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The Impact of Oil Price Changes on Economic Growth

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The Impact of Oil Price Changes on Economic Growth

Projekt IGA

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Abstract

This paper investigates the oil price-macroeconomy relationship by means of analyzing the impact of oil price changes on economic growth in the U.S. using quarterly data from 1947 to 2001, and in selected EU countries using monthly data from 1961 to 2002. For the purpose of this investigation three different proxies of oil price changes are employed. The results suggest that oil price increases which overcome their own maximum values from the previous three years have a greater negative effect on economic growth than oil price increases which exceed only a one year maximum and than simple oil price changes. The paper also presents a hypothesis that oil price decreases do not contribute to economic growth in both analyzed cases. All these results allow us to maintain the nonlinear interpretation of the examined relationship suggested by Hamilton.

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JEL classification: E32, C32, Q43

Keywords: oil shock, economic growth, nonlinear

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1. Introduction

Recent developments in the world crude oil markets have underlined the strategic importance of crude oil and have caused this topic to become an area of intense interest to both media and consumers. The widespread fears that rising crude oil prices might harm world economic activity has caused the topic of oil price-macroeconomy relationships to become the main focus of several analyses and scientific publications.

The relationship between crude oil prices and economic activity has been investigated for several years and a considerable body of research has been written to date. A period of high interest in this topic started at the end of 1973 when the first oil shock took place. From that time until the present, economists have presented many different opinions and explanations regarding how oil price increases are correlated with economic activity. From this multitude of interpretation two main explanations of how oil price shocks affect macroeconomic stability have established dominance in the field of economics. One explanation presented for example by Bohi (1989), Hooker (1996), Bernanke, Gertler and Watson (1997) and Barski and Kilian (2000) suggests that oil price increases have no negative influence on economic growth, whereas the other explanation holds that oil price shocks contribute to economic slowdown in countries which are completely dependant on imported oil, see Pierce and Enzler (1974), Pindyck (1980), Hamilton (1983), Mork (1989), Davis and Haltiwanger (2001) and Cuñado and Pérez de Gracia (2000). Within the latter explanation persists a discrepancy about the channel through which oil price increases cause a recession.

From the economic literature it is obvious that "Supply-side Shock" is the most widely presented interpretation of the oil price-macroeconomy relationship. In these models an oil price increase firstly would reduce the overall price level and secondly, economic activity, which can be expressed by GDP or any other macroeconomics indicator. According to this view the relationship between oil prices and economic activity can be seen as a linear one. On the other hand, there have been several studies presented which suggested that the oil price-macroeconomy relationship is nonlinear, rather than linear, and the channel through which the oil price shocks affect economic growth can be considered as „Demand-side Shock". Uncertainty about the future development of energy prices during the period of increasing oil prices caused households to postpone their consumption of large items such as cars or housing until a time when better information would be available. The same type of behavior is also observable within many different kinds of industries.

The paper is organized as follows: Section 2 reviews a brief summary of oil price history in the second half of the last century. Section 3 discusses economics explanations of the oil price-macroeconomy relationship with a focus on "Demand-Side Shock" interpretations. Section 4 provides the main definitions of oil price variables used in this paper to measure the intensity of an oil price shock. Section 5 reveals the empirical results fromthe U.S. Findings for a chosen sample of EU countries and the Czech Republic are presented in section 6. Conclusions are offered in section 7.

2. Historical development of crude oil prices

In this section I would like to provide a brief description of the most important oil shocks that occurred in the second half of the twentieth century. As can be seen from Figure 1 the crude oil price exhibited a very stable path until the beginning of the Seventies. The main reasons for such stable development were the price regulation imposed continually in the United States from World War II until the late Seventies, and the very close cooperation of leading oil companies on the world petroleum market.

The first oil shock, which is widely interpreted as a milestone in oil price history, took place at the end of 1973. But if one delves further into the history, one finds that several unexpected oil price increases occurred for many times before 1973. The "Suez Crises" stands as a clear example of one of these earlier unexpected price increases. In October 1956, in response to the Israeli invasion to Egypt's Sinai Peninsula, Arabian countries initiated a shutdown of the Suez Canal. World oil supply decreased by more than 10 % in response to the blockade and oil prices increased by more than 13 %.

In October 1973, Egypt and Syria started a military action against Israel and the Organization of Petroleum Exporting Countries (OPEC), particularly its Arabian members, imposed an oil embargo against supporters of Israel such as the United States and Holland. This exogenous reduction of the world oil supply by almost 10 % subsequently caused oil prices to increase by more than 10.0 dollars per barrel ($/bbl).

Another oil shock occurred in November 1978 during the Iranian revolution, when almost the entire Iranian oil production, which represented 9 % of the then total world supply, was removed from the market and the price of oil increased by more than 20.0 $/bbl. The Iranian revolution progressed to a war between Iraq and Iran. The outbreak of new military conflict in an oil abundant region brought about another oil shock within a relatively short period of time. The price of oil, in response to a 7% decline in World oil production, increased by more than 5.0 $/bbl.

Figure 1 – World Oil Price (U.S. dollars per barrel)

Source: IFS

As can be seen from the Figure 1, the price of oil plunged in the middle of the Eighties. Some of the principal reasons for such a strong shift in the oil price trend were as follows: the overproduction of oil from OPEC and the relatively stable demand for oil.

In October 1990 the Iraqi army invaded Kuwait and another oil shock was underway. Oil production of these two countries, almost 9 % of the World oil supply, was stopped all together and the price of oil increased by more than 20.0 $/bbl.

The most recent dramatic change in oil prices that can be designated as an oil shock took place during the last two years of the twentieth century. The price of oil climbed by more than 20.0 $/bbl within twenty consecutive months in response to OPEC's reduction in oil production. At its meeting in March 2000 OPEC, desiring to protect oil prices from falling, settled a price bend mechanism by which it would maintain its own oil price within the range of 22.0 – 28.0 $/bbl. Since that time, thanks to this mechanism, OPEC has been very successful in stabilizing the price of oil at a relatively higher level.

3. Oil price-macroeconomy relationship

Chapter 2 outlines the most important historical movements in oil prices that can be considered as oil shocks. Each of these abnormal price increases were followed by a severe economic slowdown in most industrialized countries.[1] Is this negative correlation between oil price and GDP only a coincidence or it is a causal relationship? I would like to propose an answer to this question on the following pages.

In economics theory there exist a multitude of hypotheses of how oil shocks might influence economic activity in oil importing countries. In this paper I would like to pursue the argument that there is a nonlinear relationship between oil prices and economic growth, thus oil price increases might cause a recession, whereas oil price decreases which occur either after an oil price shock or in the period of stable prices do not contribute to an economic boom. The principal distinction between this theory and the large body of linear interpretations of the impact of an oil shock on GDP is the channel through which oil price increases bring about an economic slowdown.

Hamilton (2001) suggests, “that the price and availability of gasoline matter for car sales not simply because they affect the overall price level but further because they are the key inputs in how cars get used.” (see Hamilton 2001: 35) The consumer’s decision about the size and gasoline efficiency of their next car is markedly influenced by their expectations where oil and gasoline prices are heading. The consumers’ uncertainty about the maximum price level is the key factor which leads them to postpone their purchase of a new car until a time when better information about prices is available. The same type of behavior is also observable within many different kinds of industries. It is possible from this simplified assumption to conclude that a decline in consumption of gasoline and its complements caused by an oil shock might affect economic activity in the short run.

Hamilton (2001) further claims that, “if allocative disturbances are indeed the mechanism whereby oil shocks affect economic activity, then there is no reason to expect a linear relationship between oil prices and GDP. An oil price increase will decrease demand for some goods but possibly increase demand for others. If it is costly to reallocate labor or capital

[1] From the contemporaneous point of view it is obvious that, for example, the deep recession which took place after the first oil price shock was also caused by other economics factors than just the enormous increase in oil prices. On the other hand, I suppose that the oil price shock was one of the principal reasons for the economic slowdown in the middle of the Seventies.

between sectors, the oil shock will be contractionary in the short run.[2] Note moreover that oil price decrease could also be contractionary in the short run. A price decrease also depresses demand for some sectors, and unemployed labor is not immediately shifted elsewhere. Furthermore, if it is primarily the postponement of purchases of energy-sensitive big-ticket items that produce the downturn, then oil price decrease could in principle be just as contractionary as an oil price increase. Of course, an oil price decrease is not all bad news because of its effect on price level. But surely it is unreasonable to assume that an oil price decrease would produce an economic boom that mirrors the recession induced by an oil price increase." (see Hamilton 2001: 35)

4. Definitions of oil price variables

The intensity of oil shocks is measured by three different kinds of oil price variables in the following paper.

i) Oil Price Change:

$$oil_t = 100\, x\, (\ln oil_t - \ln oil_{t-1}) \quad (1)$$

This variable contains both oil price increases and decreases. Nevertheless, for the purposes of testing a hypothesis of nonlinearity it is more appropriate to use the subsequent expression of oil price shock.

ii) Net Oil Price Increase (1Y):

$$oil_t^{+} = max\, [0;\, 100\, x\, (\ln oil_t - \ln oil_{t-1})] \quad (2)$$

The difference between variables i) and ii) is that the latter contains values of oil price increases which overcome its own values from the previous months and of zero otherwise. This variable can be used to test the nonlinear presumption mentioned above. However, Hamilton (2001), states that if one wants to measure the negative impact of oil price increases

[2] One of the methods of how to test such a claim seems to be exploitating a time series of dispensable income for the examined countries into our econometrics framework and verifying whether oil price shock might influence this economic variable and consequently the demand for goods and services. Unfortunately, it is not possible to provide such an empirical verification, because of the insufficient time series.

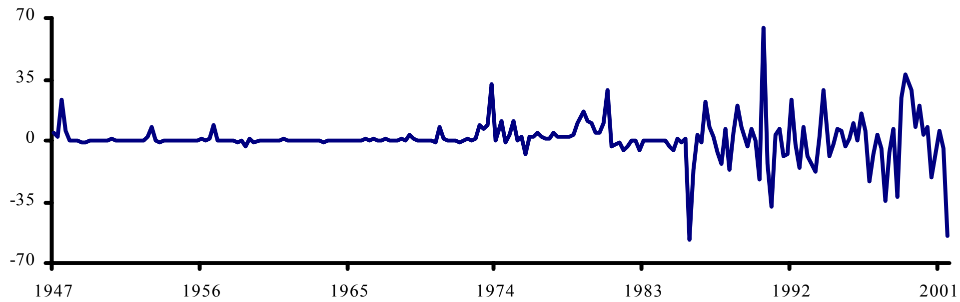
on the household and business decisions regarding future spending, it is much more suitable to compare the present level of oil prices with their level from the previous several years. If the oil price increase in time *t* exceeds its own values from the previous three years, then this increase can be defined as an oil shock. This variable can be expressed as follows.

iii) Net Oil Price Increase (3Y):

$$oil_t^{\#} = max\ [0;\ 100\ x\ (\ln(oil_t) - \ln max(oil_{t-1}, oil_{t-2}, \ldots, oil_{t-12}))] \quad (3)$$

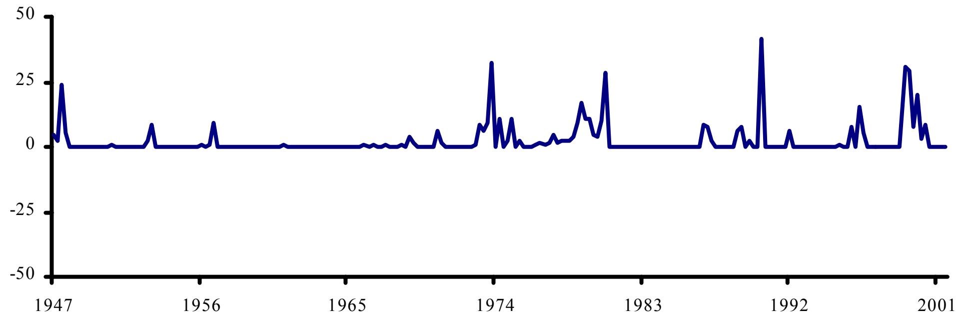
These three definitions of oil shocks will be applied in the followings estimations. I use the same oil price variables for EU regressions but on monthly bases. Figures 2 to 4 plot the above-defined variables.

Figure 2 - Oil Price Change (in %)



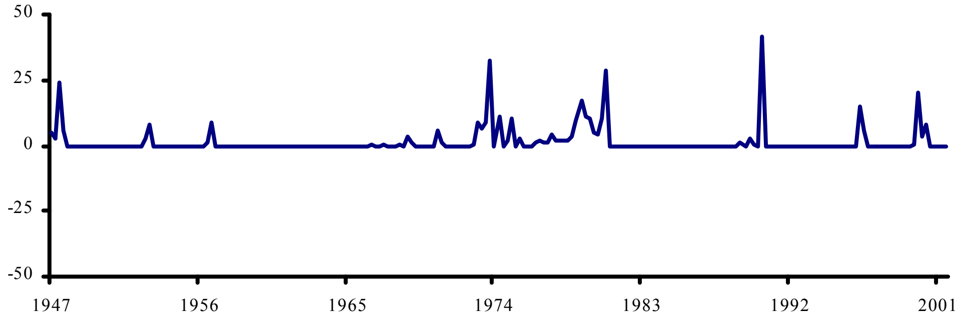
Source: Bureau of Labour Statistics, author

Figure 3 - Net Oil Price Increase (1Y) (in %)



Source: Bureau of Labour Statistics, author

Figure 4 - Net Oil Price Increase (3Y) (in %)



Source: Bureau of Labour Statistics, author

5. Oil price-macroeconomy relationship in the U.S. environment

I would like to begin the entire analysis of the oil price-macroeconomy relationship with the example of the United States of America. The econometrics method used for the examination of the investigated relationship is a Vector Autoregressive Analysis (VAR).[3] A time series of real quarterly GDP, further denoted as (y_t),[4] is used as a variable that measures economics activity.

In the first step, I would like to investigate the linear relationship between the examined variables mentioned above. For the purpose of the investigation of linearity, the first defined oil price variable (oil_t) (which contains both oil price increases and decreases) is used. When this regression is estimated for data from 1947:II to 2001:III, the following result is obtained.

$$\underset{}{y_t} = \underset{(0{,}11)}{0{,}709} + \underset{(0{,}07)}{0{,}288}\, y_{t-1} + \underset{(0{,}07)}{0{,}132}\, y_{t-2} - \underset{(0{,}07)}{0{,}073}\, y_{t-3} - \underset{(0{,}07)}{0{,}124}\, y_{t-4}$$

$$- \underset{(0{,}006)}{0{,}003\, oil_{t-1}} - \underset{(0{,}006)}{0{,}003\, oil_{t-2}} - \underset{(0{,}006)}{0{,}004\, oil_{t-3}} - \underset{(0{,}006)}{0{,}016\, oil_{t-4}} \quad (4)$$

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[3] Brief characteristics of VAR along with a reasoning as to why such an econometrics method is used in this analysis are presented in Appendix B.

[4] Since the time series of U.S. GDP is in nominal values non-stationary I have adjusted it by the log of quarterly change. The results of the Duckey-Fuller and Phillips-Perron test allow us at the 5% and 1% significance level to reject the null hypothesis of Unit Root and ratifies the desired stationarity.

As can be seen from the regression the linear relationship between oil price changes and GDP growth is evident. This result is confirmed by the standard error (in parenthesis) which belongs to the fourth lag of (oil_t). Since the reciprocal interaction between defined variables is examined, it is necessary to calculate Impulse-Response Function (IRF) in order to make a proper interpretation of the regression (4). The result of IRF calculated for this regression indicate that a 10% increase in oil prices will result four quarters later in a level of GDP lower by 0.186 % than it otherwise would be. Because of the imposed linearity the above mentioned interpretation of IRF should be valid conversely, thus a 10% decrease in oil prices will result in a higher level of GDP by 0.186 % four quarters later.

One can say that the relationship between the oil prices and GDP described by equation (4) is sufficient for the prediction of GDP in the U.S. Before this claim can be accepted, however further verification is necessary. One of the methods that can be used for this purpose is the Granger causality test. The results of this test are summarized in Table 1.

Table 1 - Results of Granger causality test for the U.S. data

Null hyphotesis	Observations	F-statistic
$oil_t \rightarrow$ HDP	210	1,82695
$oil_t^{+} \rightarrow$ HDP	210	3,42337
$oil_t^{\#} \rightarrow$ HDP	210	5,85897
$oil_t^{-} \rightarrow$ HDP	210	0,19964

Source: author
Critical values of F-statistics are for 0,05 – 2,42 and for 0,01 – 3,41. This table contains only the first half of the test. The rest of it is shown in Appendix B.

As can be seen from the first row of Table 1 the F-statistic value does not allow us to reject the null hypothesis that oil prices (oil_t) do not affect GDP ($\boldsymbol{y_t}$) at the 5% significance level. Therefore, the earlier expected linearity between the investigated variables cannot be unambiguously accepted. When the same regression is re-estimated, but the second oil price variable (oil_t^{+}) is used the results are as follows.

$$\underset{}{y_t} = \underset{(0,13)}{0,876} + \underset{(0,07)}{0,258}\, y_{t-1} + \underset{(0,07)}{0,118}\, y_{t-2} - \underset{(0,07)}{0,081}\, y_{t-3} - \underset{(0,07)}{0,138}\, y_{t-4}$$

$$- \underset{(0,012)}{0,009}\, oil^{+}_{t-1} - \underset{(0,012)}{0,008}\, oil^{+}_{t-2} - \underset{(0,022)}{0,013}\, oil^{+}_{t-3} - \underset{(0,012)}{0,032}\, oil^{+}_{t-4} \quad (5)$$

The values of standard errors inform us that the forth lag of oil price variable (oil_t^{+}) is statistically significant in this regression as well as in the preceding equation. However, the impact of oil price increases on economic activity in regression (5) is almost two times higher then in regression (4). From the results of the Granger causality test it is obvious that the latter regression might serve as a better tool for the prediction of GDP in the U.S than the first linear specification. The F-statistic value (second row of Table 1) allows us to overwhelmingly reject the null hypothesis that oil price does not effect GDP at the 5% and 1% significance levels.

When the IRF is calculated, this regression implies that a 10% increase in oil prices will result four quarters later in a level of GDP lower by 0.44 % than it otherwise would be. Furthermore, in this example it is not possible to say that a decline in oil prices by 10 % will contribute to economic growth in the U.S.

The expected nonlinearity between investigated variables is proven by regression (5). In order to predict GDP in the U.S., Hamilton (2001) and some other authors recommend using our third defined oil variable ($oil_t^{\#}$) in the regression. This oil price variable contains only price increases which exceed their own values from the previous three years. Therefore, this variable can be used as a significant indicator which leads households and business to postpone their consumption to the future. The results of this regression are presented in the following equation:

$$y_t = \underset{(0,13)}{0,963} + \underset{(0,07)}{0,228}\, y_{t-1} + \underset{(0,07)}{0,109}\, y_{t-2} - \underset{(0,07)}{0,092}\, y_{t-3} - \underset{(0,07)}{0,151}\, y_{t-4}$$

$$- \underset{(0,02)}{0,024}\, oil^{\#}_{t-1} - \underset{(0,02)}{0,016}\, oil^{\#}_{t-2} - \underset{(0,02)}{0,019}\, oil^{\#}_{t-3} - \underset{(0,01)}{0,042}\, oil^{\#}_{t-4}$$

(6)

The estimated effect of the oil price variable ($oil_t^{\#}$) on economic growth in the U.S. is considerably larger then those implied by the linear regression (4) and first nonlinear estimation in (5). The values of standard errors indicate that the coefficient of the fourth lag of the oil price variable ($oil_t^{\#}$) is statistically significant as well as in the previous two regressions. As shown in Table 1, the Granger causality test also confirmed high statistical relevance of this regression. When the IRF is estimated, regression (6) implies that a 10% increase in oil prices will result four quarters later in a level of GDP lower by 0.581 % than it otherwise would be.

It is almost certain that regression (6) might serve as the best tool for predicting GDP in the U.S. and simultaneously confirming our earlier imposed expectation of the nonlinear relationship between oil prices and economic growth. For a further affirmation of this statement Mork (1989) suggests estimating the same VAR but instead of applying the oil price variables used earlier, he establishes a new one which would contain only the negative values of oil price changes. This new variable, which will henceforth be denoted as (oil_t^-), only represents situations where the price of oil decreased.[5] When our VAR is re-estimated but this new oil price variable is used, the results are as follows:

$$\begin{aligned} y_t = \underset{(0,12)}{0,648} + \underset{(0,07)}{0,302}\, y_{t-1} + \underset{(0,07)}{0,133}\, y_{t-2} - \underset{(0,07)}{0,073}\, y_{t-3} - \underset{(0,07)}{0,118}\, y_{t-4} \\ + \underset{(0,01)}{0,0004}\, oil^-_{t-1} + \underset{(0,01)}{0,005}\, oil^-_{t-2} - \underset{(0,01)}{0,004}\, oil^-_{t-3} - \underset{(0,01)}{0,002}\, oil^-_{t-4} \end{aligned} \quad (7)$$

As equation (7) reveals, the estimated effects of oil price decreases are not statistically significant at all. Therefore, the expectation that oil price decreases should help to boost economic growth cannot be accepted. If one abstracted from the statistical significance of individual coefficients of oil price variable in this regression, it would be very interesting to mention the signs which belong to them. If the relation expressed by regression (7) represents the true clarification of the real state, then the oil price decreases would have a positive impact on GDP only during the first two quarters after the prices of oil decline. In the following two quarters the effect would be reversed and economic growth would be retarded. Since the relation expressed by equation (7) is not statistically significant this interpretation should only be considered as a speculation.

[5] This new oil price variable is calculated in the same way as our third oil price variable with the exception that only the negative values of oil price changes are considered.

6. Application of the U.S. findings on the chosen sample of EU countries

Most studies investigating the relationship between crude oil prices and economic activity have only been focused on the U.S. environment. Thus, I would like to contribute to the smaller body of research which has examined the oil price-macroeconomy relationship in countries other than the U.S. In the following pages of this paper I would like to present a brief summary of results obtained from an analysis of data concerning eight EU countries. The percentage share of the Czech export of goods and services into EU countries from 1993 to 2002 has been used as a principal criterion for the sample selection of European countries investigated in this analysis. The main reason for such a selection is so that this research will better serve my effort to analyze how oil price shocks might influence economic activity in the Czech Republic.

Among the reasons for the insufficient amount of investigation into this critical relationship within European countries might be the absence of a competent data series of economics indicators. In fact, during my own search for sufficient European data series, especially of GDP, I have repeatedly had to deal with the low availability of complex data. While, I have been partially successful in finding the time series of GDP for all eight chosen EU countries, all the series were totally unsuitable for the purpose of this research. Therefore, I decided to follow the procedure suggested by Burbidge and Harrison (1984) as well as Cuñado and Pérez de Gracia (2000) by replacing the indicator of economic activity expressed by GDP with the Industrial Production Index (IPI). The time series of monthly IPI from 1961:1 to 2002:3 for all chosen EU countries were obtained from International Financial Statistic (IFS) published by the International Monetary Found. Another very serious problem which emerged regarded the choice of a proper representative of the oil price variable in the case of this EU analysis. After a consideration of all possible alternatives I decided to employ the so-called World Oil Price (which summarizes the development of prices of different kinds of oils called "benchmark" crudes, and are traded on all main world crude oil markets) as a representative of the oil price variable for this analysis. The evolution of this price of oil is shown in Figure 1. Monthly world oil price is also obtained from IFS for the period from 1961:1 to 2002:3. In my opinion, using monthly oil price rather than quarterly might be more efficient for the entire analysis, due to its better ability to describe all price movements which cannot be displayed in the latter case.

The conversion of world oil price expressed in U.S. dollars to the national currencies of all chosen EU countries is provided by means of the market exchange rates. This transformation reveals later to be very important because of the difference in magnitude of oil price shocks expressed in dollars and national currencies. For example, during the first oil shock in 1973 and 1974 the national currencies of all European countries devaluated against the dollar, therefore crude oil happened to be more expensive for consumers in Europe than in the U.S. On the other hand, during the Gulf War in 1991 the situation reversed and European currencies appreciated against the U.S. dollar. In this case, imported oil was cheaper in Europe than in North America.

For the purpose of investigating the oil price-macroecoomy relationship within the chosen sample of EU countries, the same empirical method as in the case of the U.S is used. The same transformation of oil prices (in national currencies) and IPI is thoroughly provided, whereby the desired stationarity of investigated variables is guaranteed. The only difference between this EU analysis and the U.S. analysis is the various frequencies of the investigated variables mentioned above, and from that, the resulting number of lags imposed in VAR. The correct choice of the lag length has proven to be a very serious matter for further analysis. In contemporaneous economic literature there exists a multitude of different suggestions regarding the lag length in this type of VAR. One suggestion is to use only a few lags from 1 to 6 at maximum. On the other hand, this lag length is considered to be insufficient for the proper estimation of VAR based on monthly data and more lags are recommended to be used. Finally, I decided to employ 12 lags in my estimations which are, among others, recommended by Enders (1995) and Hamilton and Herrera (2002).

Since such VAR requires numerous coefficients to be estimated, in total 50 for each country, the same method of results presentation as in the case of the U.S. cannot be used. Due to this fact, only the statistically significant coefficients are presented on the following pages. Tables including all 12 lags regarding the oil price variable are displayed in Appendix A.

As in the case of the U.S. analysis, the linear relationship between oil price variable (oil_t) and economic activity expressed by IPI is also estimated first for the EU sample. As can be seen from Table 2, the estimated linearity cannot be proven at the 5% significance level in the case of Austria, Germany and United Kingdom. The linear relationship between (oil_t) and IPI is evident from VAR results for the majority of the estimated sample of EU countries;

nevertheless, the results of the Granger causality test which are summarized in Table 3, indicate that we fail to reject the null hypothesis that oil prices do not effect IPI at the 5% significance level for all EU countries except the Netherlands.

Table 2 – Results of VAR (oil_t – IPI)

	Austria	Belgium	France	Germany	Italy	Netherland	Spain	UK	IC *
oil_t	-	-0,027 (0,013)	-0,018 (0,009)	-	-0,034 (0,013)	-0,033 (0,012)	-0,029 (0,012)	-	-0,010 (0,004)

Source: author
* IC – Industrialized Countries

Table 3 – Results of Granger causality test for chosen EU countries

	Observation	oil_t - IPI	oil^+_t - IPI	$oil^\#_t$ - IPI	oil^-_t - IPI
Austria	482	0,804	1,177	**2,524**	0,997
Belgium	482	1,382	**1,908**	**2,465**	1,215
France	482	1,277	**2,748**	**2,873**	0,412
Germany	482	0,537	1,373	**1,778**	0,763
Italy	482	1,182	**2,065**	**2,029**	0,891
Netherlands	482	**2,312**	**2,390**	**2,208**	**2,359**
Spain	482	1,150	**1,817**	**2,099**	0,689
UK	482	0,923	1,579	**1,947**	0,355
IC *	482	1,349	**3,650**	**4,074**	0,349

Source: author
* IC – Industrialized Countries
Critical values of F-statistics are for 0.05 – 1.75 and for 0.01 – 2.18. This table contains only the first half of the test. The rest of it is shown in Appendix B.

As can be seen from Tables 2 and 3, the results of VAR and Granger causality test, indicate that the estimated linearity cannot be unambiguously accepted for EU countries as well as for the U.S. In order to make a proper interpretation of estimated results the IRF is calculated. Table 4 shows how much lower the level of IPI would be, if the price of oil increased by 10, 20 and 30 %. The decrease in the level of IPI in this case, would occur eleven or twelve months after the oil shock. In addition, it is worth mentioning the fact that the decline in economic activity would happen with the same lag as in case of the U.S.

Table 4 – Results of IRF (oil_t – IPI)

	Austria	Belgium	France	Germany	Italy	Netherland	Spain	UK	IC *
10%	-	-0,283	-0,176	-	-0,314	-0,300	-0,359	-	-0,113
20%	-	-0,566	-0,352	-	-0,628	-0,600	-0,718	-	-0,226
30%	-	-0,849	-0,528	-	-0,942	-0,900	-1,077	-	-0,339

Source: author
* IC – Industrialized Countries

Table 5 presents the results of VAR for our EU sample, when the same regression is re-estimated, but the second oil price variable (oil_t^+) is used. In this example the negative impact of oil price shocks on the economic activity of selected EU countries is much more obvious for all countries except Austria. This conclusion is roughly supported by the F-statistic values obtained from the Granger causality test, which indicate the rejection of the null hypothesis at the 5% significance level for almost all EU countries except Germany and the United Kingdom.

Table 5 – Results of VAR (oil_t^+ – IPI)

	Austria	Belgium	France	Germany	Italy	Netherland	Spain	UK	IC *
oil^+_t	-	-0,054 (0,020)	-0,033 (0,013)	-0,043 (0,014)	-0,061 (0,018)	-0,063 (0,018)	-0,045 (0,017)	-0,029 (0,013)	-0,026 (0,006)

Source: author
* IC – Industrialized Countries

Table 6 – Results of IRF (oil_t^+ – IPI)

	Austria	Belgium	France	Germany	Italy	Netherland	Spain	UK	IC *
10%	-	-0,379	-0,265	-0,393	-0,592	-0,602	-0,561	-0,273	-0,235
20%	-	-0,758	-0,53	-0,786	-1,184	-1,204	-1,122	-0,546	-0,47
30%	-	-1,137	-0,795	-1,179	-1,776	-1,806	-1,683	-0,819	-0,705

Source: author
* IC – Industrialized Countries

Since the higher negative impact of net oil price increases (oil_t^+) on the economic activity of EU countries and the expected nonlinearity between estimated variables are evident, I can continue in my analysis and the last oil price variable ($oil_t^\#$) might be installed into the VAR. The previous results obtained from the U.S. estimations, which suggest that the oil price increases which exceed their own values from the previous three years have the most significant effect on economic activity, are also confirmed by the outcomes of VAR obtained from this last EU estimation. In contrast to the previous two estimations, the negative impact of ($oil_t^\#$) on IPI is also evident for Austria. The results for all eight EU countries analyzed are shown in Table 7. Although, the impact of ($oil_t^\#$) is almost the same as the impact of (oil_t^+) in Belgium and the Netherlands, the F-statistic values gained from the Granger causality test confirm the adverse impact of ($oil_t^\#$) on IPI for all selected EU countries.

As can be seen from Table 8, the highest negative effect of increasing oil prices on IPI is evident in Italy, where a 10% increase in oil prices will result eleven months later in a level of IPI lower by 0.624 % than it otherwise would be. On the other hand, the smallest negative effect of oil price shock on IPI is visible in the United Kingdom, where a 10% increase in oil prices will result eleven months later in a level of IPI lower by only 0.289 % than it otherwise would be. For the purpose of comparison, the results gained for the industrialized countries as a whole are displayed in the last column of the tables. The expectation about the nonlinear relation between investigated variables is also evident in this case.

Table 7 – Results of VAR ($oil_t^\#$ – IPI)

	Austria	Belgium	France	Germany	Italy	Netherland	Spain	UK	IC *
$oil^\#_t$	-0,039 (0,019)	-0,056 (0,022)	-0,040 (0,013)	-0,051 (0,014)	-0,063 (0,019)	-0,061 (0,018)	-0,051 (0,018)	-0,031 (0,013)	-0,028 (0,006)

Source: author
* IC – Industrialized Countries

Table 8 – Results of IRF ($oil_t^\#$ – IPI)

	Austria	Belgium	France	Germany	Italy	Netherland	Spain	UK	IC *
10%	-0,566	-0,367	-0,301	-0,458	-0,624	-0,587	-0,598	-0,289	-0,263
20%	-1,132	-0,734	-0,602	-0,916	-1,248	-1,174	-1,196	-0,578	-0,526
30%	-1,698	-1,101	-0,903	-1,374	-1,872	-1,761	-1,794	-0,867	-0,789

Source: author
* IC – Industrialized Countries

As the last step of the EU analysis, is the affirmation of the recommendation suggested by Mork (1989). The regression is re-estimated, but only the negative values of oil price changes (oil_t^-) are used. The outcomes of VAR and the Granger causality test gained from this last estimation, confirm our earlier accepted hypothesis that oil price declines do not need to be the impulse for economic recovery in all of the analyzed EU countries, except the Netherlands. As can be seen from Table 9 in Appendix A, the negative changes in oil prices could contribute to economic growth only in Holland, three months after the decline in the price of oil. The earlier proposed nonlinear relationship between oil prices and economic growth is also evident for most of the analyzed EU countries as well as for the case of the U.S.

One of the objects of this paper is to provide a brief outline of how oil shocks might influence economic activity in the Czech Republic. The decision of which EU countries should be used in the above analysis was significantly subordinate to this purpose. In my opinion, the very close economic connection of the Czech Republic with the chosen sample of EU countries, to where almost 60 % of Czech goods and services are exported, allow me to accept the assumption that the results obtained from the analysis of selected EU countries should also be valid in the Czech environment. It is likely, that the oil shock which occurred in 1999 and 2000 could have contributed to the slowdown of economic growth in the Czech Republic. The insufficient length of the time series of Czech IPI and GDP does not enable me to use the same detailed analysis as for the U.S. and EU, to prove the above mentioned assumption. Therefore, I constructed a new econometrics model by which EU findings are applied to the Czech Republic. [6] The result of this estimation indicates that a 10% increase in oil prices expressed by ($oil_t^{\#}$) will result eleven months later in a level of IPI lower by 0,377 % than it otherwise would be. When one compares this result with the outcomes gained for

[6] Detailed specification of this model is far beyond the scope of this paper, therefore its exact specification is not provided.

EU countries it is obvious that the impact of oil price shock on IPI in the Czech Republic is very close to the effects in Belgium, France and Germany. However, it is necessary to notice that in the case of the Czech Republic it is only a very rough estimation.

7. Conclusion

The aim of this paper is to demonstrate how oil price shocks influence economic growth using as examples the United States of America, selected EU countries and the Czech Republic. As can be seen from the results obtained from the analysis of the oil price-macroeconomy relationship for the chosen countries, the nonlinear interpretation of the relationship between the investigated variables can be accepted. Price increases which exceed their own values from the previous several years have a very strong negative effect on economic activity within all examined countries, whereas oil price decreases do not contribute to economic growth in any of the selected countries except the Netherlands. The analysis reveals that differences in magnitude of impacts of oil price shocks exist within the analyzed sample. The biggest negative effect of oil price increases on IPI is evident in Italy, where a 10% increase in oil prices will result eleven months later in a level of IPI lower by 0.624 % than it would otherwise be. On the other end of the spectrum, the smallest negative effect of oil price shock on IPI is observable in the United Kingdom, where a 10% increase in oil prices will result eleven months later in a level of IPI lower by only 0.289 % than it would otherwise be. In my opinion these differences could be attributed to the specific economic conditions within the individual countries. For each of the investigated countries crude oil represents a commodity with a distinct importance. For example, there are several countries which can be designated as “Net oil importers” and which do not have their own natural crude oil resources and their entire oil consumption has to be supplemented by imported oil. On the other hand, there exist some countries “Net oil exporters” which can meet their own demand for crude oil from their own production and, in addition, profit from the export of the surplus oil production to foreign countries. The latter type of country in my investigated sample of EU countries is the United Kingdom, which exhibits the smallest impact of oil price shocks on its own economic activity.

From the Czech Republic’s point of view it is very important to know how oil shocks might influence economic activity in neighboring countries such as Germany where the biggest share of Czech goods and services is exported. The clear negative correlation between oil prices and economic growth is proven in the case of Germany, where a 10% increase in oil prices will result eleven months later in a level of IPI lower by 0.458 % than it otherwise would be. Since one of the goals of this paper, is to estimate how oil price shocks might affect economic activity in the Czech Republic, a new econometrics model by which the results of this EU analysis are applied to the Czech environment is established. This model reveals that a negative correlation between oil prices and economic growth is evident in the Czech Republic as well as in the other analyzed countries. When the IRF is calculated, this model implies that a 10% increase in oil prices will result eleven months later in a level of IPI lower by 0.377 % than it would otherwise be. I believe that this paper reveals a possible explanation of how oil price increases might influence economic growth and leaves the door open for some further investigation into this very interesting topic.

Appendix A

Table 9 – Results of VAR (oil_t – IPI)

	Austria	Belgium	France	Germany	Italy	Holland	Spain	UK	IC *
oil_{t-1}	0,017 (0,012)	-0,004 (0,013)	0,002 (0,009)	0,003 (0,009)	-0,008 (0,012)	0,022 (0,012)	0,005 (0,012)	0,006 (0,008)	0,000 (0,004)
oil_{t-2}	0,006 (0,012)	0,020 (0,013)	0,000 (0,009)	-0,005 (0,009)	-0,006 (0,013)	-0,019 (0,012)	0,006 (0,012)	-0,007 (0,008)	0,000 (0,004)
oil_{t-3}	0,014 (0,012)	0,008 (0,013)	0,002 (0,009)	0,006 (0,009)	0,014 (0,013)	0,021 (0,012)	-0,005 (0,012)	0,013 (0,008)	-0,001 (0,004)
oil_{t-4}	0,012 (0,012)	**0,029** (0,013)	0,004 (0,009)	0,012 (0,009)	0,013 (0,012)	0,024 (0,012)	0,004 (0,012)	0,010 (0,008)	0,001 (0,004)
oil_{t-5}	0,004 (0,012)	-0,017 (0,013)	0,001 (0,009)	-0,001 (0,009)	-0,005 (0,013)	0,003 (0,012)	-0,001 (0,012)	0,001 (0,008)	-0,002 (0,004)
oil_{t-6}	-0,009 (0,012)	-0,004 (0,013)	0,009 (0,009)	-0,001 (0,009)	0,000 (0,013)	-0,014 (0,012)	-0,002 (0,012)	0,001 (0,008)	-0,002 (0,004)
oil_{t-7}	0,017 (0,012)	-0,001 (0,013)	0,004 (0,009)	-0,003 (0,009)	0,012 (0,013)	-0,018 (0,012)	0,004 (0,012)	0,005 (0,008)	-0,005 (0,004)
oil_{t-8}	-0,005 (0,012)	0,021 (0,013)	-0,013 (0,009)	0,004 (0,009)	-0,007 (0,013)	0,005 (0,012)	-0,010 (0,012)	-0,010 (0,008)	-0,001 (0,004)
oil_{t-9}	0,003 (0,012)	-0,012 (0,013)	-0,005 (0,009)	-0,006 (0,009)	0,002 (0,013)	0,009 (0,012)	0,018 (0,012)	-0,002 (0,008)	0,002 (0,004)
oil_{t-10}	0,002 (0,013)	0,004 (0,013)	-0,002 (0,009)	-0,004 (0,009)	-0,009 (0,013)	0,003 (0,012)	**-0,029** (0,012)	-0,004 (0,008)	-0,003 (0,004)
oil_{t-11}	-0,013 (0,013)	-0,005 (0,013)	**-0,018** (0,009)	-0,014 (0,009)	**-0,034** (0,013)	**-0,033** (0,012)	-0,012 (0,012)	-0,014 (0,008)	**-0,010** (0,004)
oil_{t-12}	0,011 (0,012)	**-0,027** (0,013)	-0,016 (0,009)	-0,001 (0,009)	-0,002 (0,013)	-0,020 (0,012)	-0,016 (0,012)	0,001 (0,008)	-0,008 (0,004)

Source: author
* IC – Industrialized Countries

Table 10 – Results of VAR (oil_t^+ – IPI)

	Austria	Belgium	France	Germany	Italy	Holland	Spain	UK	IC *
oil^{+}_{t-1}	0,026 (0,019)	0,000 (0,020)	-0,005 (0,012)	0,008 (0,014)	-0,031 (0,018)	0,013 (0,018)	-0,001 (0,017)	-0,007 (0,013)	-0,003 (0,006)
oil^{+}_{t-2}	0,017 (0,019)	0,022 (0,020)	-0,001 (0,012)	0,000 (0,014)	-0,001 (0,018)	-0,011 (0,018)	0,016 (0,017)	-0,006 (0,013)	-0,003 (0,006)
oil^{+}_{t-3}	0,017 (0,019)	0,028 (0,020)	0,004 (0,013)	0,000 (0,014)	0,023 (0,018)	0,001 (0,018)	-0,008 (0,017)	0,020 (0,013)	-0,001 (0,006)
oil^{+}_{t-4}	0,001 (0,019)	0,018 (0,020)	0,005 (0,013)	0,007 (0,014)	0,020 (0,019)	0,009 (0,018)	-0,013 (0,017)	0,019 (0,013)	0,004 (0,006)
oil^{+}_{t-5}	-0,004 (0,019)	-0,036 (0,020)	-0,005 (0,013)	0,000 (0,014)	0,009 (0,019)	0,013 (0,018)	-0,019 (0,017)	0,006 (0,013)	0,000 (0,006)
oil^{+}_{t-6}	-0,005 (0,019)	-0,015 (0,020)	0,017 (0,013)	-0,003 (0,014)	-0,019 (0,019)	-0,010 (0,018)	-0,009 (0,017)	-0,003 (0,013)	-0,006 (0,006)
oil^{+}_{t-7}	0,016 (0,019)	-0,023 (0,020)	0,010 (0,013)	-0,028 (0,014)	0,011 (0,019)	-0,031 (0,018)	0,008 (0,017)	0,008 (0,013)	-0,009 (0,006)
oil^{+}_{t-8}	-0,020 (0,019)	0,033 (0,020)	**-0,027** (0,013)	-0,006 (0,014)	0,000 (0,019)	0,014 (0,018)	0,001 (0,017)	-0,004 (0,013)	0,004 (0,006)
oil^{+}_{t-9}	-0,029 (0,019)	-0,003 (0,021)	-0,017 (0,013)	0,010 (0,014)	-0,014 (0,019)	0,004 (0,018)	0,023 (0,017)	-0,016 (0,013)	0,004 (0,006)
oil^{+}_{t-10}	0,012 (0,019)	-0,006 (0,020)	-0,018 (0,013)	0,000 (0,014)	-0,008 (0,018)	-0,002 (0,018)	**-0,045** (0,017)	-0,021 (0,013)	-0,012 (0,006)
oil^{+}_{t-11}	-0,024 (0,019)	**-0,054** (0,020)	**-0,028** (0,013)	**-0,043** (0,014)	**-0,061** (0,018)	**-0,063** (0,018)	-0,020 (0,017)	**-0,029** (0,013)	**-0,026** (0,006)
oil^{+}_{t-12}	-0,021 (0,018)	-0,031 (0,020)	**-0,033** (0,013)	-0,011 (0,014)	-0,019 (0,018)	**-0,051** (0,018)	**-0,044** (0,017)	-0,004 (0,013)	**-0,015** (0,006)

Source: author
* IC – Industrialized Countries

Table 7 – Results of VAR ($oil_t^{\#}$ – IPI)

	Austria	Belgium	France	Germany	Italy	Holland	Spain	UK	IC *
$oil^{\#}_{t-1}$	0,025 (0,019)	0,004 (0,021)	-0,008 (0,013)	0,009 (0,014)	-0,030 (0,019)	0,014 (0,018)	0,003 (0,018)	-0,009 (0,013)	-0,004 (0,006)
$oil^{\#}_{t-2}$	0,020 (0,019)	0,019 (0,021)	-0,002 (0,013)	0,002 (0,014)	0,004 (0,019)	-0,005 (0,018)	0,015 (0,018)	-0,007 (0,013)	-0,001 (0,006)
$oil^{\#}_{t-3}$	0,011 (0,020)	0,019 (0,021)	0,004 (0,013)	-0,009 (0,015)	0,023 (0,019)	-0,007 (0,019)	-0,021 (0,018)	0,020 (0,013)	-0,002 (0,006)
$oil^{\#}_{t-4}$	-0,006 (0,020)	0,009 (0,021)	0,005 (0,013)	0,004 (0,015)	0,009 (0,019)	0,004 (0,019)	-0,014 (0,018)	0,018 (0,014)	0,003 (0,006)
$oil^{\#}_{t-5}$	0,001 (0,020)	-0,028 (0,021)	-0,004 (0,013)	-0,002 (0,015)	0,004 (0,019)	0,020 (0,019)	-0,020 (0,018)	0,005 (0,014)	0,001 (0,006)
$oil^{\#}_{t-6}$	-0,003 (0,020)	-0,013 (0,021)	0,013 (0,013)	0,000 (0,015)	-0,019 (0,019)	-0,008 (0,019)	-0,013 (0,018)	-0,002 (0,014)	-0,004 (0,006)
$oil^{\#}_{t-7}$	0,008 (0,020)	-0,034 (0,021)	0,008 (0,013)	**-0,032** (0,015)	0,019 (0,019)	-0,033 (0,019)	0,003 (0,018)	0,012 (0,014)	-0,011 (0,006)
$oil^{\#}_{t-8}$	-0,026 (0,019)	0,030 (0,021)	**-0,027** (0,013)	-0,012 (0,015)	-0,003 (0,019)	0,004 (0,019)	0,004 (0,018)	-0,005 (0,014)	0,002 (0,006)
$oil^{\#}_{t-9}$	-0,025 (0,020)	0,001 (0,021)	-0,009 (0,013)	0,010 (0,015)	-0,023 (0,019)	0,005 (0,019)	0,029 (0,018)	-0,018 (0,014)	0,006 (0,006)
$oil^{\#}_{t-10}$	0,013 (0,019)	-0,015 (0,021)	-0,021 (0,013)	0,000 (0,015)	-0,007 (0,019)	-0,003 (0,019)	**-0,045** (0,018)	-0,025 (0,013)	**-0,012** (0,006)
$oil^{\#}_{t-11}$	**-0,039** (0,019)	**-0,056** (0,021)	**-0,030** (0,013)	**-0,051** (0,014)	**-0,063** (0,019)	**-0,061** (0,018)	-0,018 (0,018)	**-0,031** (0,013)	**-0,028** (0,006)
$oil^{\#}_{t-12}$	-0,027 (0,019)	-0,036 (0,021)	**-0,040** (0,013)	-0,018 (0,015)	-0,019 (0,019)	**-0,055** (0,019)	**-0,051** (0,018)	-0,006 (0,013)	**-0,016** (0,006)

Source: author
* IC – Industrialized Countries

Table 7 – Results of VAR (oil_t^- – IPI)

	Austria	**Belgium**	**France**	**Germany**	**Italy**	**Holland**	**Spain**	**UK**	**IC ***
oil^-_{t-1}	0,009 (0,016)	-0,009 (0,017)	0,004 (0,012)	0,001 (0,012)	-0,002 (0,017)	0,026 (0,016)	0,018 (0,016)	0,006 (0,011)	0,003 (0,006)
oil^-_{t-2}	0,003 (0,026)	0,040 (0,028)	-0,002 (0,019)	0,000 (0,019)	-0,012 (0,028)	-0,046 (0,025)	-0,020 (0,026)	-0,014 (0,018)	0,004 (0,009)
oil^-_{t-3}	0,003 (0,026)	-0,043 (0,028)	-0,001 (0,019)	0,018 (0,020)	0,023 (0,029)	**0,066** (0,026)	0,014 (0,026)	0,017 (0,018)	-0,007 (0,009)
oil^-_{t-4}	0,004 (0,026)	0,054 (0,028)	0,008 (0,019)	0,001 (0,020)	0,015 (0,029)	-0,008 (0,026)	-0,001 (0,026)	-0,001 (0,018)	0,004 (0,009)
oil^-_{t-5}	-0,013 (0,026)	-0,053 (0,028)	-0,005 (0,019)	-0,013 (0,020)	-0,041 (0,029)	-0,043 (0,026)	0,005 (0,026)	-0,009 (0,018)	-0,004 (0,009)
oil^-_{t-6}	-0,012 (0,026)	0,019 (0,028)	0,011 (0,019)	-0,005 (0,020)	0,042 (0,029)	-0,006 (0,026)	-0,010 (0,026)	0,009 (0,018)	0,005 (0,009)
oil^-_{t-7}	0,033 (0,026)	0,009 (0,028)	-0,014 (0,019)	0,014 (0,020)	-0,015 (0,029)	0,007 (0,026)	0,011 (0,026)	-0,008 (0,018)	-0,003 (0,009)
oil^-_{t-8}	-0,028 (0,026)	0,005 (0,028)	0,002 (0,019)	0,005 (0,020)	-0,017 (0,029)	0,011 (0,026)	-0,027 (0,026)	-0,009 (0,018)	0,002 (0,009)
oil^-_{t-9}	0,032 (0,026)	-0,018 (0,028)	-0,005 (0,019)	-0,020 (0,020)	0,037 (0,029)	0,027 (0,026)	0,029 (0,026)	0,018 (0,018)	0,004 (0,009)
oil^-_{t-10}	-0,029 (0,026)	0,020 (0,028)	0,019 (0,019)	0,000 (0,020)	-0,042 (0,029)	-0,015 (0,026)	-0,027 (0,026)	-0,004 (0,018)	-0,004 (0,009)
oil^-_{t-11}	0,016 (0,026)	0,014 (0,028)	-0,026 (0,019)	0,011 (0,020)	0,003 (0,029)	-0,038 (0,025)	-0,003 (0,026)	-0,007 (0,018)	-0,001 (0,009)
oil^-_{t-12}	-0,013 (0,016)	-0,027 (0,017)	0,010 (0,012)	-0,005 (0,013)	0,010 (0,018)	0,025 (0,016)	0,016 (0,016)	0,001 (0,011)	0,000 (0,006)

Source: author
* IC – Industrialized Countries

Appendix B

Vector Autoregressive Analysis

This very popular econometrics method investigates the reciprocal interaction between two or more endogenous variables. In the framework of VAR each endogenous variable is explained by its own lagged values and the lagged values of other endogenous variable or variables.

Mathematically VAR can be expressed as follows:

$$y_t = \alpha + \alpha\, y_{t-1} + \dots + \alpha\, y_{t-n} + \beta\, x_{t-1} + \dots + \beta\, x_{t-n} + \varepsilon_t$$

$$x_t = \alpha + \alpha\, y_{t-1} + \dots + \alpha\, y_{t-n} + \beta\, x_{t-1} + \dots + \beta\, x_{t-n} + \varepsilon_t$$

The historical development of the relationship between oil prices and economic growth (expressed by GDP or IPI) reveals a reciprocal interaction between these two variables. An unexpected increase in oil prices might contribute to a decline in economic activity in countries which are totally dependent on imported oil. On the other hand, economic recession (caused by oil shock or any other event) might result in a lower demand for oil and oil products and consequently, a drop in oil prices.

Because of this fact, I believe that using VAR in my analysis has its own foundation. This opinion is also supported by the work of other economists such as Burbidge and Harrison (1984), Mork (1989) and Hamilton (2001) who employed VAR in their own clarification of the correlation between oil prices and economic activity, and eventually in some other economic variables.

Granger causality test

Table 1 – part two

Null hyphothesis	Observations	F-statistic
HDP $\rightarrow$ oil_t	210	0,46783
HDP $\rightarrow$ oil_t^{+}	210	0,56686
HDP $\rightarrow$ $oil_t^{\#}$	210	1,16404
HDP $\rightarrow$ $oil3_t^{-}$	210	0,26529

Source: author

Critical values of F-statistics are for 0,05 – 2,42 and for 0,01 – 3,41. This table represents the second half of the test.

Table 3 – part two

	Observation	*IPI - oil$_t$*	*IPI - oil^+_t*	*IPI - oil$^\#_t$*	*IPI - oil^-_t*
Austria	482	1,160	1,403	0,362	0,674
Belgium	482	0,539	0,914	1,223	0,307
France	482	0,666	1,154	1,353	1,012
Germany	482	0,359	0,634	0,753	0,506
Italy	482	1,46	1,212	**3,761**	0,334
Netherlands	482	1,039	0,303	0,377	1,517
Spain	482	0,413	0,641	0,717	0,274
UK	482	0,741	1,179	1,302	0,682
IC *	482	0,456	0,514	0,649	1,329

Source: author
* IC – Industrialized Countries
Critical values of F-statistics are for 0.05 – 1.75 and for 0.01 – 2.18. This table represents the second half of the test.

Exchange rates and their purpose in this analysis

From economic theory it is obvious that exchange rates by themselves represent a very important economic variable and might influence the economic growth of individual countries. Therefore one can assert that the conversion of the world oil price expressed in U.S. dollars to other national currencies might seem to bias the entire analysis. However, I believe that if the purpose of this analysis is to measure how oil prices influence economic activity in the countries whose national currencies are not the dollar, it is necessary to use oil prices expressed in national currencies. As mentioned above, the exchange rates had a significant effect on the magnitude of the oil price shocks in European countries. For example, during the first oil shock in 1973, European currencies devaluated against the dollar and oil happened to be more expensive for consumers in Europe than for consumers in the U.S, Conversely, during the Gulf crisis in 1990 European currencies appreciated and partially reversed the negative impact of rising oil prices.

The following table, displays the statistically significant coefficients which are obtained from the regression, where oil prices expressed in dollars for each selected EU country are employed. Our third defined oil price variable is used ($oil_t^\#$).

Tabulka 13 - Výsledky VAR ($oil_t^{\# (USD)}$ – IPI)

	Austria	Belgium	France	Germany	Italy	Netherlands	Spain	UK
$oil^{\#(USD)}_t$	-0,036 (0,019)	-0,054 (0,021)	-0,039 (0,013)	-0,047 (0,014)	-0,068 (0,019)	-0,066 (0,020)	-0,051 (0,018)	-0,026 (0,013)

Source: author

As can be seen from Table 13, the impact of the dollar oil prices on economic growth in the EU countries analyzed is almost identical to its impact on national oil prices. Only in the case of Austria it is not possible to accept the hypothesis that dollar oil prices affect economic growth in this country at the 5% significance level. When statistical verification of the equality of the coefficient displayed in Table 7 and Table 13 is provided, one realizes that they are almost identical. [7]

[7] Appropriate statistical tool for this verification is so-called Wald test.

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