

Czech University of Life Sciences Prague

Faculty of Economics and Management

Department of Economics



DIPLOMA THESIS

**ECONOMIC ANALYSIS OF CRUDE OIL MARKET AND ITS
IMPACT UPON FUEL PRICE IN THE CZECH REPUBLIC**

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DIPLOMA THESIS ASSIGNMENT

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Economics and Management

Thesis title

Economic analysis of crude oil market and its impacts upon fuel price in the Czech Republic

Objectives of thesis

The diploma thesis aims to analyze the development of prices of fuels, with focus on the price of crude oil, value added tax and excise tax of fuels as main factors affecting the price of fuels in the Czech Republic.

Methodology

Regression analysis of relationship between price of fuels, price of crude oil, value added tax and excise tax

Economic modelling of relationship between price of fuels, price of crude oil, value added tax and excise tax

Trend analysis for theoretical short term prognosis of price of fuels and price of crude oil with expectation of stable progress of history, e.g. there will not occur any new war conflict etc.

Statistical significance of parameters testing

The proposed extent of the thesis

60 pages

Keywords

crude oil, fuels, OPEC, Platts, CCS, FOB Rotterdam

Recommended information sources

BRAIN M. 2000, What does octane mean? [online] available at:

<http://auto.howstuffworks.com/fuel-efficiency/fuel-consumption/question90.htm>

CZECH REPUBLIC, 2004, Act no. 235/2004 Coll. about value added tax [online] available at:

<https://portal.gov.cz/app/zakony/zakonPar.jsp?idBiblio=57849&fulltext=da~C5~88~20z~20p~C5~99idan~C3~A~ content>

CZECH REPUBLIC, 2003, Act no. 353/2003 Coll. about excise tax [online] available at:

<https://portal.gov.cz/app/zakony/zakon.jsp?page=0&nr=353~2F2003&rpp=15#seznam>

FREUDENRICH C., Ph.D., 2001, How Oil Refining Works [online] available at:

<http://science.howstuffworks.com/environmental/energy/oil-refining.htm>

ISHIMWE D., 2014, Origin and Formation of Petroleum [online] available at:

<http://connect.spe.org/blogs/donatien-ishimwe/2014/09/11/origin-and-formation-of-petroleum>

SPEIGHT, James G, 2011. An introduction to petroleum technology, economics, and politics. Hoboken, N.J.: Wiley, 302 p. ISBN 1118012992

SUMMERS V., 2015, The Origin of Crude Oil or Petroleum: Biotic or Abiotic? [online] available at:

<http://www.decodedscience.org/origin-crude-oil-petroleum-biotic-abiotic/54008>

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Declaration

I declare that I have worked on my diploma thesis titled "Economic analysis of crude oil market and its impact upon fuel price in the Czech Republic" 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

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Economic analysis of crude oil market and its impact upon fuel price in the Czech Republic

Abstract

The price of crude oil and crude oil fuels is a much discussed topic nowadays. It is due to the fact that the crude oil is one of the mostly used commodities all around the world. The diploma thesis aims to analyze relationship in price of crude oil and fuels, to evaluate impact of excise tax and value added tax on the price of fuels and to analyze the situation of crude oil fuel price in the Czech Republic. 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 situation in the world which is influenced by organizations and policies. The analytical part of thesis is focusing on development of crude oil price and price of fuels, relations between fuel price, crude oil price and taxes as well as explaining of price making process and analyzing of chosen gas stations situation. Furthermore the analytical part provides short prognosis of development of fuel price. It is found that around half of the fuel price is consisting of taxes alone.

Key words

Crude oil, fuels, OPEC, Platts, CCS, FOB Rotterdam

Ekonomická analýza ropného trhu a jeho dopad na cenu pohonných hmot v České republice

Souhrn

Cena ropy a ropných paliv je v dnešní době velmi diskutované téma. Je tomu tak, neboť je ropa jednou z nejpoužívanějších komodit na světě. Diplomová práce se zaměřuje na analýzu vztahu mezi cenou ropy a cenou pohonných hmot, zhodnocení dopadu spotřební daně a daně z přidané hodnoty a analýzy situace cen pohonných hmot v České republice. Teoretická část práce popisuje faktory ovlivňující cenu ropy a pohonných hmot a to od původu ropy přes těžbu a proces zpracování až k současné situaci ve světě, která je ovlivněna organizacemi a politikou. Analytická část se soustředí na vývoj cen ropy a pohonných hmot, vztahy mezi cenou pohonných hmot, cenou ropy a daněmi a také na vysvětlení cenotvorby a analyzování situací vybraných čerpacích stanic. Dále analytická část poskytuje krátké prognózy vývoje cen pohonných hmot. Zjistilo se, že přibližně polovina ceny pohonných hmot je tvořena pouze daněmi na ně uvalenými.

Klíčová slova

Ropa, pohonné hmoty, OPEC, Platts, CSS, FOB Rotterdam

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1 Introduction

The thesis, as the name of it says, deals with economic analysis of crude oil and its impact upon the price of fuels in the Czech Republic.

The crude oil is the most common material used for production of fuels for engines all over the world. Other products made of raw crude oil combined with the importance of fuels for engines are making crude oil one of the most important and demanded material in the world. The technology which is currently used requires crude oil fuels to be functional in most cases. Even with nowadays focus on alternative resources the development of technologies which will not use crude oil at all will take many years. That is reason why the crude oil is still so important.

As the crude oil affects transportation, heating etc. it is affecting economy of countries as well. To predict the development of economy, it is necessary to understand all different factors which are affecting it. One of those factors is price of crude oil. Other factors which are affecting economy are products made of crude oil.

This thesis focuses on development of crude oil price and development of crude oil fuels price. One of the goals of the thesis is to find connection between price of crude oil and price of fuels and how the price of crude oil is affecting price of fuels. As it is obvious, the price of fuels is not affected only by the price of crude oil and therefore the thesis is also taking into the consideration policies which are influencing price of fuels, such as excise tax and value added tax.

The theoretical part of thesis in form of literature review deals with origin of crude oil and the whole process which the crude oil goes through to reach its consumer in its final form of fuel. The chapters are dealing with theories behind origin of crude oil, how the crude oil is extracted and processed. Further, the theoretical part is describing history of Organization of Petroleum Exporting Countries (in short OPEC) which is directly affecting price of crude oil on the world market and at the same time it is one of the most important factors which influence the crude oil market itself. Other chapters are describing the production process of crude oil fuels as well as the factors affecting price of raw crude oil and the crude oil fuels.

The analytical part shows development of crude oil price in history, development of prices of crude oil fuels in the Czech Republic (namely Natural 95 and Diesel), as well as development of policies applied upon the fuels such as excise tax and value added tax. Further the analytical part provides econometric model of relationship between price of fuels, price of crude oil, excise tax and value added tax. The thesis also provides other way of price calculation which is commonly used in the Czech Republic. Further the thesis shows real examples of crude oil fuels development based on case studies from different gas stations in the Czech Republic. In the end of the analytical part are calculations of prognosis for fuels development, which are based on theoretical econometric model and regression analysis. The prices of crude oil fuels are internal data provided by To&Mi Vdf. spol. s.r.o. and the CCS company and as such are not available for public.

The results of analytical part of the thesis are summarized in the end of thesis in form of conclusion and the recommendations of author are involved as well.

2 Objectives and Methodology

2.1 Objectives

The thesis focuses on development of the crude oil price and development of prices of crude oil fuels. The main idea of relationship in this case is that the price of crude oil fuels is influenced by the price of crude oil and policies set upon the crude oil fuels, namely excise tax and value added tax. Because every state in the European Union and the world as whole is setting its own value of excise tax and value added tax, the state used for this thesis is Czech Republic.

The objective is to discover the exact relation between these variables and based on the calculated model calculated theoretical prognosis. The prognosis is not counting with political changes or changes of situation in the world.

2.2 Methodology

Author used in the theoretical part of thesis, in other words in the literature review, methods of synthesis, extraction, induction and deduction. The purpose of the literature review was to describe and explain terms which were further mentioned in analytical part of the thesis. The literature review is explaining terms affecting situation and price of crude oil and fuels made of crude oil from the theories of crude oil origin to the nowadays factors influencing it.

The analytical part is using comparative and descriptive methods as well as econometric modelling, statistical significance, regression analysis and prognosis. In the analytical part is shown and explained development of crude oil price which is further affecting price of crude oil fuels. Real historical prices are compared with estimated prices based on econometric model which is using 3 explanatory variables. These variables were chosen due to direct connection with explained variable which is price of crude oil fuels, namely Natural 95 and Diesel. The prognosis was prepared with usage of time series regression analysis and the result is on theoretical basis which is not counting with political changes or changes of situation in the world. Further the analytical part contains case studies of 4 gas stations in the Czech Republic with their prices which are compared with the average prices of fuels in the Czech Republic as well as the amount of fuels sold.

3 Theoretical part of thesis

3.1 Origin of crude oil

There are 2 theories which are dealing with the origin of crude oil. First theory comes from independent hypotheses which were used in different works of Dimitri Mendeleev and Marcellin Berthelot. This theory is based on inorganic origin of crude oil. The crude oil was formed by the effect of hot steams on carbides of heavy metals in times when they occurred near the Earth's surface. [9] [17] [18] [22]

This theory is supported by the possibility to prepare hydrocarbons from carbides of uranium, lanthanum, and cerium and created hydrocarbons are in either solid, liquid or gas form. Theory of inorganic origin of crude oil is also supported by leakage of methane from the depths of planet in certain areas on Earth. [9] [17] [18] [22]

After the World War II. was this theory reintroduced by Soviet geologist Nikolai Kurdjavcev. According to his theory are all crude oil hydrocarbons created by chemical reactions in depths of hundred kilometers below the Earth's surface and the amount of inorganic carbonates are nearly inexhaustible. [9] [17] [18] [22]

Russian Academy of Science conducted experiments and proved that reduction of calcium carbonate at temperature of 2732 degrees of Fahrenheit or 1500 degrees of Celsius and pressure of 5 GPa creates not only methane but also alkanes, isoalkanes, and some alkenes. Those are forced up to surface by geostatic pressure and rotation of the planet Earth. This keeps the crude oil deposits refilling and the option of extraction of last drop of crude oil is denied. These experiments were confirmed by scientists of Carnegie Institution of Washington later. [9] [17] [18] [22]

V. A. Krayushkin from the Ukraine Academy of Science supported the theory of inorganic origin of crude oil by foundation of new crude oil deposits in Dnieper-Donetsk region, where should not be any deposit according to the original assumptions. [9] [18] [22]

Another person which significantly contributed to the discussion about inorganic origin of crude oil, was American astrophysicist Thomas Gold from Cornell University. According to his idea, Earth has locked gigantic amount of methane from universe under

its surface. The stocks of methane can be found in depths up to 300km under the surface. Extreme temperatures and pressure is transforming methane into more complicated compounds which are forces up to the surface of the planet. The compounds are getting to contact with thermophilic bacteria which are gaining life energy from these carbonic compounds. These compounds together with the rests of dead bacteria are source of crude oil and earth gas. [9] [18] [22]

Thomas Gold is also suggesting that life originated deep under the Earth's surface and not in the oceans. This hypothesis got a lot of attention. This hypothesis is not commonly accepted but the foundation of hyperthermophilic unicellular organisms which are able to survive the temperature higher than 248 degrees of Fahrenheit or 120 degrees of Celsius are supporting this hypothesis. Many geologists are accepting the hypothesis, which assume that there might exist much more extended bacteria biosphere in depths of Earth than is it known, nowadays. [9] [18] [22]

This theory is further supported by arguments such as existence of methane on other planets of the solar system, meteors, moons and comets. The theory of organic origin of crude oil cannot explain some of the characteristics of hydrocarbon deposits either. Also helium and other rare gasses are connected with hydrocarbons. [9] [18] [22]

However the theory of inorganic origin of crude oil is denied in world because of its dependency on many uncertain assumptions and is not able to deny the theory of organic origin of crude oil. [9] [18] [22]

Second theory dealing with the origin of crude oil is based on organic origin. This theory is assuming that the crude oil which is extracted nowadays was created millions years ago. Main source for creation of crude oil was sea plankton. [9] [18] [22]

In the past, over 150 billion tones of crude oil were extracted and the remaining stock under the surface is making another 120 billion tones. With considerations of origin of crude oil, it seems to be impossible this amount of crude oil was formed only from plankton alone. Modern research proved massive spread of plankton in the oceans. Phytoplankton which has enough of sunlight for photosynthesis up to 60-80 meters deep has in certain areas concentration higher than 1 g/m³ and is can be seen even on photos from satellites. Phytoplankton is gathering in calm waters. Balance calculations conducted

later proved that phytoplankton is producing approximately same amount of organic carbon as all terrestrial plants on the planet together. [9] [18] [22]

Life cycle of plankton lasts only few weeks. The lush vegetation of plankton caused large amount of dead remains which fell to the sea bottom. With the gathering of dead plankton the long way of transformation which ended at creation of crude oil started. [9] [18] [22]

In the 1st phase is part of organic sludge called sapropel decomposed with the aid of bacterial and chemical oxidation. Deeper in the ocean is eliminated most of the organic material by anaerobic bacteria. Only the most resistant components (mostly lipids) with high contain of hydrogen and carbon remain. [9] [18] [22]

Furthermore, occurred sedimentation and falling layers. Compression of these layers has forced water out of material and decreased material porosity. The result of subsequent complex chemical transformations made sapropel to become kerogen, high solid insoluble organic matter containing nearly 86% bound carbon. [9] [18] [22]

Kerogen is further transformed into bitumen. Kerogen was pushed to the depth of 2 to 5 km where was kerogen exposed to temperature of approximately 356 degrees of Fahrenheit or 180 degrees of Celsius and geostatic pressure of 150 MPa. Molecules of kerogen could not resist the pressure and its structure was simplified by cracking which resulted in creation of bitumen. Bitumen is a semi-solid hydrocarbon mixture which is soluble in organic solvents (e.g. toluene). Bitumen includes aside of hydrocarbons also small amount of resins and asphaltenes. [9] [18] [22]

At the end of this phase had bitumen transformed further, which was result of thermal cracking. The fragment cleavage of hydrocarbon chains reduced the molecular weight of bitumen. Result of this was converting bitumen into a floating liquid which is lighter than water and is composed mostly of hydrocarbons. This liquid, which is the result of a very slow transformation process, is called crude oil. [9] [18] [22]

The theory of organic origin of crude oil is commonly preferred which is reason why it is accepted as correct. Because the process of creation of crude oil takes more than 5 million years, the crude oil is considered as fossil unrenewable resource. The acceptance of

this theory and the speed of extraction of crude oil are reason of increased focus on alternative resources which are renewable. [9] [18] [22]

3.2 Crude oil extraction

3.2.1 History

Very first mention of extraction of crude oil can be found in the book of Genesis which is part of the Old law of Bible. Crude oil is mentioned as a material used instead of grout (meant as asphalt). In this book is also mentioned location of first crude oil deposit which is valley Sidim. Sidim is known as Dead Sea nowadays. [1] [20]

Records of first concrete usage of crude oil and natural gas come from ancient China, more precisely from the period around 200 years B.C. Natural gas as a loyal companion of crude oil was used for heating under boilers. In these boilers was obtained salt from saline suspense. [20]

First mentions about extraction of crude oil and asphalt in Europe are dated to the period of feudalism. Records are pointing at deposits in Bavaria, Lower Saxony and Tyrol. However there are no records of effort to search for deposits or investigation. [20]

The real increase of crude oil extraction can be noted in modern history, namely second half of 19th century. In the year 1853, Austria officially started to export crude oil as tradeable goods. In this period of time the Poland pharmacist Ignacy Lukasiewicz used process for distillation of crude oil which was invented by Canadian named Gesner and started to produce kerosene. He became a part of history with invention of kerosene lamp later. The kerosene lamp started to be used in the world very quickly. [20]

From this moment the demand for exploring of geologically similar locations such as Slovakia and Hungary rapidly increases. This was the beginning of whole new sphere of industry – the oil industry. [20]

3.2.2 The ways of crude oil extraction

The crude oil is extracted in several different ways. At the beginning it was not the extraction in the real meaning of a word but more likely it was collecting of crude oil. Crude oil was found as a liquid freely bubbling out of the earth. At the time when the

crude oil was collected and it was not bubbling out on the surface anymore, the wells were built in these places so it was possible to collect crude oil from it. [21]

As the time goes, the wells were becoming deeper up to the point when the deep drilling is used. Deep drilling is the most common way of crude oil extraction nowadays. Other option is surface extraction. The perfect example can be extraction of oil-bearing sands in Alberta, Canada. [21]

3.2.2.1 Crude oil drilling – extraction of convention crude oil

Original drilling was not done by the same way as it is done nowadays. It was more like a chiseling during which the huge chisel was hitting the ground and crashing rocks. The rocks had to be extracted from the well later. By this way it was possible to created well of even few hundred meters depth. The strong leakage of gas or liquids from the well was very often during the drilling. [21]

This method was updated in the second half of 19th century by introduction flushing which is a circling liquid send to the well. The flushing was extracting rocks from the well and also reduced eruptions during drilling. [21]

In the end of 19th century, the method of nowadays extraction was introduced. This method is using rotating drilling head. The method was updated during time up to the form used nowadays. The drilling head is slowly drilling hole into the ground up to the depth of its own length. After that, the drilling head is unplugged and prolonged by pipe. Repeating of this process is ensuring never ending prolonging of drilling set which can reach depths of hundreds or even thousands meters. [21]

If the drilling head hits some solid layer (such as rock), the operating crew of drilling machine sets so called hammering on. Hammering adds hitting of pneumatic hammer to the rotation of drilling head which increases penetration ability of drilling set. [21]

When the drilling head is getting blunt, it is necessary to change it. The whole drilling set of drilling head and prolonging pipes is slowly pulled out of well, the prolonging pipes are unplugged one by one until the whole set is up. After changing of drilling head is set slowly pushed back to the well again and prolonging pipes are plugged

one by one back to the set until the drilling head reaches bottom. Then it is possible to continue with the drilling process. [21]

During the drilling process the flushed liquid, rocks and eventually even gases which are coming from well are analyzed. The drilling keeps going until well hits so called collector. Collector is porous rock layer. Pores are usually filled with crude oil from 60% to 80%. The well must be hardened during process. Hardening is done by special so called casing pipe. Space between the wall and casing pipe is filled with grout. That hardens walls of well and prevent its colliding into the well. Logically with increasing number of casing pipes in well, the diameter of well is decreasing. The top casing pipe is equipped with special pressure valve which prevents leakage of crude oil. [21]

Further, the well is equipped with technologies and is ready for extraction. The drilling wells are built in locations with high amount of crude oil, because the cost of preparation for extraction is extremely high. Usually these locations are continental flatlands which were used to be sea or on the bottom of current sea. [21]

The locations of extraction areas which are directly connected with the bottom of sea are actually partly supporting the theory of organic origin of crude oil. [21]

The drilling wells are mostly perpendicular because it is logically using shortest way to reach high depths. However sloping drilling wells are possible and were mentioned during case of stolen crude oil in conflict between Iraq and Kuwait. [21]

After the new drilling well is opened, the so called self-flow extraction is used. It is phenomenon where crude oil is getting out of the well all by itself. This phenomenon caused by high pressure in the collector which is pushing the crude oil up. With the decreasing pressure is also leaking gas from crude oil, therefore the crude oil is pushed on the surface under pressure. The pressure is decreasing until the flow stops. That is moment when the so called primary extraction with which is it possible to extracted approximately 20% of deposit ends. [21]

After the primary extraction is finished, the secondary one begins. The secondary extraction is done by using of depth pump or by artificial increasing of pressure in the collector. [21]

Depth pump is in principle a hollow piston with valves. Electric engines are propelling gears which are transforming rotation motion to pendulum one. Valves of piston are using difference between pressure under and above of piston in dependence of movements of piston, if it is up or down. [21]

It is also possible to use other types of pumps, such as gear pumps or membrane pumps. However due to high risk of damaging of these pumps by admixtures in crude oil, these pumps are almost never used. [21]

Increasing of pressure in collector is done by injection of compressed air or gas, eventually even water injection when the water is injected to the surrounding of deposit. The yield of deposits is increased up to 50 - 60%. [21]

Third phase is finishing extraction done by special methods. The special methods are for example reduction of viscosity by heating of crude oil. Heating is done with usage of injected steam or hot water, gas or chemicals into the deposit. This is increasing intensity of remaining crude oil inflow into the drilling well. [21]

3.2.2.2 Extraction of unconventional crude oil

Difference between conventional crude oil which is created of liquid hydrocarbons hidden under pressure deep under the surface and the unconventional crude oil is that the unconventional crude oil is obtained mostly from crude oil sands or oil slate. Crude oil sands can be found in many countries however most of deposits are in Canada and Venezuela. The best known deposits are in province Alberta in Canada, which covers area approximately same as Bohemia. The crude oil sands in Alberta contain bitumen and the extraction is done in large surface mines. [21]

Bitumen is label for viscous organic matter of black color such as asphalt or tar. Extracted sand is cleaned with mixture of hot water and chemicals due to which is bitumen separated from sand. Separated bitumen is tanked and transported for processing and refining. [21]

Surface extraction has its disadvantages. One of these disadvantages is high energy demand for obtaining bitumen, high consumption of water and also fact that surface mines

can reach only about 75 meters depth. This way, it is possible to extract only about 20% of deposit supply. [21]

That is a reason why there effort to find new way for extraction and how to reach deeper in surface. Principle of many methods is heating of deposit in depths. Heating is significantly reducing viscosity of bitumen which results in possibility to extract it from drilling well in which it flows. There is also assumption that current surface extraction of crude oil sands will change to strictly deep extraction by time. [21]

The most common way of heating is injection of steam which has temperature of 572 degrees of Fahrenheit or 300 degrees of Celsius under high pressure. Steam is injected to the ground for several weeks. After that the steam is left for another several weeks to rest so the heat is absorbed to the ground. This way it is possible to extract mixture of water and bitumen to the surface for several weeks up to months. When the volume of bitumen in the mixture starts to fall, the heating process starts again by injection of new steam into the ground. [21]

Another source of unconventional crude oil is slate deposits. The most famous deposit of slate crude oil and gas is located in Bakken region in North Dakota in USA. Until recent this deposit was considered as the biggest deposit of slate crude oil and gas in the world. The American geologist found apparently the biggest nonconventional oil field in the year 2016. It is located in the region of Wolfcamp in western Texas. According to the assumptions, this deposit has up to 3 times higher supply of crude oil than the deposit in the Bakken. [16] [21] [26]

Slate crude oil is extracted with usage of hydraulic fission, so called fracking. Fracking is a shorter name for hydraulic fracturing. It is a method which is using mixture of water, sand and certain supportive chemicals (also called fracking fluid) which je pumped under pressure to the ground and is creating splits in ground. Chemicals should ease the passing of the mixture to the ground. It is fulfilling the role similar to the dish detergent in a certain way. The sand is supposed to keep splits passable for the liquid, in the first place for the gas and with it for the crude oil as well. By this way the crude oil is getting to the bigger deposits which are economically lucrative for extraction. [16] [21] [26]

This method is however meeting high worries of negative influence on the environment from the ecologists lately. First negative influence are tremors which are created by damaging of ground structure. Second aspect is huge consumption of water which is usually taken from the surrounding water sources. The consequence of it is lower supply of water and its possible global shortage in the extraction area and its surroundings. Third factor are chemicals which are pumped to the ground. It is assumed that nearly half of chemicals is returning to the surface after fragmentation. [16] [21] [26]

The extraction of slate crude oil is very expensive. That is probably also one of the reasons why the extraction will go on full capacity at the moment when the price of crude oil increases. [16] [21] [26]

The foundation of deposits resulted in the huge decrease of crude oil prices on the market. That is also a reason why most of the crude oil is still under surface, because it is not worthy for miners to build new drilling wells. Miners would need the crude oil price to increase at least to the 60 USD per barrel, that way it would be worthy to start extraction on full capacity. [16] [21] [26]

3.3 Factors affecting 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 grow. Nevertheless there are also other factors which are affecting price of crude oil. One of these factors is Organization of Petroleum Exporting Countries (in short OPEC). 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. [13]

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. [14] [15]

Other factors which are affecting price of crude oil are economic cycles in separate countries because 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 example of such regression can be economic crisis during years 2008 and 2009 where demand for crude oil products and crude oil itself declined and therefore there was surplus of crude oil. That resulted in decline in price of crude oil on world market.

Last but not least, the price of crude oil is influenced by technological and ecological trends. The alternative sources of energy such as electricity or Light Petroleum Gas (in short LPG) 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. [21]

However the demand for crude oil fuels nowadays is on so high level that the extraction capacities are fully used. But the technological development and direction in which is development moving will strongly affect the demand for crude oil in the future and the price of crude oil will be declining as result of this development. [21]

Against this prognosis is going assumption based on accepted theory of crude oil origin. This theory assumes that crude oil, as fossil resource, has limited supply. Therefore with the decreasing supply of crude oil the price should be increasing. Scientists are expecting that the total amount of crude oil extracted by now is representing half of the total supply of crude oil on Earth. [19]

However the assumption with consideration of current extraction capacities is that the supply of crude oil will last another 100 years. This assumption is supporting prognosis of declining price of crude oil in the near future. [14] [15] [19]

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. Therefore the reserves of crude oil will cover possible

decrease of extraction capacities and the price of crude oil will remain unchanged. [14]
[15]

3.4 Factors affecting price of crude oil fuels

Price of crude oil fuels is affected by many different factors. In these factors belong mainly costs of production process and taxes. Primary factor which is setting the price of crude oil fuels is price at which are refineries selling the fuels to distributors. This price is based on price of crude oil for which are refineries buying crude oil and then adds their production margin. Further is price of crude oil fuels affected by taxes in individual state. More precisely it is excise tax and value added tax. [4] [5] [6] [10] [11]

Secondary is price of crude oil fuels affected by profit margin of distributors and in case of consumers also profit margin of gas stations. [11]

Based on the mutual agreement are all refineries in European Union selling crude oil fuels at same price. This price is decided on Rotterdam stock exchange. Thanks to this agreement are profit margins of refineries irrelevant and therefore only relevant aspect of production process as a factor affecting the price of crude oil fuels is price of crude oil itself. [4] [5] [6] [10] [11]

As the other primary factors are excise tax and value added tax which is decided by each state individually. In most of the European states are excite tax upon crude oil fuels around 30% of total price. The value added tax is in most European countries at level around 20%. That means nearly 50% of crude oil fuels price is made by taxes which are set upon crude oil fuels. [4] [5] [6] [10] [11]

Another factor which is affecting price of crude oil fuels in each state is exchange rate between the currency of state and either U.S. Dollar or Euro, because those are currencies used on Rotterdam stock exchange. [4] [5] [6] [10] [11]

3.5 History of OPEC

OPEC, which is shortage for Organization of the Petroleum Exporting Countries, was established in 1960, during conference in Baghdad. At the conference were 5 states which became establishing member of OPEC. Namely those states were Iraq, Iran, Kuwait, Saudi Arab and Venezuela. [13]

3.5.1 The 1960s

In the 1960s when OPEC was established, large decolonization in developing world was ongoing. That resulted in creation of many new independent states. At this time the international market with crude oil was controlled by so called “Seven Sisters”. “Seven Sisters” was a nickname of seven international companies from Europe and America. These companies were not a subject to former Soviet Union or any other centrally planned economies. [13]

In this period of time, OPEC introduces its collective vision, set up its goals and established its first Secretariat. First headquarters of its Secretariat was established in Geneva, Switzerland. After 5 years has Secretariat moved from Geneva to Wien in Austria. [13]

In the year of 1968, OPEC accepted the Declaratory Statement of Petroleum Policy in Member Countries which was emphasizing and inviolable right to all countries to preserve its permanent sovereignty over its natural resources which are in accordance with the interest to promote the development of the state. [13]

During the 1960s has number of OPEC member states increased to 10. That happened after Qatar got its membership in 1961, Indonesia and Libya in 1962, United Arab Emirates in 1967 and Algeria in 1969. [13]

3.5.2 The 1970s

In the 1970s, OPEC member states overtook control over its domestic crude oil industry. That resulted in gaining of enough influence to control the price of crude oil on the world market. Price of crude oil has twice rapidly grown during these years. First rapid increase was a result of crude oil embargo in Arab countries in year 1973. The second reason of crude oil price grown was Iran revolution in year 1979. [13]

In the year 1975 in Algeria, the Summit of heads and governments carried out where OPEC increased power of its mandate. During that time the critical situation in poorer countries was discussed. The goal was to support world economic development and stability. That was a reason why OPEC called for the beginning of new era in area of cooperation and international relationships. [13]

Result was establishment of fund for international development under the aegis of OPEC in year 1976. Member states have joined this ambitious project for supporting of socio-economic development. [13]

During this decade few more states got its membership. Namely those states were Nigeria in 1971, Ecuador in 1973 and Gabon in 1975. Total number of member states of OPEC has increased to 13. [13]

3.5.3 The 1980s

In the beginning of 1980s the price of crude oil reached record level, then the price started to fall and in the year of 1986 reached lowest level which was result of surplus of crude oil on market and at the same time deflection of consumer's interest for this hydrocarbon. [13]

The share of OPEC on crude oil market rapidly fall and the total revenues from crude oil dropped under one third of former maximum. This situation resulted in serious complications in economy of many member states of OPEC. [13]

Although the prices of crude oil increased again in the end of 1980s, the price level reached only around half of former maximum. Nevertheless the share of OPEC on market started to recover with growing consumption of crude oil in the world. [13]

OPEC further introduced group production limits. Those were distributed among the member states which supported growth of crude oil price by preventing of overwhelming of market by surplus of crude oil. [13]

Following steps were introducing of reference package for crude oil pricing and significant progress in negotiations and cooperation between OPEC and states which are not members of OPEC. These steps and negotiations supported stability of the market and reasonable prices of crude oil, where the demand is setting the extraction limits. [13]

3.5.4 The 1990s

In the 1990s were fluctuations in price of crude oil much less fierce than they were in 1970s and 1980s. Early measures of OPEC helped to reduce the impact of market on unfriendly situation in Middle East, mostly in years 1990 and 1991. [13]

However the strong instability and overall low level of crude oil prices dominated in the 1990s. Economic stagnation in South East Asia and gentle winter on northern hemisphere in years 1998 and 1999 resulted in increase of crude oil price to the same level as it was in 1986. [13]

Full recover came together with more integrated market which was a result of changes in post-Soviet regions, increased regionalism, globalization, revolution in communications and other high-tech trends. Further development happened as well in communication between producers and consumers and relations between OPEC member states and states which are not members of OPEC. [13]

In the year 1992, UN world summit took its place. During this summit were concluded negotiations about changes of climate. At this time, OPEC tried to find a fair balance and real solution in questions of crude oil supply. [13]

Also certain changes happened in OPEC member states during this decade. Ecuador suspended its OPEC membership in year 1992. Two years later, in year 1994, the Gabon left the OPEC. [13]

3.5.5 The 2000s

At the beginning of this decade, OPEC came with innovative solution how to set prices of crude oil, which strengthen and at the same time stabilize the prices of crude oil. However the combination of factors of market, speculations and other factors resulted in increase of crude oil price and destabilization of well supplied crude oil market in the 2004. [13]

Price of crude oil reached new record maximum in the 1st half of 2008. After reaching this point price of crude oil started to fall again. That was a consequence of increasing global financial chaos and economic recession in following period. [13]

OPEC in this period focused on support of crude oil sector. That became part of global effort of finding solution of economic crisis. During 2nd and 3rd summit which took place in Caracas in year 2000 and in Riyadh in year 2007 which rooted for creation of stable market with energy, stable development and environment as three main topics. These ideas were accepted as long run complex strategy in year 2005. [13]

In the year 2007 Ecuador recovered its OPEC membership while Angola left OPEC at the same year. Further the Indonesia suspended its OPEC membership in the year of 2009. [13]

3.5.6 The 2010s

At the beginning of last decade, the world economy seemed like a highest risk because global macroeconomics was full of uncertainties and higher risks around international finance system were burdening economies. Increasing social uncertainties on many places around the world affected both, the demand and the supply of the crude oil although the market remained balanced in the 1st half of this decade. Price of crude oil has stabilized during period from 2011 to 1st half of 2014. [13]

Further speculations and surplus of crude oil resulted in decrease of crude oil price in the 2014. Trade agreements kept changing which was also a consequence of increasing demand from Asia countries. [13]

Meanwhile the focus on questions about environment was increasing and the new agreements about climate changes led by UN members were expected, OPEC was trying to increase stability of crude oil market. [13]

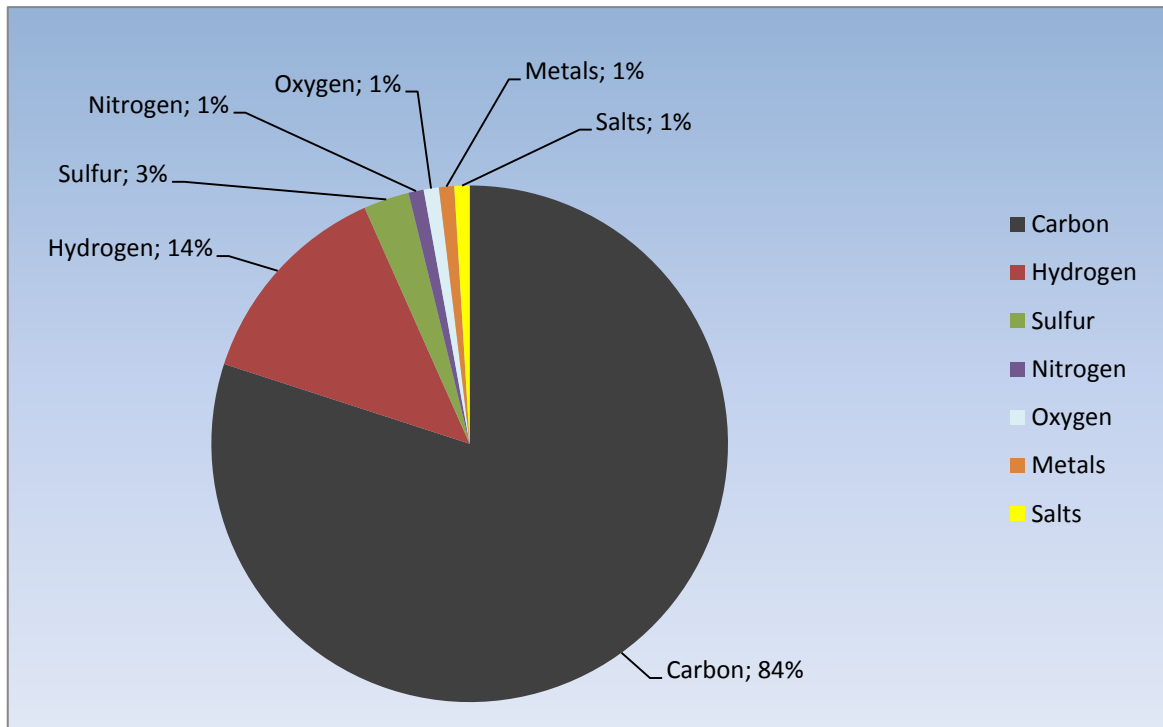
Further the OPEC was trying to support negotiations and cooperation between consumers of crude oil and producers which are not members of the OPEC. [13]

3.6 Crude oil fuels

Crude oil fuels are produce by process called refining. During refining are obtained different products such as plastics, heating oils, jet fuels, kerosene, rubber, diesel, gasoline and other from raw crude oil. [2] [7]

Crude oil contains in average from 84% of carbon, 14% of hydrogen, 1-3% of sulfur, less than 1% of nitrogen, oxygen, metals (such as nickel, iron, copper, vanadium, arsenic) and salts (chlorides of sodium, magnesium and calcium). [2] [7]

Figure 1: Crude Oil Components



Source: Data – science.howstuffworks.com; own figure (2017)

Process of refining is simple in basis. Raw crude oil is heated in so called boiler to the temperature up to 1112 degrees of Fahrenheit or 600 degrees of Celsius. By continuous heating are separated components with lower vapor temperature. It could be said that refining is actually distillation. The number of carbon atoms in product is directly affecting the vapor temperature, more precisely the less atoms of carbon in product the lower temperature is required for vaporization. Thanks to this products can be reliably separated. [2] [7]

Continuously are separated Petroleum Gas, Naphtha (which is also called Ligroin), Gasoline, Kerosene, Gas Oil (which is also called Diesel Distillate), Lubricating Oils, Heavy Gas (also called Fuel Oil) and Residuals. [2] [7]

Table 1: Refined products

Petroleum Gas	Small alkanes (1 to 4 carbon atoms)
	Commonly known by the names methane, ethane, propane, butane
	Boiling range: less than 104 degrees Fahrenheit / 40 degrees Celsius
	Often liquified under pressure to create LPG (liquified petroleum gas)
Naphtha (also called Ligroin)	Mix of alkanes (5 to 9 carbon atoms)
	Boiling range: 140 to 212 degrees Fahrenheit / 60 to 100 degrees Celsius
	Intermediate that will be further processed to make gasoline
Gasoline	Mix of alkanes and cycloalkanes (5 to 12 carbon atoms)
	Liquid form
	Boiling range: 104 to 401 degrees Fahrenheit / 40 to 205 degrees Celsius
	Motor fuel
Kerosene	Mix of alkanes (10 to 18 carbon atoms) and aromatics
	Liquid form
	Boiling range: 350 to 617 degrees Fahrenheit / 175 to 325 degrees Celsius
	Used as fuel for jet engines and tractors; starting material for making other products
Gas oil (also called Diesel distillate)	Alkanes containing 12 or more carbon atoms
	Liquid form
	Boiling range: 482 to 662 degrees Fahrenheit / 250 to 350 degrees Celsius
	Used for diesel fuel and heating oil; starting material for making other products
Lubricating oil	Long chain (20 to 50 carbon atoms) alkanes, cycloalkanes and aromatics
	Liquid form
	Boiling range: 572 to 700 degrees Fahrenheit / 300 to 370 degrees Celsius
	Used for motor oil, grease and other lubricants
Heavy gas (also called Fuel oil)	Long chain (20 to 70 carbon atoms) alkanes, cycloalkanes and aromatics
	Liquid form
	Boiling range: 700 to 1112 degrees Fahrenheit / 370 to 600 degrees Celsius
	Used for industrial fuel; starting material for making other products
Residuals	Multiple-ringed compounds with 70 or more carbon atoms
	Solid form
	Boiling range: greater than 1112 degrees Fahrenheit / greater than 600 degrees Celsius
	Coke, asphalt, tar, waxes; starting material for making other products

Source: Data - science.howstuffworks.com; own table (2017)

3.6.1 Refining process

As it was said, during the refining process raw crude oil is heated in boiler and therefore components which are also called fractions are separated. That is most common and oldest way in which is refining done. This process is also called fraction distillation during which is crude oil vaporized and steam is cooled down to condense. [2] [7]

Newer way of refining is using chemical processing. During the chemical processing is possible to use fractions of crude oil to create other products. This process is

called conversion. This process allows breaking chemical chains to create shorter ones, which mean, it is possible to transform diesel to gasoline if the demand for gasoline increase. [2] [7]

In any process it is necessary to clean each fraction, because impurities are reducing quality of crude oil fuels and also can cause complications to consumer. Cleaning as well as all previous steps are done in refineries. [2] [7]

Refineries also have technologies which allows combining of factions (either already processed or still unprocessed) and prepare fuels of different qualities. To distinguish fuels by quality is used so called octane rating. [2] [7]

It does not matter which refining process is used, there are always waste which has to be carefully removed to minimalize impacts of air pollution and water pollution created by this waste. [2] [7]

3.6.2 Octane rating

Octane rating of gasoline is representing how much can be fuel pressed before self-ignition. This rating is very important for engines using gasoline fuel, because using of improper fuel may lead to damaging of engine. [2] [3]

If the fuel is self-ignited before spark ignites it, the early explosion occurs. Early explosion is disturbing the rhythm of engine and causes so called “knocking”. [2] [3]

It is possible to say that the stronger engine is, the higher octane rated fuel requires. Also it is possible to say that the fuel with higher octane rating can increase power of engine which is using it. However the disadvantage of these fuels is price, which is increasing as the octane rating is increasing as well. [2] [3]

3.6.3 Fraction distillation

As it was said before, the most common way how to separate each fraction from the raw crude oil is fraction distillation. During this process it is necessary to continuously increase the temperature of substance mixture which is in liquid form so it is possible for fractions to vaporize. For heating is usually used pressured steam of temperature up to 1112 degrees of Fahrenheit or 600 degrees of Celsius. [2] [7]

Vapors from substances are entering the high distillation column. This column has plates within itself. The plates has tiny holes in them which are allowing vapor to go up but keeps and divert the condensed liquids to the pipes which lead to the further cooling process. The higher vapor goes the lower temperature in column is. Due to that it is possible to separate all fractions during a single process. The vapors keep going up in the column until the temperature in column is equal to the vapor temperature of fraction. At this point vapors starts to condensate and transform to the liquid form again. [2] [7]

These condensed liquids are pumped through the cooling pipes which are further decreasing temperature of liquids either to the storage tanks or to the further chemical processing. [2] [7]

3.6.4 Chemical processing

There are 3 different possible ways how to chemically process fractions which are providing possibility to transform one fraction to another. Namely, these possible ways are called cracking, unification and alteration. [2] [7]

Process of cracking is transforming large hydrocarbons into smaller ones which are sended to the fraction distillation column again. [2] [7]

There are several different ways how to crack fraction. First one is thermal cracking. Large hydrocarbons are exposed to high temperature and in many cases also to high pressure until they crack. [2] [7]

Temperature of steam which is used for heating of hydrocarbons is reaching 1500 degrees of Fahrenheit or 816 degrees of Celsius. At this heat level are cracked ethane, butane and naphtha into ethylene and benzene which are used for production on chemicals. [2] [7]

Another way of thermal cracking is so called light cracking (visbreaking). Residuals from distillation are heated to the temperature of 900 degrees of Fahrenheit or 482 degrees of Celsius. Further is substance cooled down by gas oil and instantly burned (ignited) in distillation column. This process is used for reduction of viscosity of heavy oils and to production of tar. [2] [7]

Last way of thermal cracking is so called coking. During this processing are residuals from distillation heated to temperature over 900 degrees of Fahrenheit or 482 degrees of Celsius. During this process are cracked rests of heavy oils, gasoline and naphtha. What remains after this process is heavy, nearly pure carbon which is called coke. Coke is cleaned of cokers and is sold. [2] [7]

Second option of cracking is catalytic cracking. Catalytic cracking is using catalysts which are hastening the process of cracking. Catalysts used during this process are zeolite, aluminum hydrosilicate, bauxite and silica-alumina. The catalytic cracking is dividing into 2 ways. [2] [7]

First way is liquid catalytic cracking. Liquid catalyst of temperature of 1000 degrees of Fahrenheit or 538 degrees of Celsius breaks down heavy crude oil into diesel and gasoline. [2] [7]

Second way used is called hydrocracking. The actual process is very similar to the first one however in each way are used different catalysts. Another difference is using if lower temperature of catalyst, higher pressure and hydrogen. The result of this process is gasoline and kerosene which is used as jet fuel. [2] [7]

Second option of chemical processing is unification. During this process are combined lesser hydrocarbons which are becoming larger ones. Main process of unification is catalytic reforming. Catalytic reforming is using catalysts such as platinum and platinum-rhenium mix. During this process is used light naphtha and the aromatics are produced. Those are further used for production of chemicals and for mixing of gasoline. [2] [7]

Side product of this process is hydrogen which is used either in hydrocracking or it is sold.

Third and last option of chemical processing is alteration. Alteration is recreating molecular structure of fraction and creates other by this process. The most common process which is used during alteration is called alkylation. [2] [7]

The compounds used during the alkylation process have low molecular weight. Compounds which belong to this category are for example propylene and butylene. These

substances are mixed with catalyst which can be hydrofluoric acid or sulfuric acid. These catalysts are created as a side product during the cleaning process of many different crude oil products. [2] [7]

The result of alkylation is high octane hydrocarbons which are mixed with gasoline. This mixture results in higher octane rating of gasoline. [2] [7]

3.6.5 Production of finished products

After the crude oil is processed it is necessary to finish products and prepare them for actual use. To finish products it is necessary to treat and mix fractions. Distillated and chemically processed fractions are cleaned from impurities which can be organic compounds containing sulfur, nitrogen, oxygen, water, metals and inorganic salts. [2] [7]

Cleaning process is done by using of column with sulfuric acid. This process removes unsaturated hydrocarbons which are containing carbon to carbon double bindings, compounds of nitrogen and oxygen and solid residuals such as tar or asphalt. [2] [7]

Further processing is using absorption cylinder with dryers which remove water. Last step is removal of sulfur. After this process are fractions ready for mixing which results in finished products. [2] [7]

These products are gasoline, diesel, jet fuel, plastics and polymers and lubrication oils such as 10W-40, 5W30 etc. [2] [7]

3.7 Trade with crude oil fuels

3.7.1 Ways of trading with crude oil fuels

Trade in the Czech Republic same as trade in most countries in the whole Europe is differed between large distributors and vendors which sell crude oil fuels to end consumers. Most of the trade is assured by large companies with their net of gas stations. Those are located on the whole territory of state and its density is closely connected with the lucrativeness of the area. The higher density of motor vehicles in certain area is, the higher density of gas stations can be found in that area. It is obvious then that the highest density of gas stations can be found around highways, main roads of large cities, near the borderline crossings etc.

Between largest and therefore also most famous network of gas stations belong Benzina with 338 stations in the Czech Republic. This network of gas stations is owned by company Unipetrol RPA, Ltd. [23]

Significant part of the gas station net is owned directly by this company. Rest is not directly owned by company but is running under their trade mark in form of so called franchising.

Franchising in this form is a contract deal between owner of gas station and some of well-known trademark company. Company owning such a trade mark lends the gas station its appearance. That means the company will adjust the gas station so it meets specific standards and the colors of gas station matches other stations under same name. These adjustments are paid by company providing trademark. The gas station is marked by trademark logo further. The owner of gas stations in exchange makes a deal that he will buy crude oil fuels exclusively from his partner of which he is using logo. [8]

This partnership is usually signed for several years so it is ensured that the investments paid for adjustments of gas station “color” return to the owner of trademark. [8]

Other very large and famous networks of gas stations are using trademarks of OMV, Shell, EuroOil, MOL, RobinOil, KM Prona etc. The number of their gas stations is counted in dozens or hundreds per each trademark within the Czech Republic. [8]

These networks are setting prices of fuels for end customers based on the location and near competition. In most cases are these trademark companies setting prices even at the gas stations of their contract partners, e.g. franchisers. [8]

Those are obliged to respect set selling prices. Franchise gas stations with crude oil fuels are trading in two different ways. Specific way is written in contract with owner of trademark. [8] [24]

First is trade without purchasing of crude oil fuels. This way consist in fact that owner of gas station is getting crude oil fuels for free from owner of trademark. The crude oil fuels are owned by owner of trademark until the end customer buys it. Officially the

owner of gas station is not selling crude oil fuels. The owner of trademark is selling fuels instead. [8] [24]

The operator of gas station provides overview of sold fuels every day and based on set time intervals is sending all income from selling of fuels to the owner. After that, again in set time interval, the operator gets his earnings. This time period is usually set monthly. [8] [24]

The earnings are usually set as reward for every sold litre of crude oil fuels. These earnings are mostly in tens of cents per litre sold, which is not much. The advantage of this way of trading is that operator does not need high capital for purchasing of fuels. [8] [24]

For his money, he can buy good to the shop instead. These goods can be engine oils, food, drinks or other goods for motorists. [8] [24]

Second way is direct purchasing of crude oil fuels. The price of fuels is set before, respectively purchasing of fuels at price which has set way of its calculation. [8] [24]

4 Analytical part of thesis

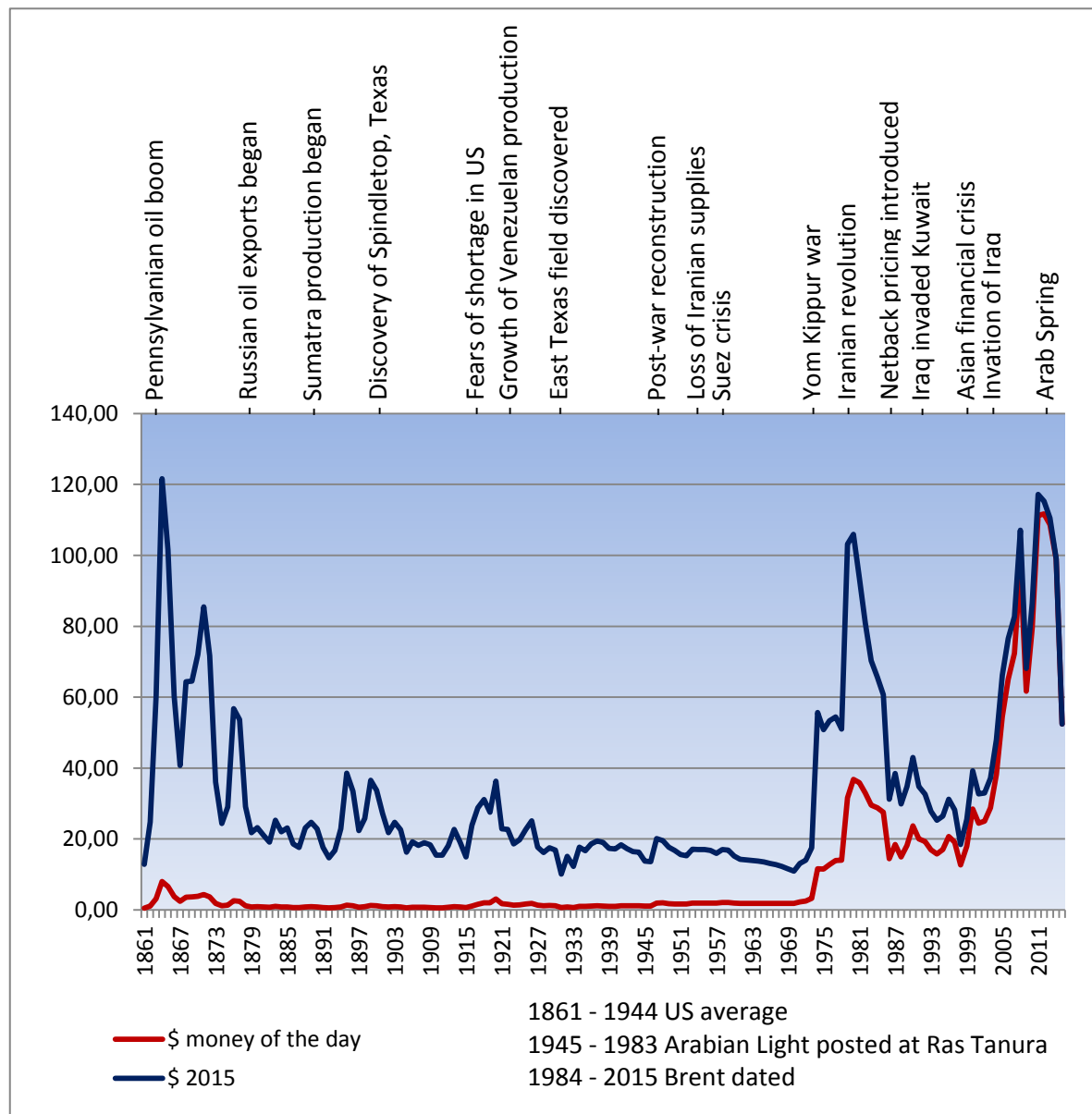
4.1 Development of Crude oil price

The crude oil price is one of the most significant factors affecting price of crude oil fuels. As such it is important to see what affected price of crude oil in history to be able to predict future development of crude oil price and therefore the crude oil fuel price itself.

4.1.1 Development of Crude oil price in history

In the following figure are available prices of crude oil in units of USD per barrel at the time period from 1861 to 2016.

Figure 2: Development of Crude oil in history



Source: Data - British Petroleum, 2016; own figure (2017)

After the Pennsylvanian oil boom in 1861 when the crude oil price significantly dropped and 1880 when Russia started to export the crude oil, the prices reached nearly lowest level in history. There were small fluctuations till 1973 when Yom Kippur war started.

Yom Kippur war was a conflict between Egypt, Syria and Israel.

Approximately two years before that the economic stagnation in the United States.

The former President Nixon wanted to stop the economic stagnation by actions, one of those actions was to break away the US dollar from so-called gold standard. The gold standard determined fixed value of the currency. That means the dollar was backed by gold (specifically, 1/20 of an ounce of gold), and it was not possible to issue fiat money and increase inflation. Detachment of dollar from the gold standard logically meant a decline in the value of the dollar. And because the price of crude oil has always been expressed in dollars, oil-producing country suddenly started to get less money for crude oil than before.

During this period, OPEC (Organization of Petroleum Exporting Countries) decided to reduce oil extraction. The objective of extraction reduction was an attempt to influence crude oil price. At the same time there was declared an embargo on oil exports to countries that supported Israel in the war. It was primarily the United States and the Netherlands. Although the 1974 crisis eased and OPEC embargo appealed, the high prices had maintained until the early eighties.

The second significant jump of crude oil price occurred after the revolution in Iran, when the new regime reduced oil exports. While OPEC was trying to meet the demand by increasing of extraction and due to that the production of crude oil declined by only a few percent.

After the opening of new deposits while reducing demand for crude oil, which occurred due to the economic recession, there was a sharp decline in oil prices in the mid-eighties. An even more significant decline in prices contributed the introduction of so-called. Netback pricing, which is determined by subtracting the production costs from the associated revenue. After the significant fall, price of crude oil was almost stable.

A short-term price rise occurred during the invasion of Kuwait by Iraq in 1990 and by the following Persian Gulf War. The Iraq invasion had a direct connection with crude oil production. Iraq at the time, led by Saddam Hussein, owed tens of billions of dollars to Kuwait, Saudi Arabia and other creditors. Iraq wanted to redeem these debts by selling the extracted oil. Coincidentally, OPEC announced mining limits which bound the hands of Iraq. Kuwait added its part to this as it crossed the limits set for mining. Hussein began to provoke Kuwait and accused it of stealing Iraq's oil through sloped wells pitched the common borders area. Subsequently, Iraq decided to start military action. However, in this case, the rise in oil prices is really a short-term, mainly due to fears of supply reduction on the crude oil market.

The last significant increase was a consequence of Arab Spring.

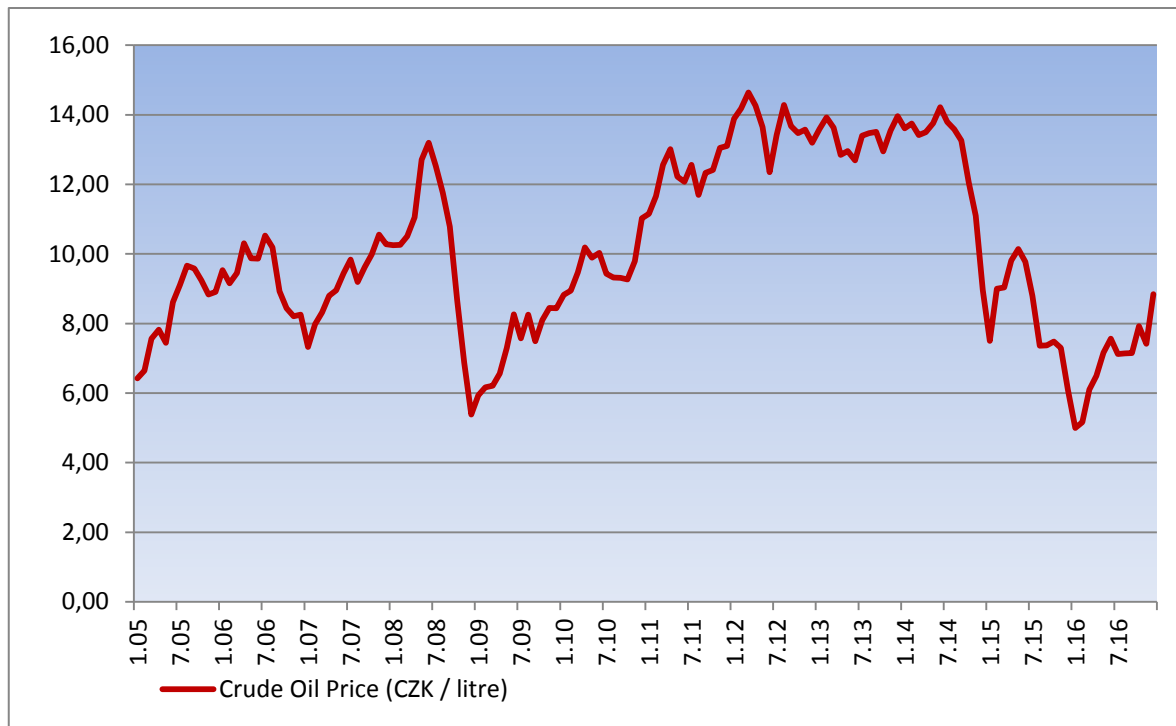
Arab Spring also called Democracy Spring was a sequence of revolutions in Iraq, Lybia, Egypt, Yemen, Bahrain, Syria, Algeria, Tunisia, Kuwait, Lebanon, Yordan, Morroco, Sudan and Oman which started in 2010. In those countries were both violent and non-violent conflicts and people were yelling slogan which could be translated as "the people want to bring down the regime". Minor conflicts were later in Palestinian territories, Saudi Arabia and Somalia.

Although the situation in some countries still did not calm down by this time and the final result is unknown, globally this issue does not affect the price of crude oil and the price is gradually declining. Certain influence on this decline could have the slight increase in alternative energy sources in recent years.

4.1.2 Development of Crude oil price in period 2005 – 2016

In the following figure is available month development of crude oil price in period from January 2005 to December 2016. Prices in figure are month averages based on daily reports from stock market and units used for this figure are CZK per 1 litre of Crude oil.

Figure 3: Development of Crude Oil Price in period 2005 - 2016



Source: Data – kurzy.cz, 2017; own calculations (2017)

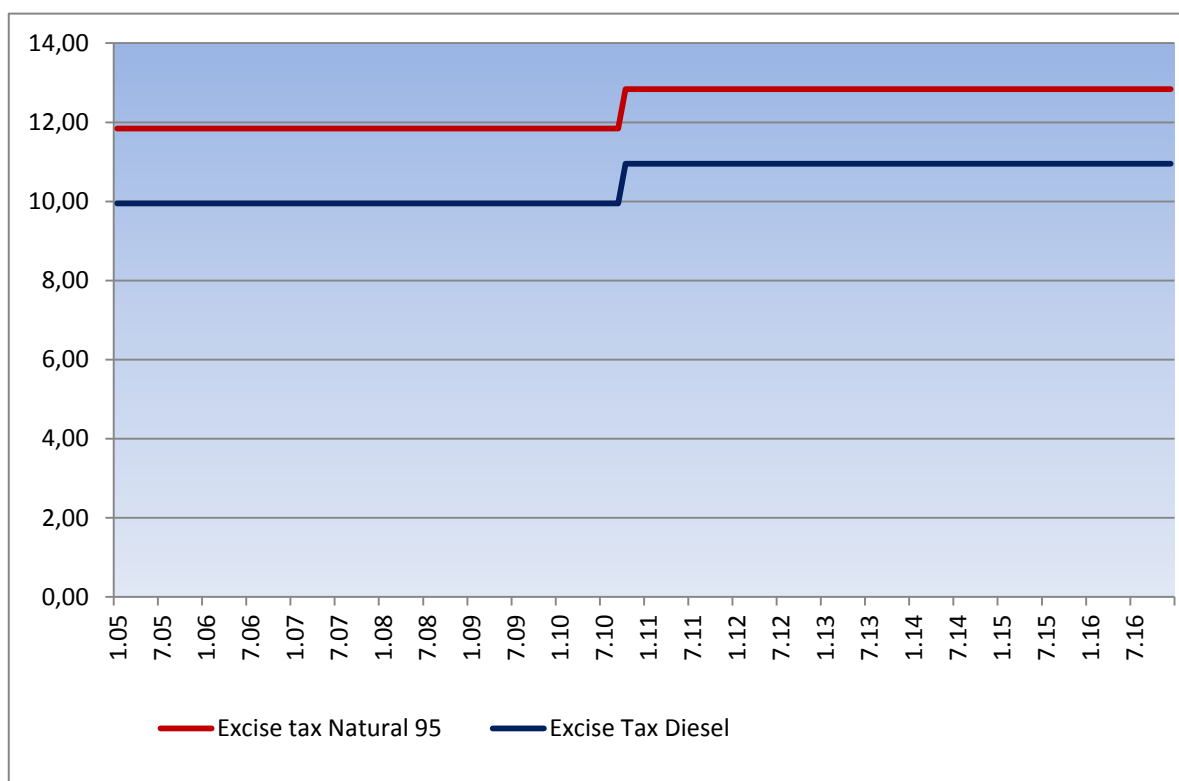
The figure shows the short run history of the development of crude oil prices. There is quite noticeable drop in prices during the second half of 2008. This decline was caused by the global economic crisis, which grew into a financial crisis, where even the high price of crude oil played a role. High crude oil price was reason of speculative trades, weak dollar and rising demand for crude oil in China. Subsequently, the originally US mortgage crisis intervenes in Europe, there is a collapse of world stock exchanges and banks are collapsing. Governments of European states are saving big banks, taking over their management or guarantee for them. Despite these steps the investor's confidence and consumer's demand are declining. As a result of reduced demand for crude oil is a significant drop in its price. After overcoming the initial shock and regulation of mining, the price stabilizes and increases up to 14 CZK per litre due to the Arab Spring, where it remains until the second half of 2014. In this period there has been significant development of shale gas in the US. OPEC has decided to keep crude oil extraction in the same amount so its market share does not fall. This had resulted in a surplus of crude oil on the market

and a sharp decline in crude oil price, which at the turn of 2015 and 2016 reached the very lowest level in this time period.

4.2 Development of excise tax of crude oil fuels, 2005 – 2016

The excise tax of crude oil fuels is one of the most significant factors affecting price of crude oil fuels. During this period has excise tax of crude oil fuels change just once so far. The excise tax has different value for both of crude oil fuels, namely Natural 95 and Diesel.

Figure 4: Development of excise tax of crude oil fuels, 2005 – 2016



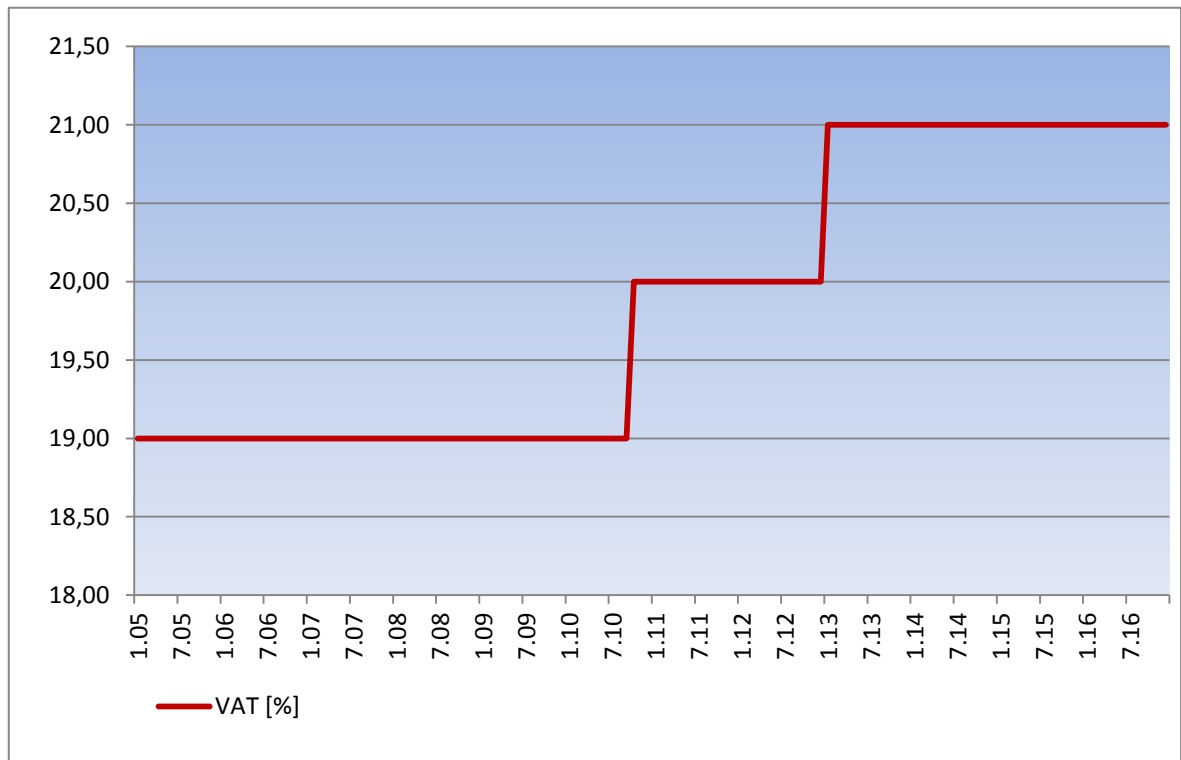
Source: Data - Act no. 353/2003 Coll. about excise tax, own figure (2017)

The value of Natural 95 excise tax at the beginning of measured period was 11.84 CZK per litre while the value of Diesel excise tax at the same time was 9.95 CZK per litre. After the change of Act no. 353/2003 Coll. on excise tax in October 2010, values of excise tax increase by 1 CZK per litre. The Natural 95 excise tax value was therefore 12.84 CZK per litre and Diesel excise tax value was 10.95 CZK per litre.

4.3 Development of Value Added Tax in period 2005 – 2016

The Value Added Tax (VAT) is the 3rd factor which significantly affects price of crude oil fuels. During measured period the VAT increased twice. As the figure above shows, 1st change of VAT was in October 2010 and the VAT increased from 19% to 20%. At the same time increased excise tax of crude oil fuels. With the beginning of 2013, the VAT increased again and level of VAT of crude oil fuels reached 21%.

Figure 5: Development of Value Added Tax, 2005 – 2016



Source: Data - Act no. 235/2004 Coll. about value added tax, own figure (2017)

4.4 Development of crude oil fuel price in period 2005 – 2016

The development of crude oil fuel price is closely related to development of crude oil price, excise tax of crude oil fuels and value added tax of crude oil fuels. This relation was also used for estimation of econometric model.

There are 2 explained models, for each of crude oil fuels separately. The 1st model is for Natural 95 where Natural 95 is affected by crude oil price, excise tax of Natural 95 and value added tax. The 2nd model is for relationship of Diesel affected by crude oil price, excise tax of Diesel and value added tax.

Estimated models are then:

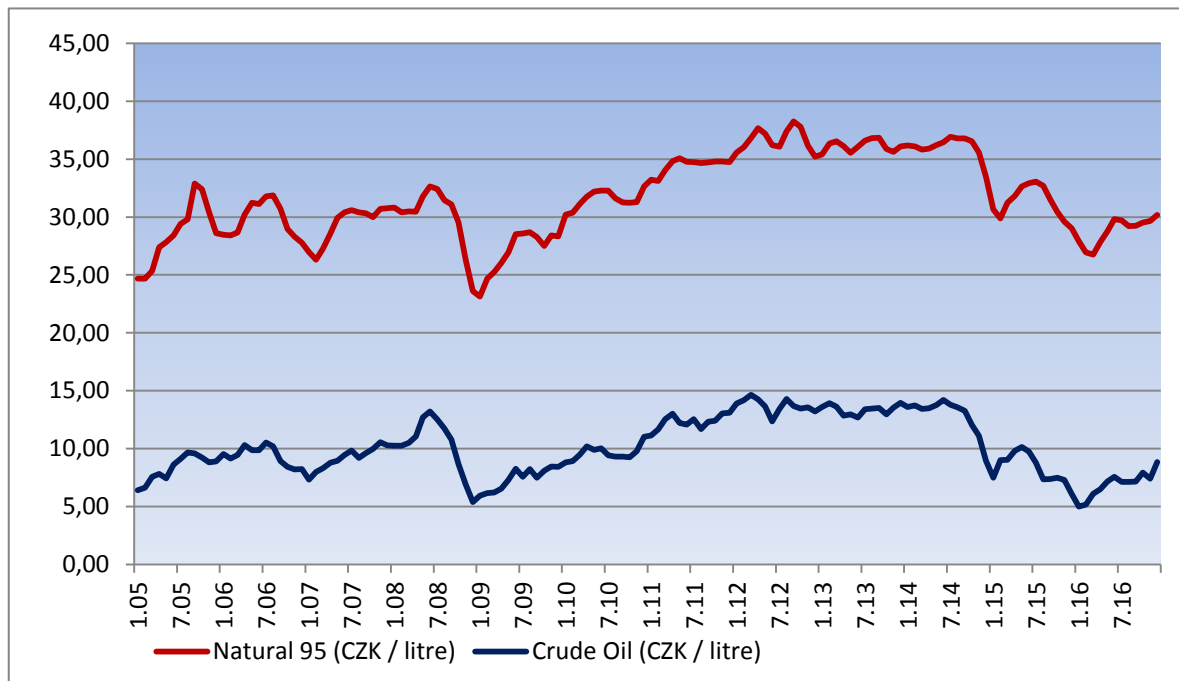
$$\text{Natural 95} = \text{const.} + \beta_1 * \text{crude oil price} + \beta_2 * \text{excise tax of Natural 95} + \beta_3 * \text{VAT} + \varepsilon_t$$

$$\text{Diesel} = \text{const.} + \beta_1 * \text{crude oil price} + \beta_2 * \text{excise tax of Diesel} + \beta_3 * \text{VAT} + \varepsilon_t$$

4.4.1 Development of Natural 95 in period 2005 – 2016

The following figure shows clearly how price of Natural 95 is tracing the price of crude oil. As such, the actual situation in the world is closely related to price of crude oil fuels in the Czech Republic. Therefore any change of situation of significant economic aspects such as United States of America, China, Russia, European Union etc. as well as any change of situation of countries producing crude oil is directly affecting the demand and supply of crude oil and thus crude oil price which is reflected on the price of Natural 95 in the Czech Republic.

Figure 6: Development of price of Natural 95 and crude oil, 2005 - 2016



Source: Data - CCS.cz, Kurzy.cz; own figure (2017)

The estimated model for relations of Natural 95 is:

$$\text{Natural 95} = \text{const.} + \beta_1 * \text{crude oil price} + \beta_2 * \text{excise tax of Natural 95} + \beta_3 * \text{VAT} + \varepsilon_t$$

After calculation of OLSM based on estimated model and with usage of

$$[(X^t * X)^{-1} * (X^t * Y)] \text{ formula}$$

where:

X is matrix of explanatory variables

Y is vector of explained variable

The exact form of model is:

$$\text{Natural 95} = -4,935803 + 1,128040996 * \text{Crude Oil Price} + 1,187426952 * \text{Excise Tax of Natural 95} + 0,526459306 * \text{VAT} + \varepsilon_t$$

Based on the parameters of model, the most influencing explanatory variable is excise tax followed by crude oil price which is almost as influencing as excise tax. While value added tax influence is in comparison to other explanatory variables significantly lower.

As the regression analysis in following table shows, Adjusted R-squared is at the value of 0.90797 which means that the estimated model is explaining 90.797% of real values. Based on statistical T test and P-value of explanatory variables where the null hypothesis is in case of crude oil price and excise tax of Natural 95 rejected. Therefore these variables are statistically significant and coefficients are positive. Due to that the original hypothesis is accepted. However VAT is rejected due to failing to reject null hypothesis, which means this variable is not statistically significant at 95% level of confidence.

Table 2: Regression statistics, significance of parameters testing, Natural 95

<i>Regression statistics</i>	
R value	0,953888483
R-squared value	0,909903239
Adjusted R-squared	0,907972594
Standard error	1,077836356
Number of cases	144

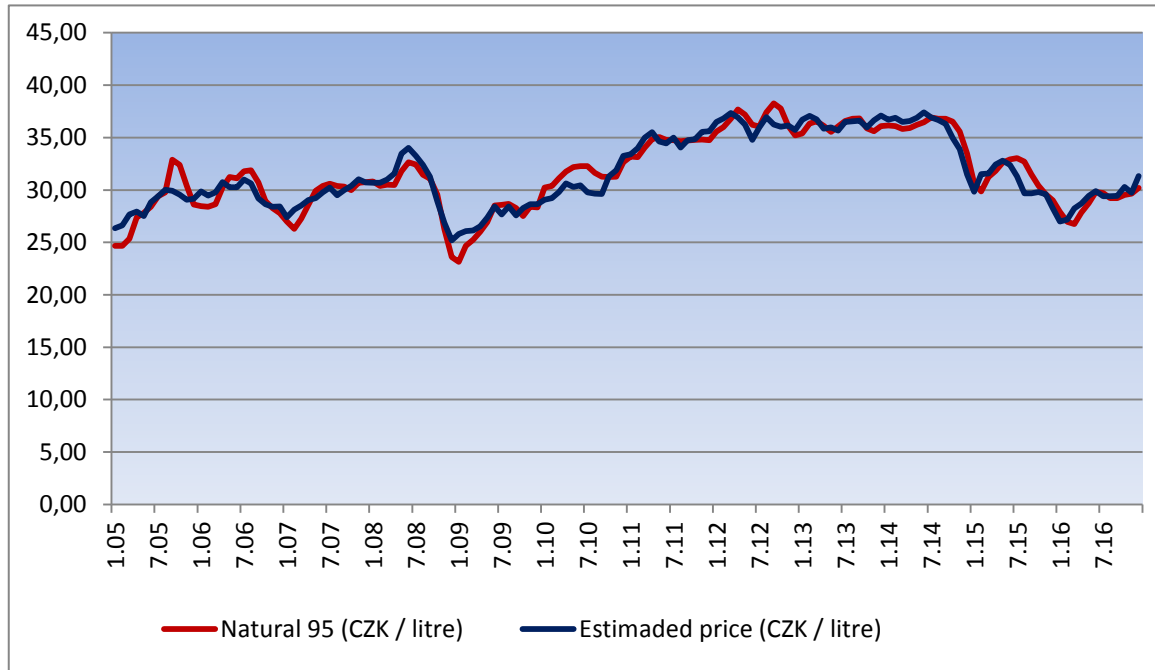
	<i>Coefficients</i>	<i>Standard error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	-4,935802999	2,355351218	-2,09557	0,037920787	-9,592458885	-0,279147112
Crude Oil (CZK / litre)	1,128040996	0,042303139	26,66566	9,96265E-57	1,044405419	1,211676574
Excise tax Natural 95 (CZK / litre)	1,187426952	0,526659523	2,254639	0,025708274	0,146192782	2,228661121
VAT [%]	0,526459306	0,27701376	1,900481	0,059425835	-0,021211778	1,074130389

Source: Data - CCS.cz, kurzy.cz, Act. No. 353/2003 Coll. about excise tax, Act No. 235/2004 Coll. about value added tax; own calculations (2017)

The accuracy of estimated model in comparison of real prices used in original dataset is provided by Figure 7. The most significant differences are in October 2005 where the real price was higher by 2.84 CZK per litre than the estimated price, and in

January 2009 where the real price was lower than the estimated price by 2.69 CZK per litre. Third significant difference was in July 2010 where the real price was higher by 2.52 CZK per litre compared to the estimated price.

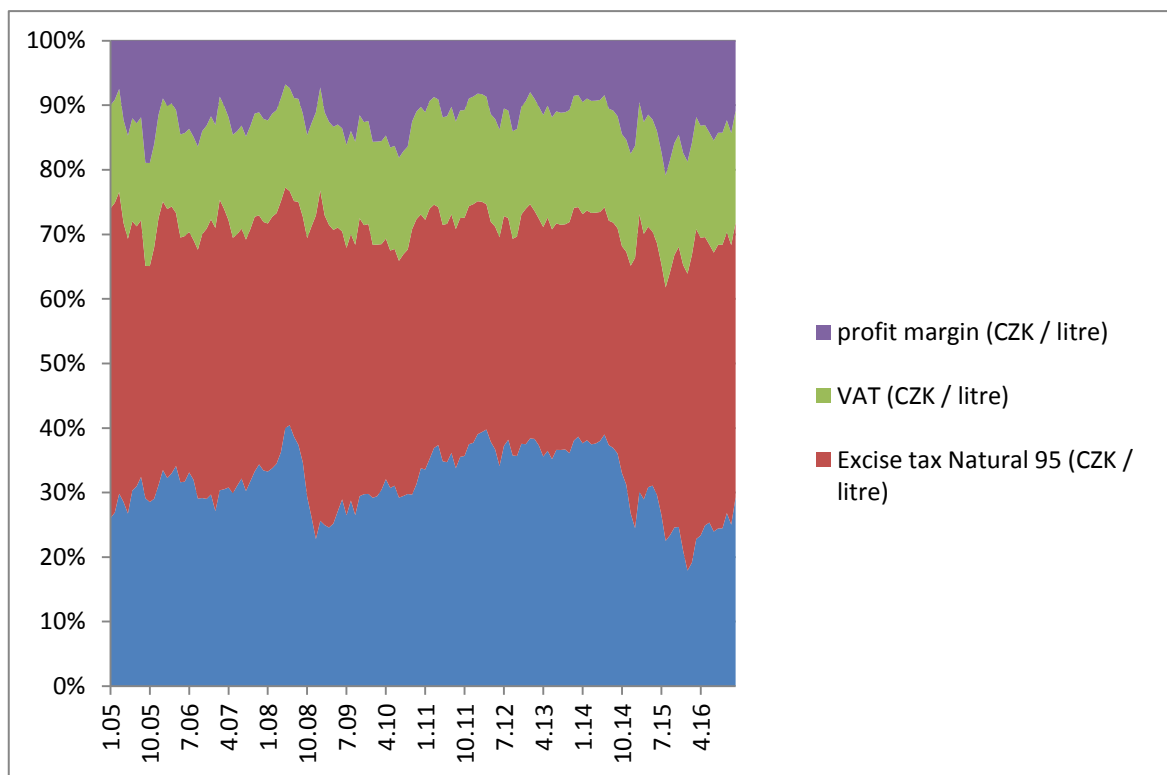
Figure 7: Comparison of real price of Natural 95 and estimated Natural 95 price



Source: Data - CCS.cz, Kurzy.cz; own calculations (2017)

Following figure shows, the highest share of price is represented by excise tax of Natural 95. This share is moving between 40% - 50%. 2nd highest share is represented by crude oil price which is moving between 20% - 40%. The VAT share is 16% and is closely tracing the crude oil price with excise tax. The last share represents profit margin of refineries and gas stations. The profit margin value is moving between 8% and 19%.

Figure 8: Structure of Natural 95 price, % shares on 1 litre

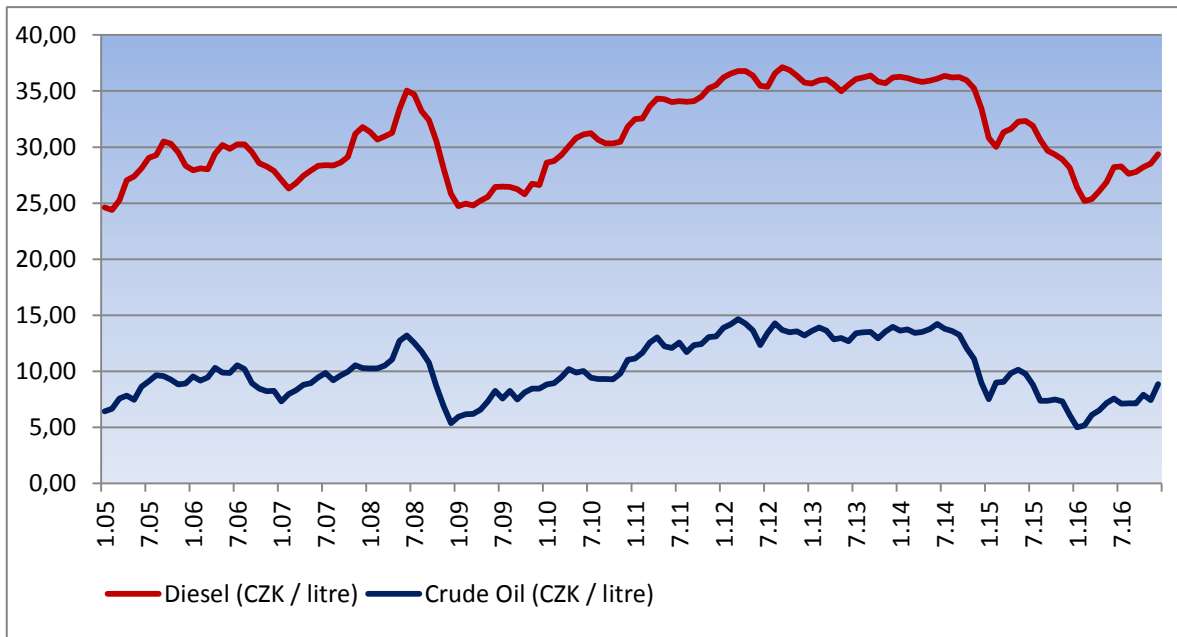


Source: Data - CCS.cz, kurzy.cz, Act. No. 353/2003 Coll. about excise tax, Act No. 235/2004 Coll. about value added tax; own calculations (2017)

4.4.2 Development of Diesel in period 2005 – 2016

Same as in the case of how price of Natural 95 is tracing the price of crude oil is following figure showing the price of Diesel tracing the price of crude oil. As such, the actual situation in the world is closely related to price of crude oil fuels in the Czech Republic. Therefore any change of situation of significant economic aspects such as United States of America, China, Russia, European Union etc. as well as any change of situation of countries producing crude oil is directly affecting the demand and supply of crude oil and thus crude oil price which is reflected on the price of Diesel in the Czech Republic.

Figure 9: Development of price of Diesel and crude oil in period 2005 – 2016



Source: Data - CCS.cz, Kurzy.cz; own figure (2017)

The estimated model for relations of Diesel is:

$$\text{Diesel} = \text{const.} + \beta_1 * \text{crude oil price} + \beta_2 * \text{excise tax of Natural 95} + \beta_3 * \text{VAT} + \varepsilon_t$$

After calculation of OLSM based on estimated model and with usage of

$$[(X^t * X)^{-1} * (X^t * Y)] \text{ formula}$$

where:

X is matrix of explanatory variables

Y is vector of explained variable

The exact form of model is:

$$\text{Diesel} = -1,22909 + 1,270671 * \text{Crude Oil Price} + 0,733651 * \text{Excise Tax of Diesel} + 0,590376 * \text{VAT} + \varepsilon_t$$

Based on the parameters of model, the most influencing explanatory variable is crude oil price followed by excise tax but unlike in case of Natural 95 model, the crude oil price is much more influencing than excise tax. The value added tax influence in comparison to influence of crude oil price influence is very significant while difference between influence of VAT and excise tax is small.

As the regression analysis in following table shows, Adjusted R-squared is at the value of 0.93596 which means that the estimated model is explaining 93.596% of real values. Based on statistical T test and P-value of explanatory variables, where the null hypothesis is in case of crude oil price and VAT of Diesel rejected. Therefore these variables are statistically significant and coefficients are positive. Due to that the original hypothesis is accepted. However excise tax of Diesel is rejected due to failing to reject null hypothesis, which means this variable is not statistically significant at 95% level of confidence.

Table 3: Regression statistics, significance of parameters testing, Diesel

<i>Regression statistics</i>	
R value	0,96814524
R-squared value	0,937305207
Adjusted R-squared	0,935961747
Standard error	0,946201593
Number of cases	144

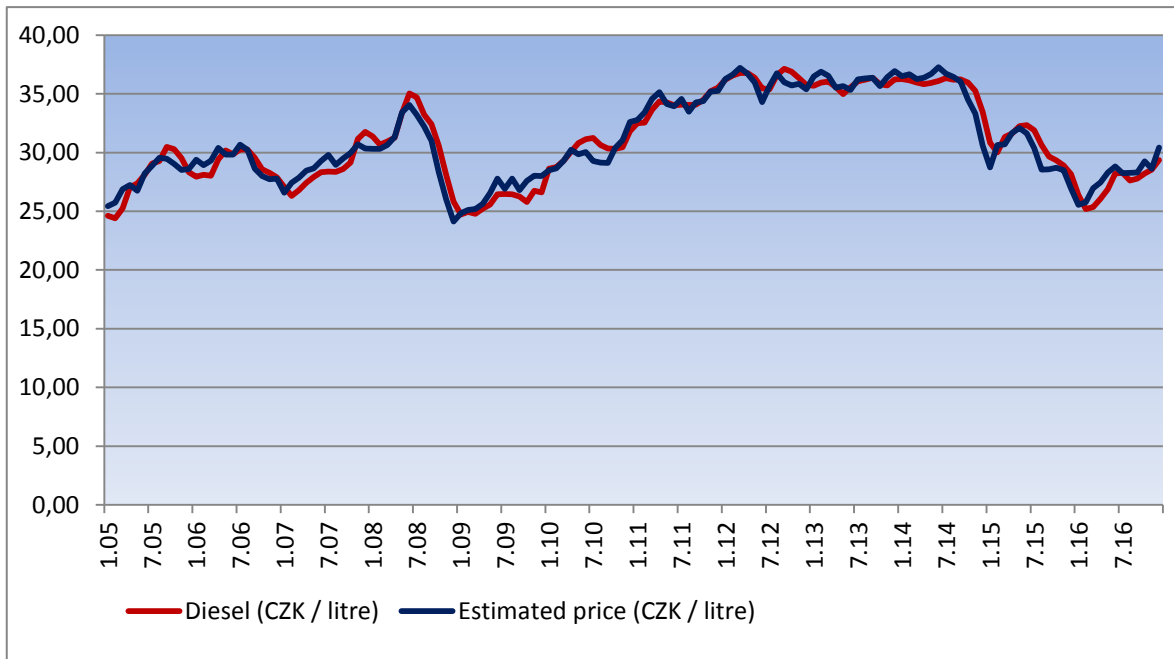
	<i>Coefficients</i>	<i>Standard error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	-1,229092116	1,781668679	-0,689854478	0,491427641	-4,751546805	2,293362572
Crude Oil (CZK / litre)	1,270670919	0,037136711	34,21603282	7,16373E-70	1,197249646	1,344092191
Excise Tax Diesel (CZK / litre)	0,733650927	0,462339275	1,586823717	0,114808624	-0,180418657	1,64772051
VAT [%]	0,590376128	0,243182426	2,427708848	0,016464494	0,109591408	1,071160849

Source: Data - CCS.cz, kurzy.cz, Act. No. 353/2003 Coll. about excise tax, Act No. 235/2004 Coll. about value added tax; own calculations (2017)

The accuracy of estimated model in comparison of real prices used in original dataset is provided by Figure 10. The most significant differences are in October 2008 where the real price was higher by 2.27 CZK per litre than the estimated price and in December 2014 where the real price was higher than the estimated price by 2.86 CZK per litre.

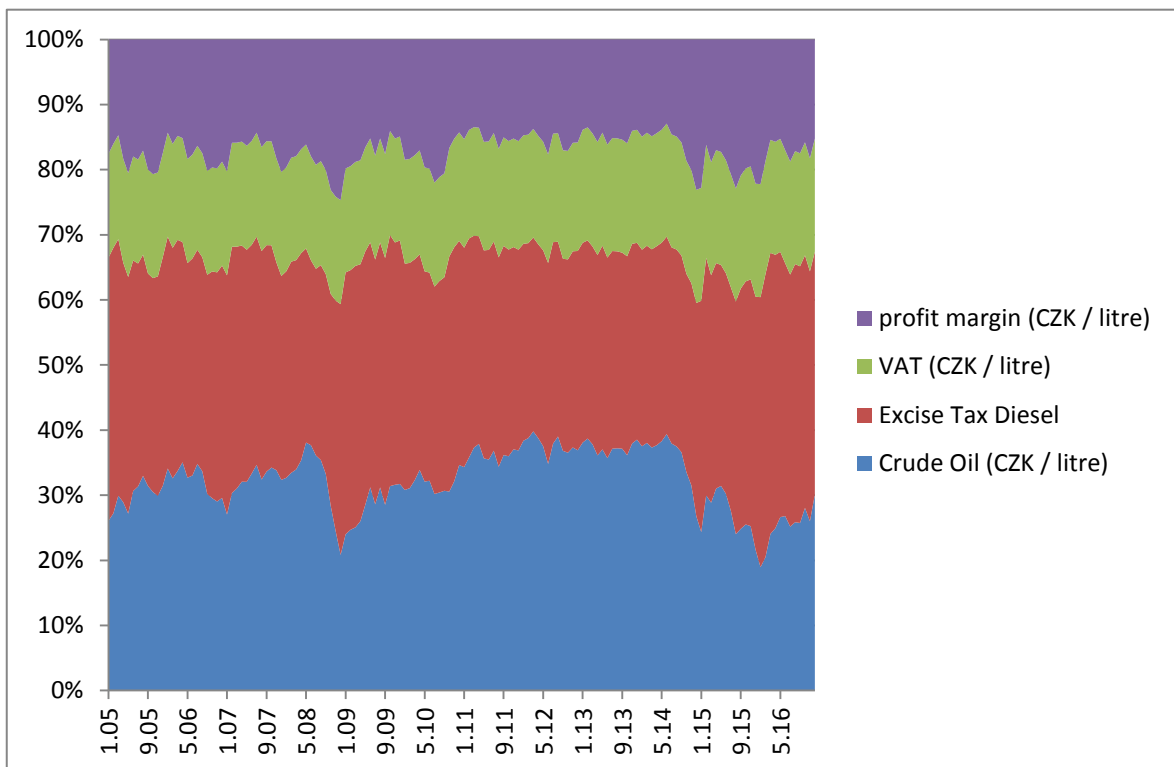
The difference between the real and estimated price of Diesel in average is 0.74 CZK per litre while the difference between the real and estimated price of Natural 95 in average is 0.83 CZK per litre.

Figure 10: Comparison of real price of Diesel and estimated Diesel price



Source: Data - CCS.cz, kurzy.cz, Act. No. 353/2003 Coll. about excise tax, Act No. 235/2004 Coll. about value added tax; own calculations (2017)

Figure 11: Structure of Diesel price, % shares on 1 litre



Source: Data - CCS.cz, kurzy.cz, Act. No. 353/2003 Coll. about excise tax, Act No. 235/2004 Coll. about value added tax; own calculations (2017)

Previous figure shows, the highest share of price is represented by excise tax of Diesel. This share is moving between 30% - 45%. 2nd highest share is represented by crude oil price which is moving between 20% - 40%. The VAT share is around 16% and is closely tracing the crude oil price with excise tax. The last share represents profit margin of refineries and gas stations. The profit margin value is moving between 15 and 25%.

4.5 Prognosis of price development

Prognosis were calculated with using of model in which was time vector used. For this reason the result is a linear regression prognosis.

4.5.1 Prognosis of crude oil price development

The development of crude oil price is based on model where crude oil price is explained variable while the time and unit vector are explanatory variables.

The estimated model for relations of Crude oil price is:

$$\text{Crude oil price} = \text{const.} + \beta_1 * \text{Time Vector}$$

After calculation of OLSM based on estimated model and with usage of

$$[(X^t * X)^{-1} * (X^t * Y)] \text{ formula}$$

where:

X is matrix of explanatory variables

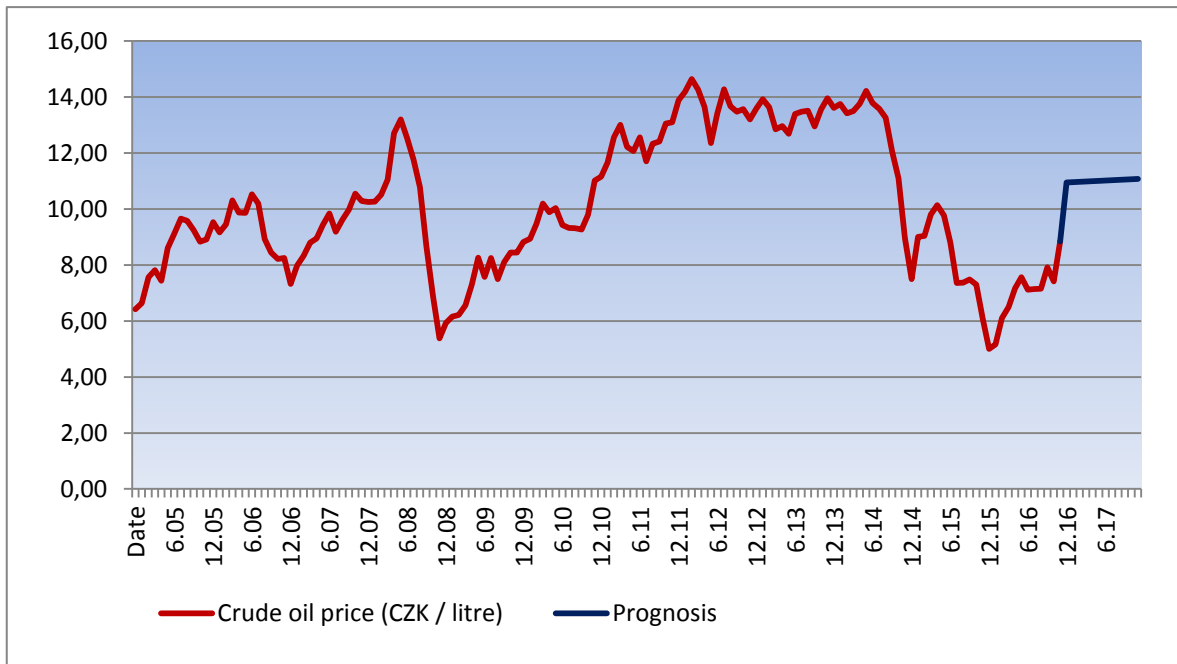
Y is vector of explained variable

The exact form of model is:

$$\text{Crude oil price} = 9,351027 + 0,011021 * \text{Time Vector}$$

The result in following figure shows that crude oil price should be, based on linear regression prognosis, increase. The significant difference between last known price of crude oil and the first estimated price is showing that linear prognosis is not accurate. The result of prognosis is 10.95 CZK per litre in January 2017 and is slowly increasing.

Figure 12: Prognosis of crude oil price development



Source: Data - CCS.cz, kurzy.cz, Act. No. 353/2003 Coll. about excise tax, Act No. 235/2004 Coll. about value added tax; own calculations (2017)

4.5.2 Prognosis of Natural 95 price development

The development of Natural 95 price is based on the original econometric model.

The estimated model for relations of Natural 95 is:

$$\text{Natural 95} = \text{const.} + \beta_1 * \text{crude oil price} + \beta_2 * \text{excise tax of Natural 95} + \beta_3 * \text{VAT}$$

After calculation of OLSM based on estimated model and with usage of

$$[(X^t * X)^{-1} * (X^t * Y)] \text{ formula}$$

where:

X is matrix of explanatory variables

Y is vector of explained variable

The exact form of model is:

$$\text{Natural 95} = -4,935803 + 1,128040996 * \text{Crude Oil Price} + 1,187426952 * \text{Excise Tax of Natural 95} + 0,526459306 * \text{VAT}$$

In the case of this model, there are 2 options of prognosis. The first option assumes that there will be change in Excise Tax and VAT. Therefore it is necessary to calculate future values of the variables.

The models for calculations are then:

$$\text{Excise Tax} = \text{const.} + \beta_1 * \text{Time Vector}$$

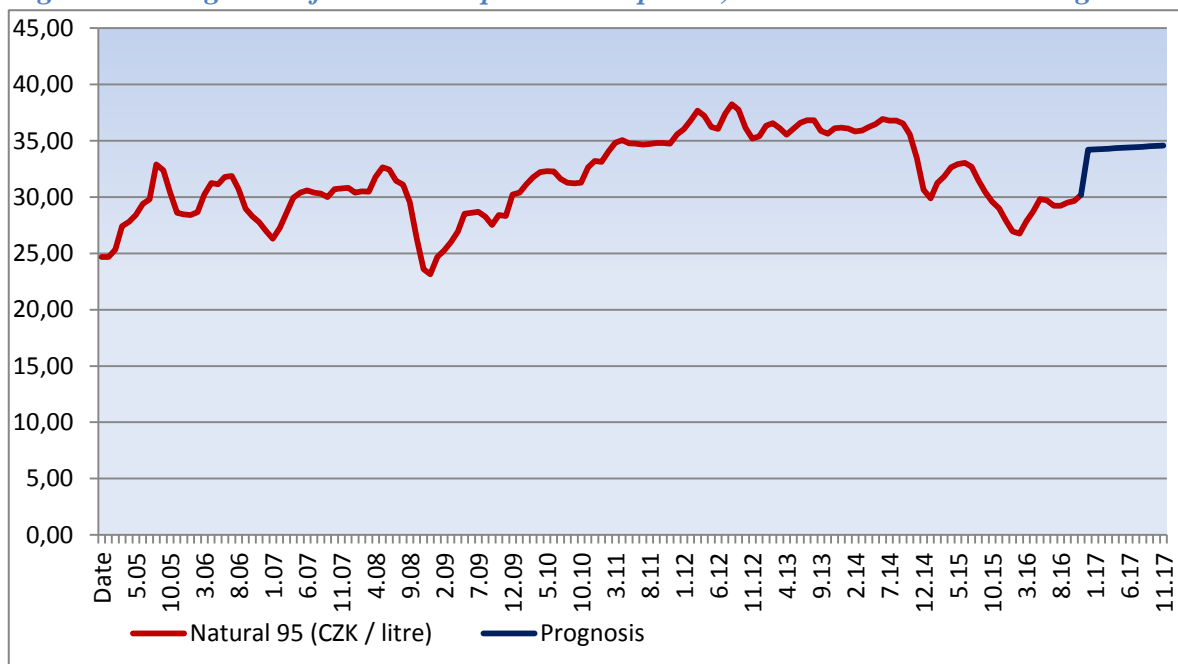
$$\text{VAT} = \text{const.} + \beta_1 * \text{Time Vector}$$

Where the exact forms of models are:

$$\text{Excise Tax} = 11,6069 + 0,010399 * \text{Time Vector}$$

$$\text{VAT} = 18,4289 + 0,019659 * \text{Time Vector}$$

Figure 13: Prognosis of Natural 95 price development, Excise tax and VAT changed

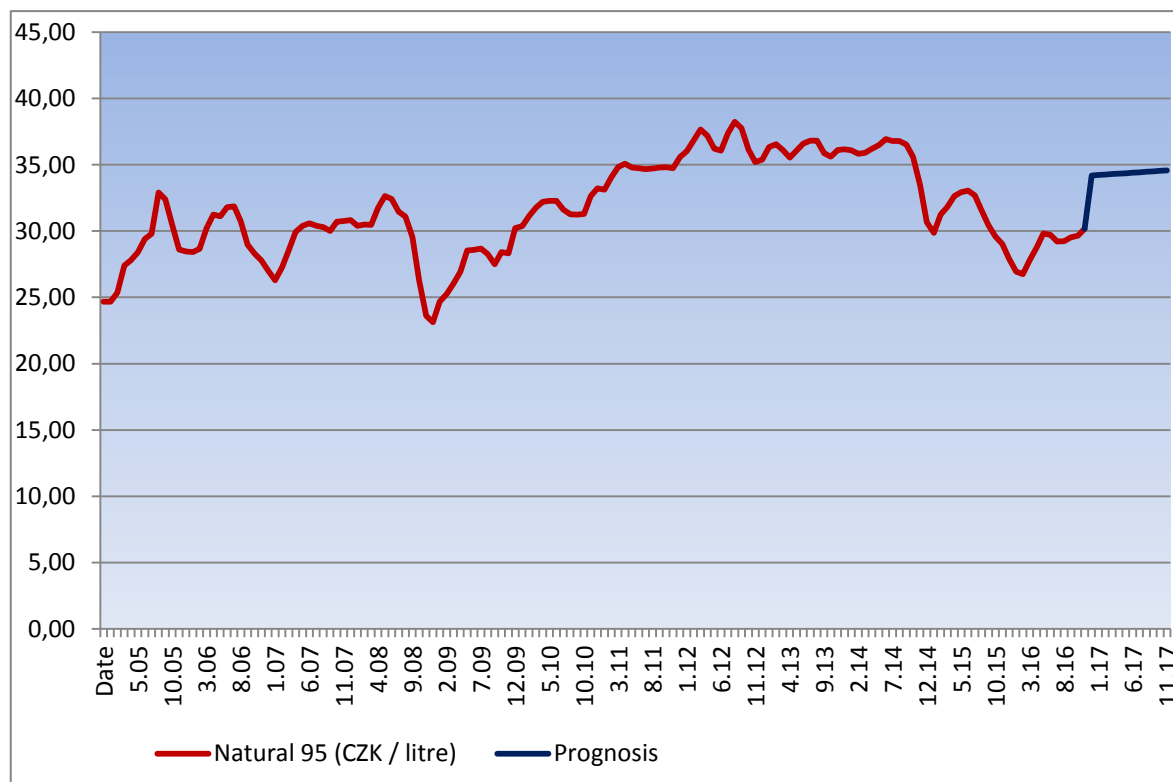


Source: Data - CCS.cz, kurzy.cz, Act. No. 353/2003 Coll. about excise tax, Act No. 235/2004 Coll. about value added tax; own calculations (2017)

The prognosis with estimated changed excise tax and VAT is then around 34.19 CZK per litre in January 2017 and is slowly increasing. The difference between the last known price of Natural 95 and the first estimated price of Natural 95 is as significant as the difference in case of crude oil price.

The second option assumes that the Excise Tax and VAT will remain same. Therefore it is not necessary to calculate future values of the variables. In this case the price of Natural 95 in January 2017 is 33.72 CZK per litre which is 0.47 CZK per litre less than in case where excise tax and VAT has changed. The prognosis is available in following figure.

Figure 14: Prognosis of Natural 95 price development, Excise tax and VAT unchanged



Source: Data - CCS.cz, kurzy.cz, Act. No. 353/2003 Coll. about excise tax, Act No. 235/2004 Coll. about value added tax; own calculations (2017)

4.5.3 Prognosis of Diesel price development

The development of Diesel price is based on the original econometric model.

$$\text{Diesel} = \text{const.} + \beta_1 * \text{crude oil price} + \beta_2 * \text{Excise Tax of Diesel} + \beta_3 * \text{VAT} + \varepsilon_t$$

After calculation of OLSM based on estimated model and with usage of

$$[(X^t * X)^{-1} * (X^t * Y)] \text{ formula}$$

where:

X is matrix of explanatory variables

Y is vector of explained variable

The exact form of model is:

$$\text{Diesel} = -1,22909 + 1,270671 * \text{Crude Oil Price} + 0,733651 * \text{Excise Tax of Diesel} + 0,590376 * \text{VAT}$$

In the case of this model, there are 2 options of prognosis. The first option assumes that there will be change in Excise Tax and VAT. Therefore it is necessary to calculate future values of the variables.

The models for calculations are then:

$$\text{Excise Tax} = \text{const.} + \beta_1 * \text{Time Vector}$$

$$\text{VAT} = \text{const.} + \beta_1 * \text{Time Vector}$$

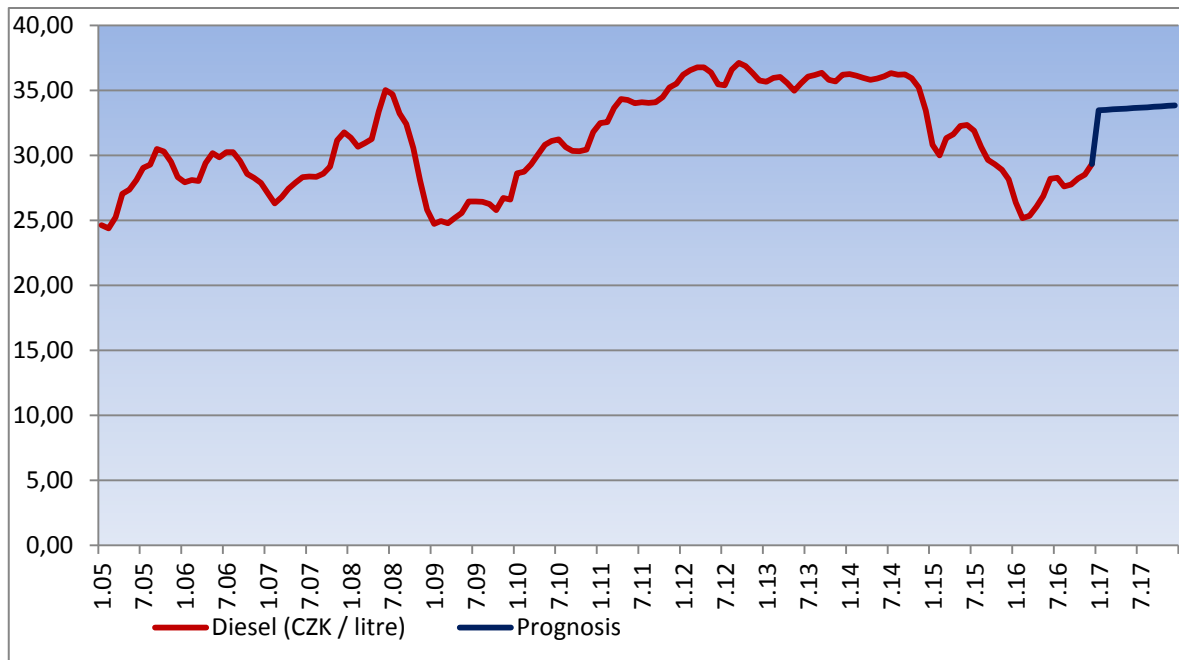
Where the exact forms of models are:

$$\text{Excise Tax} = 9,7169 + 0,010399 * \text{Time Vector}$$

$$\text{VAT} = 18,4289 + 0,019659 * \text{Time Vector}$$

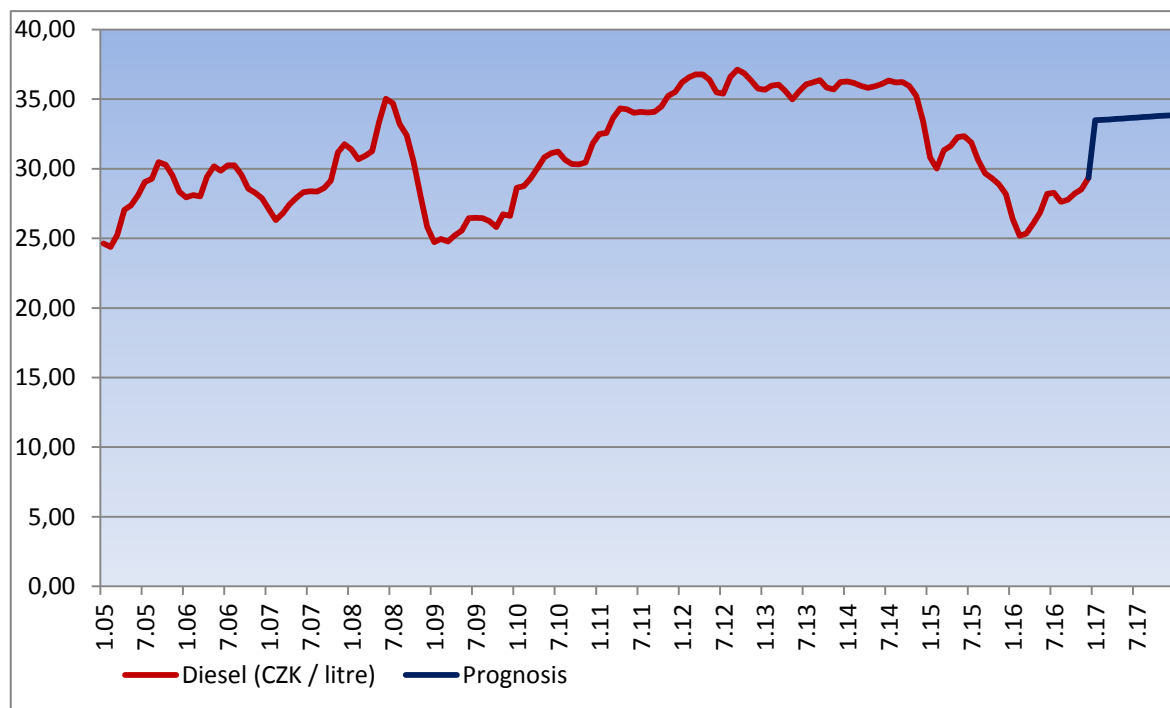
The prognosis with estimated changed excise tax and VAT is then around 33.48 CZK per litre in January 2017 and is slowly increasing. The difference between the last known price of Diesel and the first estimated price of Diesel is as significant as the difference in case of crude oil price and Natural 95.

Figure 15: Prognosis of Diesel price development, Excise tax and VAT changed



Source: Data - CCS.cz, kurzy.cz, Act. No. 353/2003 Coll. about excise tax, Act No. 235/2004 Coll. about value added tax; own calculations (2017)

Figure 16: Prognosis of Diesel price development, Excise tax and VAT unchanged



Source: Data - CCS.cz, kurzy.cz, Act. No. 353/2003 Coll. about excise tax, Act No. 235/2004 Coll. about value added tax; own calculations (2017)

The prognosis which is available in the previous figure is explaining the second option which assumes that the Excise Tax and VAT will remain same. Therefore it is not necessary to calculate future values of the variables. In this case the price of Diesel in January 2017 is 33.11 CZK per litre which is 0.37 CZK per litre less than in case where excise tax and VAT has changed.

4.6 Purchase price of crude oil fuels

The price of each crude oil fuel type, same as in case of trade with crude oil itself, is set in U.S. Dollars as a basic currency used on market. The price is based on quotation of Platts Barges FOB Rotterdam Mean for each individual product.

The price for trading is based on announced daily quotation and its calculation is done by following way:

$$P = (AQ + IB) * ER * D / 1000 * T$$

Where:

P = Price

AQ = Average of daily quotations from previous week

IB = Inline bonus – margin of trader

ER = Exchange rate of USD – Average of daily exchange rates from previous week announced by Czech National Bank

D = Density – measuring density of product

T = Traffic – Agreed price of transport per 1 litre of product

Quotations are announced by Platts Barges FOB Rotterdam Mean every day and are set in units of U.S. Dollar per 1 tonne of product. Accurate daily quotations are not available for free. Respectively they are available only after payment of considerable license charge, which can be paid only by traders with high income.

Due to the unavailability of accurate quotations it might be problematic issue during controlling of correctness of prices in business relations.

The average is calculated from announced quotations from Monday to Friday of the week. The average of USD exchange rate is calculated in the same way for the same days. If the quotations or exchange rates are not announced due to national holidays or some other reason, it is calculated from available data from other days of the week.

Inline bonus is margin of trader which is agreed ahead. It is set in USD per 1 tonne of product. Usually it is set in tens of USD.

The density of product is a constant for each kind of fuels. Motor diesel has density 845 kg per 1000 litres, automobile gasoline Natural 95 has density 755 kg per 1000 litres.

The price of traffic transport is not always set because sometimes it is part of inline bonus. If the price is set, it is usually in cents or tens of cents per litre of product.

Based on the calculation formula above, it is clear that in practice the purchasing price of crude oil fuels is changed once a week. It is always on Monday and the prices come in force on Tuesday. In very rare cases the changes occur in other days as well. Usually it happens when there are abnormally high fluctuations in quotations. It is

necessary to add excise tax to the calculated price to obtain final price of fuels without value added tax.

4.7 Quotations

Quotations are reflecting market value of the crude oil fuels in the large scale trade relationship. They are reacting on the price of crude oil on the world market, demand and supply, in real time. In the matter of fact, it is nothing less than the results of trading on stock exchange market. Every day is trading evaluated and the daily statistics of trades with each separate crude oil fuel type are made, for which are evaluated results. That means the lowest, the highest and average value. It can happen that the quotations are not announced during the year. In the first place it happens during day when the stock exchange is closed, in other words during weekends.

Secondly it is during national holidays in Netherlands of in days when the trading on exchange market is closed. Not every holiday in Netherlands means day without announcing of quotations. For the same reason are not included into the counting days of Czech national holidays. At those days the Czech national bank is not announcing daily exchange rate of USD. Such a day is logically not counted into the average due to possibility of influence of results and therefore the weekly average is counted from less number of days.

In the following table is available example of quotations for products of Natural 98 (Unl 98), Natural 95 (Prem Unl) and diesel from the first week of May 2006. In this case the quotations were not set for the day of 1st May. Accurate quotations are not public information and it is possible to obtain them only as a payed service.

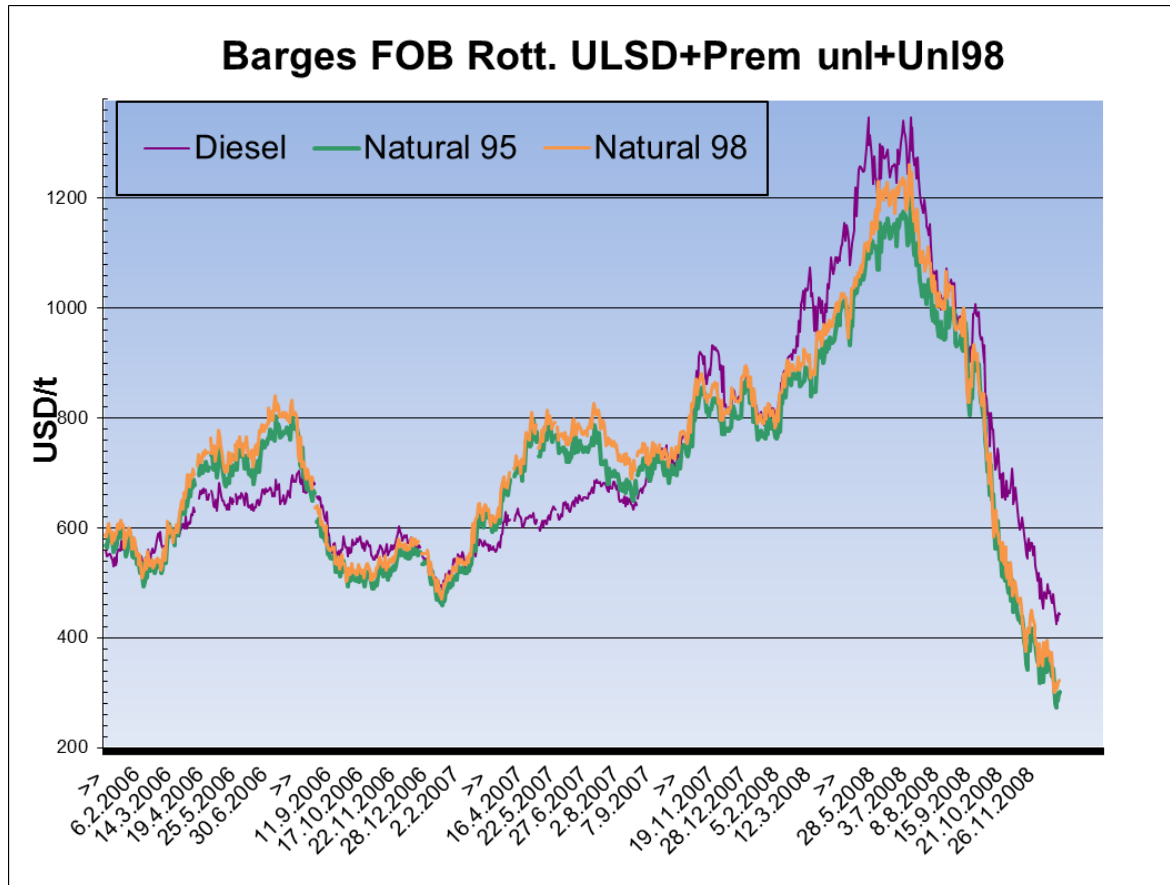
Table 4: Quotations of crude oil fuels, May 2006

Platts	Barges FOB Rotterdam								
	Unl 98			Prem Unl			ULSD/diesel 10ppm		
	low	high	mean	low	high	mean	low	high	mean
1.5.2006									
2.5.2006	762,00	764,00	763,00	732,00	734,00	733,00	668,25	669,25	668,75
3.5.2006	761,00	763,00	762,00	731,50	733,50	732,50	658,75	659,75	659,25
4.5.2006	735,00	737,00	736,00	705,50	707,50	706,50	640,50	641,50	641,00
5.5.2006	735,00	737,00	736,00	706,00	708,00	707,00	637,25	638,25	637,75
>>	748,25	750,25	749,25	718,75	720,75	719,75	651,19	652,19	651,69

Source: Data – Platts Barges FOB Rotterdam; own table (2017)

In the following figure are shown quotations for years 2006 – 2008. It is time period which is immediately preceding the world economic crisis and the period of its onset.

Figure 17: Barges FOB Rotterdam quotations, 2006 – 2008



Source: Data – Platts Barges FOB Rotterdam; own figure (2017)

From the beginning of year 2007 there is slow increase of quotations, to it prevents more rapid increase in the first half of the year 2008. In the second half of the year 2008 occurred decrease in price of crude oil and rapid decrease in quotations of crude oil fuels as well.

4.8 Selling price of crude oil fuels

The selling price of crude oil fuels is differed mostly by location in which can be gas station found. It can be said in global that the most expensive fuels can be bought at gas stations on highways. Statistically is impossible that cars will not stop at gas station when their fuel reserve is empty and which has to continue to go on highway. With the huge

amount of cars which are passing highway every day, there is no lack for customers and owners of gas stations can afford to set prices higher.

At these gas stations is the higher margin also one of the consequences of multiple times higher costs of gas station building. Lands which are suitable for building are at highways and as such are much more expensive than the lands anywhere else. That is also a reason why the highways are surrounded by gas stations which are mostly owned by famous brands which have large net of gas stations. These companies and brands are able to invest much easily than the small ones and they can invest tens or even hundreds of million CZK for purchase of land and building of gas station.

However the high investments are realistically returnable in usually short period horizon. Margin at these stations is moving up in the CZK per one litre which is providing even hundred thousand daily incomes with the several tens of thousands of litres sold every day.

Exact opposite of highway gas station are the “hidden” countryside gas stations which are reaching only a little piece of daily sales of those big, highway ones. It is not a rare case that only one person is working at such a gas station and the person is also the operator of it. If such a gas station has some competition nearby, the margin of the gas station is in rate of tens of cents per litre of fuel sold. Paying all of the operating costs is therefore usually difficult which is also a reason for often change of owner or operator of the gas station. Common rule is that the higher amount of fuels can be sold and therefore the seller is able to buy, the cheaper purchase price of fuels is because the seller is able to make contracts with lower inline bonus (IB).

If the gas station is smaller, it is usual for the gas station to go under the logo of more famous brand and the trade is without purchase of crude oil fuels with set persistent margin, a.k.a. provision.

Another factor which is influencing selling price is business strategy and price making. As an example can be used gas station OMV in Vilémov and comparison of purchase and selling price of each separate product it sold.

Table 5: Purchase price at OMV Vilémov

Purchase price	Date	Price	Excise tax	Price Netto
Diesel	01.10.2008	14,51	9,95	24,46
Natural 95	01.10.2008	11,87	11,84	23,71
Natural 100	01.10.2008	12,08	11,84	23,92

Source: Data – To&Mi Vdf. spol. s.r.o.; own table (2017)

In the concrete day the highest purchase price was the purchase price of diesel and that was even with included excise tax which is lower than the excise tax of gasoline. Based on the location of the gas station which is located near the border-crossing with the Germany, the business strategy is set according to the clients, which is absolutely obvious. Due to the fact that the Natural 95 is mostly sold fuel (German customers are buying diesel very rarely because they have to pay ecology tax for diesel engines) the profit margin at diesel is set much lower.

Table 6: Selling price at OMV Vilémov

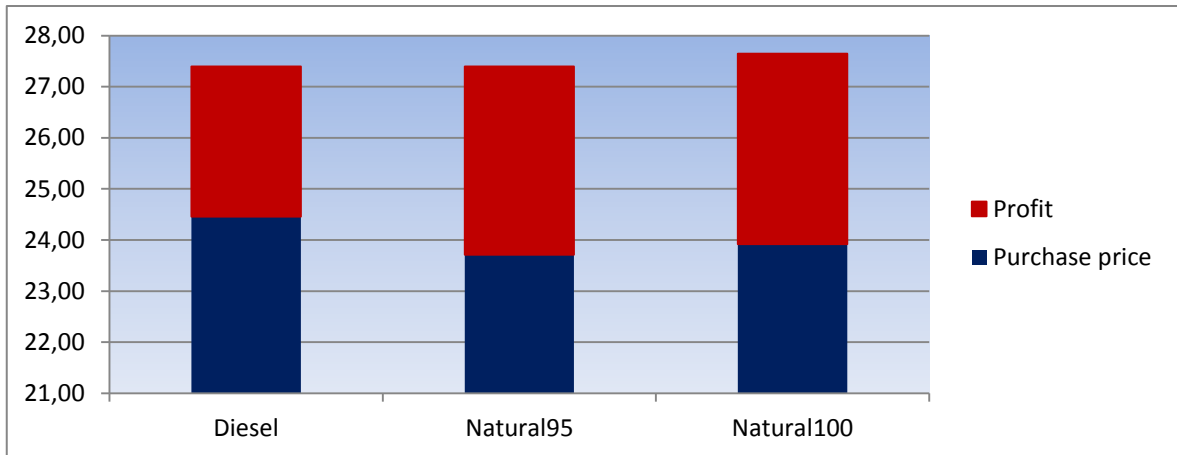
Selling price	Date	Price Brutto	Price Netto	Profit
Diesel	01.10.2008	32,60	27,39	2,93
Natural95	01.10.2008	32,60	27,39	3,68
Natural100	01.10.2008	32,90	27,65	3,73

Source: Data - To&Mi Vdf. spol. s.r.o.; own table (2017)

The profit margin at gasoline is set higher. It is necessary to point out that it is the period before of increase of excise tax in the Czech Republic and the VAT is at level of 19%. Based on the location of the gas station which is near the borders, the clients were from the 95% from the neighbor Germany where the selling prices are higher than the average in the Czech Republic.

Later on the government increased excise tax and VAT which resulted in significant decrease in profit margin and current outflow of customers due to difference between selling price difference between Czech Republic and Germany decreased.

Figure 18: Profit margins of fuels at OMV Vilémov, 01.10.2008



Source: Data - To&Mi Vdf. spol. s.r.o.; own figure (2017)

4.9 Case studies of gas stations

There are 3 gas stations used for case studies. Two of them are in the same city and therefore nearby to each other, the third is in different region but has similar conditions, namely it is near the borders. These gas stations are located in cities of Vilémov and Svatý Kříž.

4.9.1 OMV Vilémov

First of the gas stations is OMV, later renamed to Nord in Vilémov. This gas station is located on the periphery of city and at the same time near the main road used for transit to the border crossing Dolní Poustevna (CZE) / Sebnitz (GER).

Data available for this gas station are from the January 2009 to the December 2014 when the gas station was sold and new owner did not provide data. Data used are month averages.

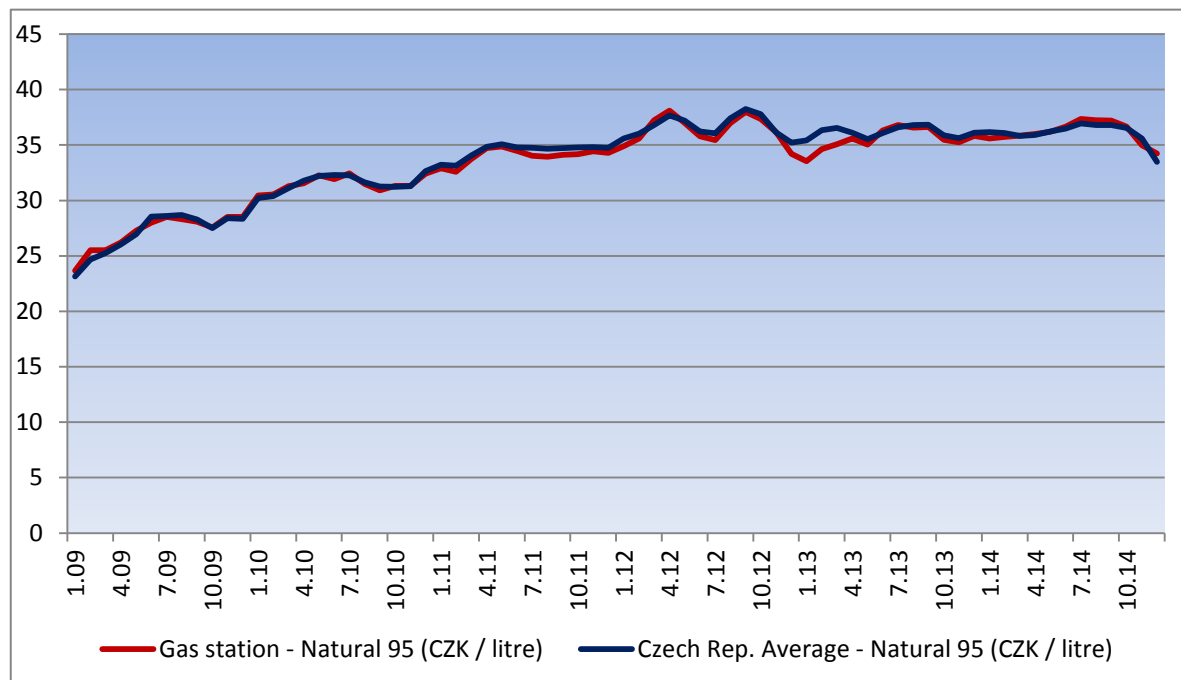
As the figure 17 shows, the price of Natural 95 at OMV Vilémov is copying the average price of Natural 95 in the Czech Republic and in many cases is even below the Czech average. The price had increasing tendency with a drop at the end of 2012 and second half of 2014.

Lowest price: January 2009 – 23.66 CZK / litre

Highest price: April 2012 – 38.10 CZK / litre

Highest difference: January 2013 – 33.53 CZK / litre, 1.87 CZK / litre below average

Figure 19: Natural 95 price at OMV Vilémov compared to average price in the Czech Republic



Source: Data - To&Mi Vdf. spol. s.r.o.; own figure (2017)

The figure 18 shows price of Diesel at OMV Vilémov with comparison to the Czech average price of Diesel. The price at OMV Vilémov was below the average in almost all cases. The tendency of price to increase is same as it is in the case of Natural 95, which is not surprising since it is the same gas station.

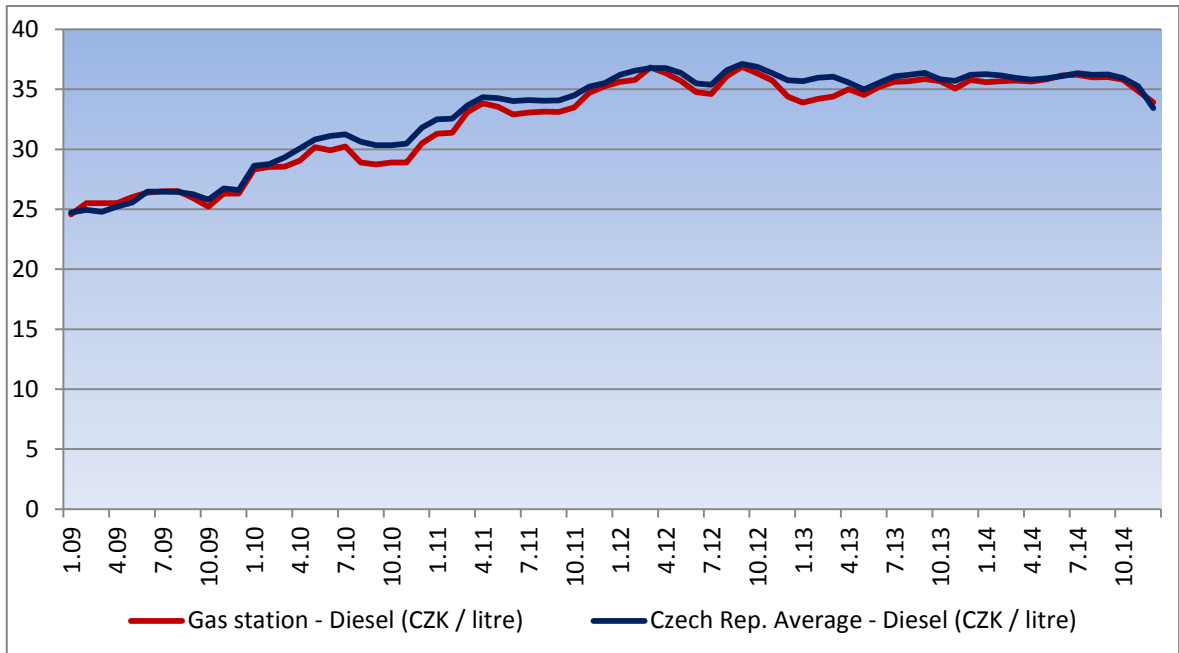
The price of Diesel dropped at the end of 2012 and on the second half of 2014, same as it happened in case of Natural 95.

Lowest price: January 2009 – 24.58 CZK / litre

Highest price: September 2012 – 36.89 CZK / litre

Highest difference: January 2013 – 33.90 CZK / litre, 1.79 CZK / litre below average

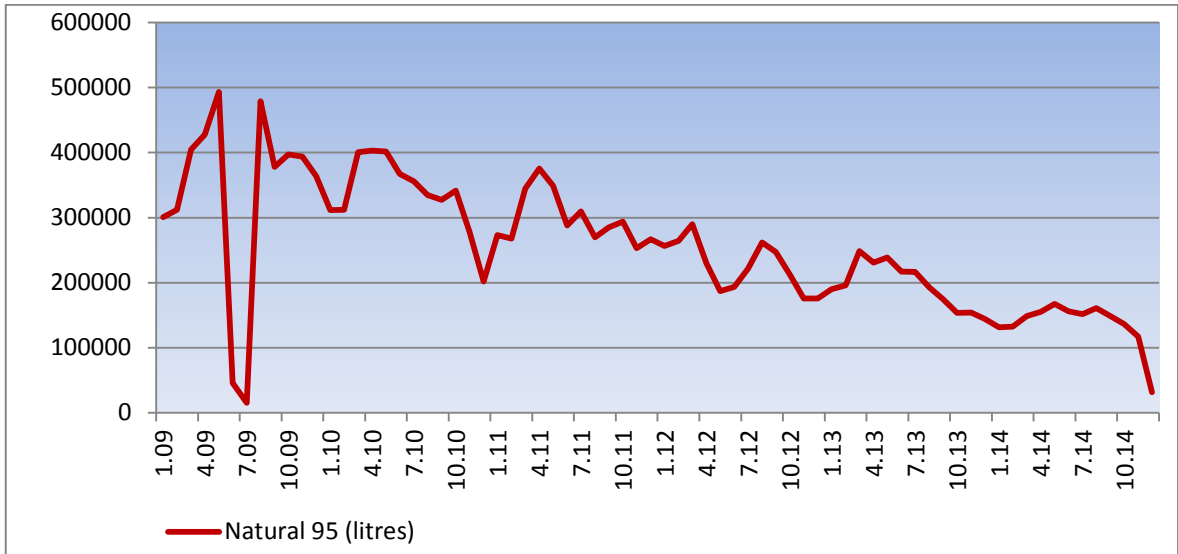
Figure 20: Diesel price at OMV Vilémov compared to average price in the Czech Republic



Source: Data - To&Mi Vdf. spol. s.r.o.; own figure (2017)

However the amount of fuels sold has a different slope. It would not be surprising that the demand for fuels will decrease with the increasing price and customers would try to find cheaper gas station. But the prices at OMV Vilémov are below the average of Czech Republic and therefore customers should come to the OMV instead of searching elsewhere.

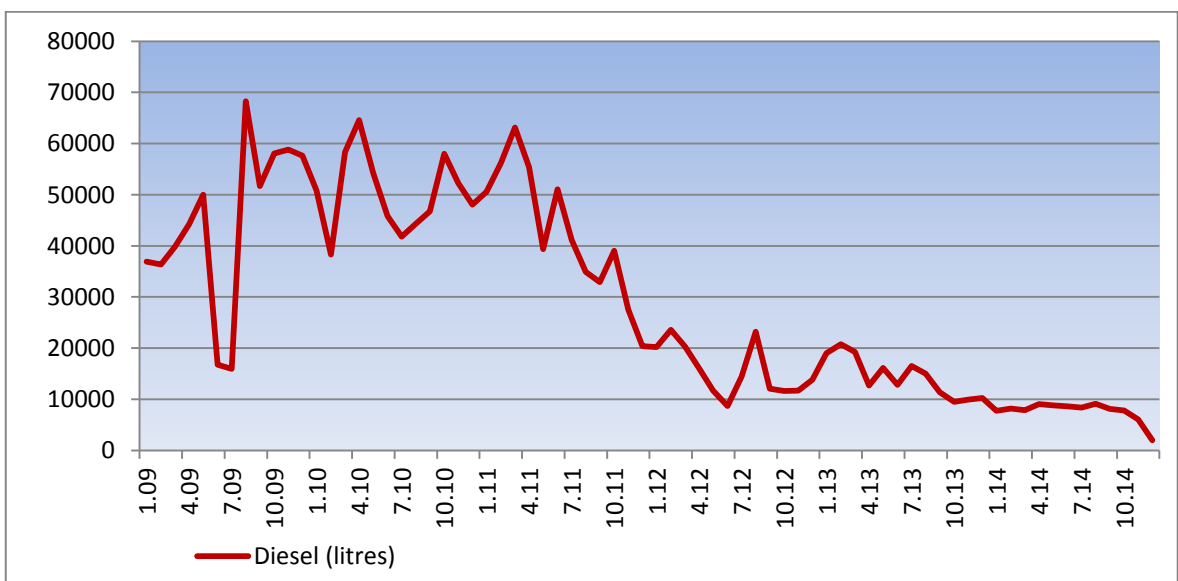
Figure 21: Natural 95 sold at OMV Vilémov



Source: Data - To&Mi Vdf. spol. s.r.o.; own figure (2017)

As the figures 19 and 20 shows, the most significant drop in amount of fuels sold was in 2009. This occurred due to reconstructions near the border crossing which prevented customers from Germany to get to the OMV Vilémov. This drop also shows the share of German customers at this gas station. Other significant drops were also caused by the reconstructions of roads and border crossing. However the overall decreasing tendency is reflecting decreasing number of customers from Germany.

Figure 22: Diesel sold at OMV Vilémov



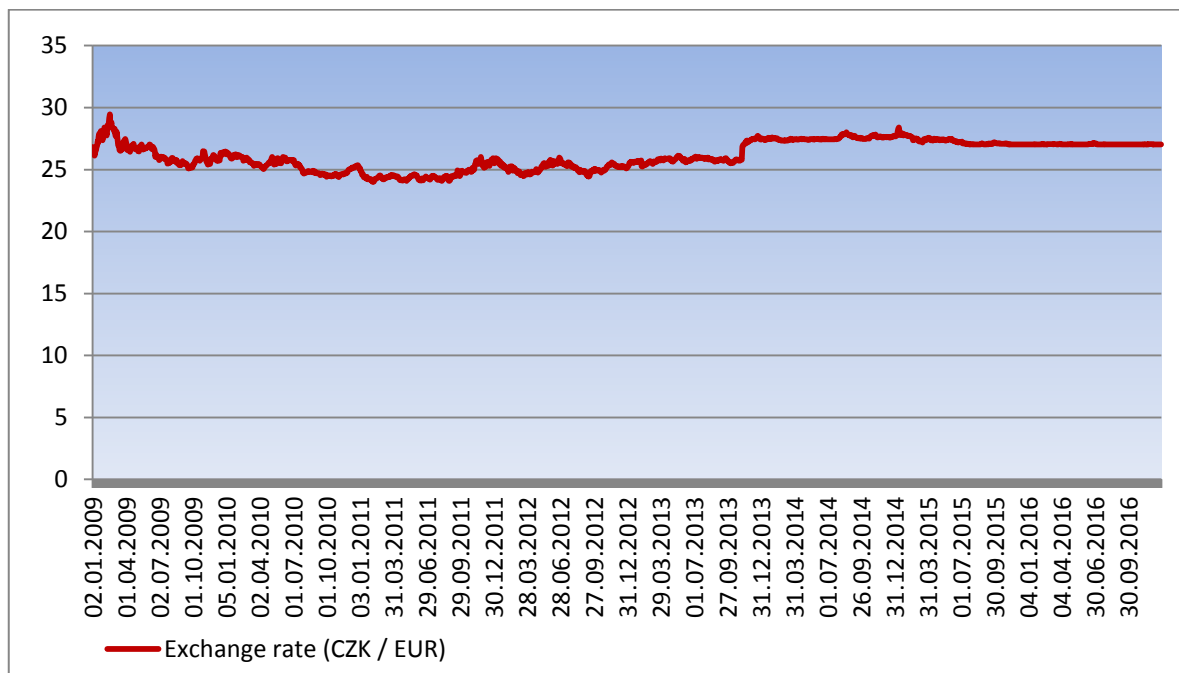
Source: Data - To&Mi Vdf. spol. s.r.o.; own figure (2017)

First hypothesis is that the decrease of customers occurred due to increase of taxes. This is rejected because the prices remained almost unchanged due to lower profit margin of gas stations.

Second hypothesis is that the decrease of customers occurred due to increasing price of fuels in the Czech Republic and Germany has lower prices. This is rejected due to the relation between price of fuels and price of crude oil and the price of crude oil was increasing. Therefore the prices should be increasing globally.

Third hypothesis is that the decrease of customers occurred due to strengthening of CZK and lower exchange rate of Euro. Daily records of exchange rate and development are available in figure 21. As the figure shows, the CZK was actually weakening and the exchange rate was getting more pleasant for German customers. This hypothesis is therefore also rejected and the reason why German customers stopped buying of fuels at this gas station is unclear.

Figure 23: Exchange rate CZK/EUR



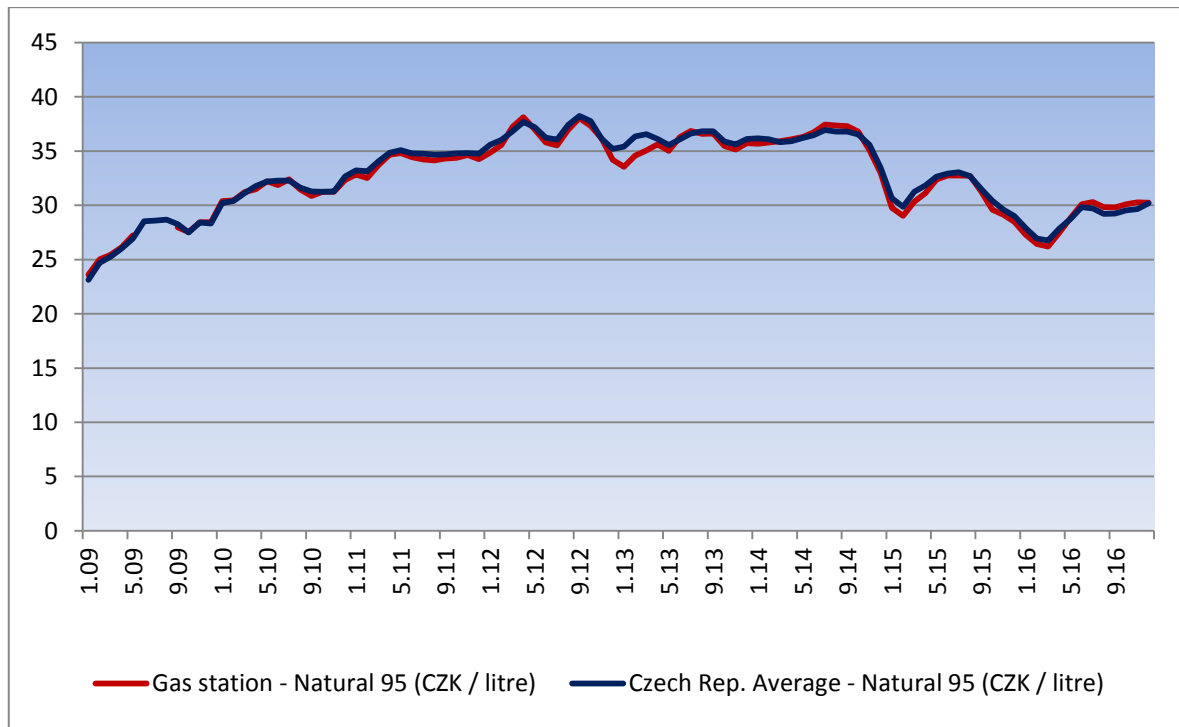
Source: Data - Czech National Bank, 2017; own figure (2017)

4.9.2 Avanti Vilémov

Second of the gas stations is Avanti, originally named Nord and renamed for the 3rd time to Tix Express in 2015. This gas station went through reconstruction in 2009 which is reason why there are no data during this period. It is located in the center of Vilémov city.

The share of German customers at this gas station is lower, because the OMV is closer to borders and German customers meet OMV before they get to Avanti. However even in this case the German customers play significant role and the situation around the border crossing is affecting this gas station as well.

Figure 24: Natural 95 price at Avanti Vilémov compared to average price in the Czech Republic



Source: Data - To&Mi Vdf. spol. s.r.o.; own figure (2017)

Due to the possible price war, the prices of Avanti are very close to the prices of OMV. Significant drops occurred in the 2012 and 2014.

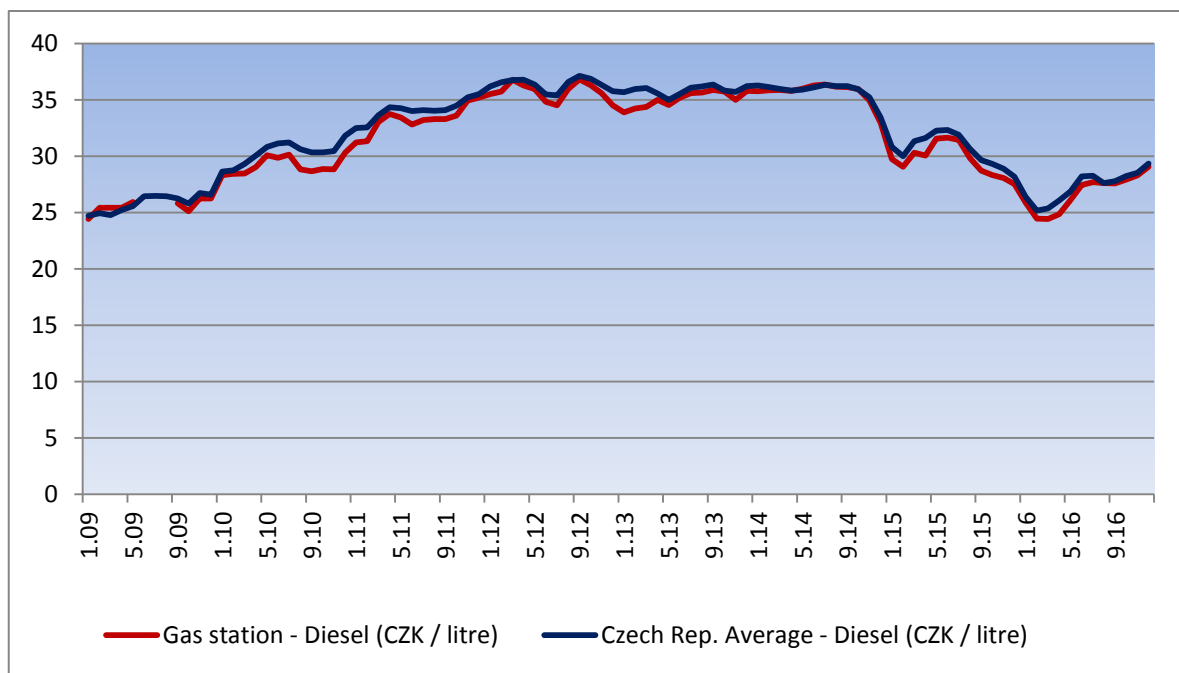
Lowest price: January 2009 – 23.60 CZK / litre

Highest price: April 2012 – 38.12 CZK / litre

Highest difference: January 2013 – 33.53 CZK / litre, 1.87 CZK / litre below average

The price of Diesel at Avanti Vilémov, same as in case of Natural 95 price, is also very close to the price level of OMV Vilémov. Again the reason is possible price war with 3rd gas station in Vilémov, since the Avanti and OMV had same owner during years 2009 – 2014. Since 2015 the OMV was sold and therefore the risk of price war is even higher. However data from new owner are not available.

Figure 25: Diesel price at Avanti Vilémov compared to the average price in the Czech Republic



Source: Data - To&Mi Vdf. spol. s.r.o.; own figure (2017)

Lowest price: January 2009 – 24.43 CZK / litre (March 2016 – 24.44 CZK / litre)

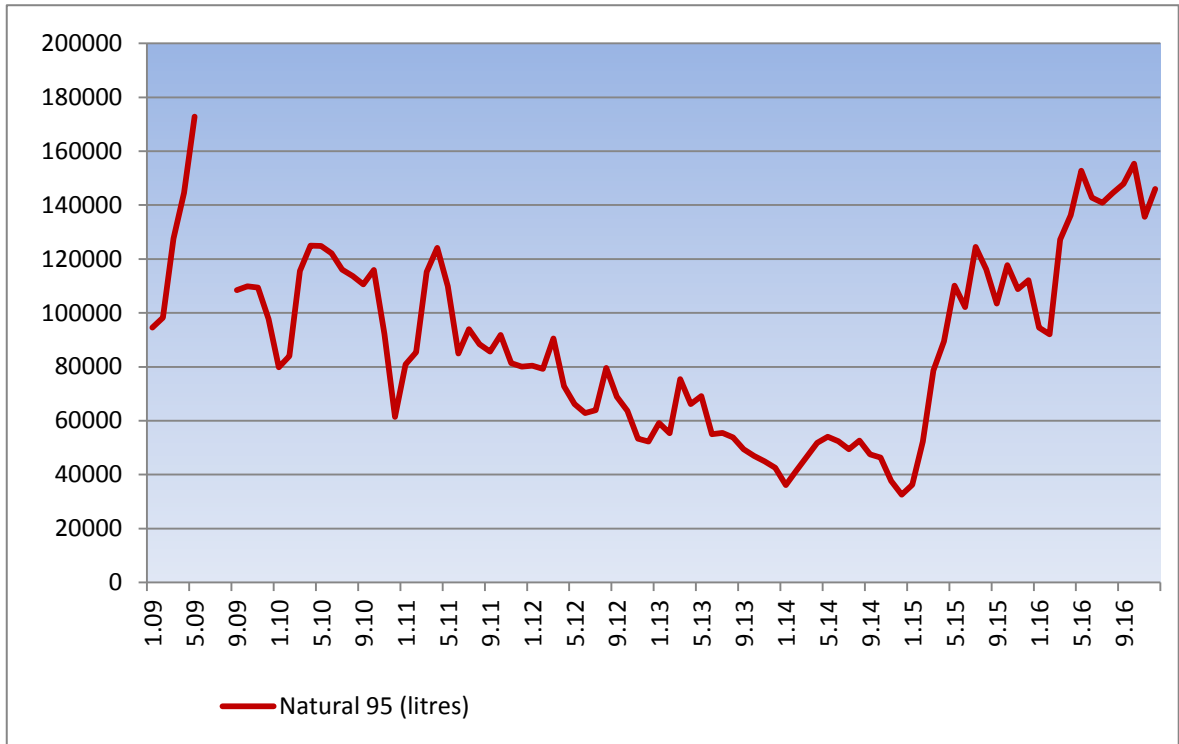
Highest price: September 2012 – 36.83 CZK / litre

Highest difference: January 2013 – 33.90 CZK / litre, 1.79 CZK / litre below average

The most significant drops of Diesel price occurred in the end of 2014 and during year 2015. The price is increasing since the January 2016 and prognosis is that the price will continue to increase.

The amount of Natural 95 and Diesel sold at Avanti had same decreasing tendency as it was in case of OMV Vilémov, which is not surprising since both gas stations are affected by same situations which occurred during the years.

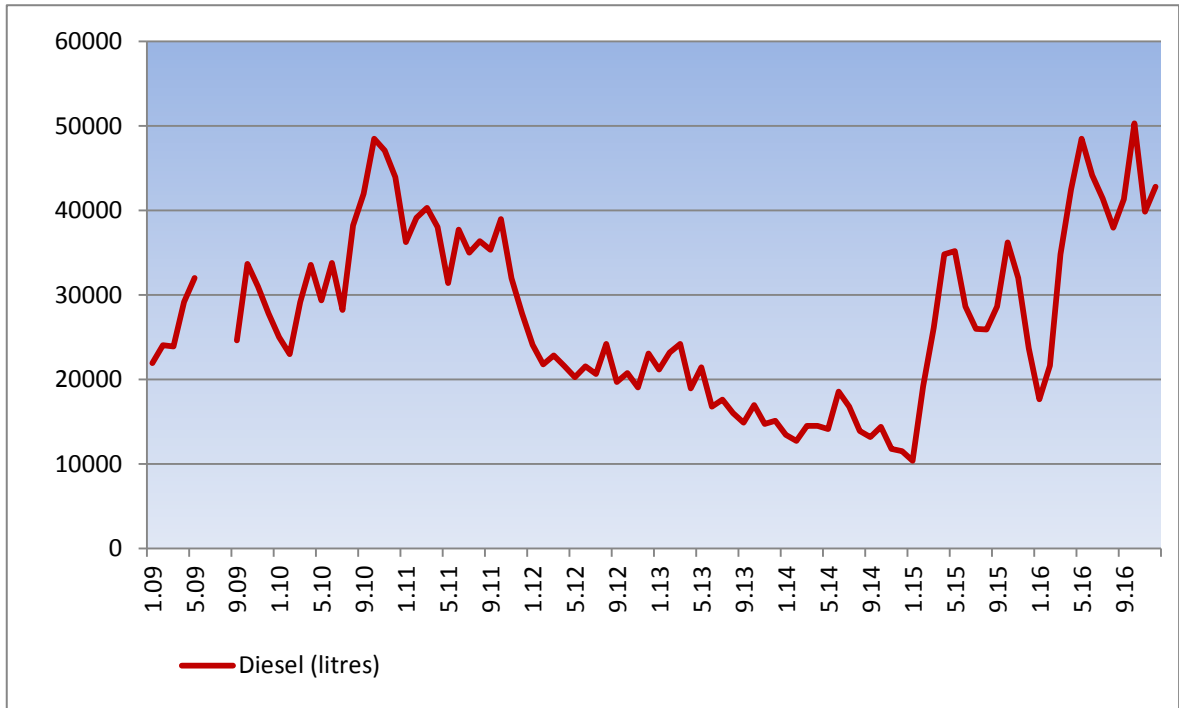
Figure 26: Natural 95 sold at Avanti Vilémov



Source: Data - To&Mi Vdf. spol. s.r.o.; own figure (2017)

In both cases, Natural 95 and Diesel, the amount of fuels sold kept decreasing till the December 2014. From the January 2015 the amount of fuels sold started to increase rapidly. One reason for this increase are lower prices of fuels which might be attractive for customers from Germany. This hypothesis can be supported by the development of the CZK / EUR exchange rate. CZK significantly weakened during the year 2013 and remains at nearly same value since then. Other fluctuations are result of reconstructions which are lowering quality of traffic and marketing actions done by gas station such as loyalty programs etc.

Figure 27: Diesel sold at Avanti Vilémov



Source: Data - To&Mi Vdf. spol. s.r.o.; own figure (2017)

4.9.3 OMV Svatý Kříž

Last of chosen gas stations is OMV Svatý Kříž. It is a border crossing gas station, 1st gas stations right behind border cross. This gas station is in different region than the other two. Similarity is however high percentage share of foreign, mostly German, customers.

Data available for this gas station are limited, because the gas station changed owner in year 2012 and the internal data from new owner are not available.

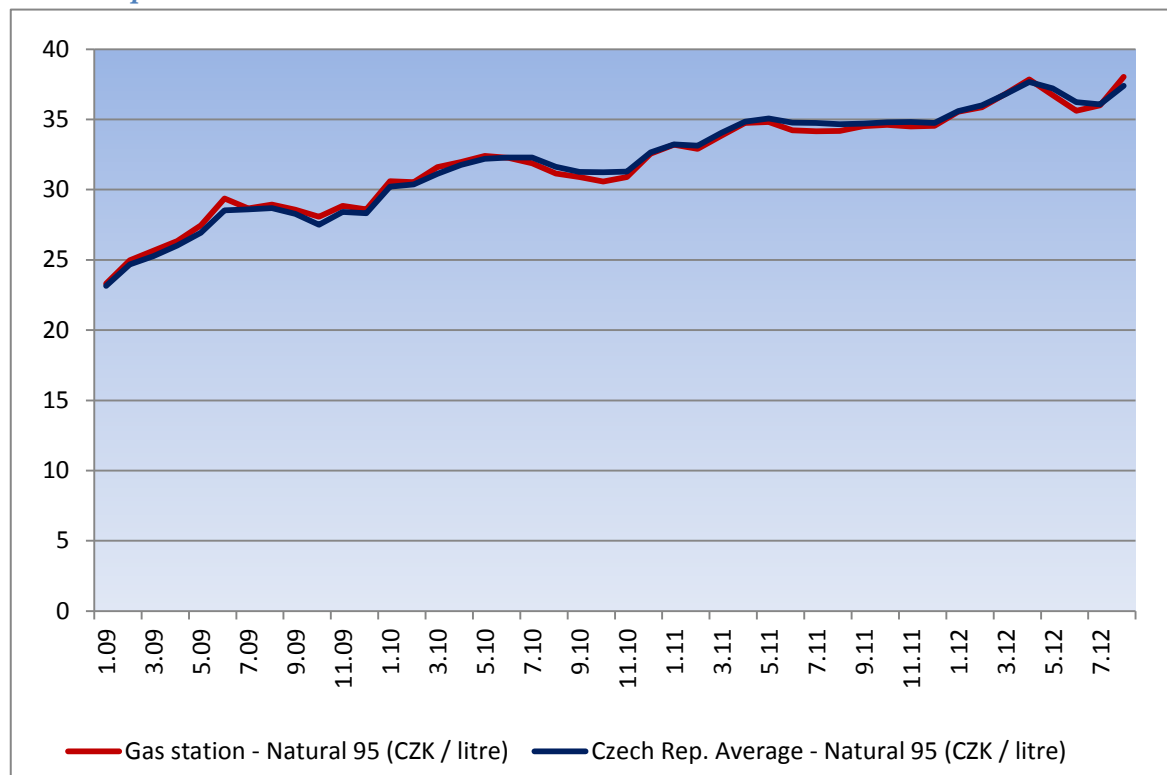
The price of Natural 95 at OMV Svatý Kříž is very close to the average price of fuels in the Czech Republic. During year 2009 and first half of the 2010, the price was above average and since then the Natural 95 was cheaper at this station than the Czech average.

Lowest price: January 2009 – 23.30 CZK / litre

Highest price: August 2012 – 38.02 CZK / litre

Highest difference: June 2009 – 29.37 CZK / litre, 0.84 CZK / litre above average

Figure 28: Natural 95 price at OMV Svatý Kříž compared to the average price in the Czech Republic



Source: Data - To&Mi Vdf. spol. s.r.o.; own figure (2017)

Unlike in case of Natural 95, the price of Diesel at OMV Svatý Kříž was almost always below the average price in the Czech Republic. Only exceptions were May 2010 when the price at OMV was higher by 0.03 CZK / litre than the average and August 2012 when the price was higher by 0.70 CZK / litre than the average.

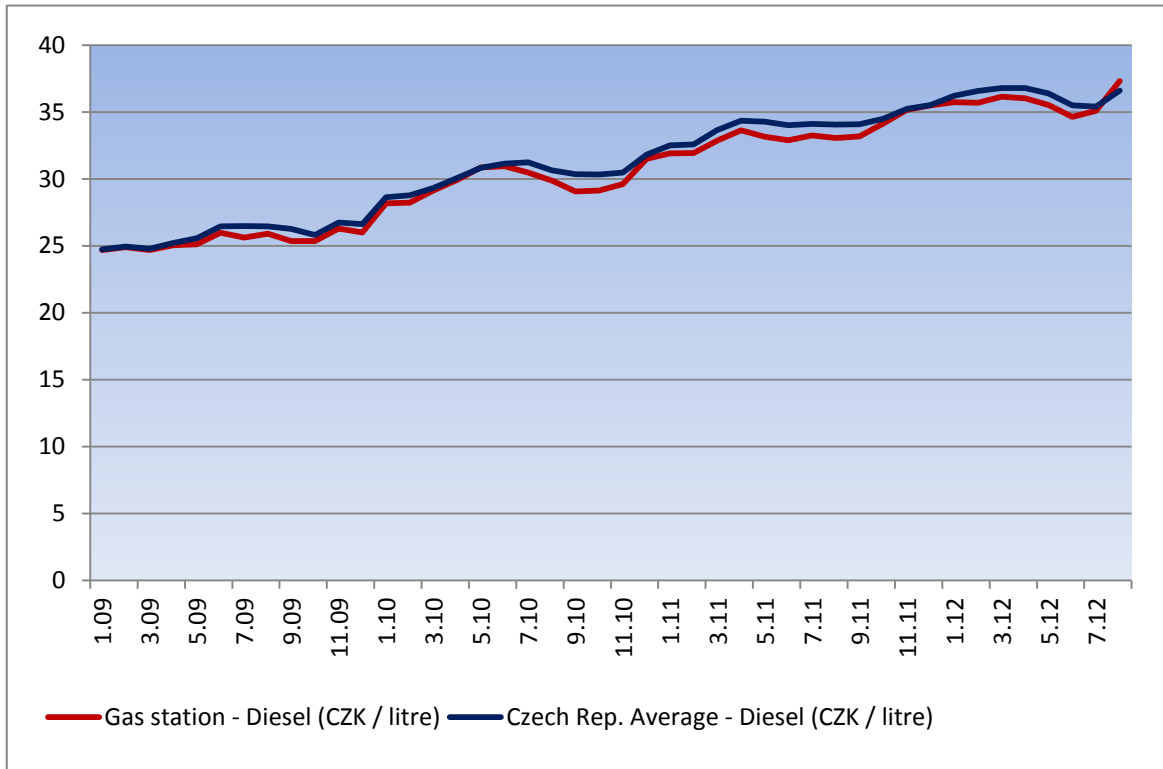
The price development of Diesel at OMV Svatý Kříž is closely following Czech average prices. Differences between price at OMV and average price are lower than it was in other 2 cases.

Lowest price: January 2009 – 24.68 CZK / litre

Highest price: August 2012 – 37.29 CZK / litre

Highest difference: September 2010 – 29.06 CZK / litre, 1.28 CZK / litre below average

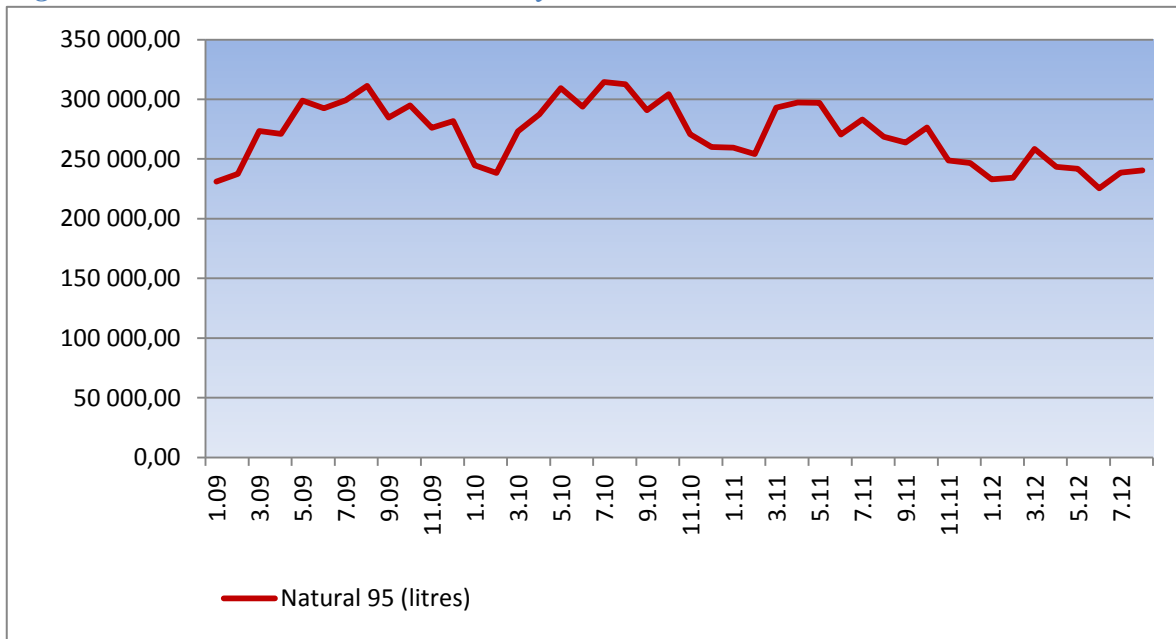
Figure 29: Diesel price at OMV Svatý Kříž compared to the average price in the Czech Republic



Source: Data - To&Mi Vdf. spol. s.r.o.; own figure (2017)

The development of Natural 95 amount sold at OMV Svatý Kříž is fluctuating however it is much more stable than development at gas stations in Vilémov.

Figure 30: Natural 95 sold at OMV Svatý Kříž

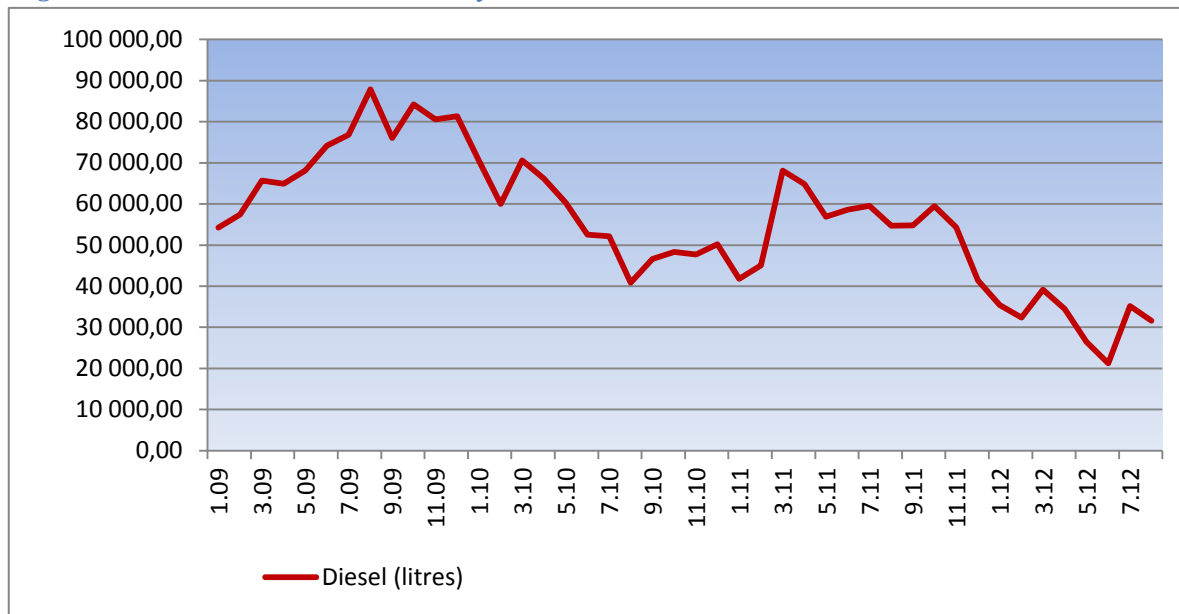


Source: Data - To&Mi Vdf. spol. s.r.o.; own figure (2017)

The fluctuations in development of Natural 95 sold at OMV Svatý Kříž are reaching its bottom during February every year. The overall trend decreasing and this is common for all 3 cases.

The development of Diesel is not so stable compared to the Natural 95. As the figure 31 shows, the fluctuations are much more intensive if it is taken as a percentage change.

Figure 31: Diesel sold at OMV Svatý Kříž



Source: Data - To&Mi Vdf. spol. s.r.o.; own figure (2017)

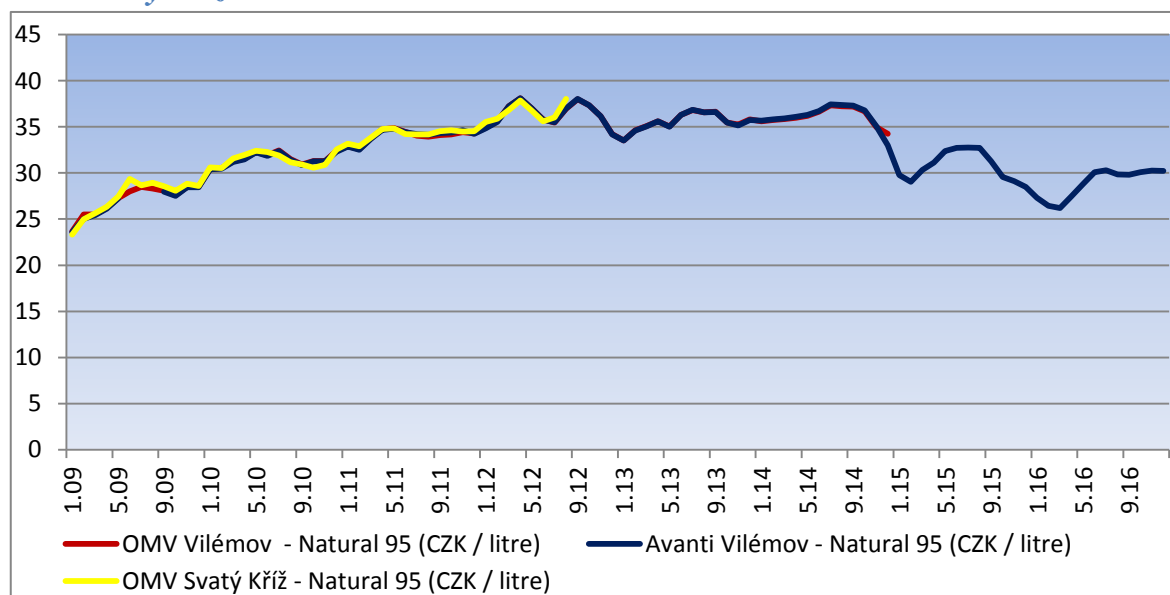
4.9.4 Comparison of OMV Vilémov, Avanti Vilémov and OMV Svatý Kříž

Comparison of the gas stations is not fully available due to lack of data for OMV Vilémov and OMV Svatý Kříž. However data provided by To&Mi Vdf. spol. s.r.o. are enough to see trends of development.

In the figure 32 is comparison of Natural 95 price development. Differences between prices are not significant. Reason is that all 3 gas stations are closely following the average prices of Natural 95 in the Czech Republic. The highest difference occurred at June 2009. The Avanti Vilémov was reconstructed at that time however OMV Vilémov was fully working. Difference between OMV Vilémov and OMV Svatý Kříž at that month was 1.38 CZK / litre (OMV Svatý Kříž was selling Natural 95 for 29.37 CZK / litre while OMV Vilémov was selling same product for 27.99 CZK / litre)

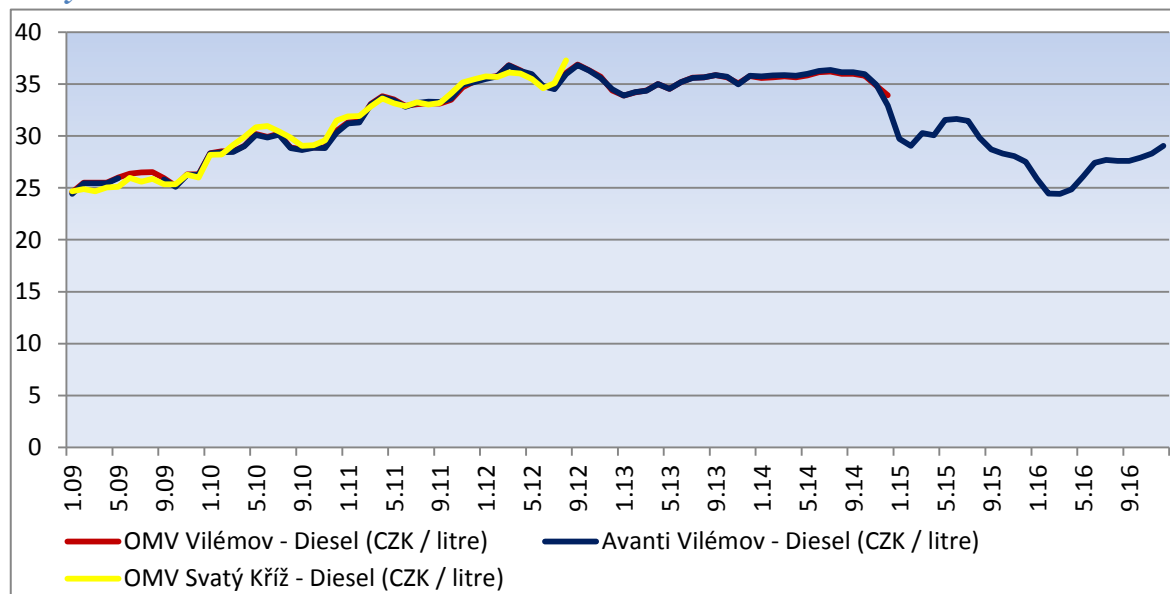
Figure 33 provides comparison of Diesel price development. As in case of Natural 95, the differences are not significant. It was again due to the close following of average price in the Czech Republic. The highest difference occurred during December 2012, where OMV Vilémov sold Diesel for 36.08 CZK / litre, Avanti Vilémov for 35.98 CZK / litre and OMV Svatý Kříž for 37.30 CZK / litre. Difference between gas stations in Vilémov is not significant since it is only 0.1 CZK / litre. However the difference between OMV Vilémov and OMV Svatý Kříž was 1.22 CZK / litre and that can be considered as significant.

Figure 32: Comparison of Natural 95 prices at OMV Vilémov, Avanti Vilémov and OMV Svatý Kříž



Source: Data - To&Mi Vdf. spol. s.r.o.; own figure (2017)

Figure 33: Comparison of Diesel prices at OMV Vilémov, Avanti Vilémov and OMV Svatý Kříž



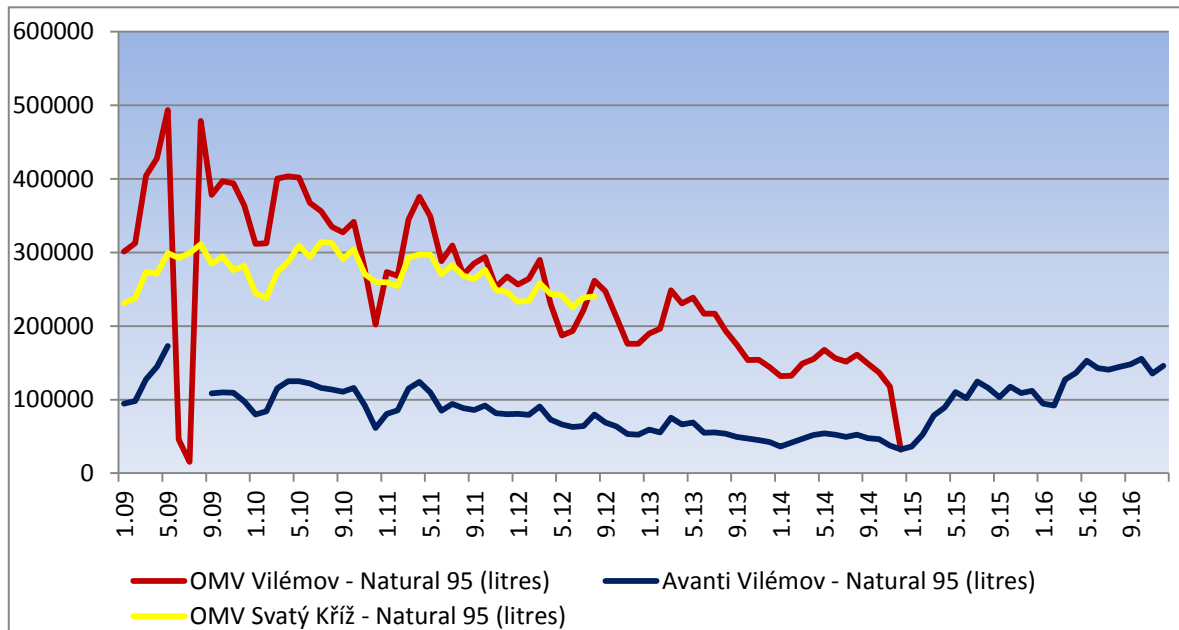
Source: Data - To&Mi Vdf. spol. s.r.o.; own figure (2017)

As for the comparison of fuel amount sold, the differences are much more significant. In the figure 34 is available comparison of Natural 95 sold by selected gas stations. The highest differences are between OMV Vilémov and Avanti Vilémov, both has stations are in the same city however OMV had much higher percentage share of German customers which were driving automobiles using gasoline engines (due to ecologic tax on Diesel in Germany). Difference in May 2009 was 320 605.66 litres. These differences were slowly narrowing. The differences between Avanti Vilémov and OMV Svatý Kříž were however nearly at the same level during years which means the amount of Natural 95 sold (even with global decreasing trend) was constant at these two gas stations and the only gas station that was actually falling was OMV Vilémov.

As the figure 34 shows, Avanti Vilémov was moving from nearly 200 thousands litres sold to the 20 thousand and then started to rise up again. The fall was then 90% however in the year 2016 the amount of sold gasoline is slowly reaching new maximum. The OMV Svatý Kříž was fluctuating between 300 thousand and 220 thousands of litres sold and therefore the differences represented around 27%. The worst development has OMV Vilémov. Its maximum was nearly half a million of litres sold per month. The most significant drop occurred in July 2009 when the amount of gasoline sold dropped by nearly 97%. The December was last month before change of owner, so it can be assumed that the

gas station was selling last reserves without buying supplies and therefore the amount of gasoline sold was only 31865.89 litres. However the constant amount of litres sold from previous months were around 150 thousands and the drop therefore was around 70% from maximum. The percentage drop was most significant at Avanti Vilémov however the actual amount drop was most significant at OMV Vilémov. The drop at OMV was around 350 thousands of litres while the drop at Avanti was 180 thousands of litres.

Figure 34: Comparison of Natural 95 sold at OMV Vilémov, Avanti Vilémov and OMV Svatý Kříž

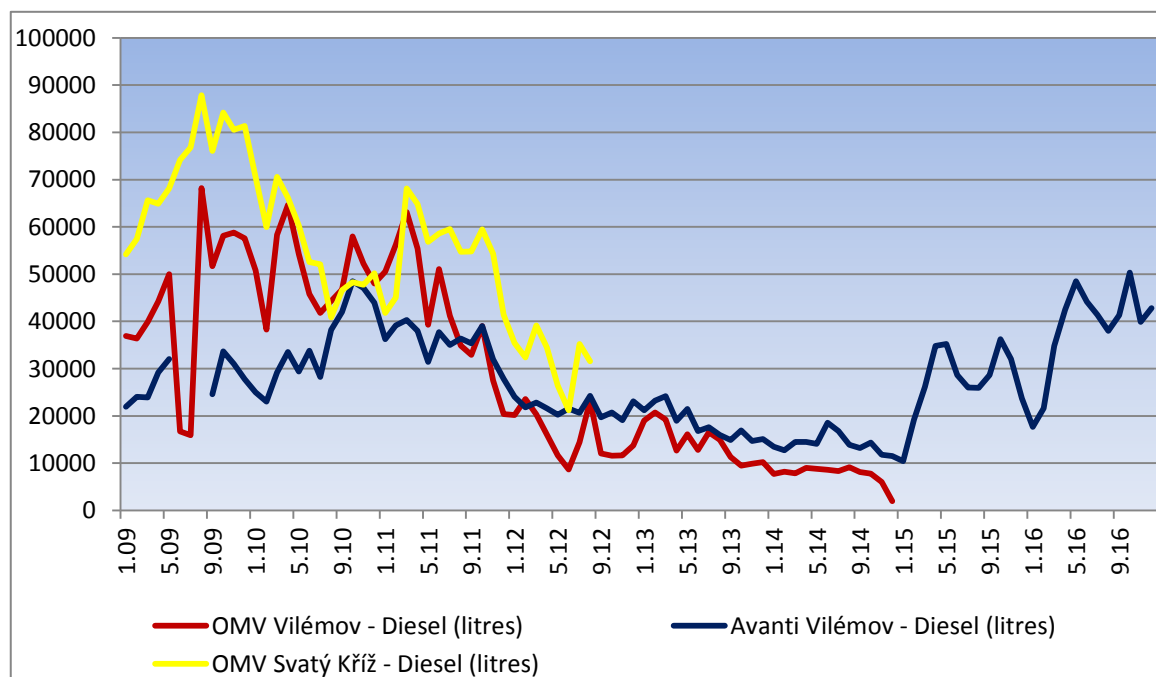


Source: Data - To&Mi Vdf. spol. s.r.o.; own figure (2017)

Unlike at the case of Natural 95, the highest amount of Diesel sold was at OMV Svatý Kříž. The OMV Svatý Kříž had many customers from nearby Cheb city. These customers were buying diesel on their way to Germany since it was the closest border crossing. Another reason was market strategy of gas station. OMV Svatý Kříž was offering invoice payments for Czech companies which were paid monthly (and included certain discount) and the Czech companies are using more diesel engines than gasoline. The fluctuations at this gas station had overall decreasing tendency. The maximum was nearly 90 thousands of litres sold and fell to the 40 thousands. The first drop was therefore 56%. The amount of Diesel sold increased to 70 thousands of litres rapidly and immediately started to fall again. The new minimum was 20 thousands of litres sold. Drop was therefore 71.43% (77.78% from maximum). At that time was OMV Svatý Kříž sold and other

development is not available. Similar progress had OMV Vilémov. Its maximum was nearly 70 thousands of litres sold and dropped to the level of 9 thousands of litres sold. The drop was therefore around 87%. The least unpleasant development had Avanti Vilémov. Its previous maximum reached 50 thousands of litres sold, and fell to the 10 thousands of litres sold. The drop was 80%, however the gas station started to increase its amount of Diesel sold and reached the new maximum of 50 325.16 litres of Diesel sold. If the last month before the selling of gas station is compared to the Avanti Vilémov, in the September 2012, the drop of OMV Svatý Kříž was nearly 60 thousands of litres sold while the drop of Avanti was around 26 thousands of litres sold. At the December 2014, the drop of OMV Vilémov was around 62 thousands of litres sold while the drop of Avanti was 40 thousands of litres. That is a reason why least unpleasant development had Avanti Vilémov and it is also probably reason why To&Mi Vdf. spol. s.r.o. sold OMVs and keep Avanti (now named Tix Express) for themselves.

Figure 35: Comparison of Diesel sold at OMV Vilémov, Avanti Vilémov and OMV Svatý Kříž



Source: Data - To&Mi Vdf. spol. s.r.o.; own figure (2017)

5 Conclusion

The development of crude oil in the history was relatively unstable if the price is recalculated to the purchase power of USD in the 2015. As it was proven, the most significant factor affecting price of crude oil is situation in countries which are located in the Middle East since these countries has one of the largest deposits of crude oil. These countries together with other countries which are exporters of crude oil have become part of Organization of Petroleum Exporting Countries (OPEC) and started to control situation around crude oil extraction in the world. The price of crude oil is directly affecting price of crude oil fuels in every country around the world and as such even the fuel price in the Czech Republic.

The fuel price is affected by the national policies which are mostly occurring in form of taxes, namely excise tax and value added tax (VAT). The excise tax in the Czech Republic has grown once during last decade. This increase came in force in October 2010 and it changed excise tax of Natural 95 from 11.84 CZK per litre to the 12.84 CZK per litre and excise tax of Diesel from 9.95 CZK per litre to the 10.95 CZK per litre. During the year 2010 the value added tax was firstly increased as well and the change was from 19% to the 20%. Second increase of value added tax came in the January of 2013. This change was again by 1% therefore the final value was 21% which remains unchanged. Based on this situation, the estimated econometric model is using relation of fuel price which is dependent on price of crude oil, excise tax and value added tax.

Regression statistics of Natural 95 stated that excise tax of Natural 95 is the most influencing factor of this relationship with the crude oil price on second place. Both of these factors are statistically significant at probability of 95%, while the value added tax is least influencing factor and at probability of 95% is not statistically significant (significant at 94%). This relation is explaining 90.8% of real situation. The calculations also prove that approximately half of final fuel price is represented by taxes.

Same process was used for relationship of Diesel. Regression statistics stated that crude oil is the most influencing factor in this relationship. Value added tax is the least influencing however statistically significant factor. The excise tax in this case is not statistically significant with same probability level used (95%). This model is explaining 93.6% of real situation. The calculations prove the same share of taxes in the final fuel

price as it was in case of Natural 95. Linear prognosis is assuming increasing price of Natural 95 and Diesel in following periods.

The real purchase prices are however set by different method than by the econometric model. The actual prices of fuels are based on calculation which involves average of daily quotations from previous week, inline bonus which is margin of traders, exchange rate of USD which is calculated as average of daily exchange rates from previous week announced by Czech National Bank, density of product which is constant based on type of fuel and price of traffic transport which is sometimes part of inline bonus.

The selling prices which are prices for end consumer are mostly affected by location of gas station. The prices are higher at gas stations at highways than at “hidden” countryside gas stations. The countryside gas stations have difficulties to pay operating costs due to low prices which is reason why these gas stations are changing owners often. This is reason why many of smaller gas stations are making franchise contracts with huge brands.

Comparison of selected gas stations shows importance of foreign customers at gas stations near the border crossings. The prices of fuels at these gas stations are usually below average price of fuels in the Czech Republic. The exchange rate of CZK per EUR is surprisingly not playing huge role for foreign customers as the CZK was weakening yet amount of fuels sold was decreasing.

The most significant complications for gas stations were increases in taxes, especially in the excise tax. In order to keep attractive prices for foreign customers, the gas stations had to lower their profit margin by amount equal to tax increase. In other words the gas stations lowered their profit margin by more than 1.2 CZK per litre of fuel sold. With the amount of fuels sold which is moving between 8 thousands to 90 thousands for Diesel and 40 thousands to 500 thousands for Natural 95, the gas stations lost profit moving between 57.6 thousands to 600 thousands CZK per month (each gas station).

Due to high purchase price, many of gas stations cannot go lower with selling prices which is making possibility to attract foreign customers impossible. Therefore the lowering of excise tax and value added tax would be a good move from Czech

government. If the Czech Republic had lower prices (due to lower taxes), as it is a transit country, the income would be higher in fact.

As the development of CZK / EUR exchange rate and development of amount of fuels sold shows, the exchange rate is not the main decision making factor for foreign customers. The devaluation of Czech Crown can decrease the relative price of fuels for foreign customers, but at the same time it increases actual price of fuel because the exchange rates are directly affecting relative price of crude oil. Similar situation occurs with the possibility of revaluation of Czech Crown.

Revaluation of Czech Crown would lower the exchange rates which would result in decrease of relative price of crude oil which is one of the main factors affecting price of fuels in the Czech Republic. With decreased price of crude oil, the price of fuels should decrease as well. The actual fuel price in Czech Republic would therefore decrease but the price is in CZK, with revaluated CZK the exchange rates would be less pleasant for foreign customers. The relative price of fuels for foreign customers therefore is supposed to remain same.

The only way how to attract foreign customers to the Czech Republic is therefore adjusting separate exchange rates. The crude oil is traded with usage of USD as main currency. If the CZK / USD exchange rate decreases while the CZK / EUR exchange rate remains same or increases, the actual price of fuels will decrease due to relatively cheaper crude oil and at the same time the relative price of fuels will further decrease due to increased purchase power of EUR.

6 References

- [1] BIBLION, o. s., 2009, Bible, překlad 21. století, ISBN 978-80-87282-01-4
- [2] BLAŽEK J., RÁDL V.: Základy zpracování a využití ropy, 2. vydání, Vysoká škola chemicko-technologická v Praze, Praha 2006, ISBN 80-7080-619-2
- [3] BRAIN M. 2000, What does octane mean? [online] available at:
<http://auto.howstuffworks.com/fuel-efficiency/fuel-consumption/question90.htm>
[2016-10-17]
- [4] BRITISH PETROLEUM, 2016, BP Statistical Review of World Energy June 2016
[online] available at: <http://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy/downloads.html> [2016-12-14]
- [5] CZECH REPUBLIC, 2004, Act no. 235/2004 Coll. about value added tax [online]
available at:
<https://portal.gov.cz/app/zakony/zakonPar.jsp?idBiblio=57849&fulltext=da~C5~88~20z~20p~C5~99idan~C3~A9~20hodnoty&rpp=15#local-content> [2016-09-27]
- [6] CZECH REPUBLIC, 2003, Act no. 353/2003 Coll. about excise tax [online] available at:
<https://portal.gov.cz/app/zakony/zakon.jsp?page=0&nr=353~2F2003&rpp=15#seznam>
[2016-09-27]
- [7] FREUDENRICH C., Ph.D., 2001, How Oil Refining Works [online] available at:
<http://science.howstuffworks.com/environmental/energy/oil-refining.htm> [2016-09-26]
- [8] GAPP B., 2015, What Is Franchising [online] available at:
https://www.franchising.com/articles/what_is_franchising.html [2016-11-07]
- [9] ISHIMWE D., 2014, Origin and Formation of Petroleum [online] available at:
<http://connect.spe.org/blogs/donatien-ishimwe/2014/09/11/origin-and-formation-of-petroleum> [2016-11-03]
- [10] 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/> [2017-02-07]

- [11] MALÉ PENÍZE, 2011, Case – composition of gasoline price at gas station (Případ – složení ceny benzínu u čerpací stanice) [online] available at:
<http://www.malepenize.cz/2011/11/07/pripad-%E2%80%93-slozeni-ceny-benzinu-u-čerpaci-stanice.html> [2016-11-17]
- [12] NOVINKY.CZ, 2016, Large slate crude oil field was found in Texas, it probably the largest in the USA (V Texasu objevili obří břidlicové ropné pole, zřejmě největší v USA) [online] available at: <https://www.novinky.cz/ekonomika/420990-v-texasu-objevili-obri-bridlicove-ropne-pole-zrejme-nejvetsi-v-usa.html> [2017-01-09]
- [13] OPEC, 2016, Brief history [online] available at:
http://www.opec.org/opec_web/en/about_us/24.htm [2016-10-19]
- [14] OPEC, 2016, OPEC Share of world crude oil reserves, 2015 [online] available at:
http://www.opec.org/opec_web/en/data_figures/330.htm [2016-12-02]
- [15] OPEC, 2016, World proven crude oil reserves: cumulative production versus net additions, 2006 – 2015 [online] available at:
http://www.opec.org/opec_web/en/data_figures/331.htm [2016-12-02]
- [16] PETR P., PATRIA ONLINE, 2014, The American mega straws USA returns to map oil superpower; However, you know the Bakken or the Permian Basin in detail? (Americká megabrčka vrací USA na mapu ropných velmocí; znáte ovšem Bakken nebo Permian Basin podrobněji?) [online] available at:
<https://www.patria.cz/zpravodajstvi/2756062/americka-megabrcka-vraci-usa-na-mapu-ropnych-velmoci-znate-ovsem-bakken-nebo-permian-basin-podrobneji.html> [2017-01-10]
- [17] PETROLEUM.CO.UK, 2015, Abiotic oil formation, [online] available at:
<http://www.petroleum.co.uk/abiotic-oil-formation> [2016-10-23]
- [18] PETROLEUM.CZ, 2007, Hypothesis about inorganic origin of crude oil (Hypotézy o anorganickém původu ropy), [online] available at:
http://www.petroleum.cz/ropa/anorganicky_puvod_ropy.aspx [2016-11-13]
- [19] PETROLEUM.CZ, 2007, Origin of crude oil (Vznik ropy), [online] available at:
<http://www.petroleum.cz/ropa/vznik-ropy.aspx> [2016-11-13]

- [20] PETROLEUM.CZ, 2007, Origin, formation, searching and extraction of crude oil (Původ, vznik, vyhledávání a těžba ropy) [online] available at: <http://www.petroleum.cz/ropa/> [2016-10-22]
- [21] SPEIGHT, James G, 2011. An introduction to petroleum technology, economics, and politics. Hoboken, N.J.: Wiley, 302 p. ISBN 1118012992
- [22] SUMMERS V., 2015, The origin of crude oil or petroleum: Biotic or abiotic?, [online] available at: <http://www.decodedscience.org/origin-crude-oil-petroleum-biotic-abiotic/54008> [2016-10-20]
- [23] UNIPETROL RPA, S.R.O., 2016, Find the closest Benzina [online] available at: <http://www.benzina.cz/en/stations/Pages/main.aspx> [2017-01-14]
- [24] ROBIN OIL, S.R.O., 2010, Draft Contract (Návrh smlouvy) [online] available at: http://www.robinoil.cz/index.php?option=com_content&view=article&id=69&Itemid=100 [2016-12-16]
- [25] ČNB, Czech National Bank, 2017, Selected exchange rates (Vybrané devizové kurzy) [online] available at: http://www.cnb.cz/cs/financni_trhy/devizovy_trh/kurzy_devizoveho_trhu/vybrane_form.jsp [2017-03-02]
- [26] ČTK, 2016, Probably the largest slate crude oil field in the USA is hiding 20 billion barrels of crude oil (Zřejmě největší břidlicové ropné pole v USA ukrývá 20 miliard barelů ropy) [online] available at: <http://www.euro.cz/byznys/zrejme-nejvetsi-bridlicove-ropne-pole-v-usa-ukryva-20-miliard-barelu-ropy-1315806> [2016-01-10]