. Downstream Oil and Gas Operations: What's the Difference?*. [online] Available at: <https://www.investopedia.com/ask/answers/060215/what-difference-between-upstream-and-downstream-oil-and-gas-operations.asp> [Accessed 3 Aug. 201].

of the well so oil passes through the base. Collection valves are fitted at the top. These valves maintain pressure when crude oil is pumped.

The oil extraction process includes the following three stages: primary, secondary, and tertiary.

### **Primary recovery**

Primary recovery is the first stage of crude oil extraction. In this stage, crude oil flows naturally under the base of the oil rig. The natural underground pressure in the oil well pushes the oil up to the surface, or an artificial lift is used to pump crude oil to the surface. This stage allows ~5% to ~15% of the oil in the reservoir to be extracted.

### **Secondary recovery**

The natural flow of crude oil due to underground pressure will diminish over time. So a secondary recovery is used to extract crude oil from the well. In this method, the natural flow of oil is increased by increasing the reservoir pressure. This is accomplished by injecting water or natural gas into the well, which drives the crude oil to the base where the oil can be pumped. This stage allows ~35% to ~45% of the oil in the reservoir to be extracted.

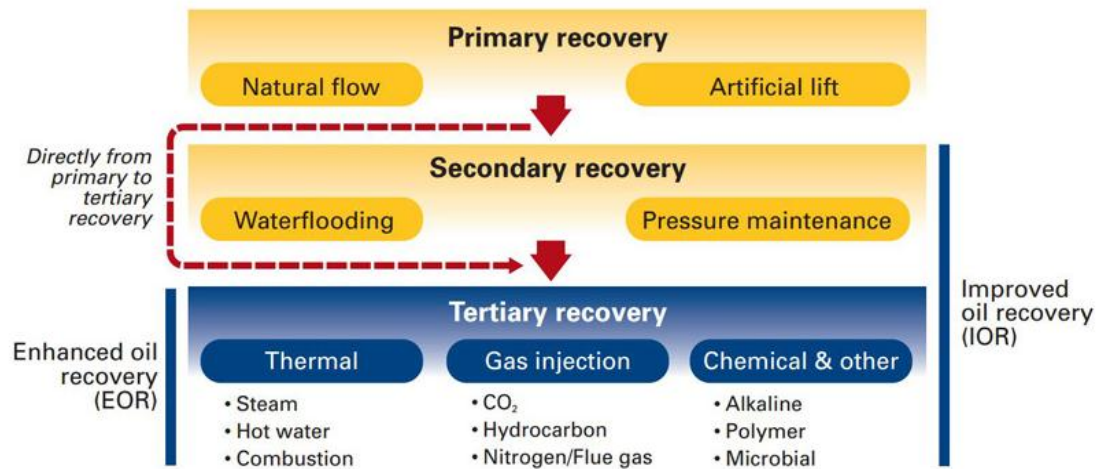
### **Tertiary recovery**

When crude oil extraction from secondary recovery becomes impossible, tertiary recovery is applied. In this method, water, gas, and chemicals are injected into the reservoir to improve the natural flow of crude oil. Finally, crude oil is extracted. This stage allows ~5% to ~15% of the oil in the reservoir to be extracted. When crude oil prices are high, this method can be used to increase oil extraction, and vice versa. <sup>15</sup>

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<sup>15</sup>Marketrealist.com. (2009). *Market Realist*. [online] Available at: <https://marketrealist.com/2015/01/production-cost-crude-oil-affect-oil-prices> [Accessed 3 Aug. 2018].

**Figure 2** Crude oil extraction process



Source: Marketrealist.com. (2009). *Market Realist*. [online]

### 3.2 Crude oil market structure

The world market of oil and petroleum products is one of the most complex markets in the world. It is not possible to determine it only by the supply and demand law, which is common for most markets of goods sold in retail establishments. However regardless the unique nature of oil market, its initial global components are producers and consumers as for any other commodity market.

The economics of oil must take into account that it is a depleting non-renewable resource and the cost of extraction of a nonrenewable resource depends not only on the current rate of production but also on the amount of cumulative production.

Crude oil prices behave much as any other commodity with wide price swings in times of shortage or oversupply. The crude oil price cycle may extend over several years responding to changes in demand as well as supply. Many pundits believe that the projections of running out of oil are based on geology, not price. Every existing oil reservoir has more than half of the original oil in place, many with more. Much of the crude oil that is left is trapped in tiny pores and cannot be recovered by simple pumping, and more advanced and expensive procedures are necessary to recover the crude oil.

Another aspect of crude oil economics is the cost of refining. Refining high-sulfur crude oil also requires greater expenditures for energy. In fact, energy accounts for approximately half of the refinery cost. Refinery location is yet another variable. The closer a refinery is to the crude oil source and the demand, the lower the transportation costs. Otherwise, the refinery must factor in the added cost of getting the products to market. Obviously, the ultimate variable in crude oil economics is the price of crude oil. Crude oil quality is another key variable. High viscosity, high-sulfur crude oil can cost up to one third less than low viscosity, low-sulfur crude oil. However, because high-sulfur crude oil requires more processing, refineries that buy primarily cheap crude oil incurs more fixed expenses for equipment and labor.<sup>16</sup> Crude oil market is very dynamic and its structure has been changing over years. In order to describe the current structure of the market it is necessary to analyze it through the history perspective in order to reason and explain nature and power of current main crude oil market players.

### 3.2.1 The Seven Sisters

From the mid-1940-1970, the global oil and gas market was dominated by a group of publically owned companies based in the United States, the United Kingdom and The Netherlands;

- Standard Oil of New Jersey (Esso)
- Standard Oil Company of New York (Socony)
- Standard Oil of California (Socal)
- Gulf Oil
- Texaco
- Royal Dutch Shell (Netherlands)
- Anglo-Persian Oil Company (UK)

This group was called the Seven Sisters in the 1950s by Enrico Mattei, an Italian government administrator eager to have Italy's Eni (Ente Nazionale Idrocarburi, or National

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<sup>16</sup>Speight, J. (2011). *An Introduction to Petroleum Technology, Economics, and Politics*. Hoboken: Wiley, p.21.

Fuel Trust) join the powerful club.

Over the next fifty years, fusions and integrations transformed the original Seven Sisters into the companies known today as ExxonMobil, Chevron, Royal Dutch Shell and BP.

Esso became Exxon, which renamed itself ExxonMobil when it merged with Mobil (formerly Socony) in 1999. Socal became Chevron, which acquired most of Gulf Oil in 1985 and then Texaco in 2001. Anglo-Persian Oil became Anglo-Iranian Oil in 1935 and then the British Petroleum Company in 1954. After acquiring Amoco (formerly Standard Oil of Indiana) in 1998 and making Atlantic Richfield Company (Arco) a subsidiary in 2000, British Petroleum officially changed its name to BP in 2001.

The Seven Sisters had significant market power for many years over Third World oil producers. In 1973, the group had around 85% of the world's petroleum reserves under control.

Over the past decades however, the power of the Seven Sisters and their successors—commonly called international oil companies (IOCs)—has been challenged for several reasons, such as establishment of OPEC (Organization of Petroleum Exporting Countries) cartel in 1960 and new state-owned company's appearance in several countries.<sup>17</sup>

### **3.2.2 OPEC**

The Organization of Petroleum Exporting Countries (OPEC) is a group of the world's major oil-exporting nations.

OPEC was founded in 1960 in Baghdad, Iraq, by five following countries: Islamic Republic of Iran, Iraq, Kuwait, Saudi Arabia and Venezuela in an effort to coordinate the petroleum policies of its members, and to provide member states with technical and economic support.<sup>18</sup>

Currently OPEC organization has a total of 14 countries, which are: Iran, Iraq, Kuwait, Saudi Arabia, Venezuela, Qatar (1961), Indonesia (1962), Libya (1962), the United Arab Emirates (1967), Algeria (1969), Nigeria (1971), Ecuador (1973), Gabon (1975), Angola (2007) and Equatorial Guinea (2017).

From the total world oil production in 2016 was 80,622,287 barrels per day from that

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<sup>17</sup>Hilyard, J. (2012). *The oil & gas Industry*. Tulsa, Okla.: PennWell, pp.30-31.

<sup>18</sup>Investopedia. (2015). *Organization Of Petroleum Exporting Countries - OPEC*. [online] Available at: <https://www.investopedia.com/terms/o/opec.asp> [Accessed 3 Aug. 2018].

amount 35,221,740 barrels per day was produced by OPEC members countries.

Thus the share of OPEC in total world production accounts for 44%.<sup>19</sup>

Officially the mission of OPEC is to "coordinate and unify the petroleum policies of its Member Countries and ensure the stabilization of oil markets in order to secure an efficient, economic and regular supply of petroleum to consumers, a steady income to producers, and a fair return on capital for those investing in the petroleum industry."<sup>20</sup>

The biggest share of the crude oil reserves controlled by OPE belongs to Venezuela and Saudi Arabia, followed by IR Iran and Iraq All of them belong to first five countries of The Smallest share has Ecuador and Gabon that joined Organization of Petroleum Exporting Countries later on in 1970.

Equatorial Guinea is not on this chart as it joined OPEC very recently (2017).

Due to OPEC operation and National oil companies appearing on a market, International Oil companies have lost their global dominance, but still many of International oil companies that used to belong to Seven Sisters are still listed between biggest world crude oil companies. They are often called "Major Companies" or just the "Majors."

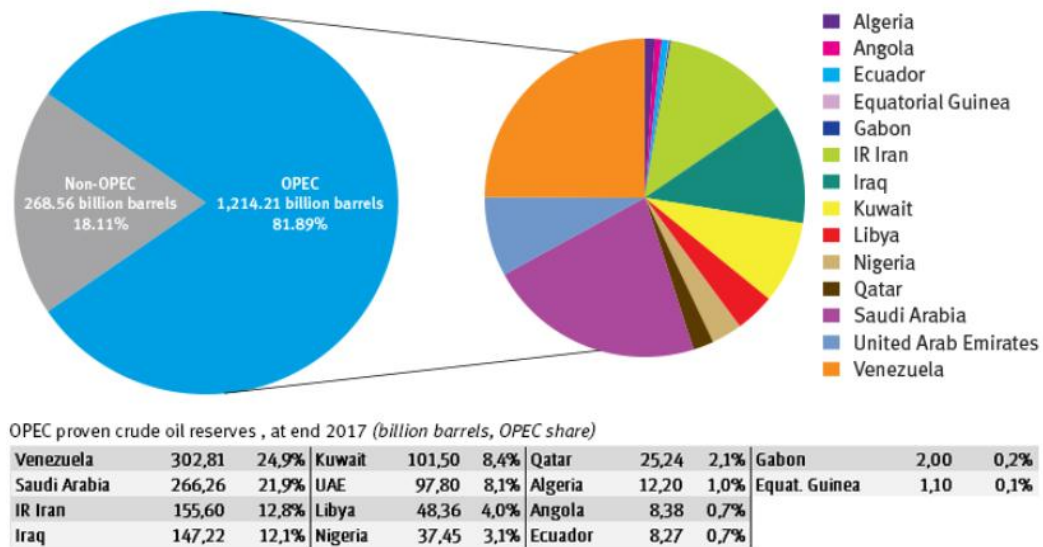
After the establishment of OPEC and growing share of National oil companies in the world, the dominance of the Seven Sister started to decrease, the structure of world crude oil market was significantly changed over the past 50 years.

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<sup>19</sup>Opec.org. (2017). [online] Available at:  
[http://www.opec.org/opec\\_web/static\\_files\\_project/media/downloads/publications/ASB2017\\_13062017.pdf](http://www.opec.org/opec_web/static_files_project/media/downloads/publications/ASB2017_13062017.pdf)  
[Accessed 15 Aug. 2018].

<sup>20</sup>Opec.org. (2017). *OPEC : Our Mission*. [online] Available at:  
[http://www.opec.org/opec\\_web/en/about\\_us/23.htm](http://www.opec.org/opec_web/en/about_us/23.htm) [Accessed 16 Aug. 2018].

**Figure 3 OPEC share of World Crude Oil reserves**



Source: Opec.org. (2018). *OPEC : OPEC Share of World Crude Oil Reserves*. [online]

According to current estimates, 81.89% of the world's proven oil reserves are located in OPEC Member Countries, with the bulk of OPEC oil reserves in the Middle East, amounting to 65.36% of the OPEC total.

OPEC Member Countries have made significant additions to their oil reserves in recent years, for example, by adopting best practices in the industry, realizing intensive explorations and enhanced recoveries. As a result, OPEC's proven oil reserves currently stand at 1,214.21 billion barrels.<sup>21</sup>

### 3.2.3 Types of oil companies

In order to analyze market it is necessary to know the nature of companies that exist currently on market, because their nature defines their operation.

Nowadays crude oil trading companies generally can be classified in three different categories, classified by the ownership: National Oil Companies ( NOCs) and Government Sponsored Enterprises ( GSEs).

International Oil Companies (IOCs)

<sup>21</sup>Opec.org. (2018). *OPEC : OPEC Share of World Crude Oil Reserves*. [online] Available at: [https://www.opec.org/opec\\_web/en/data\\_graphs/330.htm](https://www.opec.org/opec_web/en/data_graphs/330.htm) [Accessed 16 Dec. 2018].

IOCs are oil and gas companies that operate globally and 100% of their stock is owned privately.

During 1940s to the mid-1970s IOCs had major control on the market, presented mostly by the Seven Sisters group. Today's biggest IOCs on the world market are still the companies that used to be included to Seven Sisters group in the past.

The most well-known International oils companies are ExxonMobil, ChevronTexaco, BP, Shell, Total, ConocoPhillips.<sup>22</sup>

#### National Oil Companies (NOCs)

NOCs are oil and gas companies that are owned by state.

Today National Oil Companies (NOCs) control around 90 % of the global oil reserves and about 75% of the world production. Beside that, an estimated 60% of the world's undiscovered reserves lie in countries where NOCs have privileged access to reserves.

The most well-known National Oil Companies are Saudi Arabian Oil Company also known as Saudi Aramco (the world's largest Oil Company in the world), Abu Dhabi National Oil Company (ADNOC), China National Petroleum Corporation (CNPC) .

As a matter of practice, IOCs quite often manage refinery and distribution systems in oil-importing countries as well as develop oil production projects in those countries where local NOC cannot manage it due to lack of technology and resources.

Unlike IOCs, NOCs mostly operate within their country, building upon local resources with assistance of international service companies. Along with IOCs and NOCs a third type of oil companies gained popularity within the past ten years – Government Sponsored Enterprises.

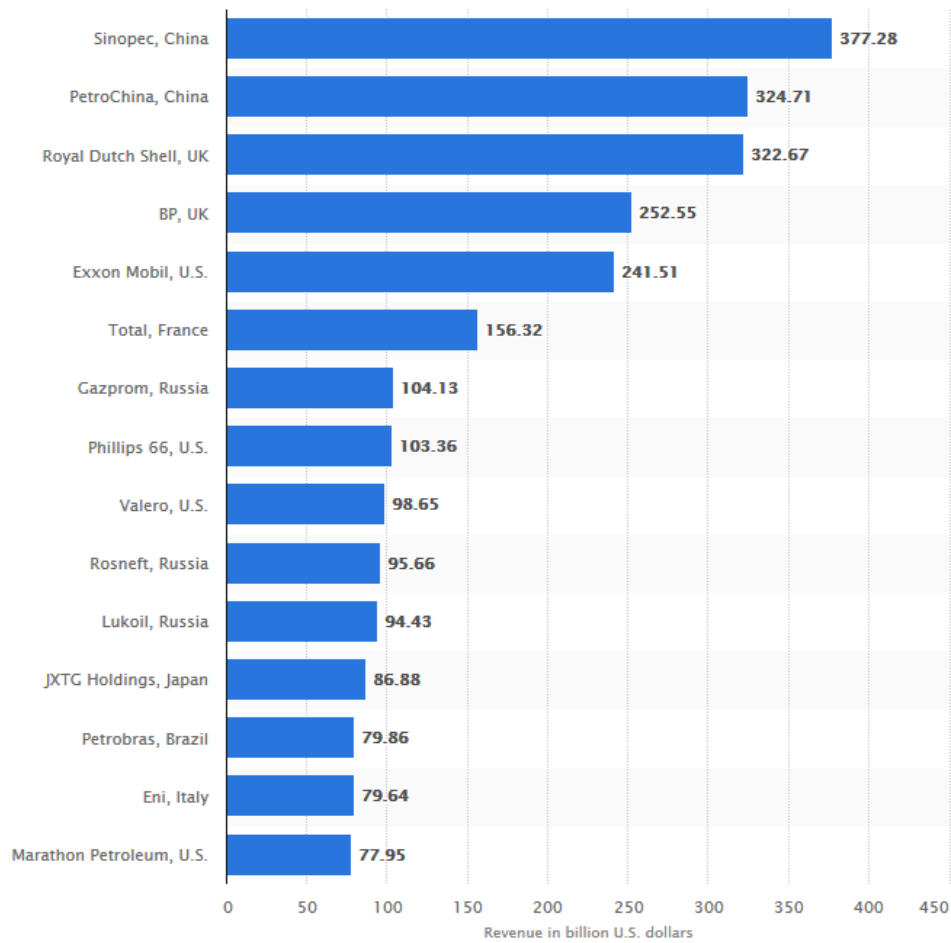
GSEs are oil and gas companies that are owned partly by government and partly by public. The most well-known Government Sponsored Enterprises are Rosneft ,Petro China. In a table provided below the top 15 world biggest crude oil trading companies are listed (Figure 4) .

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<sup>22</sup>Van Vactor, S. (2010). *Introduction to the global oil & gas business*. Tulsa, Okla.: PennWell, p.55.



Figure 4 Top 15 oil and gas companies by Revenue in 2018



Source :Ranking of the global top 10 oil and gas companies in 2018, b. (2018). *Top oil and gas companies by revenue 2018* / Statista. [online]

### 3.2.4 Types of trading

Another feature that makes crude oil market different from most of other commodity markets is that there are two different forms of trading used actively: Spot trading and Contract trading. Spot trading is a traditional form of trading, where goods are exchanged for money at certain price. Hence it is possible to purchase particular volume of crude oil at particular current price at the moment of sale.

Contract trading is more complex. It is more future-oriented. Contract trading provides the right or opportunity to buy or sell some volume of oil by an agreed date. This form of

trading is used in order to minimize the risk from future fluctuations of crude oil prices for sellers as well as for buyers.<sup>23</sup>

Three different kinds of contracts are commonly used: futures, options and swaps.

**Future contracts** obligate to buy or sell an exact quantity of oil at an agreed price at specified date in future. This type of contract is traded on exchanges.

Oil exchanges have existed at various times in the history of the industry, but none survived until NYMEX began trading heating oil in 1978. Traditionally, major companies “posted” prices for various crude oils they were willing to buy or sell. The postings allowed flexibility, as they could change with market conditions, but most of the time they were stable.

Oil traders have experienced several types of price indexing. In 1985, Saudi Arabia indexed its crude oil prices to a “netback” of petroleum product prices plus a refinery margin. The purpose of the scheme was to preserve Saudi market share in a deteriorating market. A far more common use of indexing concerns oil purchase contracts. Survival in the oil business requires flexibility, particularly in the face of volatile prices. To meet the challenge, traders tie contract prices to those published in the trade press or made available from the futures exchanges, rather than setting a flat price that might be unrealistic.<sup>24</sup>

**Options contracts** entitle (but does not obligates) to buy or sell an exact quantity of oil at an agreed price at any time during a specified period. If during the specified period a sale or purchase did not occur, the option expires and the money spent for purchasing the option is lost. Option contracts are traded through an exchange or over the counter (privately negotiated).

A **swap** is an agreement whereby a floating price for a certain amount of a certain type of oil is exchanged for a fixed price during specified period. There is no transfer of physical oil; obligations are settled by both parties by cash or a transfer. This type of contract is traded over the counter only.

Futures and swaps do not obligate the investor to proceed physical acquisition or delivery of the actual oil. In fact, mostly in case of these types of trade no actual oil is delivered.

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<sup>23</sup>Hilyard, J. (2012). *The oil & gas Industry*. Tulsa, Okla.: PennWell, p50

<sup>24</sup>Speight, J. (2011). *An Introduction to Petroleum Technology, Economics, and Politics*. Hoboken: Wiley, p.55.

Beside the services offered by exchanges, several trading service providers offer oil (and gas) trading to individuals through Internet futures accounts.

Indeed, the NYMEX contract identifies only one type of crude oil at one location—light sweet oil at Cushing, Oklahoma. Even though futures traders price a derivative contract, it corresponds directly to prices in the physical market and affects all oil transactions.

### **3.3 Main players of crude oil market**

Oil is the main source of energy in the world since 1950 to 2010, compared with other energysources such as coal, nuclear energy and renewable energy. It is supposed to remain so overthe next 20 years according to the latest research conducted in the field of economy andenergy.

#### **3.3.1 Main producers of crude oil**

Conditionally, the world crude oil production can be divided into 2 stages: from the very beginning until 1979 when the first relative maximum of petroleum production (3235 million tons) was reached, the second stage from 1979 to the present. From 1920 until 1970 the crude oil production was increasing year after year. Since 1979, the world oil production growth rate has slowed down and in 1980 there was a decline, but despite this, the oil production is growing steadily.<sup>25</sup>

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<sup>25</sup>Iranicaonline.org. (2017). *OIL INDUSTRY ii. IRAN'S OIL AND GAS RESOURCE – Encyclopaedia Iranica*. [online] Available at: <http://www.iranicaonline.org/articles/oil-industry-ii> [Accessed 3 Dec. 2018].

**Figure 5** Top 10 Oil Producing Countries in 2017

Country	Million barrels per day	Share of world total
United States	15.65	16%
Saudi Arabia	12.09	12%
Russia	11.21	11%
Canada	4.96	5%
China	4.78	5%
Iran	4.69	5%
Iraq	4.45	5%
United Arab Emirates	3.72	4%
Brazil	3.36	3%
Kuwait	2.82	3%
Total top 10	52.10	53%

Source :Eia.gov. (2018). *What countries are the top producers and consumers of oil? - FAQ - U.S. Energy Information Administration (EIA)*. [online]

United states produced the most oil in 2017, with output increasing from 14,855,000 barrels per day (bpd) in 2016 to 15,647,000 bpd in 2017. The US has been described as a swing producer because its production fluctuates alongside market prices. The International Energy Agency forecasts that the country will continue to satiate the world's appetite for oil as demand expands in the next five years.

Saudi Arabia holds 18 percent of the world's proven petroleum reserves and ranks as the largest exporter of petroleum. Its oil and gas sector accounts for about 50 percent of its GDP, and about 85 percent of its export earnings. Saudi Arabia is produced 12,090,000bpd in 2017. In 2016, Saudi Arabia played a key role in OPEC's decision to hold back oil output; however, in 2018 the country has increased its output by 1 million bpd.

Russian crude oil production has been increasing progressively over the years, but sank a little from 11,240,000 bpd in 2016 to 11,210,000 bpd in 2017. Most of Russia's reserves are located in West Siberia, between the Ural Mountains and the Central Siberian Plateau, and in the Urals-Volga region, extending into the Caspian Sea.<sup>26</sup>

Canada boosted its annual oil production to 4,958,000 bpd in 2017, nearly all of Canada's proven oil reserves are located in Albertaand 97 percent of oil reserves there are

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<sup>26</sup>Eia.gov. (2019). *International Energy Outlook 2018*. [online] Available at: <https://www.eia.gov/outlooks/ieo/> [Accessed 3 Dec. 2018].

in the form of oil sands. Energy exports to the US account for the vast majority of Canada's total energy exports.

China's annual oil output decreased in 2017, going down to 4,779,000 bpd from 4,863,000 bpd in 2016. China is the world's second-largest consumer of crude oil. China is the world's most populous country and has a rapidly growing economy — those factors have driven its high overall energy demand.

Iran's oil output increased in 2017, rising to 4,695,000 bpd from 4,215,000 bpd in 2016. Iran holds the world's fourth-largest proven oil reserves and the world's second-largest natural gas reserves. Despite the country's rich reserves, Iran's oil production has significantly fallen in recent years.<sup>27</sup>

In 2017 Iraq marginally increased its oil production from 4,448,000 bpd in 2016 to 4,455,000 bpd in 2017. It holds the world's fifth-largest proven oil reserves at 144 billion barrels; that represents nearly 18 percent of the reserves in the Middle East and almost 9 percent of global reserves.

The United Arab Emirates is an OPEC member, and has ranked among the top oil-producing countries for decades. In 2017 its output was 3,720,000 bpd, having a slight decrease in comparison to 2016. The country holds the world's seventh-largest proven oil reserves at 97.8 billion barrels; most of those reserves are located in Abu Dhabi. The other six emirates combined account for just 6 percent of the country's total reserves. In 2017 Brazil's oil production jumped dramatically from 3,240,000 bpd in 2016 to 3,363,000 bpd in 2017.

Total primary energy consumption in Brazil has nearly doubled in the past decade because of constant economic growth

Output of Kuwait dropped in 2017, falling from 3,072,000 bpd in 2016 to 2,825,000 last year. Kuwait's oil and gas sector accounts for about 60 percent of country's GDP and about 95 percent of its export revenues.<sup>28</sup>

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<sup>27</sup>Eia.gov. (2019). *International Energy Outlook 2018*. [online] Available at: <https://www.eia.gov/outlooks/ieo/> [Accessed 3 Dec. 2018].

<sup>28</sup>Eia.gov. (2019). *International Energy Outlook 2018*. [online] Available at: <https://www.eia.gov/outlooks/ieo/> [Accessed 3 Dec. 2018].

### 3.3.2 Consumption of crude oil

Global oil product consumption continued to grow in 2017, driven by an increasing demand from transport and petrochemical industry. This trend, coupled with the economic growth, offset the efficiency gains posted since 2005 in the United States and Europe and oil demand slightly increased in these two markets in 2017. Petrochemical oil demand is mainly linked to global economic growth.

Asian countries, which accounted for most of the global increase, perform a steady growth in oil consumption, especially in China, India (above 5% in both countries). US is the world's biggest oil-consuming country, consumed 19.88 million barrels of oil per day (mbd) in 2017, which accounted for nearly 20.2 percent of the world's total oil consumption per day. China's oil consumption stood at 12.79mbd in 2017, accounting for about 13 percent of the world's total oil consumption making it the second biggest oil consumer after the United States.

The top five here is completed by India, consuming 4.69 million barrels of oil per day; Japan, consuming 3.98 million barrels of oil per day; and Saudi Arabia consuming 3.91 million barrels of oil per day. Together, these five countries gobble up more than 45 million barrels every day. So, just five nations account for more than 46% of global oil consumption.

The world's biggest oil consuming countries and share of total world oil consumption (Thousand Barrels per Day) in 2017 is presented in the table below.

**Figure 6 Top 10 consuming Countries in 2017**

Country	Million barrels per day	Share of world total
United States	19.69	20%
China	12.79	13%
India	4.44	5%
Japan	4.01	4%
Russia	3.63	4%
Saudi Arabia	3.30	3%
Brazil	2.98	3%
South Korea	2.61	3%
Canada	2.47	3%
Germany	2.38	2%
Total top 10	58.31	60%

Source :Eia.gov. (2018). *What countries are the top producers and consumers of oil? - FAQ - U.S. Energy Information Administration (EIA)*. [online]

### **3.3.3 Reserves of crude oil**

Oil reserves are an estimate of the amount of crude oil located in a particular economic region. Oil reserves must have the potential of being extracted under current technological constraints. For example, oil pools situated in unattainable depths would not be considered part of the nation's reserves. Reserves are calculated based on a proven/probably basis.<sup>29</sup> In January 2017, there were 1.665 trillion barrels of oil in the world. That's enough to last another 50 years since the world uses 90.5 million barrels per day. Only proven reserves are counted in the total world reserves. This number changes only slightly every year.

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<sup>29</sup>The Balance. (2019). *Where Are the World's Largest Oil Reserves?*. [online] Available at: <https://www.thebalance.com/oil-reserves-definition-categories-world-s-largest-3305873> [Accessed 12 Mar. 2019].

Figure 7 Countries with The Largest Proven Oil Reserves

Rank	Country	Reserves (millions of barrels), 2017 US EIA
1	Venezuela	300,878
2	Saudi Arabia	266,455
3	Canada	169,709
4	Iran	158,400
5	Iraq	142,503
6	Kuwait	101,500
7	United Arab Emirates	97,800
8	Russia	80,000
9	Libya	48,363
10	United States	39,230
11	Nigeria	37,062
12	Kazakhstan	30,000
13	China	25,620
14	Qatar	25,244
15	Brazil	12,999

Source:Dillinger, J. (2018). The World's Largest Oil Reserves By Country. [online]

With 300,878 million barrels of proven reserves, Venezuela has the first position in world's proven oil reserves. Venezuela's crude oil discovery is a comparatively new. Before, Saudi Arabia had the leading position.

The oil sand deposits in Venezuela are quite comparable to Canadian ones. Venezuela also has a lot of conventional oil deposits. Venezuela's Orinoco tar sands have radically smaller viscosity comparing to Canada's, so the oil sands there can be extracted using conventional oil extraction methods, giving it a significant advantage over the Northern



American rival in terms of capital requirements and extractions costs.<sup>30</sup>

For a long time Saudi Arabia has been viewed as the modern state most iconic of oils equation to opulence and influence in global politics.

While the Saudis' 266,455 million barrels of proven oil reserves are slightly smaller than those of Venezuela, all of Saudi's oil is in conventionally accessible oil wells within large oil fields. In addition to that , Saudi Arabia's reserves are considered to cover a fifth of the entire world's conventional oil reserves.

Canada has close to 170,000 million barrels of proven oil reserves, the bigger part of which is in the form of oil sands deposits in the province of Alberta. Moreover, most of the country's conventionally accessible oil reserves are located there as well. As extracting oil from the vast majority of Canada's oil reserves is a labor and capital-intensive process, production tends to come in sporadic bursts rather than steady streams. Oil companies, therefore, begin by extracting lower density, higher value oils first, and directing their efforts into extracting crude deposits only in times of high commodity prices.

Iran has almost 160,000 million barrels of proven oil reserves, making it quite wealthy in terms of global oil resources. When taking in consideration the most easily accessible reserves (excluding many of the unconventional, difficult-to-extract reserves in Canada), Iran goes right after Venezuela and the Kingdom of Saudi Arabia.

Oil in Iran was first produced in 1908 and, at its current rate of extraction, Iran's oil will last close to 100 years more. Unlike Saudi oil, which is spread throughout a few huge and very rich oil fields, Iranian oil is found in close to 150 hydrocarbon fields, many of which have both petroleum crude oil and natural gas.

Iraq has 142,503 million barrels. Regardless of unstable political situation in its modern history, the country of Iraq sits upon some of the world's largest proven reserves of petroleum crude oil. As a matter of fact, owing to the civil unrest and military occupations which have characterized the national scene over the last few decades, it was not possible to do any meaningful exploration of Iraq's oil reserves.

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<sup>30</sup>Dillinger, J. (2018). *The World's Largest Oil Reserves By Country*. [online] WorldAtlas. Available at: <https://www.worldatlas.com/articles/the-world-s-largest-oil-reserves-by-country.html> [Accessed 2 Jan. 2019].

Kuwait's proven crude oil reserve is 101,500 million barrels. Even as a small country in terms of land area, Kuwait has more than a fair share of the world's petroleum oil reserves. Over 5bbl of reserves is located within the Saudi-Kuwaiti neutral zone which Kuwait shares with Saudi Arabia, while over 70 million barrels of Kuwaiti oil are in the Burgan field, the second largest oil field in the world.

United Arab Emirates - 97,800 million barrels. The United Arab Emirates sources most of its oil from the Zakum field, which has an estimated 66 million barrels, making it the third largest oil field in the region, following only Ghawar Field (Saudi Arabia) and Burgan Field (Kuwait). Approximately 40% of the country's GDP is based on oil and gas output and, after its discovery there in 1958, has made it possible for the UAE to become a modern state with a high standard of living.

Russian Federation holds reserves of 80,000 million barrels. Russia is a country full of natural resources for energy use, most notably the country's massive oil reserves under the vast Siberian plains.

Libya has 48,363 million barrels, its largest oil reserves are located in Africa and the ninth largest globally. In the long run, it is expected that untapped oil reserves will encourage more economic investment as the political situation stabilizes.

United States reserves account for 39,230 million barrels. The oil reserves of the United States increased in recent years due to increased usage of unconventional drilling methods that allow extraction of more shale oil and gas than was possible in the past.<sup>31</sup>

### **3.4 Determinants of crude oil price**

Crude oil price, same as price of any other commodity, is primarily affected by its supply and demand. If the demand is lower than supply price of crude oil declines, on the other hand if the consumption of crude oil is higher than its production and as such the demand is higher than supply, the price of crude oil grows.

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<sup>31</sup>Dillinger, J. (2018). *The World's Largest Oil Reserves By Country*. [online] WorldAtlas. Available at: <https://www.worldatlas.com/articles/the-world-s-largest-oil-reserves-by-country.html> [Accessed 2 Jan. 2019].

Nevertheless primary determinants of crude oil prices such as supply and demand are also influenced by many variables.

The economics of oil must take into account that it is a depleting non-renewable resource and the cost of extraction of a nonrenewable resource depends not only on the current rate of production but also on the amount of cumulative production

### **3.4.1 Supply and demand.**

Supply of crude oil is affected by such factors as: OPEC production regulations, non-OPEC capacity, geopolitics, reserves, weather, exploration and production costs as well as investments and innovations.

Organization of Petroleum Exporting Countries (OPEC) plays an important role in crude oil price formation. Its main objective is coordination of regulations and rules which are directly influencing policies about crude oil, setting exporting prices of crude oil, extraction planning, crude oil production quotas and providing financial support to developing countries.<sup>32</sup>

Although the economic impact of OPEC has decreased since the time of OPEC foundation, the OPEC is still making decisions about maximum amount of crude oil which is going to be extracted and since OPEC is also setting exporting prices of crude oil, it strongly influence the selling price of crude oil on world market as well.<sup>33</sup>

In November of 2016, the 14 members of OPEC agreed to hold back a portion of their oil production for the first time since the financial crisis, agreeing to drop their output to 32.5 million barrels per (BPD) day for the first six months of 2017, down from 33.8 million BPD at the time. A few days later several non-member nations led by Russian Federation agreed to join that pact and hold back more than 550,000 BPD in the first globally coordinated effort to cut production since 2001. Those partners would go on to extend their agreement twice, with the latest one going through the end of this year. If support for this

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<sup>32</sup>Opec.org. (2018). *OPEC : Brief History*. [online] Available at: [http://www.opec.org/opec\\_web/en/about\\_us/24.htm](http://www.opec.org/opec_web/en/about_us/24.htm) [Accessed 5 Jan. 2019].

<sup>33</sup>OPEC, 2016, OPEC Share of world crude oil reserves, 2015 [online] available at: [http://www.opec.org/opec\\_web/en/data\\_figures/330.htm](http://www.opec.org/opec_web/en/data_figures/330.htm) [2016-12-02]

agreement begins to waver, oil prices could fall, while another extension into 2019 could push crude even higher.<sup>34</sup>

OPEC actively sets production quotas for members (compliance varies) and can influence prices with announced price targets and quotas.

Non-OPEC production is typically at or close to full capacity. Unlike OPEC producers, almost no near-term price-driven variation in production levels—even with rising prices, there was almost no net annual production increase during 2005-2008.<sup>35</sup>

OPEC's policies are affected, in turn, by geopolitical developments. Some of the world's top oil producers are politically unstable. Some have faced sanctions by the US and UN. In the past, supply disruptions caused by political events have led to a dramatic oil price shift; the Iranian revolution, Iran-Iraq war, Arab oil embargo, and Persian Gulf wars have been especially notable. The Asian financial crisis and the global economic crisis of 2008-09 have also caused deep fluctuations.

Natural disasters can make huge waves in the oil market.

Other option which can affect the price of crude oil is nature disasters which could damage the extraction oil well. That could temporarily decrease the extraction capacities. However the reserves of crude oil should be enough to cover a one year consumption of crude oil in the world. It is also very unlikely or nearly inconceivable that the extraction of crude oil would stop completely.<sup>36</sup>

Crude oil is an exhaustible resource and, therefore, it is often argued that the price dynamic is affected by scarcity issues, which have always been discussed in the literature in the last two decades. However, every year there is a new discovery or a technological improvement, which has permitted the proven reserves to increase rather than decline in several regions, especially OPEC, Asia and Latin America. In fact, the world proven crude

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<sup>34</sup>Investopedia. (2018). *What Makes Oil Prices Go Up or Down*. [online] Available at: <https://www.investopedia.com/articles/investing/072515/top-factors-reports-affect-price-oil.asp> [Accessed 3 Dec. 2019].

<sup>35</sup>Eia.gov. (2018). [online] Available at: [https://www.eia.gov/pressroom/presentations/newell\\_05052011.pdf](https://www.eia.gov/pressroom/presentations/newell_05052011.pdf) [Accessed 3 Jan. 2019].

<sup>36</sup>KURZY.CZ, 2017, Development of prices of gasoline, diesel, actual price and detailed figure (Vývoj ceny benzínu, nafty, aktuální cena a podrobný graf) [online] available at: <http://www.kurzy.cz/komodity/benzin-nafta-cena/> [Accessed 3 Jan. 2019].

oil reserves in 1998 were 60% and 5% larger than that in 1980 and 1990, respectively (OPEC, 1999).

Extraction and refinery process of crude oil plays a big role in crude oil price formation. Another aspect of crude oil economics is the cost of refining. Refining high-sulfur crude oil also requires greater expenditures for energy. In fact, energy accounts for approximately half of the refinery cost. Refinery location is yet another variable. The closer a refinery is to the crude oil source and the demand, the lower the transportation costs. Otherwise, the refinery must factor in the added cost of getting the products to market. Obviously, the ultimate variable in crude oil economics is the price of crude oil. Crude oil quality is another key variable. High viscosity, high-sulfur crude oil can cost up to one third less than low viscosity, low-sulfur crude oil. However, because high-sulfur crude oil requires more processing, refineries that buy primarily cheap crude oil incurs more fixed expenses for equipment and labor.<sup>37</sup>

Investments and innovations in crude oil industry have a significant influence because it helps to invent more easy and efficient ways for exploration and decreases production cost.

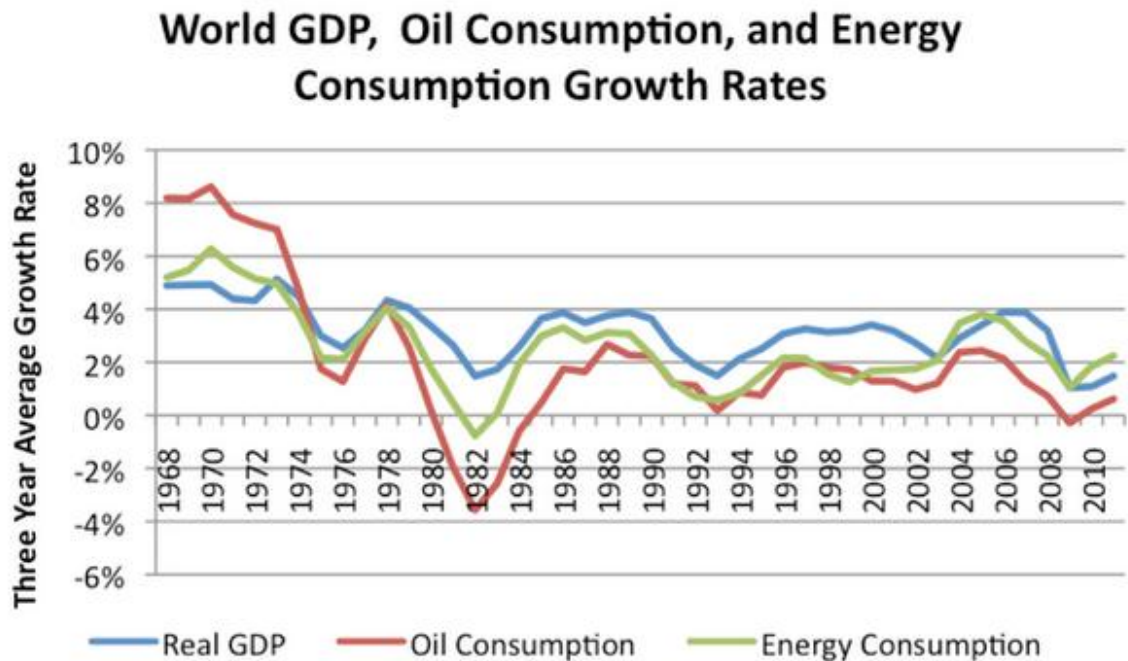
Oil consumption is determined by demand drivers and price. Demand is closely related to the state of the global economy—oil is an input into industrial production and the transport of goods. During the economic growth the demand for crude oil products and crude oil itself is increasing as well. The other case is when the economic growth stops or there is regression in gross domestic product of countries.

The most important factor shaping the demand for oil is the growth of the world economy. Since the 1990s up to the global financial crisis of 2008-2009, the steady growth of the world economy was observed, although the rates ranged from 1.59% in 1991 to 4.19% in 2000. In the same period, the annual increase in daily oil consumption averaged 1.68%. Peak demand growth (more than 3 million Bbl/d or 3.84% over the previous year) fell in 2004, when the annual growth rate of the world economy was 3.99%.

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<sup>37</sup>Speight, J. (2011). *An Introduction to Petroleum Technology, Economics, and Politics*. Hoboken: Wiley, p.55.

Figure 8 World GDP, oil consumption, and energy consumption growth rates



Source: Tverberg, G. and &rarr;, V. (2019). *An Economic Theory of Limited Oil Supply*. [online]<sup>38</sup>

Moreover the demand for crude oil is influenced by technological and ecological trends. The alternative sources of energy such as electricity or light petroleum gas are used more and more nowadays. These alternative resources and development in technologies using these resources are resulting in decline of demand for crude oil products and crude oil itself.<sup>39</sup> Another important crude oil price determinant is contract crude oil trading and other financial markets behavior (other commodity prices, commodity investment, currency exchange rates, stocks and other assets, interest rates).

<sup>38</sup>Tverberg, G. and &rarr;, V. (2019). *An Economic Theory of Limited Oil Supply*. [online] Our Finite World. Available at: <https://ourfiniteworld.com/2012/10/25/an-economic-theory-of-limited-oil-supply/comment-page-2/> [Accessed 10 Jan. 2019].

<sup>39</sup>SPEIGHT, James G, 2011. *An introduction to petroleum technology, economics, and politics*. Hoboken, N.J.: Wiley, 302 p.

## 4 Practical Part

### 4.1 Russian crude oil market overview

Russian Federation is one of the world's largest producers of crude oil. The economy of the Russian federation is very dependent on its hydrocarbons, oil and natural gas revenues account for more than one-third of the federal budget revenues.

Russian Federation is a major producer and exporter of oil and natural gas. Russia's economic growth is driven by energy exports, given its high oil and natural gas production. Oil and natural gas revenues accounted for 36% of Russia's federal budget revenues in 2016.<sup>40</sup>

Russian Federation was the world's largest producer of crude oil including lease condensate and the third-largest producer of petroleum and other liquids (after Saudi Arabia and the United States) in 2016, with average liquids production of 11.2 million barrels per day (b/d).

Russian Federation and Europe are interdependent in terms of energy. Europe is dependent on Russian as a source of supply for both oil and natural gas. More than one-third of crude oil imports to European countries in the Organization for Economic Cooperation and Development (OECD) in 2016 came from Russia. Russian Federation is dependent on Europe as a market for its oil and natural gas and the revenues those exports generate. In 2016, nearly 60% of Russia's crude oil exports went to OECD Europe. Most of Russia's oil production originates in West Siberia and the Urals-Volga regions. However, production from East Siberia, Russia's Far East and the Russian Arctic has been growing.

Russia's proved oil reserves were 80 billion barrels as of January 2017, according to the Oil and Gas Journal.<sup>41</sup> Most of Russia's reserves are located in West Siberia, between the Ural Mountains and the Central Siberian Plateau, and in the Urals-Volga region, extending into the Caspian Sea.

In 2016, Russian Federation produced an estimated 11.24 million b/d of petroleum and other liquids (of which 10.55 million b/d was crude oil including lease condensate), and it

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<sup>40</sup>Minfin.ru. (2018). *Federal budget of the Russian Federation*. [online] Available at: <https://www.minfin.ru/en/statistics/fedbud/> [Accessed 17 Jan. 2019].

<sup>41</sup>*Oil & Gas Journal*, "Worldwide Look at Reserves and Production," p. 22.

consumed about 3.6 million b/d (Figure 2). Russian Federation exported more than 7 million b/d in 2016, including about 5.3 million b/d of crude oil and the remainder in products and other liquids.<sup>42</sup>

#### **4.1.1 Exploration and production in Russia**

Most of Russia's oil production originates in West Siberia and the Urals-Volga regions (with slightly more than 12% of production in 2016 originating in East Siberia and Russia's Far East (Krasnoyarsk, Irkutsk, Yakutia, and Sakhalin) In the long term perspective, Russia's eastern oil fields, along with the largely untapped oil reserves in the Russian Arctic, may play a larger role. The Russian sector of the Caspian Sea and the predominantly undeveloped areas of Timan-Pechora in northern Russian Federation also may hold large hydrocarbon reserves. The use of advanced technologies and the application of improved recovery techniques is resulting in increased oil output from some existing oil deposits.

#### **4.1.2 Crude oil market structure in Russia**

Domestic companies dominate most of Russia's oil production. Following the collapse of the Soviet Union, Russian Federation initially privatized its oil industry. Starting in the late 1990s, privately-owned companies drove growth in the sector, and a number of international oil companies attempted to enter the Russian market with varying degrees of success. More recently, the Russian oil industry has consolidated into fewer firms with more state control. In 2016, the top five firms in Russian Federation (counting Rosneft and Bashneft as a single firm) accounted for more than 80% of total Russian oil production.<sup>43</sup>

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<sup>42</sup>Minfin.ru. (2018). *Federal budget of the Russian Federation*. [online] Available at: <https://www.minfin.ru/en/statistics/fedbud/> [Accessed 17 Jan. 2019].

<sup>43</sup>Eastern Bloc Research, " Oil production, mn tons," *Russian Energy Monthly*, Vol XXX No. 11, (January 2017), p. 8. Note, the Eastern Bloc Research figures may include crude, condensate, and NGL.



Figure 9 Russia's oil production by company, 2016

Company	Thousand b/d
Rosneft	4,021
Lukoil	1,679
Surgutneftegaz	1,225
Gazprom (including Gazprom Neft)	1,117
Tatneft	570
Bashneft	423
Slavneft	300
Novatek	247
Russneft	150
PSA operators	290
Others	853
<b>Total</b>	<b>10,875</b>

Source: U.S. Energy Information Administration based on Eastern Bloc Research.

While there was substantial privatization and diversification in the oil industry in the 1990s, the trend over the past decade has been one of increasing concentration of oil production assets in the hands of state controlled companies. State controlled oil companies (primarily Rosneft, Gazprom Neft and Gazprom) accounted for about half of all oil production.<sup>44</sup>

Russian Federation had more than 30 oil refineries with a total crude oil distillation capacity of 5.1 million b/d as of January 1, 2017, according to *Oil and Gas Journal*.<sup>45</sup> Rosneft, the largest refinery operator, owns nine major refineries in Russia. Lukoil is the second-largest operator of refineries in Russian Federation with four major refineries. Many of Russia's refineries are older, simple refineries, with mazut, a low-quality fuel oil, accounting for a large share of their output.<sup>46</sup>

<sup>44</sup>Eia.gov. (2018). *Russian Federation - International - Analysis - U.S. Energy Information Administration (EIA)*. [online] Available at: <https://www.eia.gov/beta/international/analysis.php?iso=RUS> [Accessed 29 Jan. 2019].

<sup>45</sup>*Oil & Gas Journal*, "Worldwide Look at Reserves and Production," p. 25

<sup>46</sup>Lukoil.com. (2018). *Oil Refining*. [online] Available at: <http://www.lukoil.com/Business/Downstream/OilRefining> [Accessed 19 Jan. 2019].

### 4.1.3 Russian crude oil exports

In spite of the fact that Russian Federation has quite high internal demand for crude oil, it produces significantly bigger amount of oil and gas than is consumed domestically and therefore has large volumes to export. In 2016, around 8.1 million barrels of oil and oil products were shipped abroad daily (5.1 million of this was crude oil, 3 million was refined products). In 2017, this amount increased by 8.1%. While more than 85% of all crude exports are pumped through state-monopoly Transneft's pipelines, the share of seaborne shipments among exports remains strong in spite of a global reduction. Europe is the main importer of Russian oil, and is accounted for more than half of Russian oil exports. Most Russian exports (70%) went to European countries, particularly the Netherlands, Germany, Poland, and Belarus. About 36% of Russia's federal budget revenue in 2016 came from oil and natural gas activities.<sup>47</sup>

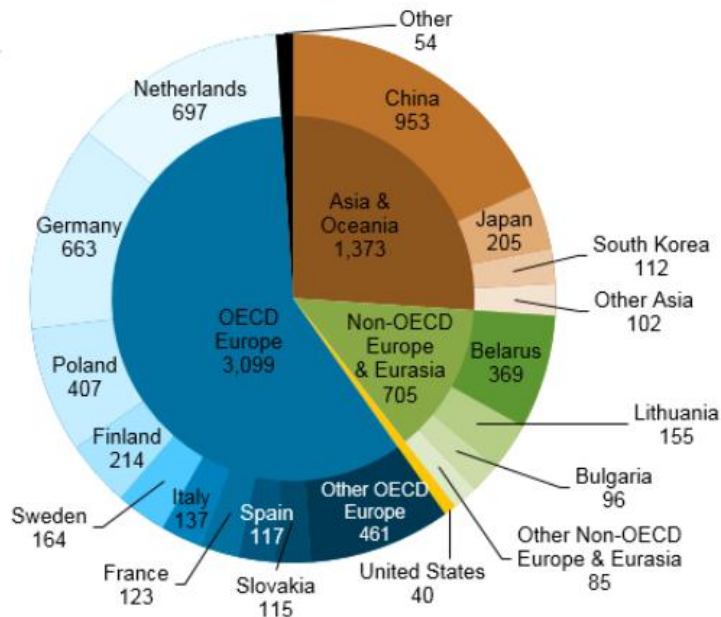
Although Russian Federation is dependent on European consumption, Europe is correspondingly dependent on Russian oil supply, with more than one-third of crude oil imports into OECD Europe in 2016 coming from Russia. In 2016, Russian Federation became China's biggest crude oil supplier for the first time and held this position in 2017.<sup>48</sup>

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<sup>47</sup>Globaltradetracker.com. (2018). *Home*. [online] Available at: <https://www.globaltradetracker.com/start/> [Accessed 19 Jan. 2019].

<sup>48</sup> Eastern Bloc Research, "Oil products trade, 2015, 2016," *Russian Energy Monthly*, Volume XXX No. 12 (February 2017), p. 22.

Figure 10 Russia's CO exports by destination 2011



Source: <sup>1</sup>Eia.gov. (2018). *Russian Federation - International - Analysis - U.S. Energy Information Administration (EIA)*.

## 4.2 Current market trends in Russia

During crude oil price drop in 2014 when from an average Brent crude oil price of \$109/barrel (b) in the first half of 2014 to an average of less than \$50/b in January, Russian state revenues from oil and natural gas activities have declined significantly hence the state's budget deficit got bigger. The Russian government has taken various steps in order to increase revenues from crude oil.

First of all, the minerals extraction tax was raised. In addition to this, the Russian government also collects dividends from oil and natural gas companies in which the state is a shareholder. In April 2016, the Russian government directed state-controlled companies to pay out a minimum of 50% of 2015 net income as dividends, nearly double the dividends companies would normally pay. Oil companies have objected to both the tax and dividend increases, arguing that they divert money from capital investment programs. Based on similar arguments, Rosneft negotiated a lower dividend payout in 2016, but the company plans to pay out 50% of 2017 income as dividends.<sup>49</sup>

Increasing crude oil prices also can help to is to increase crude oil revenues.

<sup>49</sup>*Nefte Compass*, "Rosneft to Hike Dividends at Kremlin's Request," (June 29, 2017), p. 8.

In 2016, OPEC, Russia, and a few other oil-producing countries agreed to limit production from January 2016 through June 2016 to try to stabilize the oil market. Russia agreed to reduce its production by 300,000 b/d versus its October 2016 production level, implementing these cuts gradually to reach the full cut by the end of April 2017. OPEC and Russia followed their agreed production cuts, and in May 2017, OPEC and non-OPEC countries met and agreed to extend production cuts through the end of March 2018.<sup>50</sup>

Low oil prices, a challenging economy and sanctions resulted in reduced foreign investment and outflow of capital. Oil and gas companies have been focused on maintaining current production levels and/or cutting their production costs.

At present moment the state of the Russian oil industry can be described as disadvantageous, due to the following factors: high degree of depletion of exploited oil reserves, lower quality, lower volumes of exploration and production drilling, lack of reserve of large deposits and the need to include new unconfined deposits in hard-to-reach areas in production.<sup>51</sup>

### **4.3 Relationship between crude oil price and economic performance of Russia**

Oil production directly accounts for around 20 percent of Russian GDP, while oil and gas account for about two thirds of merchandise exports. Oil and gas revenues account for about 50 percent of federal budget revenues, or around 10 percent of GDP. While the oil sector is responsible for only 2 percent of total employment, oil companies account for 30 percent of sales, general, and administrative expenses in Russia. Moreover, wholesale and retail trade of fuel make up one third of overall trade sector revenue (including major trade activities such as car sales and grocery sales).

Crude oil price has a significant influence on the performance of Russian economy. In order to prove this hypothesis I would like test dependency between GDP per capita in Russian Federation during year 1999-2017 and price for Brent crude oil during the same

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<sup>50</sup>Eia.gov. (2019). *Russia - International - Analysis - U.S. Energy Information Administration (EIA)*. [online] Available at: <https://www.eia.gov/beta/international/analysis.php?iso=RUS> [Accessed 13 Jan. 2019].

<sup>51</sup> <sup>51</sup>Eia.gov. (2018). *Russian Federation - International - Analysis - U.S. Energy Information Administration (EIA)*. at: <https://www.eia.gov/beta/international/analysis.php?iso=RUS> [Accessed 13 Jan. 2019]

period of time using regression analysis. In this model the price of crude oil will be taken as independent variable and GDP per capita as dependant one.

**Table 4-1** GDP/capita and Brent average price

Year	GDP/capita in USD	Brent annual average price \$/barrel
1999	1330,75	19,35
2000	1771,59	30,38
2001	2100,36	25,98
2002	2375,06	26,19
2003	2975,13	31,08
2004	4102,37	41,51
2005	5323,47	56,64
2006	6920,19	66,05
2007	9101,25	72,34
2008	11635,26	99,67
2009	8562,81	61,95
2010	10674,99	79,48
2011	14351,21	94,88
2012	15434,57	94,05
2013	16007,09	97,98
2014	14125,91	93,17
2015	9329,29	48,72
2016	8748,37	43,58
2017	10743,10	50,84

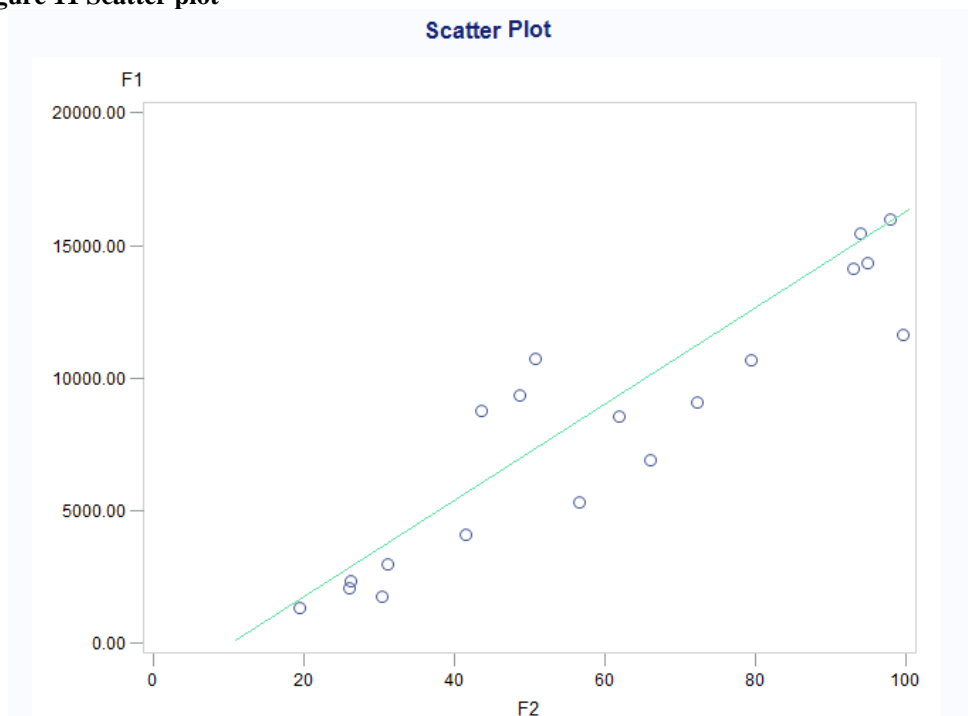
Source :Fred.stlouisfed.org. (2019). *Gross Domestic Product Per Capita for Russian Federation.*

Table 4-1 presents gdp per capita and annual average price for Brent crude oil during the period 1999 – 2017.

### 4.3.1 Linear regression model

First of all it is necessary to define an appropriate method for testing by creating a scatter plot in SAS.

Figure 11 Scatter plot



Source: Own creation,using SAS

Scatter plot represents a linear function hence simple linear regression is appropriate for testing this model.

Regression analysis is one of the most commonly used statistic in the social sciences. Regression is used to evaluate relationships between two or more feature attributes. Identifying and measuring relationships lets you better understand what's going on in a place, predict where something is likely to occur, or begin to examine causes of why things occur where they do.

The regression model used in simple linear regression follows:  $y' = f(x) + \epsilon$ ,

Where  $Y'$  is the dependent variable,  $X$  is the independent variable,  $\varepsilon$  is the random error (residual)

General economic model:

GDP per capita = f (annual average Brent oil price).

OLS (ordinary least squares) method for testing is applied.

Ordinary Least Squares (OLS) is the best known of all regression techniques. It is also the proper starting point for all spatial regression analyses. It provides a global model of the variable or process that is being predicted; it creates a single regression equation to represent that process.

The estimated regression equation for simple linear regression is :

$$y = a + bx + e$$

where for this particular model :

$y_i'$  = GDP per capita

$a$  = intercept

$b$  = the slope of the estimated regression line, the change of  $y$  if  $x$  changes by 1

$x_i$  = annual average price for Brent crude oil

$e$  - residual

### Parameters estimate

**Table 4-2** Parameters estimate

Parameters estimates					
Variable	DF	Parameter estimate	Standard Error	T Value	Pr> t
Intercept	1	-1525.04144	1117.30853	-1.36	0.1901
F2	1	162.79949	17.08844	9.53	<.0,001

Source: own creation based on SAS output

For this particular model the equation including estimated parameters is :

$$y = -1525,04 + 162,8 * x + e$$

$b = 162,8$  is defining the slope of estimated regression line, which is positive in this case

hence there is a positive correlation between y and x ( y increases with increasing x). Hence it is found that with decrease of crude oil price the GDP per capita decreases.

### Test of goodness of fit

The next step is to test how well the estimated parameters fit the existing model by using the *coefficient of determination* denoted by  $r^2$ .

The R-squared statistic measures the success of the regression in predicting the values of the dependent variable within the sample. The statistic will equal one if the regression fits perfectly, and zero if it fits no better than the simple mean of the dependent variable. The adjusted R-squared penalizes the R2 for the addition of regressors which do not contribute to the explanatory power of the model.

**Table 4-3** Goodness of fit

Root MSE	19990.13615	R-square	0.8422
Dependant mean	8190.14660	Adj R-square	0.8330
CoeffVar	24.29915		

Source: own creation based on SAS output

In this particular case  $R^2$  is 0,8422 which means that 84 % of the information is explained. The model is appropriate for prediction.

The next and probably the most important coefficient that must be taken in consideration when testing the model is coefficient of correlation „r“, which represents strength of dependence.

r is in  $<-1; +1>$  interpretation of r:

$|r|$  is in  $<0; 0.33>$  represents weak dependence

$|r|$  is in  $<0.34; 0.66>$  represents medium strong dependence

$|r|$  is in  $<0.67; 1>$  represents strong to very strong dependence

As mentioned before the coefficient of determination  $R^2$  is 0,8422 hence coefficient of correlation r is 0,912 and it is concluded that there is a strong positive linear association exists between X and Y.

### Testing the whole model.

$H_0: \beta = 0$  There is no relationship between sample and population. The model is not appropriate for general estimation.



H1:  $\beta \neq 0$  there is a relationship between sample and population. The model is appropriate for general estimation.

F-test

F value = 90,76, p value = 0.0001,  $\alpha = 0.05$ ,  $p < \alpha$  so Hypothesis H0 is rejected.

The model is appropriate for general estimation.

**Table 4-4 T-test**

Parameters estimates					
Variable	DF	Parameter estimate	Standard Error	T Value	Pr> t
Intercept	1	-1525.04144	1117.30853	-1.36	0.1901
F2	1	162.79949	17.08844	9.53	<.0001

Source: own creation based on SAS output

T-test

There is also a T-test for coefficient testing the significance in simple linear regression model.

The hypothesis to be tested:

H0:  $\beta = 0$  ; No relationship between GDP per capita and average crude oil price

H1:  $\beta \neq 0$ ; there is a relationship between GDP per capita and average crude oil price.

If H0 is rejected, we will conclude that there is a statistically significant relationship exists between the two variables. However, if H0 cannot be rejected, we will have insufficient evidence to conclude that a significant relationship exists. The properties of the sampling distribution of b, the least squares estimator of  $\beta$ , provide the basis for the hypothesis test.

$$t = |b| / \text{Standard error}$$

$$t = 9,53$$

$$p = 0,0001, \alpha = 0.05, p < \alpha$$

We can reject and conclude that  $\beta$  is not equal to zero. This evidence is sufficient to conclude that a significant relationship exists between student population and weekly sales. A summary of the t test for significance in simple linear regression follows. Test of goodness of fit showed that 84% of the model is explained and the model is good for the estimation, therefore it is possible to use this linear regression model for prediction.

F-test showed that there is a relationship between variables and parameters estimations proved that there is a directly proportional relationship between them. The t-test showed that there is a significant dependence between GDP per capita and annual average Brent crude oil price.

## 5 Conclusion

The main goal of the thesis was to find out whether there is a relationship between the economic performance of Russian federation and crude oil price.

The empirical analysis discovered that the budget system and economy of the Russian Federation highly depends on oil and gas revenues, which, in turn, is influenced by global prices for oil and natural gas.

The global prices for oil are mostly affected by supply and demand.

The supply is influenced by OPEC policies, OPEC and non-OPEC production cuts, and production costs, natural disasters, proven reserves, crude oil investments and innovations. Demand is closely related to the state of the global economy and also depends on technological and ecological trends (for example alternative sources of energy). Another important crude oil price determinant is contract crude oil trading and other financial markets behavior (other commodity prices, commodity investment, currency exchange rates, stocks and other assets, interest rates).

In 2014 average Brent crude oil price fell by more than half to less than \$50/b. With lower oil prices, Russian state revenues from oil and natural gas have declined radically, and the state's budget deficit has grown. In order to increase revenues from crude oil several measures were implemented, such as raising the taxes paid by oil and natural gas companies and collecting dividends from oil and natural gas companies in which the state is a shareholder. In addition, in January 2016, the Russian government sold some of its shares in several Russian companies.

Beside that OPEC, Russia and several other oil-producing companies agreed on limiting production in order to maintain the price in 2016.

OPEC and Russia have generally adhered to their agreed production cuts, and in May 2017, OPEC and non-OPEC countries met and agreed to extend production cuts through the end of March 2018.

The Linear Regression model testing proved that there is a strong relationship between GDP/capita in Russia and annual average Brent crude oil price. When the price for crude oil declines the GDP/per capita declines too. GDP per capita is a good indicator of the general economic performance of a country therefore the conclusion is that Russian economic performance is very dependant on crude oil price.

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