University of Economics in Prague

Faculty of Economics

Study Program: Economic Policy

Development of Oil Prices and its Impact on Inflation

Master's Thesis

Author: Bc. Magdalena Krkošková

Thesis Supervisor: Zdeněk Pikhart

Prohlášení:

Prohlašuji, že diplomovou práci na téma

Development of Oil Prices and its Impact on Inflation

jsem vypracovala samostatně. Použitou literaturu a podkladové materiály uvádím v přiloženém seznamu literatury.

V Praze dne 15.8. 2014 **Magdalena Krkošková**

I would like to thank Mr. Ing. Zdeněk Pikhart for professional supervision of my diploma thesis. Furthermore, I would like to thank my family for all the support during my studies.

Vysoká škola ekonomická v Praze **Národohospodářská fakulta**
Katedra hospodářské a sociální politiky **2014/2015**

ZADANÍ DIPLOMOVÉ PRÁCE

Autorka práce: Bc. Magdalena Krkošková
Studijní program: Ekonomie a hospodářská správa
Obor: Hospodářská politika

Název tématu: **Development of Oil Prices and its Impact on Inflation**

Rozsah práce: 70

Rámcový obsah:

1. The aim of the thesis is to observe correlation between the development of oil prices and inflation rate. Both oil prices and inflation tend to move in the same direction. Development of oil prices has an impact on the aggregate supply as oil is one of the main inputs in the economy. The correlation will be testified on the data of the United States.
2. Oil belongs to unsustainable resources; therefore, its scarcity is increasing in time. There is a tendency to replace oil by other resources; however, its price is still moving upwards. Higher price of oil is influencing macroeconomic indicators, such as inflation. The focus will be on the relationship of oil prices and inflation.
3. In the theoretical part, the theory of aggregate supply and its changes in accordance with the oil price changes will be discussed. This problem gained the attention with the oil shocks during the 1970s of the previous century. Secondly, there will be distinguished different types of inflation, concentrating on the cost-push inflation. Thirdly, different methods of measuring of inflation will be discussed.
4. With the use of statistical methods, there will be verified whether the oil price changes have statistically significant influence on inflation. This analysis will be based on the data of FED and development of WTI.

Seznam odborné literatury:

1. HOLMAN, R. *Makroekonomie : středně pokročilý kurz.* Praha: C.H. Beck, 2010. ISBN 978-80-7179-861-3.
2. Barsky R. B.; Kilian L.: Oil and the Macroeconomy Since 1970s, J. of Econ. Perspectives 18: Fall, 115-134.
3. Bernanke B. S.; Gertler M.; Watson M.; Sims C. A.; Friedman B. M.: "Systematic monetary policy and the effects of oil price shocks," Brookings Papers on Economic Activity, Vol. 1997.
4. Bodenstein M., Guerrieri L., Kilian L. 2012. Monetary Policy Responses to Oil Price Fluctuations. IMF Econ. Rev. 60: 470-504.
5. Hamilton, J. D. 2009. Causes and Consequences of the Oil Shock of 2007 – 08, Brookings Papers on Economic Activity, spring 2009.

Datum zadání diplomové práce: **březen 2014**

Termín odevzdání diplomové práce: **září 2014**

Bc. Magdalena Krkošková
Řešitelka

Ing. Zdeněk Pikhart
Vedoucí práce

doc. Ing. Miroslav Ševčík, CSc.
Vedoucí ústavu

doc. Ing. Miroslav Ševčík, CSc.
Děkan NF VŠE

Abstract

The purpose of the thesis is to observe relationship between the development of oil price and the rate of inflation. Oil is one of the main inputs in the economy, and, therefore, the price change influences the aggregate supply and macroeconomic indicators, such as inflation. The aim is to analyze whether there is a positive relationship between the price of oil and inflation. Theoretical part of the thesis is concentrated on the theory of inflation, its components and way of measurements. Furthermore, there is discussed chronological development of oil prices and the relationship between oil prices and inflation. Practical part is based on the econometric model used in order to testify the dependence of inflation on the price of oil. There are used quarterly data of the United States of America collected from the U.S. Energy Information Administration and Federal Reserve Bank of St. Louis from January 1986 to March 2014. The final part discusses the results of four used models and meeting of aims.

Key words

inflation, oil price changes, monetary policy

JEL Classification

E31, E52, L71

Abstrakt

Cílem diplomové práce je zkoumání vztahu mezi vývojem cen ropy a mírou inflace. Ropa patří k hlavním vstupům ekonomik, a proto také změna její ceny ovlivňuje agregátní nabídku a makroekonomické indikátory mezi něž se řadí také inflace. Úkolem je analyzovat, zda-li je mezi cenami ropy a inflací pozitivní vztah. Teoretická část práce se soustřeďuje na teorii inflace, její komponenty a způsoby měření. Dále je v této části diskutován chronologický vývoj cen ropy a z něj vyplývající vztah mezi cenami ropy a inflací. Praktická část pracuje s ekonometrickým modelem, který je použit za účelem testování vztahu mezi změnami cen ropy a inflace. Model pracuje s čtvrtletními daty USA sesbíranými z amerického úřadu pro energetické informace, který poskytuje oficiální energetické statistiky (U.S. Energy Information Administration) a Federal Reserve Bank of St. Louis. Model je postaven na časovém období od ledna 1986 do března 2014. Závěrečná část práce diskutuje výsledky provedené analýzy a poskytuje porovnání výsledků čtyř použitých modelů společně s diskuzí o naplnění cílů.

Klíčová slova

inflace, změny cen ropy, měnová politika

JEL Klasifikace

E31, E52, L71

Table of Contents

Introduction

Rate of inflation and price of oil are very much discussed on the daily basis. Both of them influence not only the economy as a whole but also individuals. There are permanent needs to find the way to replace usage of oil by other alternative resources. These needs are a result of the fact that oil belongs to unsustainable resources, whose scarcity is, therefore, increasing in time. Despite of the tries to replace the usage of oil, its price continuously rises.

During 1970s, world economies experienced two oil shocks that brought the price of oil to inconceivable heights. It was during these few years when the connection between the price of oil and inflation was noticed. Inflation was moving suspiciously similarly as the oil price. There was no reason for wondering: oil is one of the most important inputs in economies; therefore, the increase in its price will have an impact on prices of other goods and services whose production demands oil. The correlation between the oil price and inflation was quite significant during the 1970s; as a matter of fact, the most significant in comparison to following decades. Even though, world has experienced other oil shocks, for example during Iraq-Kuwait War in 1990, or more recently during the financial crises in 2008, rate of inflation was never copying the increase in the price of oil as significantly as during 1970s.

In most of the world's economies, monetary policy chooses inflation as its final aim. Inflation targeting was used in New Zealand for the first time in 1990. The Czech Republic adopted the system in 1998 and has been using it till nowadays. By uttering the inflation target, central banks commit themselves to keep it. When the oil price rises as it did during 2008, committed central banks have to keep the level of inflation in the target zone. That might be one of the reasons why the inflation does not adjust to the increase in oil price as significantly as during 1970s. However, central banks use the information about the price of oil for their prognostic activity, which may indicate of the oil price's ability to evoke the rate of inflation to change.

The thesis is divided into four parts. Theoretical part pays attention firstly to the theory of inflation, its components and different ways of measuring; secondly, it concentrates on the chronological development of oil prices; and, thirdly, it discusses

the relationship between the price of oil and the rate of inflation. Practical part is applied to an empirical analysis in order to testify whether there is a positive relationship between the nominal price of oil and inflation. The analysis is based on the data of the United States that was collected from the U.S. Energy Information Administration and Federal Reserve Bank of St. Louis from January 1986 to March 2014 and is executed in statistical program EViews. The aim of the thesis is to testify the relationship between oil price and inflation in the period of time that is supposed to be characterized by a weaker relationship between the two variables.

1. Inflation

Inflation is defined by the Federal Reserve System as *"a general increase in the overall price level of the goods and services in the economy."*[1]

Back in the days, it was not easy to raise amount of money in a country: precious metals were used for trade. The only way to increase the amount was to change material of coins, either by changing the type of metal entirely, or by substituting part of the structure by a cheaper replacement. As the new coin was lighter and cheaper to make, the difference between its nominal value and the costs (both production and transaction costs) appeared. Such difference became a profit, and it is known as the term coinage.

An example of such inflation in history could be seen in the Roman Empire during the first three centuries. The military expenses may be considered as the main reason for inflation. All the costs, which could not have been covered with continuously increasing tax rates, were covered by the coinage. Government was aware of consequences and started to accept tax payments in perquisites to be better off. Between 258 and 275, the prices rose almost by 1000 %.[2] Another well-known example is the case of Spain during the Age of Discovery. When the so-called New World was

[1] Board of Governors of the Federal Reserve System
[2] Peden, 2009

discovered, not only the land, but also its treasury was revealed. Precious metals were brought back to Europe. At the beginning, it might have seemed like an increase in country's wealth; however, the prices started to rise together with increasing fortune brought to Spain from outside of the country. However, it took long time to mine and subsequently bring the precious metals from America back to Europe; it was also very costly, and, therefore, the inflation was moderate comparing to the levels it reached during the 20th century.[3]

The costs of issuing money are significantly lower and bank notes can be easily printed: this activity falls within responsibility of central banks. With the system of fractional reserve banking, not only central banks, but also commercial banks increase the amount of money in the economy. Commercial banks have to keep only a fraction of deposits; the rest could be provided as loans in order to support investing activities.

During the 1990s, central banks started to use inflation targeting. The first bank that used such rule of monetary policy was Reserve Bank of New Zealand.[4] The only long-term aim of monetary policy is the rate of inflation, which is guaranteed to meet. Such aim is announced up front; if the central bank is trustworthy, people adopt themselves, and, therefore, the aim is closer to be fulfilled. There are different causes of inflation (as it will be discussed later); therefore, central banks use a range for inflation instead of targeting one exact number. For example, the Czech National Bank determines its inflation target as a range of 1 to 3 % in 2014.[5]

1.1 Components of inflation

Inflation consists of three components: demand-pull inflation, built-in inflation, and cost-push inflation.

$$\pi = \pi_e + [\varepsilon \cdot (u^* - u) - \eta] + \nu, \tag{1.1}$$

where π stands for total inflation,

[3] Kugler, Bernholz, 2007
[4] Holman, 2004, p. 379
[5] Česká národní banka, 2014

π_e for built-in (expected) inflation,

$[\varepsilon \cdot (u^* - u) - \eta]$ for demand-pull inflation,

ν for cost-push inflation.[6]

1.1.1 Demand-pull inflation

Graphical expression of inflation could be seen on the aggregate demand and aggregate supply diagram. Demand-pull inflation is called according to the change in aggregate demand that causes actual inflation. As aggregate demand curve represents balance on both the market of goods and services and money market, its movement must be caused by changes in either one of them. Aggregate demand is, therefore, influenced by either fiscal or monetary policy. Fiscal policy directly increases aggregate expenses, monetary policy increases the aggregate demand through the increase of money supply that initiates the transmission mechanism. The impacts of either one of the policies are not definite. In order to discuss these impacts, the explanations will be supported by the macroeconomic theory of IS-LM model[7] for closed economy and by Mundell-Fleming model[8] for opened economy. Furthermore, there might be asked a question, whether fiscal stimulus can cause an increase in general price level by itself.[9] If government expenditures are increased, government debt increases as well; in order to pay such debt, government bonds might be issued. If the central bank buys these government bonds, money supply rises, and, therefore, also general price level increases. Monetary accommodation is, therefore, caused by financing the debt by a central bank; this process holds for further description of implementation of fiscal policy in different regimes.

Fiscal policy uses the fiscal stimulus to stimulate the economy. The most frequent way is to increase public spending (eventually to decrease taxation). If this stimulus was implemented in closed economy, there would be two counter effects

[6] Holman, 2004, p. 318
[7] Hicks, 1937
[8] Mundell, 1963
[9] Canova, Pappa, 2011, p. 9

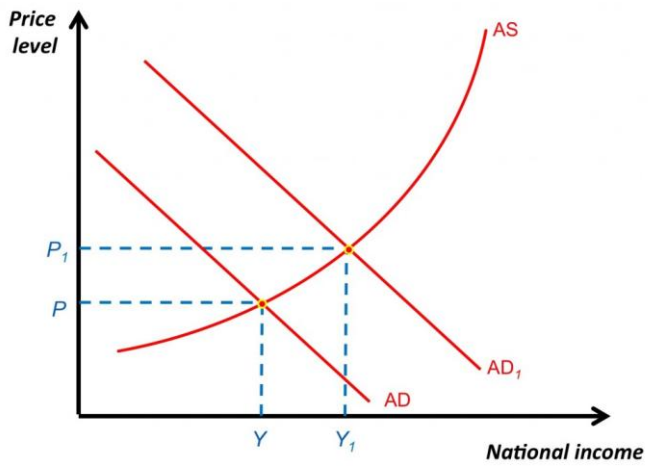
launched: on one hand, multiplication effect of public spending, and, on the other hand, displacement effect. Multiplication effect means that the gross domestic product increases by multiple times until the multiplication effect is drained. As the gross domestic product increases, also disposable income increases, and money demand shifts upwards together with the interest rate, as people tend to hold higher amount of money. Higher interest rate causes a decline in investing activities as well as in consumption. This effect is known as the displacement effect. Both effects counteract each other. Aggregate multiplication effect is built on assumptions of idle resources and uninvested savings; furthermore, it holds for fixed price level, exchange rate and wages. If the assumptions are not met, the multiplier would equal to infinity, and, in such case the process does not hold.

If the government increases government expenditures in opened economy, it might have two different results depending on the regime of exchange rate. In the economy with the floating exchange rate, fiscal policy is fully ineffective. This inefficiency is caused by displacement of net exports by government expenditures. On the other hand, stimulation of aggregate demand in the regime of fixed exchange rate is fully efficient. If the economy operates in the regime of fixed exchange rate, central bank of such economy guaranties to keep the exchange rate in an exactly determined range. The pressure for appreciation will be stopped by the intervention of a central bank: central bank will sell the currency, and, therefore, increase the money supply. The multiplication effect will appeal; however, displacement effect will be suppressed in this case.

Monetary policy influences the amount of money in economy, i.e. money supply, and it is in hands of a central bank. There are three final objectives of monetary policy: inflation, unemployment, and net export. While specifying the aims, it is necessary to specify also the time range. Unemployment rate and net export could be thought of as short-term objectives; whereas, inflation is the only long-term objective of monetary policy. Monetary policy reaches the goals by using policy tools that leads to fulfillment of operation objectives, furthermore intermediate objectives, until if finally reaches the final objectives.

Changes in money supply lead to the changes in aggregate demand. The efficiency of such changes differs regarding to the regime of the exchange rate. If the economy operates in the regime of floating exchange rate, monetary policy is fully efficient. If the money supply increases, the gross domestic product rises as well. On the other hand, in the economy with the regime of fixed exchange rate, monetary policy is fully ineffective. In case of increasing of money supply, a pressure for depreciation appears. However, central bank guaranties to keep the exchange rate in determined range, and, therefore, it must react on such pressure for depreciation by decreasing of money supply.

Figure No. 1 Demand-pull inflation



Source: *Inflation and Deflation.* Available at: http://revisionguru.co.uk/

1.1.2 Built-in inflation

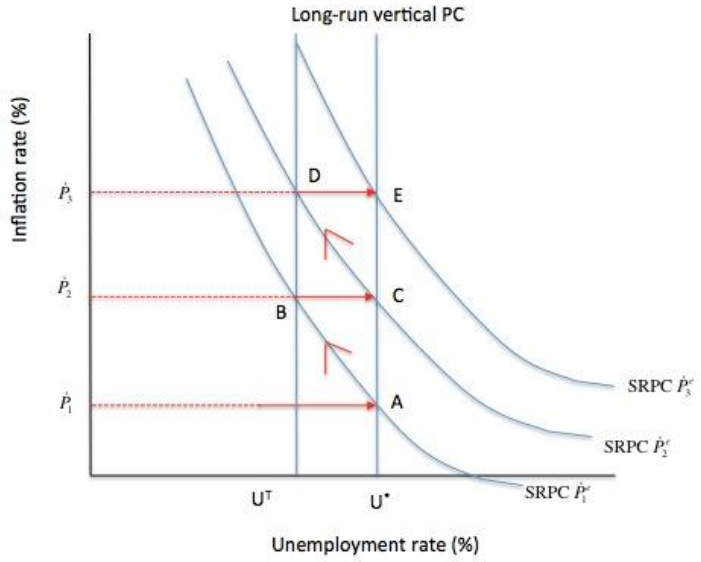
Built-in inflation is caused by inflation expectations. People accommodate themselves to a lot of things; inflation is no exception. Inflation expectations are a function of monetary accommodation and the change in productivity. Furthermore, increasing expectations push the real interest rate down; therefore, people are motivated to use credit services and to take loans. And thus higher inflation expectations are enough to cause monetary expansion. There could be distinguished two types of expectations: adaptive expectations and rational expectations.

Adaptive expectations hypothesis was most famously introduced by Milton Friedman in 1968.[10] However, it was introduced by Irving Fisher in the book "The Purchasing Power of Money" for the first time in 1911.[11] Friedman also introduced the term natural rate of unemployment that replaced the term full employment.[12] If the economy reaches its potential product, it does not mean there is zero rate of unemployment; however, there is the natural rate of unemployment in the economy. The potential product is automatically reached on such rate of unemployment in long run. In short run, it could seem like there might be a choice between inflation and the rate of unemployment: this trade-off was graphically expressed by Phillips curve introduced by New Zealander William Phillips in 1958.[13] He was observing a relation between increase in nominal wages and the unemployment rate. Friedman observed that the relation is functional; however, only in short run, until people realize the change in price level and the unemployment rate returns to the level of the natural rate of unemployment. The cause for decreasing and consequential increasing of the unemployment rate is a time delay in peoples' inflation perception. As the money supply increases, also aggregate demand moves upwards, which brings along an increase in prices and nominal wages. People are not able to distinguish between changes in nominal wages and real wages, and, therefore, they may mistake the change in nominal wages for the change in real wages. Higher real wage motivates individuals to offer more work execution than before. Some people would not be willing to work for one wage evaluation, they are better off at home; however, another wage evaluation – higher one – could already be a motivation for them to enter the labor market. Under the confusion of higher real wages, labor supply increases. After some time, people notice the higher prices and they realize that the change in their wage was only a change in nominal wage, not the real one. They will accommodate their labor supply to these findings and the unemployment rate will be increasing until it reaches the level of the natural rate of unemployment. According to the short-run and long-run view on Phillips curve, there could be distinguished two different developments of short-run and long-

[10] Friedman, 1968
[11] *Monetarism: Adaptive expectations*. Policonomics
[12] Birol, 2013
[13] Phillips, 1958

run Phillips curve. Short-run Philips curve is convex to the origin, and intersects the long-run Phillips curve that is perpendicular to the x-axis.[14]

Figure No. 2 The expectations – augmented long-run Phillips curve



Source: *Unemployment and inflation*. Available at: http://bilbo.economicoutlook.net

Adaptive expectations are based only on previous experience. If the inflation rate is 2% this year, people expect 2% inflation also in the upcoming year. Disadvantage of this hypothesis may be particularly seen in the source of expectations: there might have been different conditions last year that do not have to fit this year situation. Answer to this problem is given by controversial hypothesis introduced by John Muth in 1961 for the first time.[15] John Muth (1930-2005) was an American economist and he is considered the father of the rational expectations revolution in economics.[16] Even though he introduced the term, Robert E. Lucas Jr., a representative of New Classical economists, worked with the terminology and it became a part of macroeconomic approach in general. The theory he was working with – the Lucas Model – is one of the theories of economic cycles. In the model, he points out that firms might sometimes

[14] Birol, 2013
[15] Muth, 1961
[16] Server: http://www.macrosearch.org

face the confusion, whether the increase in prices is the result of higher demand, and, therefore, they should adapt their production in order to satisfy the higher demand, or the increase is an increase in overall price level. The firms might not recognize the real cause of higher prices, and they might increase their production, even though the demand did not change; however, the economy is experiencing inflation. In such case, inflation could cause an increase in GDP. Lucas works with the rational expectations according to which people are able to base their decisions not only on previous experience but they also collect information to approximate their decision to the situation, which will appear in future. The reason for above described confusion of firms deciding on quantity of their production is disability to gain information about inflation and use it to adopt the expectations. One of the problems of Lucas model is the fact that rationally thinking individuals can adopt their expectations monthly in real world, as the rate of inflation is evaluated every month.[17]

The difference between adaptive and rational expectations is significant. Adaptive expectations are based only on previous experience that builds in peoples' expectations for the future events; rational expectations are made regarding to more decisive factors. According to this approach, not only that people use their previous experience, they also have an access to current information that is useful in the decision-making process. Information does not have to be always correct: there might appear unpredictable events that could not have been expected, and may deviate the rationally expected result from the correct result. However, in general, the expectations are deployed around the correct result, which also supports the critics of Lucas Model.

Rationality of people is also hidden in their use of information. Gaining information does not bring only higher probability of correct result, it brings also costs. The cost-benefit analysis may be applied here. Cost-benefit analysis was introduced by a French[18] economist Jules Dupuit (1844).[19] His observations were based on public sector, where he was comparing benefits from public work and actual generated

[17] Romer, 2006

[18] Jules Dupuit was born in Italy; however, his family emigrated to France at his young age; therefore, he is considered French engineer and economist.

[19] Maneschi, 1996

revenues from public work that did not match.[20] Over the time, cost-benefit analysis became a useful tool in different fields, not only public sector. Gary Becker (1976)[21] was able to use the economic approach on any topic, even the one not considered an economic topic. Principle of economic rationality lies in the effort to maximize personal utility. By applying cost-benefit analysis on the problem of obtaining information to make an expectation that matches the correct result, rational person always tend to balance cost of obtaining the information and benefits that result from this information. If the costs of information would be higher than benefits, it is not rational to "buy" any further information.

Phillips curve with rational expectations is perpendicular to the x-axis: the policies are predictable, and, therefore, people react by changing their expectations, and the rate of unemployment does not decrease below the natural rate of unemployment. According to New Classical economists, who work with rational expectations, the only effective policy is the one that is not expected and could not be predicted. Whichever from these two hypothesis – adaptive expectations, rational expectations – is used, each one of them results in the fact that built-in inflation is caused by the rate of inflation that is expected in the economy.

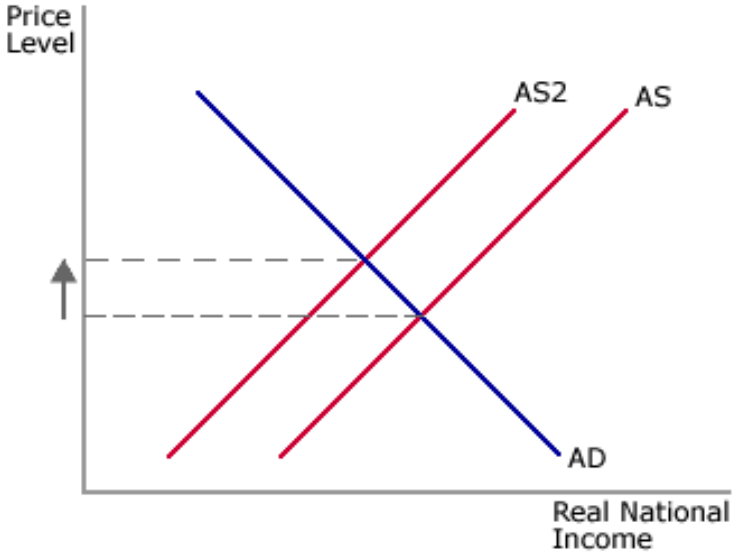
1.1.3 Cost-push inflation

Cost-push inflation is a type of inflation caused by the change in aggregate supply, and such change is a result of negative supply shock. In general, the negative supply shock is a result of increasing costs that push the price level upwards. However, not prices of all costs could have such a huge impact on causing inflation. Costs, which are able to cause an increase in price level, are the ones that come into production of significant number of products or services in the economy – such as oil or labor. Another impact of such shock is abandonment of the potential product in the economy and decreasing of the real product under the potential one. This impact is a result of higher costs that make production more costly, and, therefore, the aggregate supply moves to the left. As already mentioned above, if the economy is on its potential and

[20] National Center for Environmental Economics
[21] Holman, 2005, p. 440

embodies potential product, there is not a zero rate of unemployment but the natural one. With the decrease of real product, the rate of unemployment increases above the natural one, and there could be seen not only higher price level in the economy but also raised unemployment. Such situation is known as stagflation.[22]

Figure No. 3 Cost-push inflation



Source: *Monetary Policy – Inflation – Causes.* Available at: http://www.bized.co.uk

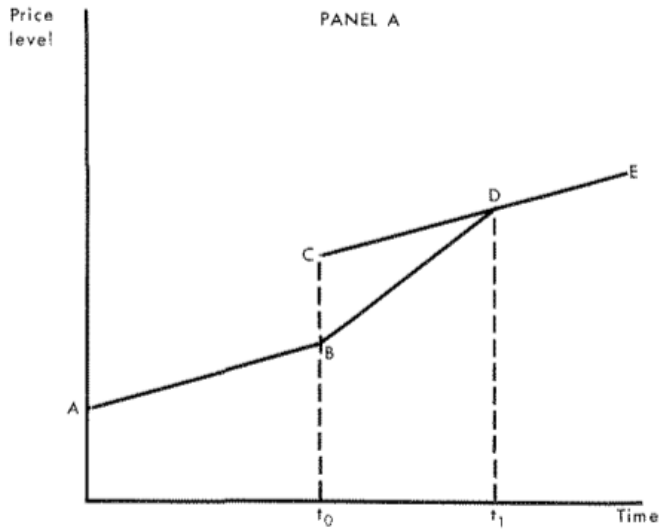
There might be opinions that cost-push inflation is just a myth, and no inflation like that actually exists. Batten (1981) evaluated that excessive money growth is the cause of everything. Inflation in every country and in any time can be explained in a different way; however, the headlines in the newspapers or on the Internet often blame OPEC from increasing the price of oil based on its own decision, or the crop failure this year, sometimes even the argument accusing businessmen who want to increase their prices in order to gain higher profits. Batten does not deny that increased prices of raw materials gradually send higher prices to whole economy; however, he tends to search for the cause for inflation even deeper. To support his view of inflation cause, it is necessary to distinguish between the change in overall price level and the relative price changes. According to the definition of inflation used in Chapter 1, inflation is a general

[22] Holman, 2004, p. 317

increase in the overall price level of the goods and services in the economy.[23] Therefore, inflation is such change in prices that applies for all prices, not the prices of individual goods and services. However, changes of some goods and services might have an impact on the measurement of inflation as will be discussed in the Chapter 1.2 Measurement of inflation that is focused on the different ways of measuring.

When the economy experiences a supply shock, it causes the change in overall price level. However, Batten emphasizes that such increased overall price level does not change the rate by which the price level grows. In other words, such supply shock causes the one time increase in overall price level; however, it does not have any impact on its further growth rate. He supports this opinion by following figure:

Figure No. 4 The supply shock and its impact on the trend rate of inflation



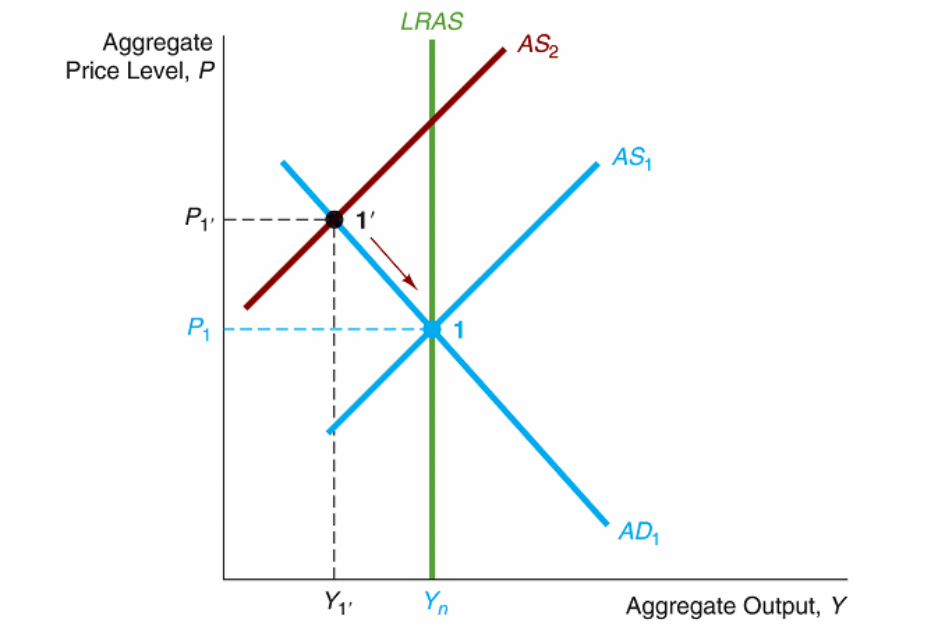
Source: BATTEN, Dallas S. *Inflation: The Cost-Push Myth.* p. 21. Federal Reserve Bank of St. Louis, June/July 1981, pp. 20 - 26

On this figure, which Batten used in his work, there might be seen different rates between points B and D. This abscissa expresses the temporary higher rate of growth of price level until the economy absorbs the supply shock in time t_1; from that point, the rate holds the same as between the points A and B.

[23] Board of Governors of the Federal Reserve System

Also other presumable causes of inflation are mentioned in the *"Inflation: The Cost-Push Myth"*. These other so-called causes of inflation often come from the explanations made by politicians, who try to look harmless in the eyes of society, and they rather blame trade unions or businesses, as already mentioned above. However, they might be partially right about the trade unions, which are not fully innocent in this area; they cannot take all blame for inflation though. Trade unions tend to protect the employees' rights; at least that is how they represent themselves. One of the things, they try to help the employees with, is protection of their wages from inflation. However, it is not easy to distinguish whether the growth rate of price level is permanent or only temporary as could be seen on Figure 4. If the wages rise in case of a supply shock, it might make it impossible for the price level to naturally decrease.

Figure No. 5 Supply shock and trade unions



Source: *Money and Inflation.* Available at: http://economistsview.typepad.com

On Figure 5, there could be seen the movement of aggregate supply upwards, as the supply shock appears. That causes the rise of price level from P_1 to $P_{1'}$. After some time, the aggregate supply would move back to AS_1 as the arrow illustrates and the price level would decrease back to P_1. However, as mentioned before, one of the types of protection provided by trade unions is to prevent the employees' wages from the negative impacts of inflation. Wages have to be automatically corrected according to the

actual price level; however, they cannot be lowered. Therefore, the economy can get stuck in the point 1' with higher price level and product that is under the potential one.

By Batten, the myth of cost-push inflation is seen in the source of inflation, which is always permanent excessive growth of aggregate demand. Businessmen, even the ones having a monopoly, which makes them profitable, are not able to increase prices of their products and services permanently. A monopolist always tends to find the way to maximize his profit; however, with increasing prices, the demand for his goods or services decreases, and sooner or later, his profit reaches the maximum, and with higher prices and lower amount bought it will start to decrease. Further increase in price would not make his business better off and he will not raise the prices anymore; therefore, the increase in prices is only temporary. As the theory about monopolists increasing eventually the overall price level was not confirmed, decreasing level of competition in economy started to be blamed for inflation. Product decreases with lower level of competition, and, therefore, price level rises. Even this thought was not supported by empirical studies.

According to Batten, the stimulus increasing prices moves through the sectors in the economy, and it always starts with increase of the aggregate demand. Higher aggregate demand reflects higher demands for goods and services. In order to satisfy the consumers' needs, businesses draw from their inventories, which have to be modified to meet the new higher demand. Adopted bigger amount of inventories is supplied from their suppliers, who will, eventually, have to increase their own inventories. This incentive is moving through the economy until it reaches the suppliers of raw materials. In case of raw materials, it is not that easy to accommodate demanded quantity, and, therefore, the price of raw materials increases with greater demand. The higher prices of raw materials will cause more costly production of goods and services, and, that might be seen as the actual reason for higher prices of all goods and services.[24]

[24] Batten, 1981, pp. 20 – 26

There might be seen two similar, but not very same thoughts: both of them agree on blaming the excessive money growth from inflation. When the economy experiences the supply shock, monetary institutions might fall under confusion, and they might consider decreased product as permanent, and, therefore feel the incentive to intervene by increasing of the money supply, which leads to an increase in aggregate demand. The economy will reach higher product; however, in exchange for higher overall price level. In such case, a question asking about whom to blame for inflation might appear.

The second thought was discussed above in details, and it is the thought expressed by Dallas S. Batten in the article *"Inflation – The Cost-Push Myth"*. According to this opinion, inflation is always caused by increased aggregate demand, in other words, by growth of money supply. In a nutshell, such increased aggregate demand creates a stimulus travelling through individual sectors until it reaches market with raw materials. At this point, the prices of raw materials really increase, and cause more costly production. The cause of inflation cannot be thrown at the suppliers of raw materials, who supposedly want to gain higher profit; it is necessary to search for the cause much deeper, namely in the increase of aggregate demand.

Even Milton Friedman with his wife Rose concentrated on the proximate cause of inflation in their book *"Free to Choose"* (1980), and commented on the constant need of government for blaming everyone for inflation but themselves.

"No government is willing to accept responsibility for producing inflation, even in less virulent degree. Government officials always find some excuse - greedy businessmen, grasping trade unions, spendthrift consumers, Arab sheikhs, bad weather, or anything else that seems even remotely plausible."[25]

Even though the question of the actual cause of inflation is very interesting and very much discussed topic in many crucial economic works, this work will be further concentrated on the development of oil prices, as oil is a crucial source used for overall production, and its impact on inflation. The cause of inflation will not be further examined in this study.

[25] Friedman M., Friedman R., 1980

1.2 Measurement of inflation

Inflation reflects the growth in overall price level. A person comes to a shop and chooses a good he would like to purchase, but he is not able to make such purchase today. He will come a week later and the price is 20 % higher. Such situation does not mean that the economy experienced inflation. Inflation causes an increase in prices of all goods in the economy. The change in price of the good he wanted to buy might have been caused by higher demand for such good; it cannot be considered as inflation's fault based only on increase in one good's price. It is not easy to measure inflation in the economy, and, on the top of that, there is not the only way to do so.

1.2.1 Consumer price index

One of the ways to measure inflation is consumer price index – CPI. The rate of inflation is then expressed as a percentage increase in consumer price index. The Economic Times use following definition of CPI: *"A comprehensive measure used for estimation of price changes in a basket of goods and services representative of consumption expenditure in an economy is called consumer price index."*[26]

Czech Statistical Office uses the CPI to measure the rate of inflation in the Czech Republic. In order to measure the changes, there must be two identical baskets of goods and services in two different time period. There are about 700 items in the basket in the Czech Republic, and the individual items have different weight in the basket. The weight of an item represents portion of consumption that the item is a part of on entire household consumption. The consumer basket consists of groceries, and other goods and services. In the first group, there are also Tabaco products except for food and drinks. Food and drinks are specified, they are not concentrated only on basic groceries. There are divided different specified types of bakery products, meat, etc. The entire list of items used for measuring CPI in the Czech Republic is published on the website of Czech Statistical Office. The second group includes products such as clothing, furniture and other equipment used for housing, mobile phones, means of transportation, and so

[26] *Definition of 'Consumer Price Index'.* The Economic Times

on. The third group specifies services that are used by households: health services, financial services, repair services, social care, public transportation, or services used to fill free time.[27]

As there are different types of inflation, and different types of measuring it, there are also different ways to measure inflation by consumer price index. In order to measure the rate of inflation correctly, it is necessary to specify factual, areal and time delimitation. Czech Statistical Office uses 4 different types of rate of inflation most often:

- Rate of inflation expressed as an increase in average annual CPI,
- Rate of inflation expressed as an increase in CPI relative to the same month of previous year,
- Rate of inflation expressed as an increase in CPI relative to previous month,
- Rate of inflation expressed as an increase in CPI relative to the base period.[28]

Each of these rates of inflation is suitable for different areas. The first type of rates of inflation that is expressed as an increase in average annual CPI expresses a percentage change in average price level in last 12 months compared to the average price level in previous 12 months. This rate of inflation could be used to modify or review average variables; for example, it is used for counting real wages, incomes and so on.

The second type representing the rate of inflation expressed as an increase in CPI relative to the same month of previous year expresses the percentage change in average price level in an actual month to the average price level in the exact month one year before. This type helps to purge from seasonal influences since the same month of the year is compared. This rate of inflation is suitable for counting real interest rates, real increase in property prices or valorization.

[27] Czech Statistical Office
[28] Ibid.

The third type is the proof of evaluating rate of inflation monthly as the critics of Lucas Model point out. It measures the change in price level in relation to previous month. It is counted by fixed base indexes. In the Czech Republic, year 2005 is set as the base year. The rate of inflation is, therefore, measured as the change in CPI of an actual month to the base period – year 2005. The Czech Statistical Office uses this rate of inflation for analyzing long-term detailed trends of price level development and costs of living.[29]

There is never only one rate of inflation that is correct, and the rest of them are wrong. It is necessary to distinguish among the types of rates of inflation and choose the most suitable one for the actual discussed topic. Furthermore, CPI is evaluated as an overestimated value. Such imperfection may be a result of its inability to capture substitution (more discussed in chapter 1.3). Laspeyres price index is used in order to measure the price changes:

$$P_L = \frac{\sum p_1 \cdot q_0}{\sum p_0 \cdot q_0} \tag{1.2}$$

1.2.2 Producer price indexes

Another important index to record changes in prices is the producer price index – PPI. By means of time series, it measures relative changes in prices in time. Such prices reflect the evaluation of production by producers on domestic market. The changes in retail prices are recorded on the primary market.[30] This index is used for goods that were produced in the same country as they were purchased for consumption; the price development does not include goods designed for export.[31]

[29] Czech Statistical Office

[30] There are two definitions for primary market. The first widely-spread definition is used on the financial market for the market issuing securities. The second one used in relation to PPI specifies the *"market in which buyers and sellers negotiate and transact business directly, without any intermediary such as resellers."* Both definitions are available at: http://www.businessdictionary.com/definition/primary-market.html. In this case, it means the prices are made between the producer and his first purchaser.

[31] *PPI – index cen průmyslových výrobců.* Server: http://www.kurzy.cz

Methodology of Czech Statistical Office distinguishes prices of four different sectors in the economy: prices of industrial producers, prices of construction work, prices of market services, and prices of agricultural producers.

The prices of industrial producers are captured for around 4,600 representatives every month. These prices are, as mentioned above, a result of negotiating between a supplier and a purchaser within the Czech Republic, and they do not include VAT or consumption tax. Based on detected prices, there is a price index of industrial producers counted. This index measures the average price development of all industrial goods produced and sold on domestic market. Methodology of the price index of industrial producers slightly changed some of its classification, and also changed the base year from 2005 to 2010. The whole methodology including current changes is described on the website of Czech Statistical Office in details. The trend of price development is indicated as a percentage change of price level of tracked prices in actual month and the average price level of the same month in last year.[32]

Another type of prices distinguished by the producer price index is the price of construction work according to the Czech Statistical Office. Price index of construction work is, in contrast to the price index of industrial producers, tracked quarterly; monthly values of this index are estimated based on other surveys of the Czech Statistical Office: input values for such estimation are price index of materials and goods consumed in the field of civil engineering, as well as quarterly value of the actual price index of construction work. As the monthly estimations are not always correct, they are retroactively put more precisely based on the up-to-date quarterly price index. As well as the price index of industrial producers, the prices used for measuring the change in price level of construction works are implemented contractual prices arranged by both sides, and they are recorded based on survey sampling, which is executed quarterly. The base year for this index is year 2005. The change in the price index of construction work reflects the percentage by which the average price level of these prices increased in relation to the price level of the comparative period. Comparative period may be the same time period in previous year (the monthly evaluated price index may use the same

[32] Czech Statistical Office

month in last year, quarterly price index uses the same quarter in last year), previous time period (previous quarter), or the base year 2005.[33]

Czech Statistical Office includes following prices into the group of prices of market services: land and tubular transportation, water transportation, storage and transportation support services, post and courier services, publishing services, telecommunications services, financial services, insurance business, information and communication services, professional services, and services in the field of real estates, administrative and support services. Change in prices of market services reflects a percentage by which the average price level of these prices has changed in relation to the average price level in the same month of last year.[34]

The last distinguished prices are the prices of agricultural producers. Methodology of the Czech Statistical Office uses monthly-recorded reports, which are adjusted for value added tax and they are valid for both domestic and foreign markets without addition of transportation costs. Year 2010 was determined as the base year, and there was made an arithmetical average from the 2010 prices. This average is used as a comparison to monthly prices of individual products. Since some of the agricultural products are prone to the season of the year, and, therefore, they might be sold only in a specific season, or might be cheaper in one season and significantly more expensive in another one, there are distinguished two different methods of evaluation, one for seasonal products and one for non-seasonal products. The Czech Statistical Office uses variable monthly weights to take the seasonality into account while evaluating the price index of agricultural producers since January 2013.[35]

1.2.3 GDP deflator

GDP deflator may be considered the most complex measurement of the general increase in prices. It does not include a specific type of products; it basically examines every good that is contained in GDP. The GDP deflator represents the ratio of GDP

[33] Czech Statistical Office
[34] Ibid.
[35] Ibid.

expressed in current prices and GDP in constant prices: in other words, the ratio of nominal and real GDP. Paasche price index is used in order to measure the increase in prices:

$$P_P = \frac{\sum p_1 \cdot q_1}{\sum p_0 \cdot q_1} \tag{1.3}$$

In contrast to the Laspeyres index, Paasche price index is seen as an underestimated value. As GDP includes all the goods and services produced in the economy in determined time period, it is able to capture changing patterns in people's expenditures. Furthermore, GDP deflator is able to account improvement in quality of products or services, which, on the other hand, CPI is not capable of.

Even though the GDP deflator profiles as the most complex indicator, it has several disadvantages. It might be challenging to obtain all necessary data; the data is usually received from different types of firms' statements that are forwarded to the statistical office, and the data is usually depreciated by several-month delay. Another disadvantage may be seen in its complexity thanks to which it is not possible to use the information in decision-making process within the scope of individual sectors, such as households.[36]

1.3 Measurement of inflation by Federal Reserve System

Central banking differs from country to country, even though the functions of central banks are usually very similar. There might be countries with no central bank, such as Monaco[37] or Andorra.[38] On the other hand, there might be countries with more than one central bank, such as the United States of America. The first central bank in America was established in 1791, and its official seat was in Philadelphia, PA. However, the bank had also its enemies, who criticized mostly its size and its geographical position. Therefore, it lost its charter in 1811 and the United States started

[36] *Česká republika: hlavní makroekonomické ukazatele.* ČSÚ, MPSV, ČNB, MF a ČHMÚ, 2014

[37] 1999/96/EC: Council Decision of 31 December 1998 on the position to be taken by the Community regarding an agreement concerning the monetary relations with the Principality of Monaco

[38] Andorra has an institute called Institut Nacional Andorrà de Finances; its function might be considered similar to responsibilities of a central bank. More about the financial institute is available at: https://www.inaf.ad/index.php?lang=en

to operate without a central bank that brought up several problems, such as not having the common currency, or any regulations on banking and credit. The U.S. had to experience such event one more time until the Federal Reserve Act was passed to the president Woodrow Wilson. The law has been valid since December 1913.[39] The Federal Reserve System (referred to as "the Fed") could be considered a central bank of the U.S.; however, it consists of twelve central banks.[40] Responsibilities of the Fed are specified in four fields. Firstly, the Fed is in charge of monetary policy, which is used to ensure the stable price level. Secondly, it provides supervision over the financial sector, eventually implements regulations. Thirdly, it maintains the stability of the financial system and helps to detect potential risks. Lastly, it is the bank of the state, and, therefore, it provides financial services to federal institutions.[41]

As well as the Czech National Bank, also the Federal Reserve uses several price indexes to measure inflation because each index represents different basket of goods and services, and each one is measured in a different way. Federal Reserve Bank of Cleveland emphasizes similar indexes to the ones used by the Czech Statistical Office: consumer price index, producer price indexes, GDP deflator, but also personal consumption expenditures index, or more specialized indexes such as employment cost index or international price program.[42] American Bureau of Labor Statistics (further "BLS") provides complete, very detailed, but also very comprehensible description of methodology, advantages/disadvantages, and also monthly statistics.

Consumer price index (further "CPI") is used in three different areas: as an economic indicator, a deflator of other economic series, and a means of adjusting dollar values.[43] CPI is evaluated as the most widely used indicator of inflation in the United States. Over the time, doubts about whether the CPI is overestimated or underestimated appeared. CPI did not take into account possible substitution, which might be a product of increasing prices. Consumers substitute the products and services they consume based on their quality and prices. Such substitution may cause a change in relative

[39] Federal Reserve Bank of Cleveland
[40] The Federal Reserve Board
[41] Board of the Governors of the Federal Reserve System
[42] Federal Reserve Bank of Cleveland
[43] Bureau of Labor Statistics

weight of particular goods and services in the basket that is used to measure changes in prices. Based on these doubts and revisions, BLS evaluated the CPI as overestimated and prepared backgrounds for its adjustment. Between 1987 and 1998, there were made several changes, one of them was dealing with capturing substitution: there were implemented procedures to capture changes in relative weights of items whose prices are more likely to rise.[44] CPI is a very discussed topic and there are several opinions on whether it is a trustworthy index or not. American economist Walter J. Williams accuses American government from manipulating the CPI, and, therefore, underestimating inflation. He, on the other hand, compares the CPI measured by the newest methodology with the methods that used to be applied before the changes were implemented. His results are significantly different from the official ones – the difference is about 3 percentage points.[45]

There are always efforts to refine the methodology of CPI. Another American Economist Albert Cavallo started a project at the Massachusetts Institute of Technology that is called the Billion Prices Project. The project is still in progress and it uses prices of hundreds of online retailers to capture increase, eventually decrease, in prices. The results, unfortunately for the critics of CPI, practically match the measurements of BLS; however, the Billion Prices Project is able to provide measurements on daily basis.[46]

There might be different opinions on the used methodology for measurement of CPI, and its impact on correctness of the rate of inflation; however, the thesis will be based on the data on CPI collected from the Federal Reserve Bank of St. Louis, which were drawn from BLS in order to announce the actual inflation rate by the Fed.

2. Development of Oil Prices

American professor of economics James D. Hamilton[47] captured whole history of development of oil prices and changes in demand and supply over the time in his paper *"Historical Oil Shocks".* The paper is mostly concentrated on American oil market,

[44] Bureau of Labor Statistics, 2007
[45] John Williams' Shadow Government Statistics
[46] The Billion Prices Project @ MIT
[47] University of California San Diego

and, therefore, the information is found suitable for the thesis. This part of the thesis will be discussing the development of oil prices that is crucial for the registration of a correlation between changes in oil prices and the rate of inflation.

2.1 Oil Production from 1859 till the 1950s

Production of crude oil is connected with the name of Edwin Laurentine Drake, who was the first person that started to drill for oil. Before his invention, the crude oil was available only when it cropped up, and that was not a controllable resource, and, therefore, different types of sources were preferred. His invention was not successful from the very beginning; however, finally, he managed to create a drive pipe that led 69 feet under the ground and was able to drain crude oil in Pennsylvania in 1859. As other producers accommodated the new method of draining crude oil, which Drake did not patent, supply increased and the scarcity of oil went down as well as the price decreased from $20.00/barrel to about $9.60/barrel only a year later.[48]

Hamilton recognizes the first oil shock in history in the situation between years 1862 and 1864. The main reason for an increase in prices might be seen in general rise of demands, and, therefore, also rise in overall prices. Another reason was seen by Hamilton in implementing higher taxes on alcohol that was one of the main sources before crude oil started to be drained. Therefore, alcohol started to be even more substituted by oil and higher demand for oil pushed the prices upwards.

When the time goes, the importance of some sources may change; oil was not an exception. As at the beginning of the 19th century oil started to be more useful than at the time of Drake's invention, it was more crucial source in almost any type of production than at the beginning of the 19th century. Its importance grows over time. The boom in the need of oil might be seen in development of transportation, railroads and motor vehicles during the 20th century. Only between years 1915 and 1919, American consumption of oil increased by 53 % and by additional 27 % between 1919

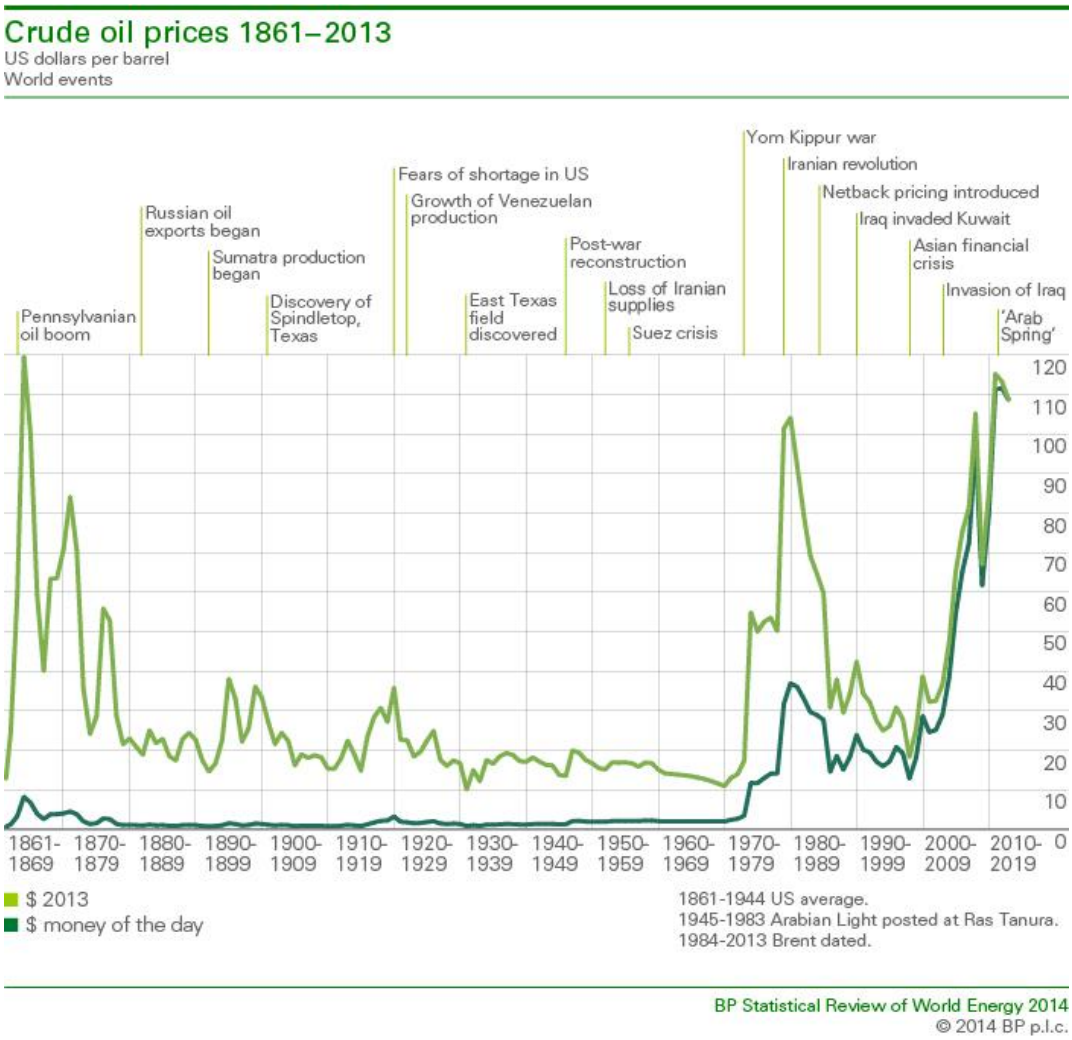
[48] Hamilton, 2011, p. 1

and 1920.[49] Deficiency of crude oil resulted not only into higher prices, but also into limitations and additional time costs due to long queues for oil.

There were several reasons for an increase of oil prices during the 1950s. Right after the World War II, Hamilton emphasizes the fact that the automotive industry experienced a fast grow that resulted into an increase of crude oil prices by 80 % as the number of registered vehicles rapidly increased. European prices of oil were very much influenced by the Suez Crises in 1956, when Egyptian president Gamal Abdel Nasser nationalized Suez Canal that was owned by the French and British. Suez Canal meant European access to Middle Eastern oil, so its nationalization created a threat to Europe.[50] The impact of lacking supply of crude oil was seen not only in the shortage of fuel for vehicles, but in whole industry that started to shorten the working hours of employees as they were not able to keep up with the previous production quantity without the use of oil. Also the producers of cars had to decrease their production as the demand for cars got lower in order to inability to purchase the fuel.[51]

[49] Hamilton, 2011, p. 5
[50] U.S. Department of State
[51] Hamilton, 2011, p. 11

Figure No. 6 Development of Crude Oil Prices 1861-2013



Source: *Oil Prices.* British Petroleum

2.2 OPEC

The Organization of the Petroleum Exporting Countries was founded by five countries that could be considered ones of the biggest exporters of oil: Iran, Iraq, Kuwait, Saudi Arabia and Venezuela. There are twelve current members of OPEC: Algeria, Angola, Ecuador, Libya, Nigeria, Qatar, the United Arab Emirates, and the five founding states mentioned above.[52]

[52] The Organization of the Petroleum Exporting Countries

OPEC characterizes its main objective as follows:

"OPEC's objective is to co-ordinate and unify petroleum policies among Member Countries, in order to secure fair and stable prices for petroleum producers; an efficient, economic and regular supply of petroleum to consuming nations; and a fair return on capital to those investing in the industry."[53]

The opinions on OPEC vary. By some, it is considered the biggest cartel, which actually results from its own objective's definition mentioned above; however, some authors oppose that. For example, an American-born economist Steven E. Plaut considers OPEC more as an oligopoly, where Saudi Arabia behaves as a price leader.[54] Saudi Arabia is the biggest producer out of all member states. If we considered OPEC as a cartel, there would be the same principles and also the same risks as with any other cartel: the member states have motivation to break the agreement and act according to their own interest, such as producing more oil and making additional sales with lower price; however, still price that guarantees profit. Saudi Arabia, in order to keep the prices high, has to decrease its production, and, therefore, lower quantity of oil at the market, which pushes the price back on the agreed level.[55] Such strategic behavior could be seen in further chapters describing the development of oil prices since 1960s to nowadays.

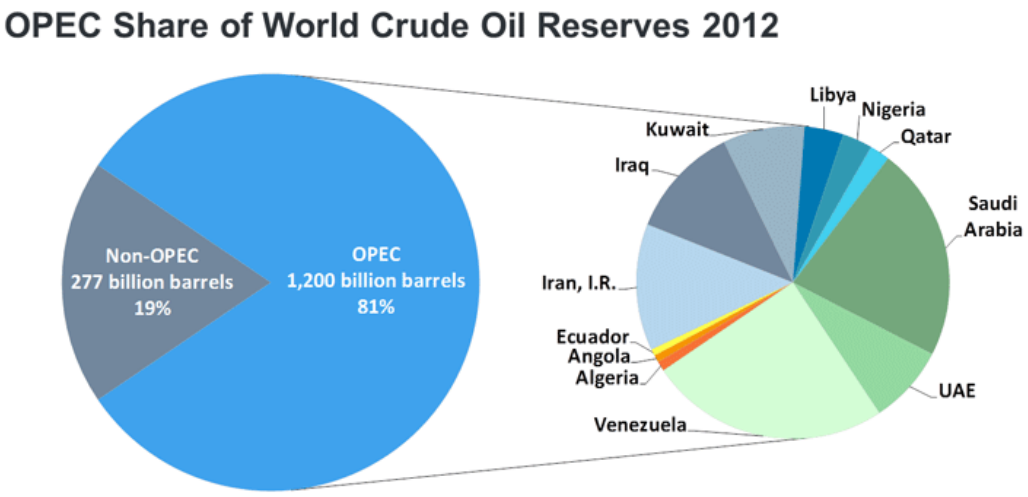
Another American economist Benjamin Zycher, a professor of economics at the University of California, Los Angeles, stresses the reason for formation of OPEC; he reminds that the cause could be found on the American side as the United States imposed import quotas on oil.[56] The program is called the Mandatory Oil Import Quota Program and was accepted during the presidential term of Dwight Eisenhower in 1959. However, this program did not impose the first quotas on crude oil. The United States flirted with the idea of imposing quotas since the Great Depression and accepted already Voluntary Program, which did not turn out very successful. There were several reasons for not succeeding: first of all, its voluntary character that did not have any strength to

[53] The Organization of the Petroleum Exporting Countries
[54] Plaut, 1981
[55] Al-Yousef, 1998
[56] Library of Economics and Liberty

force abidance by quotas; the program was also created only for crude oil, not the products made out of it; and lastly, it was accused by the antitrust principles. Therefore, it was replaced by the Mandatory Program that was supposed to cover all deficiencies of the Voluntary Program. The import quota was set at 9 % of all demanded oil at first; three years later, it was reset at 12,2 % of production realized in the United States.[57] As any other import quota, the program resulted into prioritizing domestic production of oil to oil from importing countries, especially Persian Gulf producers, but also Venezuela. In order to keep their position at American market, they would have to decrease their prices, and even then, they could not be sure, they would be able to enter the market. That was the moment, when all five original member countries of OPEC have decided to start cooperation in order to keep higher prices of crude oil.

As OPEC represents one of the highest percentages of oil production in the world, which results from the highest percentage of their reserves of oil (could be seen on Figure No. 7), it is also very often connected with the oil shocks in 1973 and 1979.

Figure No. 7 Share of OPEC on the world's oil reserves in 2012



OPEC proven crude oil reserves, end 2012
(billion barrels, OPEC Share)

Venezuela	297.7	24.8%	Iraq	140.3	11.7%	Libya	48.5	4.0%	Algeria	12.2	1.0%
Saudi Arabia	265.9	22.1%	Kuwait	101.5	8.5%	Nigeria	37.1	3.1%	Angola	9.1	0.8%
Iran, I.R.	157.3	13.1%	United Arab Emirates	97.8	8.1%	Qatar	25.2	2.1%	Ecuador	8.2	0.7%

Source: *OPEC Annual Statistical Bulletin 2013*

[57] Cichetti, Gillen, 1973

2.3 First Oil Shock 1973-1974

The first oil shock started in October 1973 and did not leave the world's economy till January 1974. So far the biggest oil shock in history evoked the prices of oil to rise quadruply during not even a year and half. Such situation could be recognized as a recession brought by an external cause. As any other recession, also the first oil shock is widely discussed, especially its origin. In most materials, the most significant guilt is accredited to Arab members of OPEC, which decided to impose embargo on particular countries in order to lock up the countries from purchasing crude oil produced by OPEC's members. OPEC probably would not impose such embargo from no reason, and, therefore, it seems necessary to search for the cause of the first oil shock more deeply.

In June 1944, there was an international conference held in Bretton Woods, New Hampshire. This conference brought the idea of cooperation in the field of monetary policy among major industrial countries. Currencies of member countries were hung on US dollar, which had a fixed peg to gold. During the 1960s, a pressure for depreciation of the US dollar appeared and this unfavorable situation finally resulted into abandonment of the gold standard based on decision of American president Richard Nixon in 1971. The reason for mentioning this historical event may be crucial in understanding the causes of the first oil price shock. After abandonment of the gold standard, the US dollar officially started to devaluate, which did not bring a favorable position for members of OPEC, whose oil prices (as all prices of oil) were denominated in US dollars.[58]

OPEC reacted to depreciation of US dollar by slow and moderate increase in oil prices in 1971. However, the biggest growth of prices could be seen during 1973 and 1974, when the price of oil went from $8.69 per barrel in 1973 to $27.20 per barrel in 1974.[59] Already mentioned American economist Benjamin Zycher stresses that the

[58] University of California, Berkeley

[59] Development of world crude oil prices between 1955 and 1990 could be seen in the table below that was completed by an American economist Benjamin Zycher, who drew from the U.S. Departments of Energy, Commerce and Labor. The table is available at: http://www.econlib.org/library/Enc1/OPEC.html

imposed embargo, which is often considered the reason for the increase in crude oil prices, was not the actual cause of raising prices. OPEC's purpose was to decrease the oil production to be able to keep prices high substantially in general. Often mentioned embargo was imposed on the countries that were allied with Israel during the Yom Kippur war that took place in October 1973. Yom Kippur war was the fourth conflict between Arab nations and Israel (also known as the Arab-Israeli War). As most of the members of OPEC are Arab countries, they did not accept any of the countries, they exported oil to, to support Israel in the conflict. Embargo mostly applied to the United States and Netherlands, and, as the embargo was selective and did not apply for all countries, both the US and Netherlands had the access to oil for the same price as any other country thanks to a possibility of reselling the oil.[60] Zycher also points out the fact that the reason for American oil shortages in the United States were not influenced by OPEC; however, by president Nixon's Economic Stabilization Program that was adopted in 1971.[61]

Table No. 1 Development of world crude oil prices 1955-1990

World Crude Oil Prices (U.S. dollars per barrel)					
Year	Nominal Price	In 1990 Dollars	Year	Nominal Price	In 1990 Dollars
1955	2.25	10.88	1973	3.27	8.69
1956	2.36	11.04	1974	11.17	27.20
1957	2.73	12.34	1975	11.57	25.66
1958	2.45	10.85	1976	12.41	25.86
1959	2.27	9.82	1977	13.33	26.05
1960	2.23	9.49	1978	13.43	24.46
1961	2.27	9.57	1979	20.19	33.78
1962	2.26	9.32	1980	32.27	49.52
1963	2.25	9.13	1981	35.10	49.10
1964	2.23	8.91	1982	32.11	42.22
1965	2.22	8.64	1983	27.73	35.10
1966	2.24	8.42	1984	27.44	33.50
1967	2.27	8.31	1985	25.83	30.63
1968	2.24	7.81	1986	12.52	14.47
1969	2.27	7.50	1987	16.69	18.69
1970	2.35	7.36	1988	13.25	14.36
1971	2.52	7.46	1989	16.89	17.59
1972	2.64	7.47	1990	20.42	20.42

Source: *OPEC.* Library of Economics and Liberty

[60] Library of Economics and Liberty
[61] Erickson, Peters, Spann, Tese, 1978

The first oil shock had several impacts, which differed from country to country. Members of OPEC obviously realized additional profit by charging higher prices; industrialized countries, on the other hand, could have noticed how much they are influenced by not producing oil and by having to rely on their suppliers. In order to decrease such dependence, both time and money were invested to the search for new areas with oil reserves: they were discovered in the North Sea in the early 1970s and started to be drawn in 1975.[62] The crises had greater impact on European countries than on the United States, which was not as dependent on the oil produced by OPEC as Europe. Furthermore, it had more negative impact on developing countries that were hardly able to substitute their suppliers or to search for new deposits of oil. After 1974, some of the OPEC's members intended to gradually increase the production of crude oil in order to satisfy their customers and make higher profit.

2.4 Second Oil Shock 1979

Second oil shock hit the world only 5 years later in 1979. Contrary of the first oil shock, the cause of the second shock is less controversial and the negative impacts affected also OPEC, not only countries that were importing oil from the Arab countries. In 1978, Iran, one of the founders of OPEC, experienced one of the greatest national events in the 20th century: the Iranian Revolution. There were gigantic protests against the autocratic pro-Western shah Pahlavi, who left the country in January 1979 and the prominent leader of the revolution Ayatollah Khomeini was welcomed by the vast majority of Iranian population. Iran officially became an Islamic Republic on the 1st of April 1979, and, therefore, the Iranian Revolution is sometimes nicknamed Islamic Revolution. The process of Islamization lasted for several years and brought up disaffection with the Western world.[63]

As Iran belonged to one of the crucial producers of crude oil, convulsions were the cause of decrease in world oil production by 7 % between October 1978 and January

[62] Bjørnland, 1998
[63] Downes, 2002

1979. Saudi Arabia, as the leader of OPEC, together with other producers of oil was able to cover about one third of the loss by increasing of production. [64]

The second oil shock was similarly as the first one accompanied by deficiency of oil, which had an impact on both the industry and consumers by themselves. There were formed long queues at the gas stations that did not dispense with panic. This period of time, which the United States were experiencing, is sometimes called the Great Gas Panic of 1979. The panic was not based only on rising prices of oil in response to the drop out of Iranian oil production, but also on the political relations between the United States and Saudi Arabia, which tended to cover the shortage of oil by greater production thanks to its high production capacity. Saudi Arabia was aware of the fact that oil production and the ability to influence oil prices were a strong weapon, and, therefore, it could form a dependency of the United States on Saudi Arabia. The United States might have been too confident about the future decrease of oil prices by Saudi Arabia; therefore, further increase in prices might have caused the Great Gas Panic. After the American president Jimmy Carter, who was in his term from 1977 to 1981, supported Israel, the relationship between the United States and Saudi Arabia cooled considerably.[65] The second oil shock had also an impact on the functioning of OPEC, whose members began to be more independent, and, as it usually happens in cartels, countries started to break the quotas in order to maximize their profits instead of quietly cooperating with other members.

2.5 Oil Market During the 1980s

Another situation influencing the world oil prices did not wait too long to pop out in 1980, and sometimes is even considered to be a part of the second oil shock: the Iran-Iraq War (1980-1981). At the end of 1979, Iran was gradually increasing its oil production to slowly reach its pre-revolution level. However, its efforts to do so were interrupted by Iraq, which decided to declare war on Iran. Saddam Hussein concluded to take advantage of current Iran's situation of being weakened and depleted by the Iranian

[64] Hamilton, 2011, p. 16
[65] Cooper, 2009

Revolution. Even though Iran did not have an army and any information about upcoming war, they were strong enough to resist Iraq's pressure.[66] As both countries were the members of OPEC, the war had naturally an impact on the economy of both countries, and the oil market was no exception. Before other countries balanced the lack of oil supply, the world oil production was reduced by 6 % thanks to the conflict, when both Iran's and Iraq's productions were decreased.[67]

The events of the 1980s may be the proof of the rational acting of individuals. After experiencing the two oil shocks during the 1970s, the consumption of oil generally decreased. It might be a consequence of preference of smoothed consumption by people, so they would rather consume less oil for current price to be able to pay higher price during experiencing another oil shock.

Such behavior led oil producers to lower their production and even the decreased production did not prevent the prices from falling. Hamilton, in his historical looking back, indicates that Saudi Arabia limited three quarters of its production and it was not enough to keep the prices at the same level. Even Iran and Iraq were recovering quite slowly after the war, and, therefore, their production was not increasing either. Hamilton points out that nominal price of oil fell down by approximately 25 %, the real one even more. However, Saudi Arabia did not want to keep its production limited anymore, and, in 1986, it has decided to abandon the limits and increase its production. The economies were able to experience a counter effect to the oil shocks during 1970s. Instead of an increase in the price of oil, the price started to decline: the difference between 1985 and 1986 was $15 per barrel.[68]

2.6 1990s until Nowadays

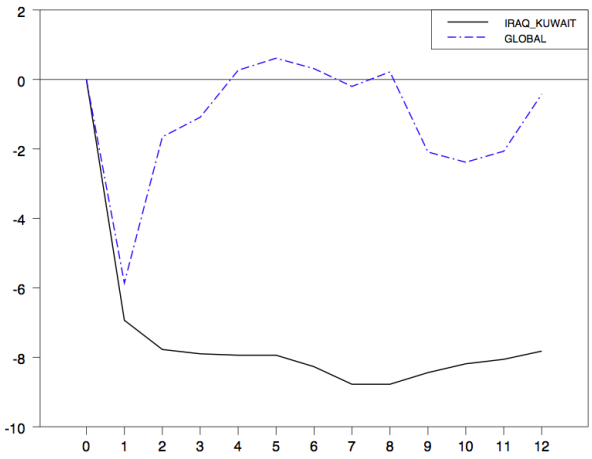
At the end of the 1980s, it might have seemed that the situation at the oil market is finally stabilizing; oil production of two belligerent countries, Iraq and Iran, reached their pre-war level. However, Iraq tended to search for other plea to unleash a new war,

[66] Samuel, 2011
[67] Hamilton, 2011, p. 17
[68] Ibid., p. 17

which resulted into the Iraq-Kuwait War. The actual cause of invasion of Kuwait is not definite. Firstly, Iraq was not satisfied with Kuwait's overproduction of oil that pushed the price of oil down and made Iraq's post-war situation tougher, as it was indebted and profit from the oil production was the way out of debts. Secondly, Kuwait obtained 900 square miles of Iraq's territory while Iraq was in the middle of the war, and, therefore, Kuwait gained an access to Iraq's oil field.[69]

Both countries were member of OPEC and quantity of their oil production was quite significant in the light of world production. The conflict has cost the world oil market 9 % reduction. However, the quantity was decreasing gradually over several months, and, therefore, it did not have consequences in the form of long queues at gas stations or panic in the United States. Saudi Arabia was able to complete the world production on its pre-invasion level within 4 months.[70] The decrease of oil production as the result of the Iraq-Kuwait War is captured on the Figure No. 8 below. The production of both Iraq and Kuwait remained on the lower level; however, the global level increased to the same level as before the invasion of Kuwait thanks to higher production of Saudi Arabia. On the horizontal axis, there are number of months captured since the invasion happened in August 1990.

Figure No. 8 Decrease in the world oil production during the Iraq-Kuwait War



Source: HAMILTON, James D. *Historical Oil Shocks.* p. 49

[69] Klein, 2003
[70] Hamilton, 2011, p. 18

A new term appeared during the 1990s: the New Economy. Such term stands for the process of creation and development of new technologies, which result into economic changes. Economies have been gradually transforming their specializations in manufacturing to providing services. One of the most significant changes could be seen in the fact that market is not determined by the supply anymore. Economies do not rely on selling what they have produced, but they rather concentrate on producing what will be sold. Therefore, markets are determined by the demand.

As some of the economies experience fast and high growth, and they are transforming their orientation, their consumption of oil is also evolving. U.S. Energy Information Administration (EIA) processes statistics on petroleum consumption, and, based on its statistics, it is significant that consumption of oil is increasing over the years. Following table, Table No. 2, is based on the data from different regions divided by EIA and shows the development of increasing consumption between years 2008 and 2012.

Table No. 2 Total Petroleum Consumption 2008-2012

Table: Total Petroleum Consumption (Thousand Barrels Per Day)					
	2008	**2009**	**2010**	**2011**	**2012**
North America	23893	23014	23534	23270	22924
Central & South America	6014	6106	6331	6571	6765
Europe	16152	15375	15337	14961	14424
Eurasia	4156	4133	4160	4366	4529
Middle East	6500	6752	6991	7537	7621
Africa	3141	3260	3374	3297	3360
Asia & Oceania	24841	26277	27800	28743	29784
World	**84697**	**84918**	**87527**	**88744**	**89407**

Source: *International Energy Statistics.* U.S. Energy Information Administration

Some of Asian countries are known under the term “Asian Tigers” that is supposed to point out countries’ fast economic growth. Since second half of 1980s these countries started to experience the economic growth that was accompanied by industrialization, and, therefore, also higher requirements for energy including oil. However, the growth was not infinite, and, in the mid 1990s, some of the fast-growing

Asian economies' rates of growth slowed down. In Thailand, even the country's currency Baht collapsed in July 1997.[71] As the energy consumption increased in these areas, where oil was imported, world production of oil increased also to cover the demand. Even though the share of consumption of energy in East Asia on the world consumption is not extreme, it still represents about 10 % without counting China as a part of East Asia and 20 % with it.[72] The crisis in the region did not lead only to a decrease in rate of growth, but also to the panic on the financial market. Foreign investors started to back off, which led to depreciation of currency and to stock decline. As the prices went down in East Asian countries, also the economic growth slowed down, requirements for energy declined as well. Therefore, the oil prices fell down under the level of $12 per a barrel till the end of 1998.[73] However, it did not take long till the East Asian countries recovered from the crisis and started to grow as fast as before 1997. The growth was also accompanied by the growth of oil prices.[74]

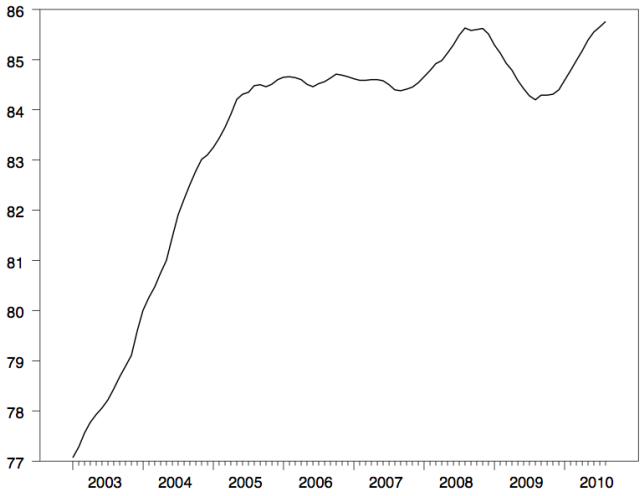
Situation between the end of 2002 and 2003 may be sometimes considered another oil crises. Two independent events caused the rise in oil prices by $10 per barrel during four months (November to February).[75] This rise was caused by a pressuring situation in Venezuela and the U.S. invasion of Iraq. Both situations led to decrease in oil production in both Venezuela (whose decrease hurt the United States the most since they were importing oil from there) and Iraq, and, therefore, the prices were pushed to grow.

Furthermore, years 2004 and 2005 could be specified as the period of fast economic growth, and such growth was naturally accompanied with increasing demand for oil, together with accommodating level of oil production. Hamilton processed a figure capturing development of demand and supply during this time period and the period afterwards, when the demand was still gradually growing, however, the supply was remaining the same. Therefore, he points out the fact that supply did not match changes in the demand for oil, and, therefore, there was a space for increasing oil prices.

---

[71] Moreno, 1998
[72] Adams, Shachmurove, 2000
[73] Hamilton, 2011, p. 20
[74] Ibid., p. 20
[75] Shore, Hackworth, 2003

Figure No. 9 Development of oil production between 2003 and 2010



Source: U.S. Energy Information Administration

Hamilton stresses behavior of the supply of oil after 2005, since when it remained at the same level; however, the demand for oil was gradually growing as the result of economic growth. Therefore, oil market experienced deficiency that resulted into an increase in prices (from $55 per barrel in 2005 to $142 per barrel in 2008). [76]

Chapter 2 briefly summarized development of oil prices since the beginning of oil production. Next chapter will be concentrated on the theoretical view of relation between development of oil prices and inflation before examining the actual relationship on real data.

3. Oil Prices and Inflation

3.1 Phillips Curve

Phillips's discovery of relation between inflation and the rate of unemployment meant a milestone in macroeconomics. He testified data collected in the United

[76] Hamilton, 2011, p. 21 – 23

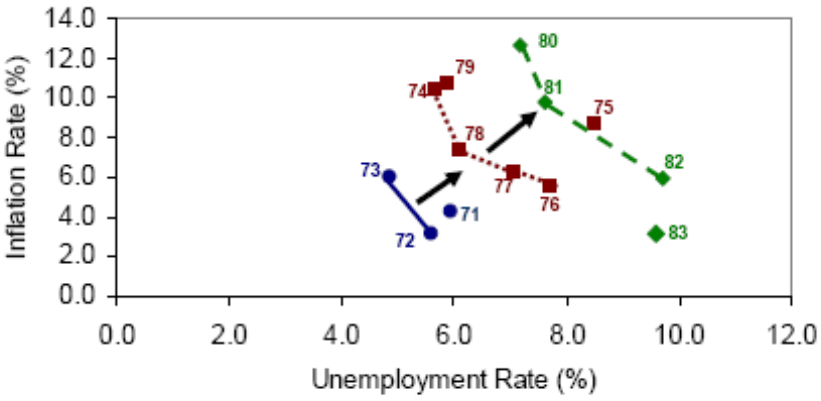
Kingdom from 1861 to 1957 to find out an inverse relationship that predicated a possibility of existing tradeoff between inflation and the unemployment rate. The original version of the curve expressed relationship between the rate of unemployment and the rate of change of money wage rates.[77] However, the original curve was adjusted by Solow and Samuelson who compensated money wage rates for inflation as wage and price inflation develop identically.[78]

If there was such tradeoff, there would be a possibility for policymakers to influence the rate of unemployment for the price of higher inflation. Such policy was used especially by Keynesians whose intention was rather to meet a specified rate of unemployment than price stability. First critics of Phillips curve were Monetarists who noticed the relationship did not apply for long run. The criticism was specified in details already in chapter 1.1.2 Build-in inflation; however, the relationship between inflation and unemployment rate seemed to be stable during the 1960s, and, therefore, the criticism was not accepted by majority.

During 1970s, Phillips curve started to behave oddly and new term appeared – "stagflation."[79] It was not possible to increase inflation in order to decrease the rate of unemployment; the tradeoff did not apply anymore - both magnitudes were rising. During 1970s, the oil market experienced two oil shocks (1973 and 1979) discussed above in chapters 2.3 and 2.4 that influenced economies all over the world by the significant rise of oil prices. Federal Reserve Bank of San Francisco provides answers to economic questions to public, and, in its section engaged in Phillips curve, points out behavior of Phillips curve during the 1970s, when inflation was rising significantly.

[77] Phillips, 1958
[78] Holman, 2004, p. 300
[79] Niskanen, 2002

Figure No. 10 Phillips curve shifts during the 1970s and early 1980s



Source: Federal Reserve Bank of San Francisco

There could be observed an increase of inflation in years 1973, 1974, 1979 and 1980 on Figure No. 10. Years 1973 and 1979 are the years of oil shocks, when the prices of oil increased in gigantic portions as it was already mentioned in chapters 2.3 and 2.4. Therefore, it could have been the first time, when possible correlation between increase in price of oil and rising inflation was captured. The explanation of behavior of inflation was not too difficult. Oil and its products represent major inputs in economy that are used in industry, transportation, but also households. If the price of oil rises, higher price will have sooner or later an impact on the price of a final good to whose production oil was used. More industrialized the economy is stronger shock might appear.

However, each period of time differs from another one. In 1970s, the reaction of inflation on rising oil prices was the strongest in history. Nominal price of oil was moving around $3 per barrel before the crises appeared in 1973 and rose to around $32 after the second oil shock.[80] During this period of time consumer price index increased more than twice from the value 41.10 in January 1972 to 86.30 till December 1980.[81] However, since 1970s there was not observed such a significant change of CPI resulting from the increase of the price of oil. At the beginning of the 1990s, there was an Iraq-

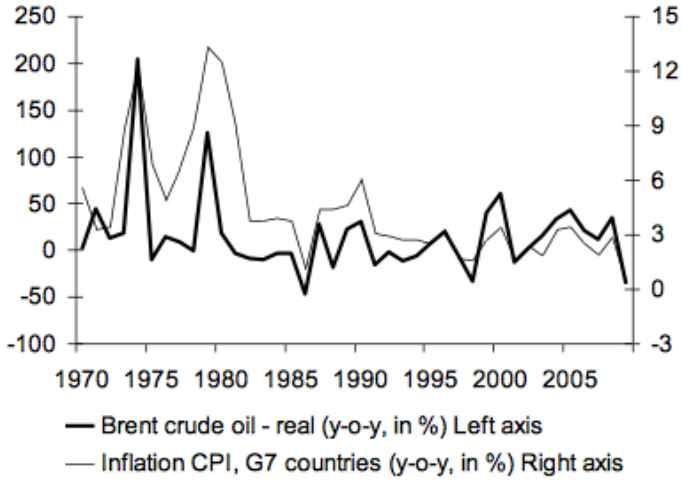
[80] See Table No. 1
[81] Lee, National Chung Cheng University

Kuwait War that caused both producers of oil to decrease their production, and, therefore, the price of a barrel of oil rose from $20 to $40; however, the CPI almost increased only negligibly (134.6 in January 1991 and 137.9 in December 1991).[82] As it was already discussed in the chapter 2.6 that covers also the beginning of 21st century and describes the gradual increase of the price of oil, the change might not have been so sudden and steep as during the oil shocks in 1970s; however, the price rose significantly from $12,49 per barrel in January 1999 to $133,48 per barrel in July 2008.[83] Such increase was accompanied with the change of CPI from 164.3 in January 1999 to 219.964 in July 2008.[84] The correlation is again more observable in this period of time. According to the data, the correlation is observable in all three mentioned time periods; however, its significance seems to differ over time. During Iraq-Kuwait War, both countries lowered its production, which led into an increase of the price of oil; however, Figure No. 8 captures the catch-up of production during four months. Such fast accommodation of the drop out of production may be the reason for not such significant change in CPI as the higher oil prices might not have been implemented to prices of goods and services, whose production is possible only with the use of oil or oil products. Although, the production might have gotten more expensive during these four months, menu cost model, introduced by the New Keynesians[85], might be applicable to explain why CPI rose only moderately while the price of oil almost doubled. Price of oil was rising only from July to October 1990; afterwards it was decreasing until it reached its previous level around $20 per barrel. By applying the menu cost model, it is not disprovable that producers did not adopt the change in their costs increased by higher price of oil yet, and, before they could have adopted their prices, the price of oil started to decrease again.

[82] U.S. Department of Labor, Bureau of Labor Statistics
[83] U.S. Energy Information Administration
[84] U.S. Department of Labor, Bureau of Labor Statistics
[85] The model was introduced by Akerlof and Yellen (1985), Blanchard and Kiyotaki (1985) and Mankiw (1985). The change of price does not bring only different profit, it also increases the costs of production. The model is built on the fact that it is costly to change prices of products or services; it is necessary to invest into reprinting menus (therefore *menu* costs), into the change of price lists, and so on.

Even though, such explanation seems to be reasonable, Hošek, Komárek and Motl mention that relationship between the price of oil and inflation appears almost immediately[86]; correlation could be seen on Figure No. 11 below.

Figure No. 11 Real price of oil and CPI inflation between 1970 and 2009



Source: HOŠEK, J.; KOMÁREK, L.; MOTL, M. *Monetary Policy and Oil Prices.* Warwick Economic Research Papers, No. 947, 2011, p.4

3.2 Monetary Policy and Oil Prices

Aims of monetary policy vary over economies; however, they are usually similar, especially when it comes to price stability. Inflation is therefore the final goal of monetary policy.[87] Previous chapter 3.1 briefly analyzed the relationship between inflation and oil prices; however, the relation is based only on data observation so far. If the relationship is verified, a question could be raised: whether central banks are or are not supposed to intervene. Economists unequivocally agree on the need of central banks to monitor and analyze development of the asset market; therefore, also oil market and markets with other commodities.[88]

[86] Hošek, Komárek, Motl, 2011

[87] Although the system of central banking in the United States differs in some areas. Not only that there are more than one central bank, also monetary policy's main tasks are different. It tends to provide price stability; however, its other final aim is the low rate of unemployment.

[88] Hošek, Komárek, Motl, 2011

Firstly, if there is such relationship between oil prices and inflation, and, if inflation reacts to the change of oil price almost immediately, as discussed above in chapter 3.1, there might be a space for prediction of inflation based on the actual price of oil. The same question crossed minds of representatives of Federal Reserve Bank of Cleveland[89], who decided to testify several models to find out, whether the obvious relationship between development of oil prices and inflation could be used for prediction of inflation. The authors constructed different variations of forecasts by using number of different variables to testify the ability to predict. However, their analysis showed that each period of time is different and the forecast does not have to fit each one of them. The use of oil prices seems to be conductive to forecast CPI inflation in the two past decades; however, it does not improve forecasting of core inflation at all. According to their results currently increased price of oil does not necessarily lead to an increase in CPI inflation in upcoming year; however, it assists to explain short-term movement of CPI.[90]

Czech National Bank (CNB) also uses oil prices in its prognostic activity. Oil prices are not considered in the core inflation, and, therefore, it seems like core inflation targeting is not the appropriate type of targeting. CNB mostly solves how monetary policy should react on an increase of oil prices forasmuch as the increase can have an impact on inflation that is the final aim of monetary policy. Negative supply shock was already discussed in chapter 1.1.3 Cost-Push Inflation and CNB has to deal with the same confusion as any other central bank: whether the shock is permanent or transitory. If the shock is transitory, CNB's suitable reaction might be a moderate raise of the real interest rate to cause slight decrease in aggregate demand. Even though the shock causes the rise of costs, the impact on consumer prices is lower, and, therefore, moderate increase in interest rates is sufficient. If the economy experiences a permanent shock, economy's potential decreases and the increase of real interest rates might seem like a possible solution. However if the potential is on lower level, there could be also expected lower productivity in the economy, and, therefore, such situation may result into a decrease of permanent wages. Simultaneously with lower wages, people cannot

[89] Research economist Mehmet Pasaogullari and research analyst Patricia Waiwood
[90] Pasaogullari, Waiwood, 2014

afford to consume as much as before and also investments consequently decrease. In such situation, the right decision seems to be temporary lowering of real interest rates in order to increase the aggregate demand.[91]

Development of oil prices is an important topic of monetary policy as it was discussed above. Reaction and attitudes of central banks may differ; however, there might be seen attempts to include and use the relationship between oil prices and inflation to forecast inflation in American central banking.

4. Empirical Analysis

Oil is one of the most important inputs for almost any line in countries' economies. However, oil prices are not static and they tend to develop, and, therefore, such development can have a significant influence on price stability in the economy. Central banks usually choose price stability as their final aim; that is why changes in prices of oil, which may result into inflation, could be also crucial for monetary policy. This part of the thesis will therefore concentrate on findings of the relationship between development of oil prices and inflation.

Existing empirical studies prove the relationship between oil prices and inflation used to be stronger in previous decades; the strongest one was observed during the 1970s. In this section, there will be testified the dependence of inflation on oil prices on the data of the United States between years 1986 and 2014. The time period was chosen based on the existing studies and their observations of decreasing intensity of the relationship in order to testify if the correlation holds. However, the rate of inflation is influenced by many other factors, not only the price of oil, and, therefore, there will be chosen also other variables that may explain inflation. There will be used quarterly time series for all used variables: dependent variable – annualized CPI inflation; independent variable – nominal price of oil WTI, unemployment rate, GDP, interest rate, and lagged

[91] Hošek, Komárek, Motl, 2011

annualized CPI inflation. There will be executed linear regression analysis in order to observe the relationship between the price of oil and inflation.

4.1 Existing Empirical Research

There is number of studies that are focused on the influence of oil price changes; however, some of them are specializing in other macroeconomic indicators, such as GDP. This section is devoted to empirical researches that testify relationship between oil prices and inflation, which could be inspiring for this thesis.

Impacts of the changes of oil prices were investigated by Michael Bruno and Jeffrey Sachs (1985) for the first time. An English economist John Stanton Flemming wrote a commentary to the piece[92] and pointed out that the book is more concentrated on the labor market than to the energy market. However, these two markets are connected through the gap in real wages, which is a result of changes in energy prices. Consequences of the first oil shock were seen especially in the disability of the labor market to adopt. Furthermore, investments were decreasing, as well as the rate of economic growth was decelerating. As there were not enough sources to cover public expenditures, the tax rate rose, and such increase had inflationary consequences.

Another work paying attention to the relationship between oil prices and inflation is the work of Olivier J. Blanchard and Jordi Galí (2008).[93] Most of the analysis is devoted to examination of the impact of the change in oil price on the rate of growth of GDP; however, this piece concentrates on both: the GDP growth and development of inflation. Authors compare two periods – 1970s and 2000s. Correlation between the change in oil prices and inflation is observable in both periods; however, the 1970s oil shocks had much more significant inflationary consequences. Generally, there might be two reasons for that: firstly, economies might have experienced also other changes during the 1970s oil shocks, such as changes in other commodity prices; secondly, the prices of oil rose during 2000s; however, productivity of labor and world demand was increasing as well, and, therefore, the higher oil price did not have to necessarily

[92] Flemming, 1987
[93] Blanchard, Galí, 2008

subscribe to significantly rising inflation. Their analysis leads to several conclusions: First of all, the increase in oil prices during 1970s explains only a part of stagflation since prices of other commodities rose too; on the other hand, the increase of oil price during 2000s was not accompanied with the rise of prices of other commodities. Furthermore, impacts of changes in oil prices have significantly changed since 1970s, when the consequences were much stronger than nowadays. Weaker impact of rising oil prices could be also explained by more flexible labor market that supports wages adjustment, and, therefore, it moderates consequences of oil shocks. Another explanation provided by the authors is the change in monetary policy that commits itself to maintain set fairly low level of inflation. Lastly, authors points out the change in importance of oil, which is not able to jar economies as during the 1970s.

Another paper was written by Jose de Gregorio, Oscar Landerretche and Christopher Neilson (2007).[94] The authors used data of nine industrial countries on which they were examining the decreasing impacts of increasing oil prices on inflation. By the use of vector autoregression analysis (VAR), they confirm their hypothesis that the impacts of development of oil prices on inflation are weaker in examined countries in recent decades. They agree on the declined importance of the oil use with Blanchard and Galí (2007); another reason may be seen in weaker impacts of exchange rate changes on inflation. Authors also point out the importance of changing monetary policy and low-inflation environment that could partially explain weaker relationship between oil prices and inflation. However, any of the explanations was sufficiently precedented by evidences.

Lastly, Bi-Juan Lee from the National Chung Cheng University wrote the paper "The Changing Effects of Oil Price Changes on Inflation" under the leadership of two professors Bwo-Nung Huang and Chin-Wei Yang. The paper is again concentrated on the diminishing power of the changes in oil prices to influence inflation over years. Author distinguished his work by dividing the data collected from 29 countries into three periods: the first includes the oil shocks of 1970s and lasts till December 1986; second one includes the Gulf War in 1990 and lasts till December 1998; and the last one

[94] Gregorio, Landerretche, Neilson, 2007

is set from January 1999 through the 2000's increase in oil price till 2008. They work with inflation as the dependent variable, and the oil price changes (divided into positive and negative), changes in interest rate and exchange rate as explanatory variables. The author concludes that the increase of oil price has a greater impact on inflation than the decrease based on the division of oil price changes to positive and negative ones. Furthermore, he confirms the results of two previous researches that the transmission of oil prices was more significant during the first determined period than in the past decades.[95]

4.2 Data

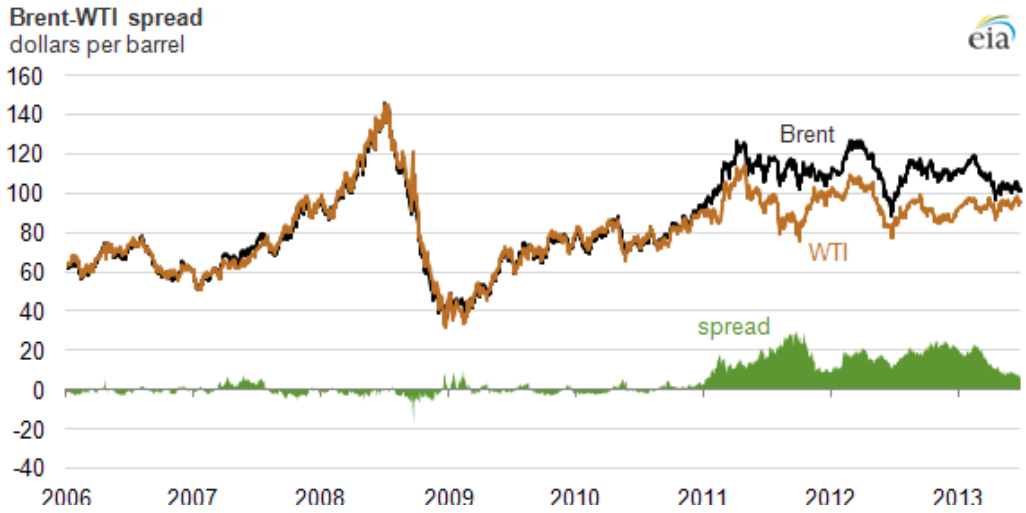
The first important step before constructing an actual model that would demonstrate the relationship between oil prices and inflation is to collect convenient data. However, it is necessary to decide what type of data is suitable for the model at first. There were collected short-run quarterly time series from U.S. Energy Information Administration and the Federal Reserve Bank of St. Louis as follows: database of CPI, West Texas Intermediate (WTI) spot price in dollars per barrel, unemployment rate, nominal GDP, and federal funds effective rate. Dataset has the advantage of complete quarterly values for all variables. Before characterizing the actual collected data used for regression analysis, there will be given a few words to give a reason for selecting these variables.

There could be distinguished more prices of oil, the most frequently used ones are WTI and Brent. The U.S. Energy Information Administration defines WTI as *"a crude stream produced in Texas and southern Oklahoma which serves as a reference or "marker" for pricing a number of other crude streams and which is traded in the domestic spot market at Cushing, Oklahoma."*[96] Brent crude oil is, on the other hand, drilled from several oil fields in the North Sea, and, therefore, it used to be mostly determined for the European oil market; however, the Brent pricing is nowadays used also for oil drilled in West Africa, Mediterranean and Southeast Asia.[97] WTI and Brent

[95] Lee, National Chung Cheng University
[96] U.S. Energy Information Administration
[97] *Brent vs. WTI.* Energy and Capital

were moving closely to each other till 2011 (see Figure No. 12 below), the slight difference was a result of the additional transportation costs of Brent while being delivered to the American oil market.

Figure No. 12 Price difference between Brent and WTI crude oil narrowing



Source: U.S. Energy Information Administration

However, since 2011, there could be observed a spread between the two prices. One of the reasons explaining the spread is seen by the U.S. EIA in improving U.S. crude oil infrastructure that was able to push the costs, and, therefore, the price of WTI down. It might have seemed like Brent could overtake the WTI's position on being the global indicator of crude oil prices. Since 2012, the spread is narrowing thanks to replacement of Brent imports to the East Coast of the United States by WTI. Such replacement pushes prices of Brent down, which could be also seen on Figure No. 12.[98]

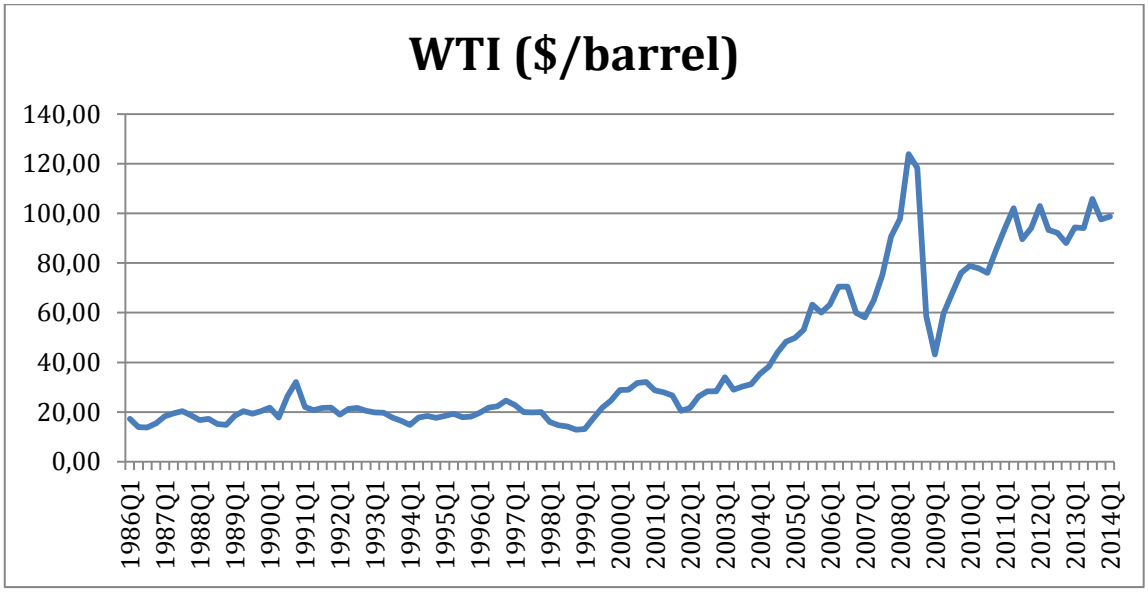
In the thesis, there will be used the values of WTI from two reasons. Firstly, greater part of the data sample comes from the period before the spread between WTI and Brent appeared. Secondly, and more importantly, even though Brent might become a more significant indicator for global oil prices, WTI is the most significant for the American market, on which the analysis is based.

[98] U.S. Energy Information Administration, 2013

On the other hand, Czech National Bank uses the Brent crude oil for their prognostic activities. Brent replaced previously used Urals crude oil in July 2006 as the Brent demonstrated the greatest explanatory substantiality.[99]

Furthermore, the data was collected for the time period from the first quarter of 1986 to the first quarter of 2014; that means 113 values for each variable. The oil price values are expressed in the nominal form, and in such form they will be used for the analysis. General difference between nominal and real price of oil is defined by the Federal Reserve Bank of St. Louis as follows: nominal prices express value of a good in the currency value at the time of production; real prices take into account changes in the general price level.[100] It is not difficult to adjust monthly real price of oil from nominal price of oil. However, the analysis will be based on nominal values of each of the variables, and, therefore, also nominal price of oil.

Figure No. 13 Development of nominal WTI oil price 1986Q1 – 2014Q1



Source: Federal Reserve Bank of St. Louis

Figure No. 13 captures the development of nominal WTI oil price based on collected data. Data set does not cover the prices of oil during the two oil shocks in

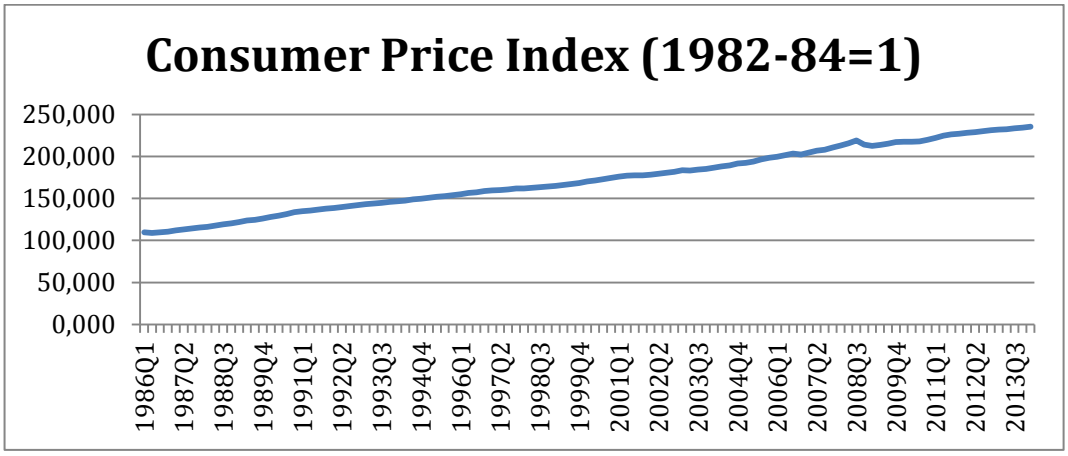
[99] Hošek, Komárek, Motl, 2011
[100] Federal Reserve Bank of St. Louis, 2007

1970s as the model will be concentrated on testifying the correlation on the time period from January 1986 till March 2014. Oil prices in this time period confirm the historical development of the price of oil discussed in chapter 2. Highest peak during 1990s could be recognized in October 1990 during the Iraq-Kuwait War, when the nominal price rose by 95,3 % since the 15th of July 1990 before the invasion (beginning of August 1990) till October when it started to decrease again. 2000's highest price was reached in June 2008 and it was the result of continuously increasing prices of oil as economies were experiencing fast economic growth. The prices rose by 44 % from January 2008 till June 2008. The second half of 2008 was experiencing fast decrease in prices. Economists' explanations of 2008 oil crisis vary: Hamilton explained the 2000's rising prices by the economic growth, and, therefore, increasing demand for oil. Such explanation would be consistent with the fact that the high prices started to fall down when the global economy slowed down as it was entering recession in the second half of 2008.[101] Since February 2009, when the prices reached their minimum of $39/barrel, they were increasing continuously except for the fall downs in 2011 and 2012; however, none of the changes was comparable with 2008 situation.

Furthermore, there will be used quarterly values of consumer price index in the United States to evaluate the level of inflation in the economy. There are several indicators of inflation as discussed in chapter 1.2; however, CPI is the most widely used in the United States, and, therefore, it will be used for further analysis. Data was collected from the Federal Reserve Bank of St. Louis.

[101] Khan, 2009

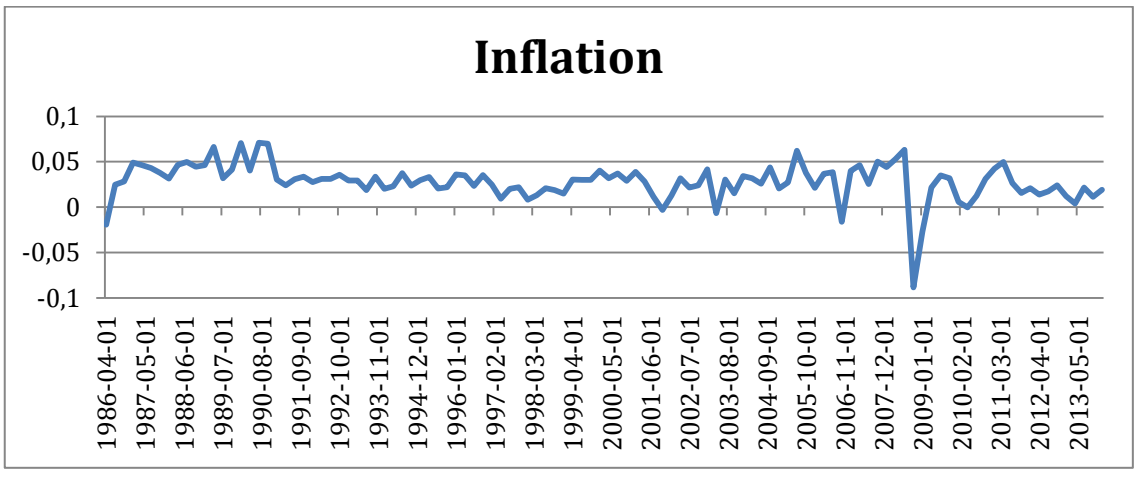
Figure No. 14 Development of CPI 1986Q1 – 2014Q1



Source: Federal Reserve Bank of St. Louis

Figure No. 14 captures the development of CPI in the United States since January 1986 till March 2014. CPI was continuously rising for most of the time; however, there could be seen exceptions. As CPI is more vulnerable for short-run deviations, the fall in 2008 is the most significant on the graph. Such fall may be a sign of correlation between changes in oil prices and inflation. However, Figure No. 15 captures the development of annualized CPI inflation, which will be used further for regression analysis that more or less matches the development of oil prices, and, therefore, predicts there might be a relationship between them.

Figure No. 15 Development of annualized inflation 1986Q2 – 2014Q1



Source: Federal Reserve Bank of St. Louis

Furthermore, there will be used other explanatory variables in the model, which are likely to influence the dependent variable – annualized CPI inflation. Firstly, one of the used independent variables is the rate of unemployment. Even though it seemed there might be a permanent relationship between the rate of inflation and unemployment, the Phillips curve[102] began to behave oddly during the 1970s, and such behavior is nowadays noted by the term stagflation: both inflation and unemployment rates rise. However, the short-run relationship between both rates seems to be inverse: if the rate of inflation increases, the unemployment rate decreases and vice versa.

Secondly, the model will contain interest rate as an independent variable, specifically effective federal funds rate. Such rate is based on the federal funds target rate that is nowadays set as the range between 0% and 0,25% by the Federal Reserve System in the United States. The effective federal funds rate is determined as a weighted average rates on brokered market.[103] The link between inflation and the interest rate might be observed as inverse. If the interest rate is lowered, people demand more loans that are thanks to the lower interest more convenient than before. More money people hold, higher spending they have; their higher consumption leads to the economic growth, and, finally, to the increase in inflation. Such relationship holds also vice versa.

Thirdly, there will be used nominal gross domestic product of the United States as an explanatory variable. It appears that there is a positive dependence between inflation and GDP: the growth in GDP brings along also an increase in inflation. The relationship between those two variables was very much discussed and there exist several opinions. There might have existed beliefs that higher inflation can buy higher growth; however, this idea seems to be already buried. The positive correlation between GDP and inflation may be better explained via interest rate. If the economy tends to increase the growth, the first step is to decrease the interest rate, which leads to more loans, higher spending and an increase in GDP, as it was already discussed above.

[102] The topic of Phillips Curve is more discussed in the chapter 3.1.
[103] Board of Governors of the Federal Reserve System, 2014

Lastly, there will be used lagged values of CPI to compare, whether there holds the positive relationship between the price of oil and inflation even with the consideration of build-in inflation. Build-in inflation as one of the components of inflation was more discussed in chapter 1.1.2. The actual rate of inflation is not only influenced by exogenous factors, it is also based on the rate that is expected. Such expectations are also influenced by the previous experience. Therefore, the previous rate of inflation may have an influence on the rate in the next time period and there will be provided a comparison between a model using lagged annualized CPI inflation as a variable and on the other hand a model that does not use it. Since build-in inflation is, based on economic theory, one of the components of inflation, it could be predicted that its inclusion in the model may induce different results.

4.3 Descriptive Statistics

Table No. 3 below concentrates on the main statistical characteristics of the data set, which consists of quarterly time series of variables that were discussed in previous chapter: consumer price index (CPI), GDP (HDP), interest rate (IR), unemployment rate (UNP) and the price of oil (WTI). The data was collected for the time period from the first quarter of 1986 to the first quarter of 2014. There were observed six values: mean, medium, maximum, minimum, standard deviation and number of observation.

Table No. 3 Summary statistics of dataset

Variable	Mean	Median	Maximum	Minimum	Std. Dev.	n
CPI	172,2158	170,1	235,247	109,033	37,10206	113
HDP	10275,48	10031	17078,3	4516,3	3843,346	113
IR	3,957168	4,5	9,73	0,07	2,688971	113
UNP	6,106195	5,7	9,9	3,9	1,510811	113
WTI	41,39124	26,22	123,78	12,93	30,28211	113

Source: Author's calculations [Eviews 7]

4.4 Econometric Model

The econometric model will testify the relationship between development of oil prices and annualized CPI inflation on collected data. Based on existing empirical research and on the data itself, there could be assumed a positive correlation between the price of oil and inflation. If the price of oil increases, the costs of production rises as well as oil is one of the main inputs in the economy, and, eventually, the overall price level also increases. The thesis' aim is to confirm such hypothesis.

4.4.1 ADF Test for Unit Roots

Before there will be executed an actual regression analysis, it is necessary to put the time series through the stationarity tests. In order to make the time series stationary, there will be used Augmented Dickey-Fuller unit root test (further ADF).

H_0: time series has a unit root

H_1: time series does not have a unit root

If the t-statistic is less than critical values (1 %, 5 %, 10 %), the time series is stationary. On the other hand, if the t-statistic is higher than critical values, the H_0 hypothesis is not rejected: the time series is not stationary. In such case, there is taken the first difference, the test is executed again and the t-statistic is compared with critical values. Tables No. 4 and 5 capture results of the ADF tests. H_0 hypothesis was not rejected for all of the testified variables on the level, and, therefore, there were taken the first differences and the test was executed one more time. The results of the ADF tests reflect that the time series are integrated of order 1 – I(1).

Table No. 4 ADF Stationarity tests – Level

	ADF			
	Level	Critical value 1%	5%	10%
CPI	-0,0629	-3,4897	-2,8874	-2,5807
HDP	0,7023	-3,4902	-2,8877	-2,5808
IR	-1,752	-3,4902	-2,8877	-2,5808
UNP	-2,46	-3,4902	-2,8877	-2,5808
WTI	-0,482	-3,4908	-2,8879	-2,5809

Source: Author's calculations [Eviews 7]

Table No. 5 ADF Stationarity tests – Level and Trend

	ADF			
	Level and Trend	Critical value 1%	5%	10%
CPI	-8,7086	-3,4902	-2,8877	-2,5808
HDP	-6,0196	-3,4902	-2,8877	-2,5808
IR	-4,9122	-3,4902	-2,8877	-2,5808
UNP	-4,5436	-3,4902	-2,8877	-2,5808
WTI	-9,6766	-3,4908	-2,8879	-2,5809

Source: Author's calculations [Eviews 7]

4.4.2 Granger Causality

ADF tests' results reflect that the time series are integrated of order 1, and, therefore, it is possible to testify Granger causality between individual variables. This statistical test testifies, whether one time series is able to forecast future values of another time series. In other words, if X is a dependent variable, there is Granger causality in such case, when a prediction based on the past values of X and Y is better than a prediction based only on the past values of X alone.[104] Test is executed on

[104] Granger, 1969

stationary time series, therefore, for the first differences in this case; and, furthermore, the data were adjusted to logarithmic form. The number of lags used is 2.

H_0: Y does not Granger cause X

H_1: Y Granger causes X

If the probability of H_0 is higher than 0,05, H_0 is not rejected, and, therefore X does not Granger cause Y. Table No. 6 captures the results of Granger causality for all variables that will be used in the regression analysis. Based on the results, it seems like the price of oil (WTI) Granger causes CPI. Furthermore, both CPI and GDP Granger cause the unemployment rate and the interest rate according to the test, and interest rate is also Granger caused by the price of oil and unemployment.

Table No. 6 Granger causality

Pairwise Granger Causality Tests
Date: 08/07/14 Time: 19:48
Sample: 1986Q1 2014Q4
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
DLHDP does not Granger Cause DLCPI	110	2.87166	0.0611
DLCPI does not Granger Cause DLHDP		0.74638	0.4766
DLWTI does not Granger Cause DLCPI	110	5.27820	0.0065
DLCPI does not Granger Cause DLWTI		1.46446	0.2359
DLUNP does not Granger Cause DLCPI	110	2.98642	0.0548
DLCPI does not Granger Cause DLUNP		4.95716	0.0088
DLIR does not Granger Cause DLCPI	110	1.09014	0.3399
DLCPI does not Granger Cause DLIR		4.87054	0.0095
DLWTI does not Granger Cause DLHDP	110	0.09000	0.9140
DLHDP does not Granger Cause DLWTI		1.06675	0.3478
DLUNP does not Granger Cause DLHDP	110	1.66074	0.1950
DLHDP does not Granger Cause DLUNP		3.44193	0.0357
DLIR does not Granger Cause DLHDP	110	0.55700	0.5746
DLHDP does not Granger Cause DLIR		11.9686	2.E-05
DLUNP does not Granger Cause DLWTI	110	1.25081	0.2905
DLWTI does not Granger Cause DLUNP		0.83819	0.4354
DLIR does not Granger Cause DLWTI	110	0.40444	0.6684
DLWTI does not Granger Cause DLIR		8.55849	0.0004
DLIR does not Granger Cause DLUNP	110	2.89768	0.0596
DLUNP does not Granger Cause DLIR		7.79494	0.0007

Source: Author's calculations [Eviews 7]

4.4.3 Johansen Cointegration Test

Furthermore, there will be executed one more statistical test before approaching regression analysis. Johansen test also testifies the possible existence of cointegrated relationships between variables. Data are in this test testified on the level and for 4 lags.

H_0: number of cointegrated relations equals 0

H_1: number of cointegrated relations is higher than 0

If the probability is higher than 0,05, H_0 is not rejected, and, therefore, there is no cointegration at all. On the other hand, if the probability is less than 0,05, H_0 could be rejected, which means there was found a relationship. There were executed two versions of Johansen test and both confirm that there is some kind of relationship. The first version was executed for all 5 variables and showed that CPI has a relation with 3 out of 5 variables at the most for the Trace statistic; and that CPI has 1 relation at the most for Max-Eigen statistic. Such relation might even be the one with the price of oil.

Table No. 7 Johansen cointegration test for all variables

Date: 08/07/14 Time: 19:55
Sample (adjusted): 1987Q2 2014Q1
Included observations: 108 after adjustments
Trend assumption: Linear deterministic trend
Series: CPI HDP IR UNP WTI
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.332812	108.9213	69.81889	0.0000
At most 1 *	0.270447	65.21555	47.85613	0.0005
At most 2 *	0.163955	31.16064	29.79707	0.0346
At most 3	0.099249	11.82073	15.49471	0.1657
At most 4	0.004912	0.531838	3.841466	0.4658

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.332812	43.70573	33.87687	0.0025
At most 1 *	0.270447	34.05491	27.58434	0.0064
At most 2	0.163955	19.33991	21.13162	0.0874
At most 3	0.099249	11.28889	14.26460	0.1403
At most 4	0.004912	0.531838	3.841466	0.4658

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Source: Author's calculations [Eviews 7]

Johansen cointegration test was also used only for two variables – the price of oil and CPI. The p-values are in all cases higher than 0,05, and, therefore, the H_0 is not rejected – there was not confirmed any relation between the two variables. However, the time series for both CPI and the oil price are not stationary in this case since the test was executed on the level. On the other hand, there was executed the Granger test that works with stationary time series and it confirmed that the price of oil Granger causes CPI with the use of stationary time series.

Table No. 8 Johansen cointegration test for CPI and the price of oil

Date: 08/07/14 Time: 20:02
Sample (adjusted): 1987Q2 2014Q1
Included observations: 108 after adjustments
Trend assumption: Linear deterministic trend
Series: WTI CPI
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.098885	11.33097	15.49471	0.1919
At most 1	0.000793	0.085701	3.841466	0.7697

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.098885	11.24527	14.26460	0.1424
At most 1	0.000793	0.085701	3.841466	0.7697

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Source: Author's calculations [Eviews 7]

4.4.4 Correlation Analysis

The relation between the price of oil and inflation could be also observed by correlation analysis, which is aimed at measuring the intensity of the testified relation. Correlation coefficient can take values from <-1 to 1>. If the correlation coefficient is higher than zero, the correlation is positive; therefore, with the increase of one variable, the other variable increases as well. In contrast, if the correlation coefficient takes values lower than zero, there is a negative correlation between the two variables; with the increase of one variable, the other variable decreases. The actual value of the coefficient could be crucial, because higher the value is, stronger the correlation between variables is: values 1 and -1 mean the strongest linear relationship; on the other hand, 0 represents the weakest one. However, it has to be taken into account that such correlation analysis works with two variables – price of oil and inflation, and, therefore, it does not include other variables that could also have a significant influence on both inflation and price of oil. Correlation analysis was executed for CPI and the price of oil, and also for annualized growth rate of CPI (annualized inflation). In both cases, there was shown positive correlation. Annualized inflation could be calculated based on following formula:

$$\pi = \left(\frac{CPI_t}{CPI_{t-1}}\right)^4 - 1 \qquad (4.1)$$

Table No. 9 Correlation analysis for CPI and WTI and for annualized inflation and WTI

	CPI	WTI
CPI	1	0,867816
WTI	0,867816	1

	Inflation	WTI
Inflation	1	0,644529
WTI	0,644529	1

Source: Author's calculations [Eviews 7]

4.4.5 Regression analysis

After the tests executed in previous chapters, there was executed linear regression analysis by the use of the method of least squares. There were used two models, each in two versions – A and B. In version A, there was ran linear regression analysis; in version B, there was also executed linear regression with the use of heteroskedasticity and autocorrelation consistent covariance matrix estimation (referred to as HAC) in order to reject heteroskedasticity hypothesis. First model includes 5 variables: annualized inflation represents dependent variable; price of oil, GDP, interest rate, and the rate of unemployment serve as independent explanatory variables. The fundamental form of this model is as follows:

$$\text{(1A)}\ \pi_t = \beta_0 + \beta_1 DLWTI_t + \beta_2 DLHDP_t + \beta_3 DLIR_t + \beta_4 DLUNP_t + u_t \qquad (4.2)$$

In this testified model (Table No. 10), the price of oil is statistically significant and there was observed positive dependence by the coefficient 0,0789. However, there could be also observed quite low value of Durbin-Watson statistic that equals 1,306. Purpose of Durbin-Watson statistic is to testify, whether there is autocorrelation in the model. The value ranges between 0 and 4. If the value is around 2, there is probably no autocorrelation in the model. Since the value in the model predicted quite strong autocorrelation of residuals, there was added another variable into model 2 – lagged inflation. It was not possible to reject the null hypothesis about heteroskedasticity of

residuals, there was used HAC in order to reject H_0.[105] The model is noted by 1B and the results are captured in Table No. 11.

Table No. 10 Regression analysis model 1A

Dependent Variable: INFLATION
Method: Least Squares
Date: 08/07/14 Time: 20:37
Sample (adjusted): 1986Q2 2014Q1
Included observations: 112 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.016155	0.003629	4.452108	0.0000
DLWTI	0.078933	0.010657	7.406447	0.0000
DLHDP	0.936144	0.274165	3.414520	0.0009
DLIR	0.013693	0.008580	1.595901	0.1135
DLUNP	0.111034	0.042286	2.625763	0.0099

R-squared	0.501871	Mean dependent var	0.027866
Adjusted R-squared	0.483249	S.D. dependent var	0.020179
S.E. of regression	0.014506	Akaike info criterion	-5.584900
Sum squared resid	0.022515	Schwarz criterion	-5.463539
Log likelihood	317.7544	Hannan-Quinn criter.	-5.535660
F-statistic	26.95095	Durbin-Watson stat	1.306003
Prob(F-statistic)	0.000000		

Source: Author's calculations [Eviews 7]

In comparison to model 1B, the results of the model 1B that uses the HAC are quite different. Even though the price of oil is still statistically significant, its coefficient's value is even lower than in the previous results. Furthermore, the rate of unemployment is not statistically significant in this model as well as the interest rate, and, therefore, annualized inflation is explained only by two variables – price of oil and GDP.

[105] Adkins, 2014

Table No. 11 Regression analysis model 1B

Dependent Variable: INFLATION
Method: Least Squares
Date: 08/08/14 Time: 18:58
Sample (adjusted): 1986Q2 2014Q1
Included observations: 112 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 5.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.002940	0.000802	3.665479	0.0004
DLWTI	0.014848	0.002356	6.301563	0.0000
DLUNP	0.021816	0.011490	1.898781	0.0603
DLHDP	0.198536	0.064306	3.087359	0.0026
DLIR	0.002648	0.002446	1.082573	0.2814

R-squared	0.493767	Mean dependent var	0.005406
Adjusted R-squared	0.474842	S.D. dependent var	0.003949
S.E. of regression	0.002862	Akaike info criterion	-8.830963
Sum squared resid	0.000876	Schwarz criterion	-8.709602
Log likelihood	499.5340	Hannan-Quinn criter.	-8.781723
F-statistic	26.09123	Durbin-Watson stat	1.221970
Prob(F-statistic)	0.000000		

Source: Author's calculations [Eviews 7]

Secondly, there was used another model that was enriched by one more variable – a lagged annualized inflation. The reason to use the variable was already discussed in the chapter 4.2 Data and is supported by economic theory. The fundamental form of this model is as follows:

(2A) $$\pi_t = \beta_0 + \beta_1 DLWTI_t + \beta_2 DLHDP_t + \beta_3 DLIR_t + \beta_4 DLUNP_t + \beta_5 \pi_{t-1} + u_t \quad (4.3)$$

Table No. 12 Regression analysis model 2A

Dependent Variable: INFLATION
Method: Least Squares
Date: 08/08/14 Time: 18:50
Sample (adjusted): 1986Q3 2014Q1
Included observations: 111 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.001527	0.000684	2.233742	0.0276
DLWTI	0.015811	0.001884	8.391093	0.0000
INFLATION(-1)	0.338255	0.062314	5.428214	0.0000
DLUNP	0.021805	0.007298	2.987775	0.0035
DLIR	0.001917	0.001491	1.286021	0.2013
DLHDP	0.163540	0.047689	3.429336	0.0009

R-squared	0.599509	Mean dependent var	0.005492
Adjusted R-squared	0.580438	S.D. dependent var	0.003860
S.E. of regression	0.002500	Akaike info criterion	-9.092218
Sum squared resid	0.000656	Schwarz criterion	-8.945757
Log likelihood	510.6181	Hannan-Quinn criter.	-9.032804
F-statistic	31.43564	Durbin-Watson stat	1.996417
Prob(F-statistic)	0.000000		

Source: Author's calculations [Eviews 7]

In the second testified model, the price of oil is also statistically significant with the positive dependence by the coefficient 0,0158 that is lower than in the model 1A and only slightly higher than in model 1B. The most important is however the positive characteristic of the dependence. Even in this model, interest rate is not statistically significant. All other variables are statistically significant, the lagged annualized inflation is not an exception – there is a positive dependence by the coefficient 0,338. Coefficient of determination is higher than in the first model – 0,6, which could mean that 60 % of values of dependent variable is explained by the second model. Adjusted R-squared has the same interpretation as the coefficient of determination; however, it is adjusted for the number of explanatory variables used in the model.[106] Based on adjusted coefficient of determination, model explains 58 % of values of the dependent

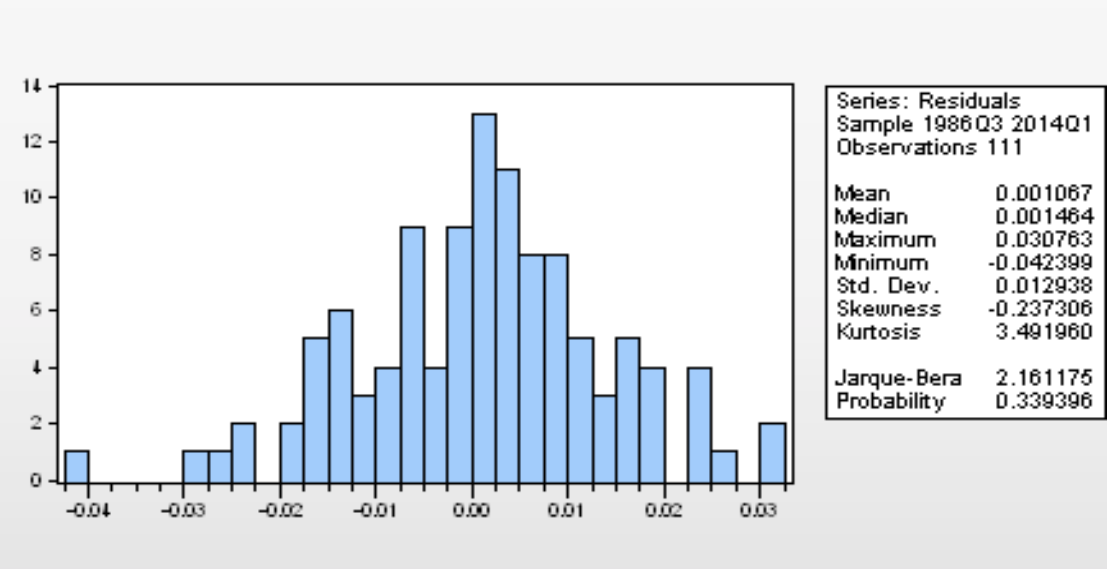
[106] Higher number of explanatory variables is used in the model, higher is the coefficient of determination, because more variables may explain more of the values of the dependent variable. Therefore, values of adjusted coefficient of determination are lower than values of the actual coefficient of determination.

variable. Value of Durbin-Watson statistic is 1,996 that could predict no autocorrelation in this model. According to the results, the actual form of the results is as follows:

$$(2A)\ \hat{\pi}_t = 0.002 + 0.016\, DLWTI_t + 0.164\, DLHDP_t + 0.022\, DLUNP_t + 0.338\, \pi_{t-1} \quad (4.4)$$

Hypothesis about normally distributed residuals is not rejected based on the Jarque-Bera test for normality, where the p-value has to be higher than 0,05 in order not to reject the hypothesis, which applies in this case (p-value = 0,34) as well as it did in the first model (p-value = 0,66).

Figure No. 16 Jarque-Bera test for normality – model 2A



Source: Author's calculations [Eviews 7]

Even for the second model, it holds that the null hypothesis about heteroskedasticity of residuals cannot be rejected. Therefore, there was used HAC in order to reject such hypothesis. The model is noted by 2B and the results are captured in following table.

Table No. 13 Regression analysis model 2B

Dependent Variable: INFLATION
Method: Least Squares
Date: 08/08/14 Time: 19:00
Sample (adjusted): 1986Q3 2014Q1
Included observations: 111 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 5.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.001527	0.000591	2.583282	0.0112
DLWTI	0.015811	0.002006	7.882891	0.0000
INFLATION(-1)	0.338255	0.102466	3.301137	0.0013
DLUNP	0.021805	0.009899	2.202623	0.0298
DLIR	0.001917	0.002182	0.878829	0.3815
DLHDP	0.163540	0.056808	2.878799	0.0048

R-squared	0.599509	Mean dependent var	0.005492
Adjusted R-squared	0.580438	S.D. dependent var	0.003860
S.E. of regression	0.002500	Akaike info criterion	-9.092218
Sum squared resid	0.000656	Schwarz criterion	-8.945757
Log likelihood	510.6181	Hannan-Quinn criter.	-9.032804
F-statistic	31.43564	Durbin-Watson stat	1.996417
Prob(F-statistic)	0.000000		

Source: Author's calculations [Eviews 7]

Results for model 2B, which could be observed in Table No. 13, seems to be similar to the ones for model 2A. Model 2B has the advantage of possibility to reject heteroskedasticity hypothesis. Price of oil is statistically significant also in this model, and more importantly, the dependence is positive, which fulfills the aim of the empirical analysis. All of the variables except for interest rate are statistically significant and analyze positive dependence. According to both normal and adjusted coefficient of determination, this model explains in the first case 60 %, in the second case 58 % of the values of dependent variable. The actual form of the model 2B looks as follows:

$$\text{(2B)}\quad \hat{\pi}_t = 0.002 + 0.016\, DLWTI_t + 0.164\, DLHDP_t + 0.022\, DLUNP_t + 0.338\, \pi_{t-1} \tag{4.5}$$

In comparison to results of model 2A, the values of coefficients do not differ. There are slightly different standard errors in both models, which is an effect of using HAC standard errors and covariance. However, thanks to the use of such method, it is

possible to reject the heteroskedasticity hypothesis in the second model as mentioned above.

There were executed four models all together in the practical part of the thesis. First two models (1A and 1B) did not include lagged annualized inflation as an independent variable. That might be the reason, why both 1A and 1B models have different results than models including lagged inflation. The use of lagged inflation variable is supported by the economic theory, as build-in inflation is one of three components of the general rate of inflation. Both other components could be also considered as included in models. Demand-pull inflation is according to the theory caused by the growth of aggregate demand and such growth could be for example captured by the growth of GDP, into which the growth of AD results. Therefore, GDP may represent this component of inflation. Lastly, and most importantly, the cost-push inflation is included in the model in the price of oil variable. Therefore, the last two models seem to include at least partially all of the components of inflation. The best out of all used models seems to be the last one (2B).

The thesis is concentrated on an observation of positive relationship between the price of oil and inflation and not necessarily on the actual value of estimated coefficient; coefficient is even in the last model (2B) very low – 0,016. However, the previous empirical studies testified decreasing relationship between inflation and the price of oil, which could be supported by the low value of the coefficient in this model. Even though, there was found a positive dependence between the variables, and, furthermore, the price of oil is statistically significant, it would be interesting to divide the data sample and testify, whether the relationship gets weaker over time. Year 2003 suggests itself to be a suitable breaking point, since the increase in price of oil is quite fast from 2003. However, this could be a recommendation for further studies.

Conclusion

Relationship between the price of oil and inflation is not one of the easiest to explain. It is not possible to investigate only these two variables alone and expect the results of such observation to be significant. Both of them are discussed on daily basis and watched by individuals, investors, central banks, etc., and that might be the reason why, during the 1970s, there was noticed behavior of these two variables that indicated dependence oriented from the development of price of oil to the rate of inflation. However, it is necessary to be aware of the influences that could have an impact on both of the variables, which could cause their movement in the same direction. According to the economic theory, inflation consists of three components; one of them is also cost-push inflation. Oil might be considered one of the main inputs in economies all over the world, and, therefore, it seems that its price could be one of many explanations for the movement of inflation.

However, inflation cannot be explained only by the price of oil, and, therefore, some of other possible explanatory variables were taken into consideration in the thesis. Gross domestic product seems to be able to influence inflation, and, furthermore, there could be expected a positive dependence of inflation on GDP. Another variable could be interest rate, whose relationship with inflation should be inverse as well as expected relationship with the rate of unemployment. Furthermore, the actual rate of inflation should be also influenced by the previous rate of inflation based on the theory of rational expectations that also takes previous experience with inflation into consideration. Even though there were used also other variables in order to explain inflation, the practical part of the thesis is mostly aimed in observation of relationship between inflation and the price of oil. All of the variables, except for interest rate, were statistically significant in the chosen testified models. There was found positive dependence for all of the significant variables. There might have been expected an inverse relationship with the rate of unemployment based on the theory of Phillips curve; however, the negative dependence was rejected already during the 1970s, therefore, there is not paid more attention to such result.

There was executed linear regression analysis by the least square method, which testified four models in the practical part of the thesis. First model was based on five

variables: annualized CPI inflation is the dependent variable; GDP, interest rate, unemployment rate, and the WTI price of oil are independent variables. For the second model, there was used heteroskedasticity and autocorrelation consistent covariance matrix estimation in order to prevent the model from possible heteroskedasticity and autocorrelation. In both models, there was seen positive dependence between inflation and the price of oil that fulfills the thesis' aim. However, there was executed linear regression on two other models, both using six variables: annualized CPI inflation is the dependent variable; GDP, interest rate, unemployment rate, the WTI price of oil, and lagged annualized CPI inflation are independent variables. Even in this case, there was ran the linear regression and also regression using HAC in order to prevent the model from heteroskedasticity and autocorrelation. The last version of the analysis seems to be the most suitable from all used in the thesis. There was observed positive dependence between the price of oil and inflation, which meets the thesis' aim. Furthermore, the model was adjusted for autocorrelation by adding another variable - lagged inflation, which has also positive relationship with inflation and it is statistically significant.

The aim of the thesis was to testify relationship between inflation and the price of oil. All of the models predict a positive dependence between the two variables, and such result matches the expectations set in the thesis. However, the value of coefficient is very low, which also agrees with the previous empirical studies. The relationship between the price of oil and the rate of inflation is not only an interesting, but also very important topic. The price of oil is included in the models of central banks around the world in order to help to predict inflation. Therefore, the topic is quite significant. Previous empirical studies testified the strength of the relationship in different time periods; the strongest one was during the 1970s. There might be several reasons for that. However, it would be interesting to divide even the data set used in this work to observe, whether the strength of the relationship decreases even in the time period from 1986. Year 2003 seems to be quite a good breaking point for the data set, because the price of oil started to rise very fast since then. However such analysis may be an interesting topic for further studies.

List of Tables

List of Figures

Sources

Internet Sources:

1973-74 Oil Crises. University of California, Berkeley. [on-line]. Available at: http://bancroft.berkeley.edu/ROHO/projects/debt/oilcrisis.html

1999/96/EC: Council Decision of 31 December 1998 on the position to be taken by the Community regarding an agreement concerning the monetary relations with the Principality of Monaco. [on-line]. Available at: http://eur-lex.europa.eu/legal-content/EN/ALL/;jsessionid=kRgSTNnhL1VnQ0hGhYLWyFlNK5TnH2ywsdTGHvB24jwjpZZgldyp!-1220958437?uri=CELEX:31999D0096

ADAMS, F. G.; SHACHMUROVE, Y. *The Effects of the East Asian Crisis on the Region's Energy Consumption.* September 2000. [on-line]. Available at: http://www.economics.sas.upenn.edu/system/files/00-13.pdf

ADKINS, L. C. *Using gretl for Principles of Econometrics, 4th Edition.* p. 211. Oklahoma State University, April 2014. [on-line]. Available at: http://www.learneconometrics.com/gretl/using_gretl_for_POE4.pdf

Aktuální prognóza ČNB. Česká národní banka, 6.2. 2014. [on-line]. Available at: http://www.cnb.cz/cs/menova_politika/prognoza/

AL-YOUSEF, Nourah. *Economic Models of OPEC Behaviour and the Role of Saudi Arabia.* Department of Economics, University of Surrey, June 1998. [on-line]. Available at: https://www.surrey.ac.uk/economics/files/apaperspdf/SEED%2094.pdf

BATTEN, Dallas S. *Inflation: The Cost-Push Myth.* Federal Reserve Bank of St. Louis, June/July 1981, pp. 20 - 26. [on-line]. Available at: https://research.stlouisfed.org/publications/review/81/06/Inflation_Jun_Jul1981.pdf

BIROL, Özlen Hiç. *"Adaptive Expectations" of Milton Friedman and Monetarists and Phillips Curve; And the Comparison of them with Other Macroeconomic Schools.* GSTF Journal on Business Review (GBR), Vol. 3 No. 1, November 2013. [on-line]. Available at: http://download.springer.com/static/pdf/34/art%253A10.7603%252Fs40706-013-0008-0.pdf?auth66=1397639327_1a9c0e0447668465c2c1f9ff5ddbfb9c&ext=.pdf

BJØRNLAND, H. Ch. *The Economic Effects of North Sea Oil on the Manufacturing Sector.* Scottish Journal of Political Economy, Vol. 45, No. 5, November 1998. [on-line]. Available at: http://home.bi.no/a0310125/Bjornland_SJPE_1998.pdf

BLANCHARD, O. J.; GALÍ, J. *The Macroeconomic Effect of Oil Price Shocks: Why Are the 2000s So Different from the 1970s?* Department of Economics and Business, Universitat Pompeu Fabra, Economics Working Papers, No. 1045, October 2008. [on-line]. Available at: http://www.econ.upf.edu/docs/papers/downloads/1045.pdf

Brent vs. WTI. Energy and Capital. [on-line]. Available at: http://www.energyandcapital.com/resources/brent-vs-wti

Brief History. The Organization of the Petroleum Exporting Countries. [on-line]. Available at: http://www.opec.org/opec_web/en/about_us/24.htm

CANOVA, F.; PAPPA, E. *Fiscal Policy, Pricing Frictions and Monetary Accommodation.* March 2011. [on-line]. Available at: http://pareto.uab.es/~evipappa/EP_paper.pdf

Ceny průmyslových výrobců – Metodika. Český statistický úřad. [on-line]. Available at: http://www.czso.cz/csu/redakce.nsf/i/ceny_prumyslovych_vyrobcu

Ceny stavebních prací – Metodika. Český statistický úřad. [on-line]. Available at: http://www.czso.cz/csu/redakce.nsf/i/ceny_stavebnich_praci

Ceny tržních služeb – Metodika. Český statistický úřad. [on-line]. Available at: http://www.czso.cz/csu/redakce.nsf/i/ceny_trznich_sluzeb

Ceny zemědělských výrobků – Metodika. Český statistický úřad. [on-line]. Available at: http://www.czso.cz/csu/redakce.nsf/i/ceny_zemedelskych_vyrobcu

Česká republika: hlavní makroekonomické ukazatele. ČSÚ, MPSV, ČNB, MF a ČHMÚ. 2014. [on-line]. Available at: www.czso.cz

Chapter 17. The Consumer Price Index. Bureau of Labor Statistics, June 2007. [on-line]. Available at: http://www.bls.gov/opub/hom/pdf/homch17.pdf

CICCHETTI, Ch. J.; GILLEN, W. J. *The Mandatory Oil Import Quota Program: A Consideration of Economic Efficiency and Equity.* Natural Resources Journal, Vol. 13, No. 3, July 1973. [on-line]. Available at: http://lawlibrary.unm.edu/nrj/13/3/01_cicchetti_mandatory.pdf

Consumer Price Index. Bureau of Labor Statistics. [on-line]. Available at: http://www.bls.gov/cpi/cpifaq.htm#Question_9

Consumer Price Index. Bureau of Labor Statistics. [on-line]. Available at: http://www.bls.gov/cpi/

Consumer Price Index. U.S. Department of Labor, Bureau of Labor Statistics. [on-line]. Available at: http://www.bls.gov/ro5/cpiushistorical.pdf

COOPER, A. S. *The 1979 "Oil Shock:" Legacy, Lessons, and Lasting Reverberations: In 1979 OPEC's Swing Producer Came Out Swinging.* The Middle East Institute Washington, DC, September 2009. [on-line]. Available at: http://chenry.webhost.utexas.edu/public_html/elephants/OilShock201979-Final.pdf

Definition of 'Consumer Price Index'. The Economic Times. [on-line]. Available at: http://economictimes.indiatimes.com/definition/consumer-price-index

Definitions, Sources and Explanatory Notes. U.S. Energy Information Administration. [on-line]. Available at: http://www.eia.gov/dnav/pet/TblDefs/pet_pri_spt_tbldef2.asp

ERICKSON, E. W.; PETERS, W. L.; SPANN, R. M.; TESE, P. J. *The Economy of Crude Oil Price Controls.* Natural Resources Journal, Vol. 18, October 1978. [on-line]. Available at: http://lawlibrary.unm.edu/nrj/18/4/07_erickson_political.pdf

FLEMMING, J. S. *The Economic of Worldwide Stagflation: Review.* Oxford Economic Papers, Issue 39, pp. 223-232, 1987. [on-line]. Available at: http://www.jstor.org/discover/10.2307/2663137?uid=2129&uid=2&uid=70&uid=4&sid=21103891230791

FRIEDMAN, Milton; FRIEDMAN, Rose. *Free to Choose. A Personal Statement.* Harcourt Brace Jovanovich, New York and London, 1980. ISBN 0-15-133481-1. [on-line]. Available at: http://www.il-rs.org.br/site/biblioteca/docs/Friedman__Milton___Rose_-_Free_To_Choose_--_A_Personal_Statement.pdf

FRIEDMAN, Milton. *The Role of Monetary Policy.* The American Economic Review, March 1968. [on-line]. Available at: http://www.aeaweb.org/aer/top20/58.1.1-17.pdf

GRANGER, C. W. J. *Investigating Causal Relations by Econometric Models and Cross-Spectral Methods.* Econometrica, Vol. 37, No. 3, July 1969. [on-line]. Available at: http://www.jstor.org/discover/10.2307/1912791?uid=3737856&uid=2129&uid=2&uid=70&uid=4&sid=21104569515303

GREGORIO, J.; LANDERRETCHE, O.; NEILSON, Ch. *Another Pass-Through Bites the Dust? Oil Prices and Inflation.* Central Bank of Chile, Working Paper No. 417, May 2007. [on-line]. Available at: http://www.bcentral.cl/estudios/documentos-trabajo/pdf/dtbc417.pdf

HAMILTON, James D. *Historical Oil Shocks.* National Bureau of Economic Research, February 2011. [on-line]. Available at: http://www.nber.org/papers/w16790

HICKS, J. R. *Mr. Keynes and the "Classics".* Econometrica, April 1937. [on-line]. Available at: http://public.econ.duke.edu/~kdh9/Courses/Graduate%20Macro%20History/Readings-1/Hicks_Mr.%20Keynes%20and%20the%20Classics.pdf

HOŠEK, J.; KOMÁREK, L.; MOTL, M. *Monetary Policy and Oil Prices.* Warwick Economic Research Papers, No. 947, 2011. [on-line]. Available at: http://www2.warwick.ac.uk/fac/soc/economics/research/workingpapers/2010/twerp_947.pdf

Inflace – druhy, definice, tabulky. . Český statistický úřad. [on-line]. Available at: http://www.czso.cz/csu/redakce.nsf/i/mira_inflace#sk

Inflace, míra inflace – Metodika. Český statistický úřad. [on-line]. Available at: http://www.czso.cz/csu/redakce.nsf/i/kdyz_se_rekne_inflace_resp_mira_inflace

Inflation and Deflation. [on-line]. Availble at: http://revisionguru.co.uk/revisionguru/wp-content/uploads/2013/01/Slide073-1024x767.jpg

International Energy Statistics. U.S. Energy Information Administration. Available at: http://www.eia.gov/cfapps/ipdbproject/IEDIndex3.cfm?tid=5&pid=5&aid=2

Introduction to Benefit-Cost Analysis. National Center for Environmental Economics. [on-line]. Available at: http://yosemite.epa.gov/ee/epa/eed.nsf/6058a0895486355785257662006 00639df3/a92f904ea01bd78f85257662007490b8!OpenDocument

James D. Hamilton. Professor of Economics. [on-line]. Available at: http://econweb.ucsd.edu/~jhamilton/

John Williams' Shadow Government Statistics. [on-line]. Available at: http://www.shadowstats.com

KHAN, M. S. *The 2008 Oil Price "Bubble".* Peterson Institute for International Economics, Policy Brief, No. PB09-19, August 2009. [on-line]. Available at: http://www.piie.com/publications/pb/pb09-19.pdf

KLEIN, David. *Mechanism of Western Domination: A Short History of Iraq and Kuwait.* California State University, Northridge, January 2003. [on-line]. Available at: http://www.csun.edu/~vcmth00m/iraqkuwait.html

KUGLER, P.; BERNHOLZ, P. *The Price Revolution in the 16th century: Empirical Results from a Structural Vectoautoregression Model.* University of Basel, January 2007. [on-line]. Available at: https://wwz.unibas.ch/fileadmin/wwz/redaktion/makro/Papers/The_Price_Revolutiona.pdf

LEE, Bi-Juan. *The Changing Effects of Oil Price Changes on Inflation.* National Chung Cheng University. [on-line]. Available at: http://econ.ccu.edu.tw/academic/master_paper/091019seminar.pdf

MANESCHI, Andrea. *Jules Dupuit: A sesquicentennial tribute to the founder of benefit-cost analysis.* The European Journal of the History of Economic Thought, Vol. 3, Issue 3, p. 411-432, 1996. [on-line]. Available at: http://www.tandfonline.com/doi/abs/10.1080/10427719600000040#preview

Member Countries. The Organization of the Petroleum Exporting Countries. [on-line]. Available at: http://www.opec.org/opec_web/en/about_us/25.htm

Monetarism: Adaptive expectations. Policonomics. [on-line]. Available at: http://www.policonomics.com/lp-monetarism-adaptive-expectations/

Monetary Policy – Inflation – Causes. [on-line]. Available at: http://www.bized.co.uk

Money and Inflation. Available at: http://economistsview.typepad.com/economistsview/2007/04/money_and_infla.html

MORENO, Ramon. *What Caused East Asia's Financial Crises.* Federal Reserve Bank of San Francisco, August 1998. [on-line]. Available at: http://www.frbsf.org/economic-research/publications/economic-letter/1998/august/what-caused-east-asia-financial-crisis/

MUNDELL, R. A. *Capital Mobility and Stabilization Policy under Fixed and Flexible Exchange Rates.* Canadian Journal of Economics, 29, 1963. [on-line]. Available at: http://jrxy.zjsu.edu.cn/jrxy/jssc/2904.pdf

MUTH, John. *Rational Expectations and the Theory of Price Movements.* Econometrica, Vol. 29, No. 3, July 1961. [on-line]. Available at: http://www.fep.up.pt/docentes/pcosme/s-e-1/Eco-29-3-315.pdf

NISKANEN, William, A. *On the Death of Phillips Curve.* Cato Journal, Vol. 22, No. 2, 2002. [on-line]. Available at: http://object.cato.org/sites/cato.org/files/serials/files/cato-journal/2002/11/cj22n2-1.pdf

Nominal vs. Real Oil Prices. Federal Reserve Bank of St. Louis, 2007. [on-line]. Available at: http://www.stlouisfed.org/publications/itv/articles/?id=1214

Oil Prices. British Petroleum, June 2013. [on-line]. Available at: http://www.bp.com/content/dam/bp/pdf/statistical-review/statistical_review_of_world_energy_2013.pdf

OPEC Annual Statistical Bulletin 2013. OPEC, 2013. [on-line]. Available at: http://www.opec.org/opec_web/static_files_project/media/downloads/publications/ASB2013.pdf

OPEC. Library of Economics and Liberty. Available at: http://www.econlib.org/library/Enc1/OPEC.html#table%201

PASAOGULLARI, M; WAIWOOD, P. *Do Oil Prices Predict Inflation?* Federal Reserve Bank of Cleveland, May, 2014. [on-line]. Available at: www.clevelandfed.org/research/commentary/2014/2014-1x.pdf

PEDEN, Joseph. *Inflation and the Fall of the Roman Empire*. Ludwig von Mises Institute, September 2009. [on-line]. Available at: https://mises.org/daily/3663

Petroleum & Other Liquids. U.S. Energy Information Administration. [on-line]. Available at: http://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=pet&s=rclc1&f=m

Phillips curve shifts during the 1970's and early 1980's. Federal Reserve Bank of San Francisco. Available at: http://www.frbsf.org/education/publications/doctor-econ/2008/march/phillips-curve-inflation

PHILLIPS, A. W. *The Relation between Unemployment and the Rate of Change of Money Wage Rates in the United Kingdom, 1861-1957.* Economica, New Series, Vol. 25, No. 100, November 1958, pp. 283-299. [on-line]. Available at: http://people.virginia.edu/~lc7p/202/Phillips58.pdf

PLAUT, E. Steven. *OPEC Is Not a Cartel.* Israel Institute of Technology, November-December 1981. [on-line]. Available at: http://www.jstor.org/discover/10.2307/40720003?uid=3737864&uid=2129&uid=2&uid=70&uid=4&sid=21104282122333

PPI – index cen průmyslových výrobců. [on-line]. Available at: http://www.kurzy.cz/makroekonomika/index-cen-prumyslovych-vyrobcu/

Price Difference Between Brent and WTI Crude Oil Narrowing. U.S. Energy Information Administration, June 2013. [on-line]. Available at: http://www.eia.gov/todayinenergy/detail.cfm?id=11891

SAMUEL, A. T. *Attacking Iran: Lessons from the Iran-Iraq War.* Belfer Center for Science and International Affairs, December 2011. [on-line]. Available at: http://belfercenter.ksg.harvard.edu/files/samuel-policy-brief-12-11.pdf

Selected Interest Rates. Board of Governors of the Federal Reserve System, August 2014. [on-line]. Available at: http://www.federalreserve.gov/releases/h15/update/

SHORE, J.; HACKWORTH, J. *Impacts of the Venezuelan Crude Oil Production Loss.* U.S. Energy Information Administration, 2003. [on-line]. Available at: http://www.eia.gov/pub/oil_gas/petroleum/feature_articles/2003/venezuelan/vzimpacts.htm

Suez Crises, 1956. U.S. Department of State. [on-line]. Available at: http://2001-2009.state.gov/r/pa/ho/time/lw/97179.htm

The Billion Prices Project @ MIT. [on-line]. Available at: http://bpp.mit.edu

The History of the Federal Reserve System. Federal Reserve Bank of Cleveland. [on-line]. Available at: http://www.clevelandfed.org/about_us/who_we_are/about_the_system/history.cfm

The Theory of Rational Expectations. [on-line]. Available at: http://macroresearch.org/blog/the-theory-of-rational-expectations/

The Twelve Federal Reserve Districts. The Federal Reserve Board. [on-line]. Available at: http://www.federalreserve.gov/otherfrb.htm

Today in Energy. U.S. Energy Information Administration. [on-line]. Available at: http://www.eia.gov/todayinenergy/detail.cfm?id=11891

U.S. Energy Information Administration. Available at: http://www.eia.doe.gov/emeu/ipsr/t44.xls

U.S. Inflation: Measuring inflation. Federal Reserve Bank of Cleveland. [on-line]. Available at: http://www.clevelandfed.org/research/Data/US-Inflation/cpi.cfm

Unemployment and inflation. [on-line]. Available at: http://bilbo.economicoutlook.net

What is inflation and how does the Federal Reserve evaluate changes in the rate of inflation. Board of Governors of the Federal Reserve System. [on-line]. Available at: http://www.federalreserve.gov/faqs/economy_14419.htm

What is inflation and how does the Federal Reserve evaluate changes in the rate of inflation. Board of Governors of the Federal Reserve System. [on-line]. Available at: http://www.federalreserve.gov/faqs/economy_14419.htm

What is the purpose of the Federal Reserve System? Board of the Governors of the Federal Reserve System. [on-line]. http://www.federalreserve.gov/faqs/about_12594.htm

ZYCHER, Benjamin. *OPEC.* Library of Economics and Liberty. [on-line]. Available at: http://www.econlib.org/library/Enc1/OPEC.html

Book Sources:

DOWNES, Mark. *Iran's unresolved revolution*. Aldershot: Ashgate, 2002. ISBN 0-7546-3188-5

HOLMAN, Robert. *Dějiny ekonomického myšlení*. Vydání třetí. Beckovy ekonomické učebnice. Praha: C. H. Beck, 2005. ISBN 80-7179-380-9

HOLMAN, Robert. *Makroekonomie středně pokročilý kurz*. Vydání první. Praha: C. H. Beck, 2004. ISBN 80-7179-764-2

ROMER, David. *Advanced macroeconomics.* Boston: Irwin/McGraw-Hill, 2006. ISBN 0-07-287730-8

Data Sources:

Federal Reserve Bank of St. Louis. Available at: http://research.stlouisfed.org

U.S. Energy Information Administration. Available at: http://www.eia.gov