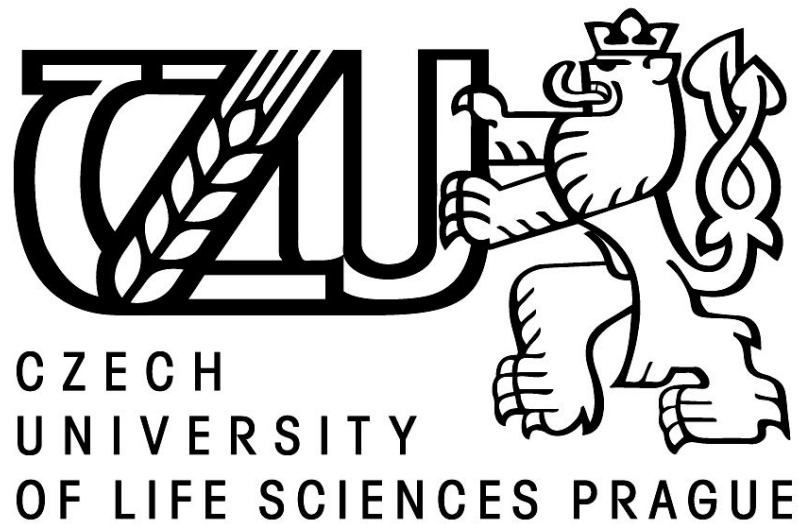


CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Faculty of Economics and Management

Department of Economics



Bachelor Thesis

Influence of Crude Oil Price upon Fuel Prices in the EU

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BACHELOR THESIS ASSIGNMENT

Jindra Košťálová

Economics and Management

Thesis title

Influence of crude oil price upon fuel prices in the EU

Objectives of thesis

Determine the main factors that influence the price of crude oil and the price of fuel. Evaluate European Union crude oil and fuel market. Compare development of fuel market in the chosen countries of the EU and the Czech Republic.

Methodology

1. Literature review is conducted using methods of synthesis, extraction, induction and deduction.
2. Analytical section makes use of comparative and descriptive methods and methods for regression analysis.

The proposed extent of the thesis

30 – 40 pages

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- SIMANZHENKOV, Vasily a IDEM, Raphael, 2003. Crude oil chemistry. New York: Marcel Dekker, 409 p. ISBN 082474098x
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Declaration

I declare that I have worked on my bachelor thesis “Influence of Crude Oil Price upon Fuel Prices in the EU” by myself and I have used only the sources mentioned at the end of the thesis. As the author of the bachelor thesis, I declare that the thesis does not break copyrights of any third person.

In Prague

.....

Jindra Košťálová

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Author: Jindra Košťálová

Influence of Crude Oil Price upon Fuel Prices in the EU

Vliv ceny ropy na cenu pohonných hmot v EU

ABSTRACT

Nowadays, the price of fuels is much discussed topic, due to frequent changes and fluctuations. This bachelor thesis aims to analyze the development of fuel prices, with a focus on the crude oil as the main factor affecting the price. The first, theoretical part describes the major and minor factors influencing the price of oil and the price of fuel. Analytical part applies these factors on the real historical prices of both petrol Super 95 and diesel. Using the regression analysis, it is shown, how the change in price of crude oil influences the price of fuels in the Czech Republic. Furthermore, it examines the difference between the final prices at petrol stations in the various countries of the European Union. Prices are subsequently cleaned from the taxes and it is evaluated, where the change in price of crude oil influences the final margin of the distributors, thus on the final price of the fuels, the most. It is found that high price of the fuels does not automatically mean a high margin of the petrol stations, it only means high rate of excise duty.

Key words

Crude oil, fuel prices, factors, influence, development, comparison, regression analysis

SOUHRN

Cena pohonných hmot je dnes velmi probíraným tématem z důvodu častých změn a výkyvů. Tato bakalářská práce si klade za cíl analyzovat vývoj ceny pohonných hmot se zaměřením na ropu, jako na hlavní faktor ovlivňující výši ceny. V první, teoretické části práce jsou popsány hlavní a vedlejší faktory ovlivňující cenu ropy a pohonných hmot. V analytické části se pak již tyto faktory zkoumají na reálných historických cenách postupně jak u benzínu Natural 95 tak u nafty. Pomocí regresní analýzy, je ukázáno jak má změna ceny ropy vliv na změnu pohonných hmot v České Republice. Dále pak se zkoumá odlišnost konečné ceny u čerpacích stanic v různých státech Evropské Unie. Ceny jsou následně očištěny od daní a je vyhodnoceno, ve kterých zemích má změna ceny ropy větší dopad na marži distributorů, tím pádem i na konečnou cenu pohonných hmot. Je zjištěno, že vysoká cena pohonných hmot neznamena vysokou marži prodejců, ale znamená to pouze vysokou sazbu spotřební daně.

Klíčová slova

Ropa, ceny pohonných hmot, faktory, vliv, vývoj, porovnání, regresní analýza

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LIST OF ABBREVIATIONS

EU – European Union

CO₂ – Carbon Dioxide

US – United States

WTI – West Texas Intermediate

OPEC – Organization of the Petroleum Exporting Countries

CNG – Compressed Natural Gas

LPG – Liquefied Petroleum Gas

IKL – Inglostadt, Kralupy, Litvínov

VAT – Value Added Tax

EUR – Euro

CZK – Czech Crown

L – Liter

1 INTRODUCTION

Crude oil is one of the most important raw material on the earth, because it enters into almost all products and services as a part of it or as a part of the production. A wide range of economies and households are dependent on oil. Some of the most important oil products are automotive fuels, such as petrol and diesel. Road transportation is the most widely used way of transport of passengers or goods in the Europe. Strong fluctuation of the price of fuels can significantly influence the whole economy of a certain country. Shortly, the world is dependent on the automotive fuels. There are many theories about the asymmetric reaction to the cost shocks. Results of the studies and people's views on this issue are very different. This thesis focuses on the composition of the price of fuels and it is analyzing the price of crude oil as the main factor affecting the final price of the petrol and diesel.

The theoretical part of this thesis focuses on the basic terms in this sector. It describes a brief history of crude oil and the main world producers and consumers of the crude oil. It describes the oil market, and two main types of crude oil – West Texas Intermediate and Brent. There are also discussed the main and secondary factors that affects the price of crude oil. The second part of the theoretical section is already focused on the price of fuels. It describes two main automotive fuels, - petrol and diesel – the similarities and differences between these two fuels. And there is discussed the composition of the finale price at petrol station, what are the main parts of it and how they are affected by any changes of the price of crude oil and how they affect the final price of the fuels. There are mention the main and the secondary factors that influences the price over the whole year.

The analytical part shows the development of the price of Brent crude oil, since it is the type of oil that is sold in the Europe and which is traded in London stock exchange. It compares the development of both unleaded petrol and diesel with this development of price of Brent crude oil in the chosen countries of the EU over the last three years. The countries have been carefully picked as the representatives of the highest and lowest prices of these two fuels and some other countries including the Czech Republic are shown just for the comparison as the representatives of the middle price. There are computed the margins of the distributors for two different periods for showing, how the change in price

of crude oil influences the petrol stations to set a higher or lower margin. The regression analysis is applied to get more detailed look at the relationship of two variables - the change in price of crude oil and the change in price of fuels in the Czech Republic. There is also shown the linear regression equation for both, the unleaded petrol and diesel. The results of the analytical part are summarized at the end of this thesis.

2 OBJECTIVES AND METHODOLOGY

2.1 Objectives

This thesis focuses on the development of the prices of petrol and diesel in the countries of the EU, with the focus on crude oil as the main factor affecting the changes in prices. The objectives are to discover the reasons of the price changes and to determine the main factors affecting the price of crude oil and other factors that influence the price of fuels. It attempts to evaluate and compare the price development of unleaded petrol and diesel in the chosen countries of the EU and the Czech Republic.

2.2 Methodology

The theoretical part was done using the methods of synthesis, extraction, induction and deduction. Author tried to understand and explain the main terms about crude oil and fuels using these methods. There were briefly described the main and the secondary factors that influences the price of crude oil, such as organization OPEC, global economic cycle, and others, and factors that influences the price of fuels, such as taxes determined in each country, competition between petrol station and so on.

In the analytical part, there were used comparative and descriptive methods. There was shown the real development of Brent crude oil price, which is traded at the London stock exchange. The methods were used to see the differences between the countries of the EU in the prices of unleaded petrol and diesel. Using the graphs, there were shown the real historical prices and described the main differences between the final prices at petrol stations. Prices were subsequently cleaned from the price of fuels at refineries and from the taxes and it was evaluated, where the change in price of crude oil more influences the final margin of the distribution, thus on the final price of the fuels. There was also used the method of regression analysis to show how the change in price of oil affects the final price of unleaded petrol and diesel in the Czech Republic.

3 THEORETICAL PART

3.1 Crude Oil as a Raw Material

Crude oil is a nonrenewable natural resource. Nowadays, it is one of the main sources of energy together with gas and coal. Almost every household and every economy depends on the oil production.

It is yellow to black oily liquid consisting of a liquids (mixture of hydrocarbons and aromatic compounds), gaseous substances (ethane, methane, carbon dioxide and others) and solids (for example paraffin). Even though, it is used mainly in energy, oil as a raw material is almost irreplaceable for the chemical industry. [7]

3.1.1 Crude Oil History

Crude oil has been serving people for a long time. Archaeologists have shown that the first use of oil is dated from 5-6 thousand years before Christ, because the petroleum has been mentioned in many archaic manuscripts. Petroleum in ancient times had several uses. They used it for medicine and also for construction works. In one manuscript, there was found what a Greek scientist Hippocrates said: *“We shall rub the patients with petroleum in such a way that the illness is taken away. White petroleum takes away the illness (cough in this case). Black petroleum takes away a reasoning of the cough.”*

Nevertheless, the greatest use of petroleum was for military works, it was source of a military power for more than two thousand years. They made a flammable substance called the napalm, which caused a huge fire when it was thrown on the wall and it could not be stopped by water. It was called a “Greek fire” and the main ingredients were a petroleum, sulfur and saltpeter.

Even though, the crude oil was used two thousand years ago, the actual production possibly started in August 27, 1859. In Oil Creek in Pennsylvania, the first industrial crude oil well was opened with a depth of 22 meters. This day could likely be marked as a beginning of modern crude oil chemistry. The company Naphtha Company Brothers Nobel, created by Alfred B. Nobel and his brothers, mined the crude oil in Russia and transported it to the first refineries. [1]

3.1.2 Other Uses of Petroleum then Fuels

Most of the people think that petroleum is only used for petrol and diesel fuel, but it has a wide range of utilization. Crude oil contains a huge amount of hydrocarbons so different refined products got included into almost everything from plastics to pharmaceuticals. The industry, that uses petroleum as a part of other chemicals, is called petrochemical industry. [8]

3.1.2.1 Agriculture

Agriculture uses petroleum in the production of ammonia, which is a source of nitrogen in fertilizers. First, the source of ammonia was only from manure and other biological processes. Fritz Haber came up with a process that started the production of ammonia in industrial scale. This is called a Haber process. In addition, pesticides are important for agriculture, so the crop yields are constant and wholesome. Almost all pesticides are made from petroleum. Basically, agriculture is one of the largest users of products made of oil, from powering the agriculture technology to fertilizing the plants. [8]

3.1.2.2 Plastics

Plastic is an indispensable part of today's life. For example polystyrene, this is a base for foam plastics Styrofoam or polyvinyl chloride (PVC), which has many uses such as plumbing, gutters, house siding etc. The most known petroleum-based plastic is nylon. It is in many things from clothes to mechanical gears. [8]

3.1.2.3 Tires

Rubber is a main component of tires. It is mainly being produced of petroleum since World War II. Until 1910, it was made naturally. During the war, there was an embargo on natural rubber imported from South America. [8]

3.1.2.4 Pharmaceuticals

Petroleum is part of many pharmaceuticals products, such as creams, shampoos for psoriasis and dandruff with contain of tar and some drugs. [8]

3.1.2.5 Other unexpected petroleum products

Ink, CD, Pillow, Deodorant, Lipstick, Guitar string, Vitamin capsules, Chewing gum, Toothpaste, Contact lenses, etc. [8]

3.1.3 Crude Oil Production

Oil production is usually tied to flat areas that once were, or still are the seabed. Petroleum was created by conversion of residues of ancient dead organism (plants and animals). Crude oil is extracted using the oil wells. Digging tip is usually set with diamonds or steel spikes and it makes the rotational movement. The speed of digging varies according to the hardness of rock from 30 cm / h up to 60 m / h. The area of oil production is characterized by considerable dismemberment (fragmentation) of the original landscape.

Oil is usually extracted progressively by three methods that are referred to as primary, secondary and tertiary. [7]

3.1.3.1 Primary method

Natural gas, which is under pressure above the oil, pushes it from the well out. Maximum of 20-35% of deposit is mined this way. The gas pressure gradually decreases, so it is necessary to go to the next method. [7]

3.1.3.2 Secondary method

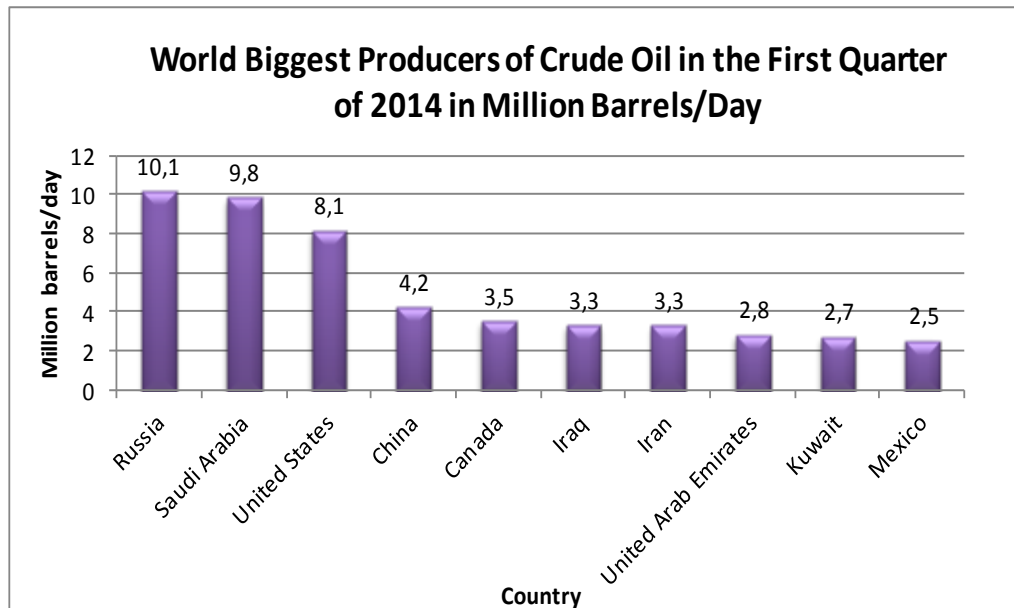
The pressure has to be restored, so there is injected water, natural gas, air, or CO₂ into the well. By this method, it can be extracted additional 5-15% of the total quantity of oil. [7]

3.1.3.3 Tertiary method

Using the injection of hot steam it is reduced the viscosity of oil and it can be obtained additional 5-15% of the total amount of oil.

Oilfield is never 100% extracted. [7]

Figure 1 World Producers of Crude Oil



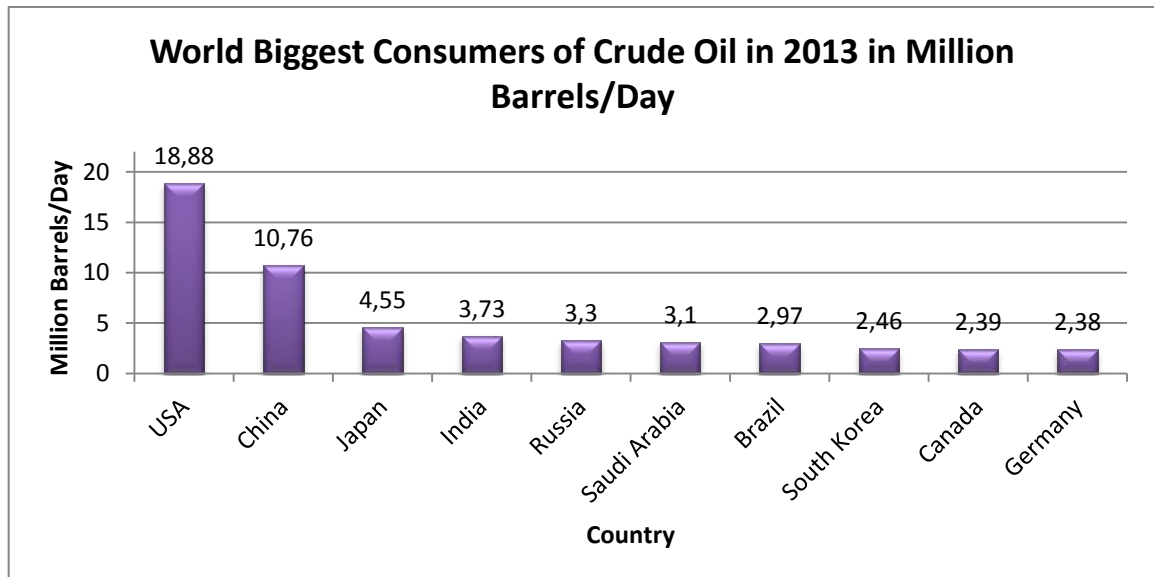
Source of data: EIA (2014)

The largest oil reserves are in Saudi Arabia, and then it is Iran and Iraq in third place. However, it is important to be able to extract the reserves. The third largest reserves in the world are in Iraq, but because of the lack of technology and other resources, Iraq, in terms of production, is not even in the top three largest producers in the world. The largest producers are Saudi Arabia, Russia and the United States. [9]

3.1.4 Crude Oil Consumption

Global oil consumption grew by 1,4% by day which is 1,4 million barrels, but oil production raised only by 0,6% in 2014.

Figure 2 World Consumers of Crude Oil



Source of data: BP (2014)

The biggest world consumer is the US with average consumption of crude oil 18,88 million barrel per day. The second biggest consumer is China. China has risen up its consumption of crude oil by more than 25% in the years 2009-2013, and the consumption is still increasing. [11]

3.1.5 Crude Oil Trade

The world trades with several types of oil. But there are 2 main types, which are traded on a major commodity markets. It is Brent and WTI (West Texas Intermediate) crude oil type. Individual types of oil are traded on different markets; Brent is traded in London (London Stock Exchange), while WTI is traded in the United States in New York (New York Mercantile Exchange). [6]

Brent crude oil is a benchmark for oil prices in Europe and WTI is a benchmark for oil prices in the United States. Brent crude is mined from the North Sea and WTI oil comes from the American continents. The difference is in sulfur content and the method of

processing and utilization. Brent is a light crude oil, but not as light as WTI oil, and it is a sweet crude oil, but again not as sweet as WTI oil. [2]

In the beginning of year 2015 the price of Brent oil was 46,77 EUR/barrel and the price of WTI oil was 43,71 EUR/barrel. [12]

3.2 Factors Influencing the Crude Oil Price

Price of crude oil is in basic form created primarily by the interaction of demand and supply, just like the other markets. Supply is generated by mining and demand is generated by consumption.

Due to very unbalanced distribution of world mining reservoir, there is a set of factors that significantly influence the world price of crude oil. [13]

3.2.1 OPEC (Organization of the Petroleum Exporting Countries)

It is an international organization founded in 1960 in Baghdad, based in Vienna. Founding members are Saudi Arabia, Iran, Iraq, Kuwait and Venezuela. Later joined countries are Qatar (1961), Indonesia (1961 - 2009), Libya (1962), the United Arab Emirates (1967), Algeria (1969), Nigeria (1971), Ecuador (1973), Gabon (1975 - 1995) and Angola (2007). So now, there are 12 member states. [14]

The main objective of this organization is the coordination of crude oil policies, especially the determination of export prices of crude oil, coordination of mining plans and production quotas and financial assistance to developing countries. In the 1980s, the economic impact of OPEC had considerably fallen mainly due to internal contradictions and increase of oil supply from countries outside of OPEC. Currently, OPEC determines the maximum amount of mining and strongly influences prices of world crude oil price. [15]

3.2.2 Global Economic Cycle

The crude oil market is very sensitive to changes in the economic cycle. During the period of growth, demand for oil increases and thus prices go up, the larger and more dynamic development of the world economy, the more significant change in price. [16]

On the contrary, an unexpected increase in prices could cause a recession as was shown for example by the oil shock in 1973. As a reaction to a war conflict, OPEC purposely reduced oil production (by approximately 5%) so they could affect its price in their favor. After one year, the price of oil was four times higher than before the oil shock. The West German government responded to this situation by issuing a general ban on Sunday driving for four weeks and temporarily reduced the allowed highway speed to 100 km / h. [17]

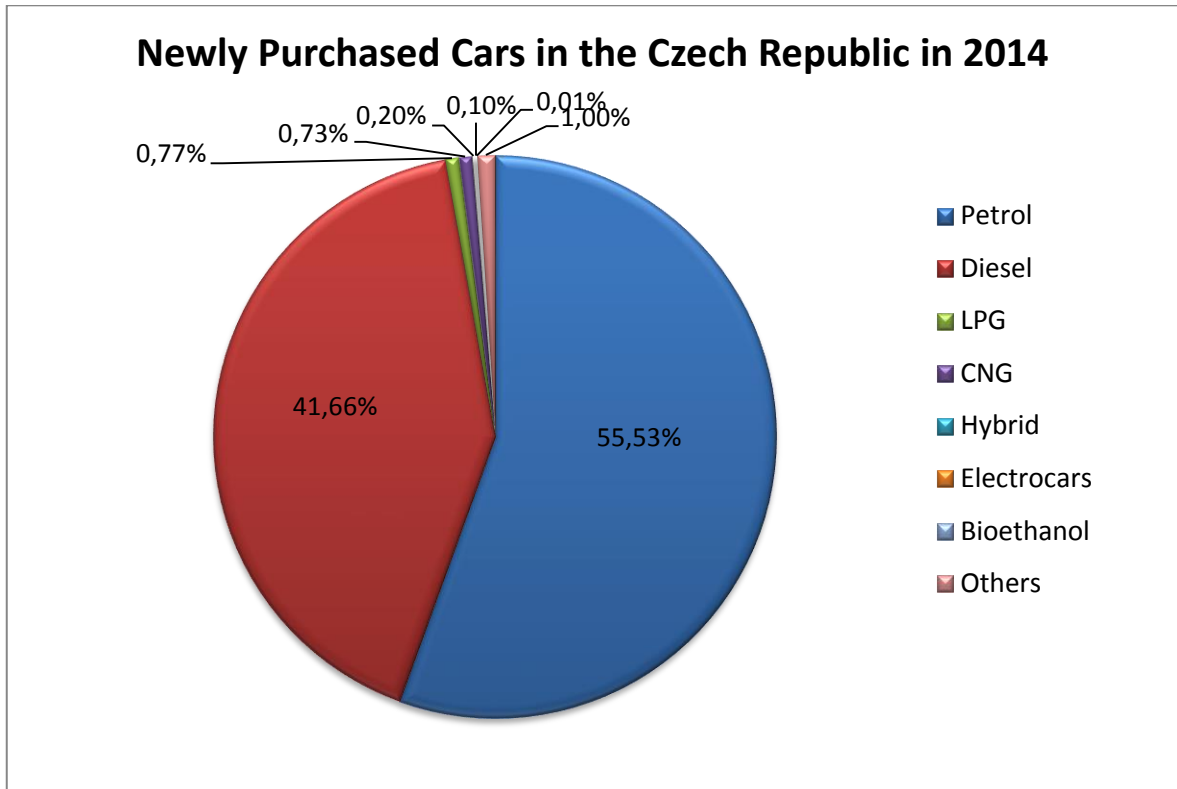
3.2.3 Alternative Fuels

We can expect that a use of alternative fuels will be increasing in the next several years, so the consumption of crude oil may decrease. For example, the electric cars are becoming more and more used and more and more affordable, so the number of electric cars is constantly increasing.

Other alternative fuel is natural gas (CNG – Compressed Natural Gas). In the Czech Republic, there are more than seven thousand cars using natural gas. In the comparison with petrol or diesel, it is cheaper, because the excise tax is very low. There are some disadvantages of using natural gas as a fuel. It is difficult to maintain and the cars must meet strict safety conditions, there is very sparse network of gas stations and the area of a trunk is significantly reduced, because of the CNG tank. [18]

LPG (Liquefied petroleum gas) is another alternative fuel. It is a mixture of heating gas, known as propane-butane. This has many advantages. It costs about half of the price in the comparison with Natural 95 or Diesel, it is more ecological friendly and it can reduce engine wear by at least 1/3. The main disadvantages are the acquisition costs and shorter durability of LPG tank and its accessories. [19]

Figure 3 Newly Purchased Cars in the Czech Republic



Source of data: SDA (2015)

In the figure 3, it is shown that nowadays there are many other fuels than petrol and diesel, but these two fuels still make up more than 97% of the used fuel in newly purchased cars in the Czech Republic.

3.2.4 Weather

Seasonal changes in weather can affect the demand for crude oil. In the summer, people drive more, so the consumption of fuel is higher. On the other side in the winter, people use more oil for heating.

Not only seasonal changes, can affect the price of crude oil, but also a natural disaster can cause significant change in the price. For example, Hurricane Katrina in 2005 caused an interruption of oil production and that caused a big increase in the price of crude oil. However, these reasons of price change usually have a short-term duration. After the problem subsides, the price goes back to the previous level. [16]

3.2.5 Demand and Supply

The change in price of crude oil responds to changes in demand and supply. If the world produces more than it consumes, which means that the supply is higher than the demand, the price goes down. On the contrary, if the consumption is higher than production, then also the demand is higher than supply and the price goes up.

The constant increase in demand over the years drives the price of oil continuously up, but in the last few months, the supply has been higher than demand, so the price of crude oil has been sharply decreasing.

Delivery of crude oil to the Czech Republic is mainly from two pipelines. The first one is Druzhba pipeline from Russia. The second one is IKL (Ingolstadt, Kralupy, Litvínov) pipeline, which mainly imports oil from the area of the Caspian Sea, North Africa and the Arabian Peninsula. [21]

3.3 Fuels

3.3.1 Petrol

Gasoline is a liquid mixture derived from oil used primarily as fuel for combustion engines. Gasoline is composed mainly of aliphatic hydrocarbons supplemented with iso-octane or aromatic hydrocarbons to increase its octane rating. Further, gasoline contains small amounts of various additives to improve performance of an engine and to reduce emissions. [22]

Petrol began to be used as a motor fuel in the second half of 19th century. It was a product obtained by simple distillation of crude oil, whose properties were given by random mix of hydrocarbons, depending on the origin of processed oil. With the gradual evolution and improvement of gasoline engine designers realized, that different gasoline has different effects on the engine power. In order to differentiate the types of gasoline, there was introduced an octane number. Now, the octane number is one of the basic characteristics of gasoline. It expresses the resistance of fuel to detonation (i.e. "knocking") during the compression of cylinder in the petrol engine. [23]

3.3.2 Diesel

Diesel is a mixture of liquid hydrocarbons. Diesel is obtained by distillation and purification of oil. The quality of diesel fuel is given by cetane number, which expresses its combustion speed. It has been recently becoming the most important motor fuel, whose consumption will probably continue to rise. [22]

Diesel began to be used in early 20th century. The inventor of the internal combustion engine, which uses diesel as a fuel, was a German inventor Rudolf Diesel, who won Grand Prix at the World Exhibition in Paris in 1900. One of the most important characteristics of diesel is its behavior under low temperatures. Since the beginning of its use, there have been available two types of diesel - summer and winter, which differed in its freezing point. It turned out, that the freezing point does not characterizes the behavior of diesel fuel sufficiently and therefore there were introduced additional parameters that would have a better explanatory power. In the mid-90s, the freezing point, as a characterization of diesel, was canceled and now it indicates the point of filtration and cloud point. [23]

3.3.3 Production and Differences between Petrol and Diesel

Petrol and diesel are both produced from oil, but the refining processes are different. Petrol is more difficult to refine than diesel, but it is harder to get diesel to the same level of emission as petrol, because there has to be extracted more pollutants. Combustion engine of the vehicle is more effective because diesel includes more energy than petrol; it has higher efficiency and lower emissions.

Hundreds of different types of hydrocarbons and different impurities are included in the crude oil. To produce diesel, petrol or any other oil product, the hydrocarbons have to be refined and separated. The process of fractional distillation separates the chains of hydrocarbons. When the hydrocarbon chain is longer, it has higher boiling point. During this process, the hydrocarbons are extracted according to their temperature of vaporization by heating up the crude oil in distillation column. The boiling point for diesel is between 250°C and 350°C and the boiling point for petrol is between 40°C and 205°C.

After distillation, there are techniques such as cracking, unification and alteration that can be used to transform some fractions to another. This allows the refineries to react to the market and to the change of demand and they can turn diesel into petrol. [24]

3.3.4 Fuel Market

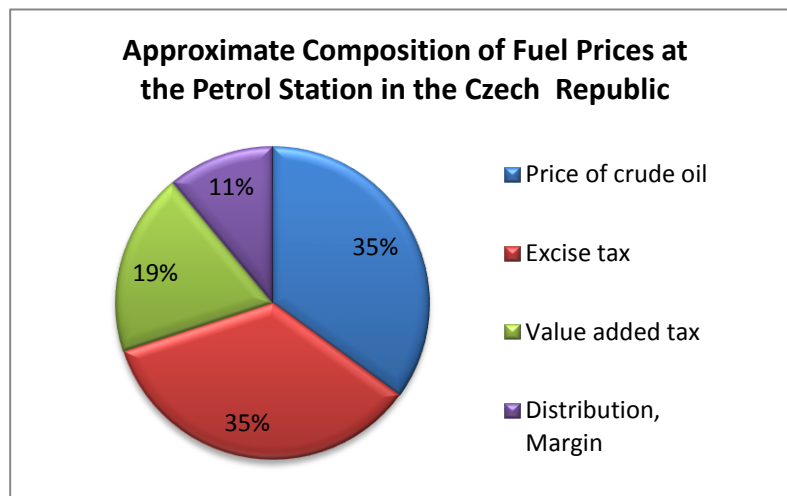
Fuel market can be determined as an oligopoly. Oligopoly is the type of market where there is only a small number of sellers and none of them has a dominance over the market, but all of them are relatively big. Oligopolistic markets have some similar features. There usually is a small number of suppliers with homogenous product, there are barriers to entry for new firms to the market, the strategy is very important and the sellers have to foresee and monitor the competitors. [3]

This can be applied to a fuel market. The number of sellers is quite stable over the years, because it is hard to entry the market, because of the barriers and they all sell the same product. Every petrol station can set its own price, but has to take into consideration how the competitors and buyers will react to it.

3.4 Factors Influencing Price of Fuels

Prices of gasoline and diesel are determined by output prices of refiners (factory, where crude oil is processed and purified). Distributors and sellers of fuel add to this their margins. According to the mutual agreement, all refineries in the European Union sell their products at the same price, determined on a commodity exchange in Rotterdam. In most countries of the world, large part of the final price of gasoline is taxes (mainly excise tax and value added tax). [22]

Figure 4 Composition of Gasoline Price in the Czech Republic



Source: malepenize.cz (2011)

3.4.1 Tax

In the average, more than 50% of the final price of the fuel consists of taxes. There are two taxes, which have to be included in the price – Excise tax and Value added tax. The first tax, which is levied on fuels, is excise tax. It is a tax that is introduced by state either to regulate the prices of certain commodities in the market or to increase revenues of state budget. Excise tax can also serve as an effective means of reducing the demand for harmful goods such as cigarettes, alcohol and so on. Excise tax levied on petrol and diesel is set in an exact amount per thousand liters. In most of the countries of the EU, the excise tax makes more than 30% of the final price of fuels at petrol stations. The rates of excise tax are shown in Table 2 Excise tax rates in the analytical part. [26]

The second tax, which is levied on the fuels, is value added tax. It is a tax on a consumption of goods and services. It is set in the percentage way and added to the final price of the service or product. The percentage of VAT, which is added to energy products, is usually around 20% in the countries of the EU and it is calculated from the price that already includes the excise tax. The exact rates of VAT are displayed on Table 1 VAT rates in the analytical part of this thesis. [27]

Energy product taxation in the European Union is governed by assignment of Council Directive 2003/96/EC. It indicates the EU framework of the energy product taxation. [28]

3.4.2 Price of Crude Oil

It is the second biggest part of the price of the fuel. The price of crude oil has risen over the last few years and so has the fuels prices. On the other hand, in the last few months the price of crude oil has dramatically decreased and again, so has the prices of fuel. In this thesis, the analysis will be done, how much can the price of crude oil influence the price of fuels. [29]

3.4.3 Competition between Petrol Stations

This is also very important factor, because a high competition can bring a lower margin of gas stations. It causes move of prices in cycles. Distributors continually reduce prices to increase sales and to maintain their competitiveness. When the price level gets too low price, sales become less profitable and distributors are forced to raise the price. This continuous decline in prices and subsequent increase in price is called a price cycle. Customers can then benefit from the fact that they follow this cycle and buy fuel at the time when the price is low.

In the Czech Republic, there is the most number of gas stations on number of people, because the Czech Republic does not determine the minimum distance between the gas stations. It means, that there is very high competition between petrol stations. [30]

3.4.4 Seasonal Fluctuations of Demand

Demand can change according to seasonal changes. In winter, the price of fuel is usually lower, because people demand oil products for the heating and they drive less. In summer, the price is higher, because people travel and drive more. However, the change of the price according to seasons is not very significant. [31]

3.4.5 The Development of Exchange Rates

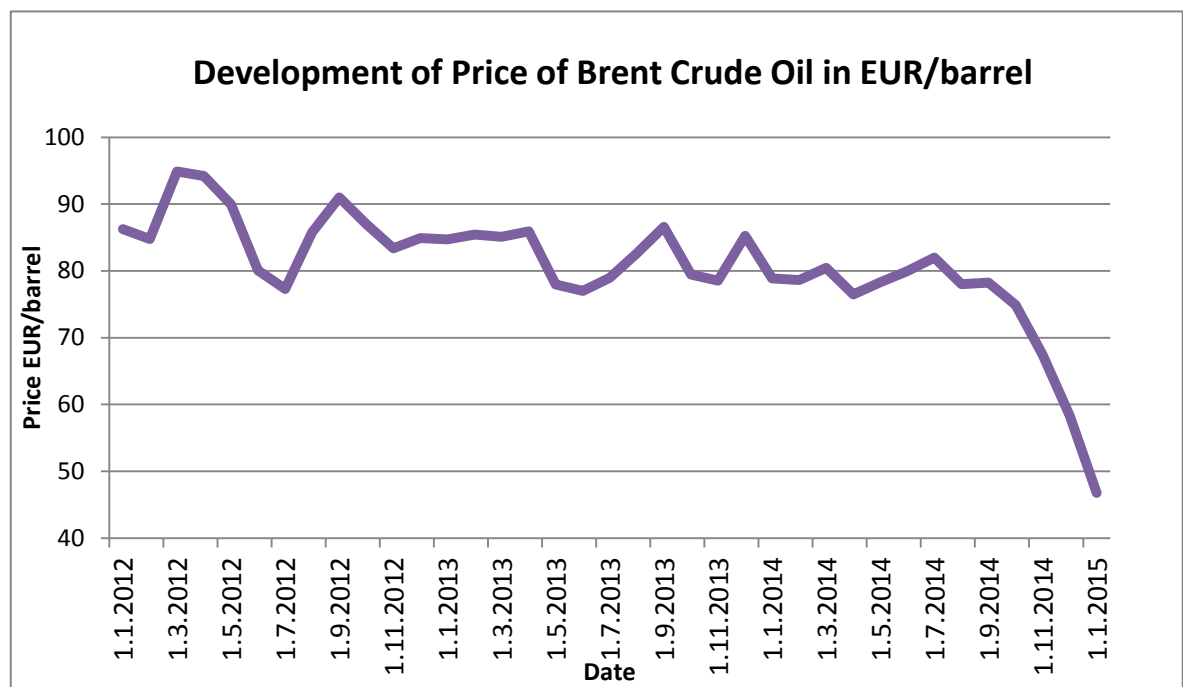
The largest trade of crude oil and refined petroleum products is carried out in the US dollars. Any change in the exchange rate between the local currency and the US dollar is therefore reflected in the price. [31]

4 ANALYTICAL PART

4.1 Development of Brent Crude Oil Price

Brent crude oil comprises 15 kinds of oil from the North Sea fields and it is primarily used in Europe. It is a light and sweet crude oil, and it is easy to transport to anywhere in the world. [33]

Figure 5 Price of Brent Crude Oil



Source: kurzy.cz (2015)

The price of Brent crude oil was fluctuating over the last three years, and since July 2014 it has been significantly decreasing. According to BBC news, the drop is mainly caused by the slowing global growth while increasing oil and gas supply, which caused over-production. OPEC rejects any cuts in production, so the expectation is further declining price in next weeks. [35]

4.2 Taxes

In the average, more than 50% of the fuel price is tax. The difference between each of the countries of EU is made mainly because of the taxes. Every country can determine the rate of excise duty and the rate of value added tax.

4.2.1 Value Added Tax

Table 1 VAT Rates

Austria	20%	Italy	22%
Belgium	21%	Latvia	21%
Bulgaria	20%	Lithuania	21%
Croatia	25%	Luxembourg	17%
Cyprus	19%	Malta	18%
Czech Republic	21%	The Netherlands	21%
Denmark	25%	Poland	23%
Estonia	20%	Portugal	23%
Finland	24%	Romania	24%
France	20%	Slovakia	20%
Germany	19%	Slovenia	22%
Greece	23%	Spain	21%
Hungary	27%	Sweden	25%
Ireland	23%	United Kingdom	20%

Source of data: VATlive (2015)

Mean	Median	Mode	Min	Max
22%	21%	20%	17%	27%

Source of data: VATlive (2015)

VAT does not make that big difference between the countries. It ranges between 17% and 27%. The lowest VAT is in Luxembourg and the highest VAT is in Hungary.

The average tax of all countries of the EU is 22 %, and the middle value, also called median, of the tax is 21% and the most common value, also called mode, is 20 %.

VAT is calculated from the final price of fuels, which means that VAT also includes excise tax.

4.2.2 Excise Tax

Table 2 Excise Tax Rates

Country	Unleaded petrol	Diesel
Austria	482,00	397,00
Belgium	615,23	428,84
Bulgaria	363,02	330,00
Croatia	478,90	374,22
Cyprus	479,00	450,00
Czech Republic	466,88	398,15
Denmark	607,90	413,77
Estonia	422,77	392,92
Finland	681,30	506,10
France	624,10	468,20
Germany	654,50	470,40
Greece	670,00	330,00
Hungary	397,36	365,95
Ireland	587,71	479,02
Italy	728,40	617,40
Latvia	411,21	332,95
Lithuania	434,43	330,17
Luxembourg	462,09	335,00
Malta	519,38	442,40
The Netherlands	766,07	482,06
Poland	399,24	348,93
Portugal	617,51	402,01
Romania	461,62	430,25
Slovakia	514,50	368,00
Slovenia	595,72	494,64
Spain	424,69	331,00
Sweden	643,34	555,47
United Kingdom	674,15	674,15

Source of data: European Commission (2015)

	Mean	Median	Min	Max
Unleaded petrol	542,25	516,94	363,02	766,07
Diesel	426,7501	407,89	330	674,15

Source of data: European Commission (2015)

Structure of excise taxes are synchronized across the EU, but it does not mean that the rates are the same. The excise duties are different in every member of the EU. The EU

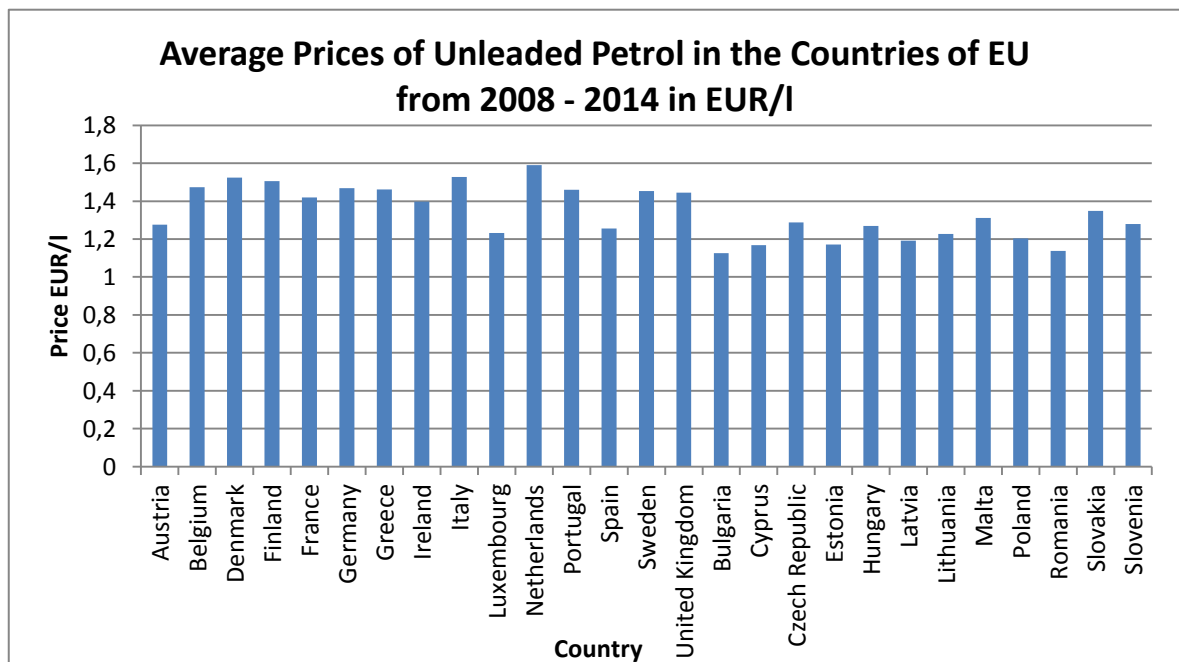
commission has set the minimum rates of excise duties. It is 359 EUR / 1000 l for unleaded petrol and 330 EUR/ 1000 l for Diesel.

The tax in the Czech Republic is 12 840 CZK / 1000 l (466,88 EUR / 1000 l) for unleaded petrol and 10 950 CZK / 1000 l (398,15 EUR / 1000 l) for Diesel. As the exchange rate is changing over the years, the excise duty tax decreases or increases in euro terms.

The average excise duty tax for unleaded petrol across the member countries of the EU is 542,25 EUR / 1000 l and for diesel it is 426,7501 EUR / 1000 l. So the average tax for diesel is over 100 EUR lower than for the unleaded petrol. The middle value of the tax for unleaded petrol is 516,94 EUR / 1000 l and for diesel it is 407,89 EUR / 1000 l. The lowest tax for both petrol and diesel is in Bulgaria. The highest tax for unleaded petrol is in the Netherlands, where the petrol is also the most expensive and for diesel it is in the United Kingdom and there is also the most expensive diesel of all the countries of the EU.

4.3 Unleaded Petrol – Super 95

Figure 6 Average Prices of Unleaded Petrol

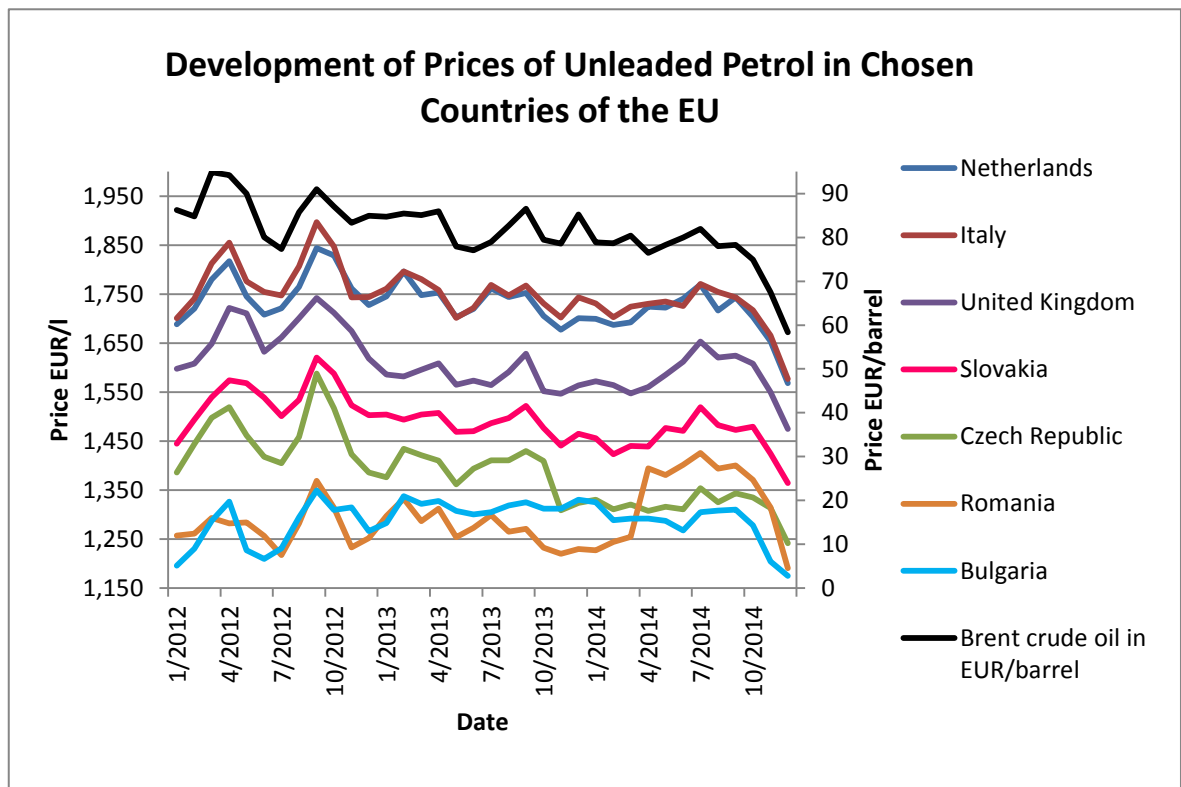


Source of data: gov.uk (2015)

This graph shows the average prices of unleaded petrol in the countries of EU from 2008-2014. The total average of price of unleaded petrol in the whole EU was 1,3412 EUR/l. The total of 13 countries are below the average and 14 countries are above the average (Croatia is not included, because it has been an European union member only since 2013).

The most expensive petrol over the years is in the Netherlands. The petrol in this country cost 1,59 EUR/l in the average in the past six years. The second most expensive petrol was in Italy, where one liter cost 1,528 EUR. On the other hand, the least expensive unleaded petrol was in Bulgaria and it was 1,126 EUR/l. Second least expensive petrol was in Romania. One liter cost 1,138 EUR in the average. The average price for petrol in the Czech Republic was 1,288 EUR/l, so it is below the total European Union average.

Figure 7 Development of Prices of Unleaded Petrol



Source of data: gov.uk (2015)

The figure 9 shows, the development of price of unleaded petrol Super 95 in chosen countries of the EU over the last three years and there is added the price of Brent crude oil in EUR/barrel for the comparison of the development. Italy and Netherlands are the countries with the most expensive petrol. Bulgaria and Romania has the least expensive petrol. The other countries, such as the Czech Republic, Slovakia and the United Kingdom are added to the graph for the comparison. All prices of unleaded petrol are in euros per liter.

As the graph shows, the fluctuation of all curves is similar. It is given by the single price of the product from refineries, which is set by the commodity exchange in Rotterdam. Every refinery in the EU has to sell their products according to this exchange. The little differences between the curves are given by other factors that influence the price of fuels, mostly by changing of the petrol station margins. Bigger distinction can be caused by a change in either VAT or excise duty tax rate. Another reason of a bigger difference between these countries is caused by the exchange rate. The price of petrol has dropped in the Czech Republic in the end of 2013. This was caused because of the intervention, which was happening in the Czech Republic. The Czech crown was depreciating, so the fuel for the foreigners that came into this country was cheaper.

The price of Natural 95 is made of the price of the fuel from refiners, which is given by the exchange in Rotterdam for all EU countries + transportation + margin of each petrol station + taxes.

4.3.1 Margins of Petrol Station in 31. 12. 2014

4.3.1.1 Italy

The price of petrol in the end of December 2014 was 1,577 EUR / l.

The price of this fuel on commodity exchange in Rotterdam was 0,3211 EUR / l. [39][40]

VAT rate in Italy is 22% and excise duty rate is 728,40 EUR / 1000 l.

Margin = 1,577 – 0,3211 – 0,34694 – 0,7284 = **0,18056 EUR / l**

4.3.1.2 United Kingdom

The price of petrol in the end of December 2014 was 1,475 EUR / l.

The price of this fuel on commodity exchange in Rotterdam was 0,3211 EUR / l.

VAT rate in United Kingdom is 20% and excise duty rate is 674,15 EUR / 1000 l.

Margin = $1,475 - 0,3211 - 0,295 - 0,67415 = \mathbf{0,18475 \text{ EUR / l}}$

4.3.1.3 The Czech Republic

The price of petrol in the end of December 2014 was 1,241 EUR / l.

The price of this fuel on commodity exchange in Rotterdam was 0,3211 EUR / l.

VAT rate in the Czech Republic is 21% and excise duty rate is 466,88 EUR / 1000 l.

Margin = $1,241 - 0,3211 - 0,26061 - 0,46688 = \mathbf{0,19241 \text{ EUR / l}}$

4.3.1.4 Bulgaria

The price of petrol in the end of December 2014 was 1,175 EUR / l.

The price of this fuel on commodity exchange in Rotterdam was 0,3211 EUR / l.

VAT rate in Bulgaria is 20% and excise duty rate is 363,02 EUR / 1000 l.

Margin = $1,175 - 0,3211 - 0,235 - 0,36302 = \mathbf{0,25588 \text{ EUR / l}}$

4.3.2 Margins of Petrol Stations in 1. 1. 2014

4.3.2.1 Italy

The price of petrol in the beginning of January 2014 was 1,731 EUR / l.

The price of this fuel on commodity exchange in Rotterdam was 0,5329 EUR / l.

VAT rate in Italy is 22% and excise duty rate is 728,40 EUR / 1000 l.

Margin = $1,731 - 0,5329 - 0,38082 - 0,7284 = \mathbf{0,08888 \text{ EUR / l}}$

4.3.2.2 United Kingdom

The price of petrol in the beginning of January 2014 was 1,572 EUR / l.

The price of this fuel on commodity exchange in Rotterdam was 0,5329 EUR / l.
VAT rate in United Kingdom is 20% and excise duty rate is 674,15 EUR / 1000 l.
Margin = 1,572 – 0,5329 – 0,3144 – 0,67415 = **0,05055 EUR / l**

4.3.2.3 The Czech Republic

The price of petrol in the beginning of January 2014 was 1,330 EUR / l.
The price of this fuel on commodity exchange in Rotterdam was 0,5329 EUR / l.
VAT rate in the Czech Republic is 21% and excise duty rate is 466,88 EUR / 1000 l.
Margin = 1,330 – 0,5329 – 0,2793 – 0,46688 = **0,05092 EUR / l**

4.3.2.4 Bulgaria

The price of petrol in the beginning of January 2014 was 1,325 EUR / l.
The price of this fuel on commodity exchange in Rotterdam was 0,5329 EUR / l.
VAT rate in Bulgaria is 20% and excise duty rate is 363,02 EUR / 1000 l.
Margin = 1,325 – 0,5329 – 0,265 – 0,36302 = **0,16408 EUR / l**

Margins of unleaded petrol at the station differ a lot in these two dates. The price of petroleum was very low in 31.12.2014. The price of unleaded petrol went also down, but not that radically as the price of petroleum. The petrol stations decreased their price of Super 95, but not as significantly, as the price of petroleum. This decrease allowed them, to set the margin higher and still be able to decrease the price of the petrol. Only factor, which was controlling the price and the margin, was the competition. Petrol stations have to watch the price of the competition, so it does not differ too much.

The highest impact of the change of crude oil in the price on unleaded petrol was in the Czech Republic. When the price of oil was low the amount of margin was second highest and on the other hand, when the price of oil was at a normal level, the amount of margin was the lowest from these chosen countries. Bulgaria has the lowest price of the unleaded petrol, yet still the highest margin in both cases. It is due to the fact, that Bulgaria has one of the lowest rate of excise duty.

4.4 Simple Linear Regression and Correlation Analysis

4.4.1 Correlation Analysis

Correlation analysis is used to determine the linear relationship between two quantitative variables. Correlation ranges from -1 to 1. If the value is close to +1, it is an increasing linear dependency. When the value is close to -1, it is a decreasing linear dependency. If the value is zero, there is any not a linear relationship between the observed quantitative characteristics. [42]

4.4.2 Regression Analysis

Simple linear regression analysis, similarly as correlation analysis, examines the relationship between two variables. Unlike correlation, it can say how much the independent variable x influences the dependent variable y , and what specific value will be dependent variable y , when it is known what value has the variable x . [41]

Table 3 Regression analysis of crude oil and unleaded petrol part 1

<i>Regression statistics</i>	
R	0,7820
R square	0,6115
Adjusted R square	0,6000
Standard Error	0,0464
Total number of cases	36,0000

Table 4 Regression analysis of crude oil and unleaded petrol part 2

	<i>Coeff.</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>p-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95,0%</i>	<i>Upper 95,0%</i>
Intercept	0,7015	0,0943	7,4397	1,25E-08	0,5099	0,8932	0,5099	0,8932
Brent crude oil	0,0084	0,0012	7,3148	1,79E-08	0,0061	0,0108	0,0061	0,0108

R, or correlation coefficient, or power of dependency, is 0,7820. It means that these two variables move in strong positive relation to each other. It is possible to say that when the price of crude oil is increasing, the price of petrol is also increasing. How the independent variable influences the dependent variable tells the R-squared. R-squared, coefficient of determination, is 61,15%. It is the proportion of variability in variable y that

is explained by the variable x. It means that 61,15% of the change in price of petrol is explained by the change in price of crude oil. The remaining 38,85% is called random error, so 38,85% of the change in price of petrol is caused by other factors or by random effect.

P-value is lower than the value of alpha ($\alpha = 0,025$), so it also tells that there is a significant relationship between these two variables.

The linear regression equation is:

$$y = 0,0084x + 0,7015 + \varepsilon$$

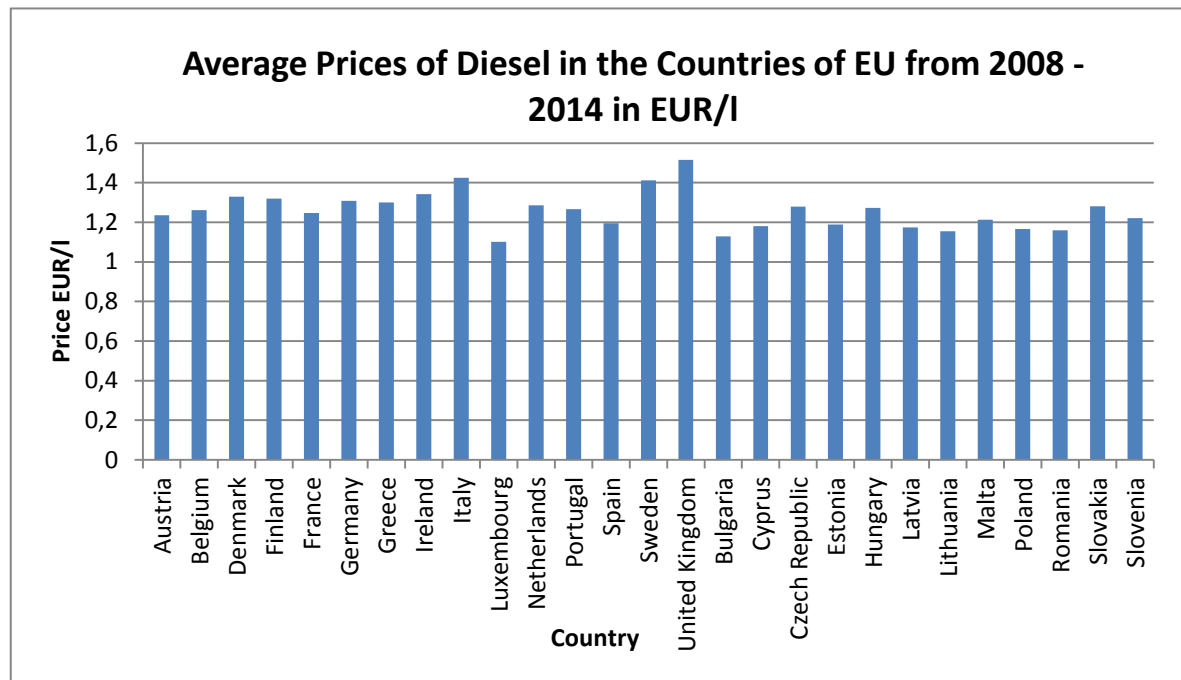
This says that if the price of crude oil increases by 1 euro per barrel, then the price of unleaded petrol will increase in average by 0,0084 euro per liter. In the end of the year 2014, the price of crude oil per barrel was 50 EUR.

$$y = 0,0084 * 50 + 0,7015 = 1,1215$$

The expected price of petrol in the end of 2014, when the price of crude oil was 50 EUR/barrel is 1,1215 EUR / l. The actual price was 1,241 EUR / l. The real price is higher than the expected price due to unexpected higher margin, that was set by the petrol stations.

4.5 Diesel

Figure 8 Average Prices of Diesel

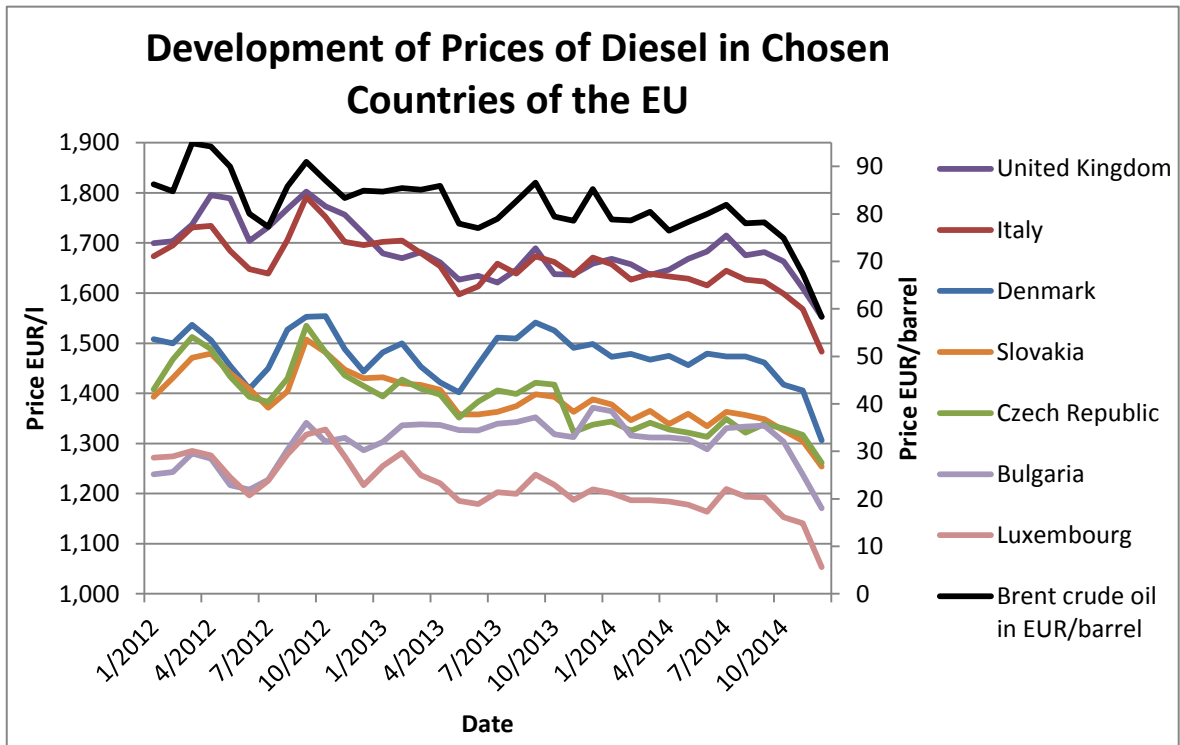


Source of data: gov.uk (2015)

This graph shows the average price of diesel in all countries of EU from 2008 – 2014, that have been members to the 2008. This differs to the average price of unleaded petrol a little bit. The total average of the price of diesel in the EU was 1,258 EUR/liter. The average is lower than the average of unleaded petrol, because diesel used to be cheaper. Nevertheless, nowadays it is same expensive in the most of the countries, somewhere even more expensive. Fourteen countries have ranked under the total average and 13 countries have ranked above the total average.

The most expensive price of diesel was in the United Kingdom. One liter cost 1,515 EUR. The reason for this is that all countries except the UK have set a lower excise duty rate on diesel. The UK has the exact same rate for the unleaded petrol and for diesel. The second most expensive diesel was in Italy, where one liter was for 1,425 EUR. The cheapest diesel was in Luxembourg. It was 1,101 EUR/l. Second country with the cheapest diesel was Bulgaria. It cost 1,1286 EUR/l. The Czech Republic was selling diesel for 1,28 EUR/l.

Figure 9 Development of Prices of Diesel



Source of data: gov.uk (2015)

It is shown, that the development of prices of diesel in chosen countries of the EU is also similar. The fluctuation of the price is in each country almost the same. It is due to the fact that the price of the product from refineries cost the same amount at each country of the EU. It is almost copying the fluctuation of the price of Brent crude oil which is mentioned in EUR / barrel. All prices are given in euro per liter.

The United Kingdom and Italy are shown as the representatives of the most expensive diesel. The cheapest diesel is in Luxembourg and Bulgaria. Denmark, Slovakia and the Czech Republic are chosen for the comparison since they are in the middle of this graph.

The little differences between the countries are caused by a single market factors in each of the EU members, such as the exchange rate, changes in excise duty rates and so on.

4.5.1 Margins of Petrol Stations in 31.1.2014

4.5.1.1 United Kingdom

The price of diesel in 1.1.2015 in the UK was 1,553 EUR / l.

The price at commodity exchange in Rotterdam was set to 0,3877 EUR / l. [39][40]

VAT rate is 20% and excise duty rate is 674,15 EUR / 1000 l.

Margin = $1,553 - 0,3877 - 0,3106 - 0,67415 = \mathbf{0,18055 \text{ EUR / l}}$

4.5.1.2 Denmark

The price of diesel in 1.1.2015 in the Denmark was 1,306 EUR / l.

The price at commodity exchange in Rotterdam was set to 0,3877.

VAT rate is 25% and excise duty rate is 413,77 EUR / 1000 l.

Margin = $1,306 - 0,3877 - 0,3265 - 0,41377 = \mathbf{0,17803 \text{ EUR / l}}$

4.5.1.3 The Czech Republic

The price of diesel in 1.1.2015 in the Czech Republic was 1,261 EUR / l.

The price at commodity exchange in Rotterdam was set to 0,3877 EUR / l.

VAT rate is 21% and excise duty rate is 389,15 EUR / 1000 l.

Margin = $1,261 - 0,3877 - 0,26481 - 0,38915 = \mathbf{0,21934 \text{ EUR / l}}$

4.5.1.4 Luxembourg

The price of diesel in 1.1.2015 in the Luxembourg was 1,053 EUR / l.

The price at commodity exchange in Rotterdam was set to 0,3877 EUR / l.

VAT rate is 17% and excise duty rate is 335,00 EUR / 1000 l.

Margin = $1,053 - 0,3877 - 0,17901 - 0,335 = \mathbf{0,15129 \text{ EUR / l}}$

4.5.2 Margins of Petrol Stations in 1. 1. 2014

4.5.2.1 United Kingdom

The price of diesel in 1.1.2014 in the UK was 1,668 EUR / l.

The price at commodity exchange in Rotterdam was set to 0,5933.

VAT rate is 20% and excise duty rate is 674,15 EUR / 1000 l.

Margin = $1,668 - 0,5933 - 0,3336 - 0,67415 = \mathbf{0,06695 \text{ EUR / l}}$

4.5.2.2 Denmark

The price of diesel in 1.1.2015 in the Denmark was 1,473 EUR / l.

The price at commodity exchange in Rotterdam was set to 0,5933 EUR / l.

VAT rate is 25% and excise duty rate is 413,77 EUR / 1000 l.

Margin = $1,473 - 0,5933 - 0,36825 - 0,41377 = \mathbf{0,09768 \text{ EUR / l}}$

4.5.2.3 The Czech Republic

The price of diesel in 1.1.2015 in the Czech Republic was 1,344 EUR / l.

The price at commodity exchange in Rotterdam was set to 0,5933 EUR / l.

VAT rate is 21% and excise duty rate is 389,15 EUR / 1000 l.

Margin = $1,344 - 0,5933 - 0,28224 - 0,38915 = \mathbf{0,07931 \text{ EUR / l}}$

4.5.2.4 Luxembourg

The price of diesel in 1.1.2015 in the Luxembourg was 1,201 EUR / l.

The price at commodity exchange in Rotterdam was set to 0,5933 EUR / l.

VAT rate is 17% and excise duty rate is 335,00 EUR / 1000 l.

Margin = $1,201 - 0,5933 - 0,20417 - 0,335 = \mathbf{0,06853 \text{ EUR / l}}$

Margins of diesel at petrol stations are roughly the same as the margins of unleaded petrol. Nowadays, the price of diesel and the price of Super 95 is almost the same, but the price of diesel at the Rotterdam commodity exchange is higher. The margins are approximately the same, because the excise duties on diesel are significantly lower, than the excise duties on unleaded petrol.

Again, you can see, that when the price of Brent crude oil is low, petrol stations can set the margin higher. When the price of crude oil is high or at a normal level, the margins of petrol stations are lower and it is around 0,08 EUR per one liter of diesel.

The highest change of margin in these two cases was in the Czech Republic. The total change in the margin was 0,14003 EUR/l. This means that when the price of crude oil goes down, the petrol stations in the Czech Republic set the margins much higher than normal. The lowest change in margins was in Denmark. The amount of margin in the first case was the second lowest one from these chosen countries, and the margin in the second place was the highest one.

4.6 Simple Linear Regression and Correlation Analysis

Table 5 Regression analysis of crude oil and diesel part 1

<i>Regression Statistics</i>	
R	0,8153
R square	0,6647
Adjusted R square	0,6548
Standard Error	0,0367
Total number of cases	36

Table 6 Regression analysis of crude oil and diesel part 2

	<i>Coeff.</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>p-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95,0%</i>	<i>Upper 95,0%</i>
Intercept	0,7761	0,0747	10,3906	4,3E-12	0,6243	0,9279	0,6243	0,9279
Brent crude oil	0,0075	0,0009	8,2090	1,4E-09	0,0056	0,0093	0,0056	0,0093

The correlation coefficient R is 0,8153. It means that there is a strong, positive correlation between variable y, which is a price of diesel and variable x, which is a price of crude oil. Coefficient of determination R^2 is 66,47%. It is possible to express it that

66,47% of the movement in the price of diesel is due to change in the price of crude oil. The rest of the 33,53% of the change of diesel is caused by other factors and by a random effect.

P-value is lower than alpha, which is set to 0,025, so there is a significant relationship between price of crude oil and price of diesel.

The linear regression equation is:

$$y = 0,0075x + 0,7761 + \varepsilon$$

The equation says that if the price of crude oil increases by 1 EUR / barrel, then the price of diesel will increase in average by 0,0075 EUR / l. In the end of the year 2014, the price of crude oil was 50 EUR / barrel. It is possible to calculate the expected price of diesel, when the price of crude oil is 50 EUR / barrel.

$$y = 0,0075 * 50 + 0,7761 = 1,1511$$

The expected price of diesel, when the price of crude oil is 50 EUR / barrel is 1,1511 EUR / l. The real price of diesel in the end of 2014 in the Czech Republic was 1,261 EUR / l. The difference is caused by the high margin of the distributors.

5 CONCLUSION

There are many factors that influence the price of fuel on the market. But certainly, some of the factors affects the price more and some less. The final fuel price at the petrol stations, whether it is price of Super 95 or diesel, consists of the price of crude oil from the refineries, excise tax, value added tax and the margin of petrol stations and distributors.

As the regression analysis in this thesis shows, the final price of the fuels increases and decreases mostly due to the change in price of crude oil. However, it is not a parallel shift of both, price of crude oil and price of fuels. When the price of crude oil goes up, the price of fuels go also up, on the other side, when the price of crude oil decreases a little bit, the price at the petrol station either does not decrease at all, or reacts to this change with considerable delay. As it was shown at the regression equations, the change in price of crude oil influences the price of unleaded petrol more. When the price of crude oil increase by 1 euro per barrel the price of one liter of Super 95 increases more than the price one liter of diesel.

There are big differences in the prices of fuels between the countries of the EU. These differences are mainly caused by the different rates of the excise duty and by the different rate of VAT in each of the country. According to the comparison of the development of the prices in the chosen countries of the EU, it is clear, that in the country with a high rate of excise duty the price of Super 95 and diesel is also high. Italy is one of the countries with the highest price of Super 95 and it is a country with second highest rate of excise duty on unleaded petrol, or the United Kingdom is a country with the highest rate of excise duty on diesel thus with the highest price of diesel.

The other differences between countries are due to the margins of the petrol stations. It is the smallest part of the final price, but they also change according to the change of crude oil price. As was shown in this thesis, when the price of oil increases, the price of fuel also increases and the margin stays the same, but when the price of oil is low, as it is at the moment, the margins increase and the final price of fuel decreases by smaller amount.

Over all, the price of crude oil significantly influences the price of fuels, because it influences every part which forms the final price. The only part, which is not influenced by the change in price of crude oil and does not change too much over the time, is the excise tax. It is only changed by the government of the certain country once in a while.

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