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Article

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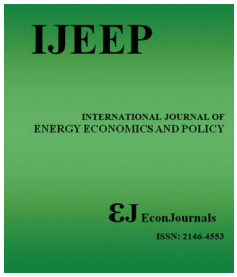
International Journal of Energy Economics and Policy

Provided in Cooperation with:
International Journal of Energy Economics and Policy (IJEEP)

Reference: Nyangarika, Anthony Msafiri/Mikhaylov, Alexey Yurievich et. al. (2018). Correlation of oil prices and gross domestic product in oil producing countries. In: International Journal of Energy Economics and Policy 8 (5), S. 42 - 48.



International Journal of Energy Economics and Policy

ISSN: 2146-4553

available at http: www.econjournals.com

International Journal of Energy Economics and Policy, 2018, 8(5), 42-48.

Correlation of Oil Prices and Gross Domestic Product in Oil Producing Countries

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ABSTRACT

This paper proposes the degree of interdependence between the prices of crude oil and gross domestic product (GDP) of leading of countries such as Saudi Arabia and as the main suppliers of crude oil to the world market. The paper examines the theoretical aspects of oil pricing and investigation between the oil prices and GDP of leading oil producing countries. The main focus was on the results of empirical studies, which showed the strong relationship between prices for crude oil and GDP. Mutual dependence between prices and GDP was observed in Russia and Saudi Arabia.The developing the alternative sources of energy the countries will make the possibility to reform their own economy and make them less vulnerable to fluctuations in oil prices.

Keywords: Oil Price, Gross Domestic Product, GARCH Model, Oil Impact, Forecasting
JEL Classification: C51, C58, F31, G12, G15

1. INTRODUCTION

The distribution of minerals, the technologies and the structure of expenditures are changing the oil price (from the bottom of 2004 to the peak in 2014). A number of foreign and domestic researchers have been trying to find a relationship between the oil prices and gross domestic product (GDP). In particular, this problem is anylised in works of Mikosch and Starica (2004), Hillebrand (2005), Kramer and Azamo (2007).

GDP is an indicator of the country's economic growth, and therefore it is extremely important to investigate how fluctuations in the cost of crude oil affect its change. It was explained by Kim et al. (2013) and Babecky et al. (2013).

The tasks of scientific work are: Research of theoretical aspects of the nature of oil shocks and changes in oil prices over a long period of time; empirical testing of the relationship between prices for crude oil and GDP; development of recommendations for minimizing dependence on crude oil prices. The subject of scientific work is the relationship between GDP of Saudi Arabia and Russia and oil prices. For the analytical part, Dickie-Fuller test and the Granger test were used.

2. LITERATURE REVIEW

During the 20th century, under the influence of various factors, there was a lot of oil shocks. In terms of economy, oil shock means a sharp change in oil prices, which has a significant impact on the level of production and living standards of the population. First of all, such changes can be caused by a change in the conjuncture in the oil market, followed by a sharp drop in production. Zhao (2010) showed that for the Chinese market there is also a correlation in GDP and oil prices in the period from 2001 to 2009. Bong-Han et al. (2015) described that oil production depends on energy resources.

These countries earned from the global growth and economic trade, as proved by Lee and Kim (1993) and Josifidis et al. (2009). In turn, this has influenced the balance of supply and demand on the national currency. In some countries, the structure is dominated by petroleum products, some gas or other energy sources as argued

by Sanso et al. (2004). Previously Kasman et al. (2011) found a long memory relationship in spillover effect in eight Eastern European stock markets. Kim and Kim (2011) have also examined the dynamic of GDP of three main U.S. trading partners (Canada, EU and Japan).

The purpose of this study is to identify the relationship between the price of crude oil and GDP of countries such as Saudi Arabia, Russia: As the main suppliers of crude oil to the world market that it was showed by Bong-Han et al. (2015). In 2012, average annual oil prices reached 121.4 dollars. US/barrel, which exceeded the historic maximum in 2008. At this stage of our study, the task is to study theoretical aspects and consider the main oil shocks that took place from 1990 to the present day. Jung and Maderitsch (2014) found evidence that the correlation of GDP and oil prices are not reflected in the many forecast model. According to research of Kasman et al. (2009), the dynamics of world oil prices can be divided into three stages:

- Stage 1: (1999–2003). It is characterized by an increase in prices from $ 11 to $ 30/barrel, which is acceptable since the cost remains within the price range of the OPEC. The main factors behind the growth of prices were:
  a. Increase energy consumption in Asia and preserve demand for oil in the USA;
  b. OPEC policy aimed at curbing oil production volumes;
  c. The stagnation of the economy in 2001–2002;
  d. The unstable internal situation in Venezuela and the problems with oil production in Iraq before and after the US invasion.
- Stage 2: (2004–July 2008). During this period, prices overcame the upper limit of the OPEC and amounted to 44 dollars in 2004. US/barrel, in 2005 - fluctuated within $ 35–60, $ 2007–$ 60. US/barrel. In this period, OPEC's policy did not create a price-creating factor, but the main role was played by demand, and speculation on the market of oil futures. There was also the question by Chaudhuri and Wu (2003) and Wang and Moore (2009) about the exhaustion of world resources.
- Stage 3: (2008–2018). The 3rd period was characterized by a sharp fall in world prices to 39 dollars. US/barrel along with a sharp restoration of prices to the level of 2007, namely - $ 60. US/barrel. The main arguments of such a "jump" are that the oil trade was speculative, and the "bubble" in the segment of oil futures was cracking that it found by Jayasinghe and Tsui (2008). According to Walid et al. (2011) pointed that the fundamental factor that led to the greatest fall in prices over the past 17 years has been the slowdown in the development of leading economies in the world and the decline of US demand for oil. This paper proposed to highlight 4 stages like Newey and West (1994): 2016 year to date: Local price rise to the average annual price of $ 57. Inclan and Tiao (1994) showed that the oil price increase was mainly due to an agreement between OPEC members to restrict production to artificially reduce supply and the foreign policy of the new US administration. According to Table 1 we can state the fact that the nature of oil shocks has changed somewhat. If by 2005 oil prices had increased, the dynamics of world GDP also increased, then after 2005 the situation is changing (Table 1).

The past price boom in the crude oil market was different from the previous, because it was characterized by the following: One of the largest growth times; it became the result of changes in the conduit in the market of crude oil. It did not affect the main macroeconomic indicators of the countries of the largest oil consumers.

The most of the downturns in the American economy were preceded by a sharpening of the political situation in the Middle East, which in turn was associated with an increase in oil prices. This study has proven that the impact of oil prices on the reduction of economic growth is lower than previously thought. For example, the situation on the world oil market has a lesser impact on macroeconomic indicators of the US economy (inflation, unemployment, investment activity) than before. This gives an illustrative example. After the decision taken in March 1999 to reduce the volume of oil production by 1.7 million barrels, the price of oil increased by 40%, and the economic downturn in the United States began only after 2 years - in March 2001, a similar situation with an already less pronounced the effect is happening today.

Based on the research, the following conclusions were made:

1. Events that took place in the East, along with OPEC''s actions, are important, but not the only factor that affects the change in oil prices;
2. The rise in oil prices may contribute to an economic recession, but not a direct cause;
3. Macroeconomic situation in the largest countries can directly affect the state of the world oil market.

As for the issue of increasing demand for oil, according to the opinion of economist. Among the factors that affect world oil prices it can be noted: Absence of free mining capacities; influence of speculation on the market of oil futures; US monetary policy.

An interesting consideration for the relationship between the price of oil and GDP is the model presented at the 2005 Tokyo International Energy Seminar. The model allows determining the elasticity of prices and real GDP. In the general context, the increase in world oil prices: Increases production costs; affects the profits of firms; adds its share in the reduction of GDP in the economy (direct primary effect); penetrates into the economy due to increase of factor prices and wages, decrease of employment; can cause a recession in the economic cycle.

There is a confirmation of these rules, which implies an extremely high impact of oil prices on GDP. For example, the fall in oil prices

Table 1: World GDP and oil prices in the period 2004–2016

Variables	2004	2005	2006	2007	2008	2009	2011	2012	2013	2014	2015	2016
Growth rates of world GDP,%	4.09	3.61	4.13	3.96	1.48	-2.01	4.1	2.83	2.19	2.27	3.2	3
Average oil prices, USD US/barrel	38.3	54.4	65.4	72.7	97.7	61.9	79.6	111.0	121.4	108.8	98.9	52.4

Source: Thomson Reuters DataStream, GDP: Gross domestic product

averaged $ 91. US $ per barrel in 2008 to $ 53 The US dollar per barrel in 2009 resulted in almost two percentage points of GDP growth in the last 2 years. From rising oil prices, exporting countries will win, but for a short period of time. Importing countries are losing the level of economic development, GDP is decreasing. However, the fall of GDP depends on various factors:

1. Dependence on the share of expenditures attributable to oil in national income;
2. Degree of dependence on imported oil;
3. Ability of end-users to reduce their oil consumption.

Greater oil price growth and a longer period of price support have a greater impact on the economy. For oil exporting countries, rising prices will directly increase national revenues due to increased exports, although later, part of this profits will be offset by a decline in export demand due to the economic recession of importing countries.

Every oil shock that is, an increase in prices preceded the event in the world community. Fluctuations in oil prices result in a change in the structure of supply and demand. Reducing oil production by OPEC member countries has contributed to an increase in oil prices. The increase in production in Saudi Arabia somewhat reduced oil prices while the Iran-Iraq war and the capture of Kuwait negatively affected the price of oil that has jumped up as these countries are among the largest oil producers. We are seeing this situation today in the context of the events that hit Libya, one of the largest oil producing countries, and oil prices began to increase rapidly after the military coup in the country, many countries have lost their supplier.

High oil prices lead to inflation, a decrease in tax revenues, an increase in the budget deficit and an increase in interest rates. All these effects can lead to an increase in unemployment, at least in the short term. The increase in oil prices also violates the trade balance and the exchange rate. Monetary and fiscal policies that contain inflationary pressures can deepen the recession and the effect of unemployment. Expansion monetary and fiscal policies, on the other hand, can simply delay the decline in national income and worsen the impact of oil prices in the long run.

The increase in oil prices undoubtedly causes a decline in GDP growth rates. Also, the rise in world prices has a negative impact on inflation, interest rates and budget deficits. Important countries are logically the most dependent on oil prices. Exporting countries in the short run will benefit from higher prices. The next section of the study will show the interdependence between oil and GDP of the selected countries.

3. METHODS

In 2004, American scientists, based on the Interlink program, introduced by the Organization for Economic Cooperation and Development, examined the impact of oil prices on key macroeconomic indicators, in particular on GDP growth rates (Table 2). The basic conditions for the model are as follows: The period 2004–2008 is considered; prices remain at $ 25 US/barrel; under the scenario of rising oil prices, prices are set at $ 35. US/barrel. The dollar exchange rate remains at the end of 2003 (in practice, any changes in the nominal value of the dollar would have a significant impact on the economy).

According to the simulation results, the impact on GDP growth is most pronounced in the first 2 years, as deteriorating terms of trade reduce income that immediately undermines investment and domestic consumption.

The impact of high oil prices on inflation is more pronounced. The consumer price level is 0.5% higher than the baseline scenario, for a period of 5 years. The impact on the level of inflation is felt most in 2005 - the second year, just when there is a high level of prices. Figure 1 shows the relationship between changes in oil prices and short-term changes in inflation (Figure 1).

Also, the level of unemployment is subject to great changes. The shift of 0.1% is equivalent to a loss of 400,000 jobs among the member countries of the Organization for Economic Development and Cooperation. The trade balance is deteriorating in the short run as oil price increases increase the cost of oil imports and generally lead to inflation. The deterioration in the current account structure reaches a peak in 2006 and exceeds $ 50 billion. USA.

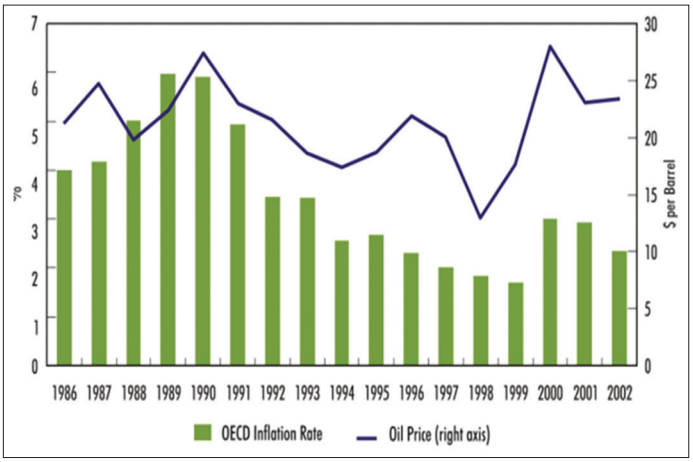
The impact of oil prices by region is given below. Countries in the Eurozone that are most dependent on oil imports suffer the most. Like the Japanese economy, which depends on imported oil. Losses of GDP in Japan and Europe will also deepen the budget deficit, which is still quite large (about 3% on average in Europe and 7% in Japan). The United States will suffer the least, due to the fact that it covers 40% of its oil needs by its own production.

Table 2: The main macroeconomic indicators in case of price increase

Variables	2004	2005
GDP (%)	−0.4	−0.4
Consumer price index (%)	0.5	0.6
Unemployment rate (%)	0.1	0.1
Current account (billion dollars)	−32	−42

Source: Thomson Reuters DataStream, GDP: Gross domestic product

Figure 1: Oil prices and inflation



Source: Organization for Economic Development and Cooperation, Thomson Reuters DataStream

In these three regions, GDP will fall by 0.5%, 0.4% and 0.2%, respectively (Figure 2).

This experiment shows a negative impact on the economy caused by an increase in oil prices. Lower prices than in the baseline scenario will bring economic benefits. In the second experiment, with a price level of $ 7. US/barrel after 2 years of GDP is 0.3% higher, while inflation and unemployment are 0.4% and 0.2% lower respectively.

We use the FIGARCH model proposed by Bailey et al. (1996).

$$\sigma^2_{(r),t} = \omega + \beta(L)\sigma^2_{(r),t} + \left(1-\beta(L)-\alpha(L)(1-L)^d\right)\varepsilon_t^2 + \varphi\xi_t^2 + \sum_{j=0}^{k}\omega_j DUM_j \quad (1)$$

Where $(1–L)^d$ – fractal operator for IGARCH; [1–β(L)–α(L)] and [$1–\beta(L)$] – single roots in GARCH (p,q); *DUM* – dummy variable; ω, α, β – parameters in GARCH model; *d* – fractal parameter from 0 to 1, showing the stability of dispersion shocks, r(i,t) – national index (currency rate) changes, P(i,t) – closing price of national index or currency rate (m) at the moment of time (t), and ε_t and ξ_t - identically distributed random error in the relationship between the stock index and the exchange rate.

In order to understand the form of the distribution we will use student's *t*-test. Like Chkili et al. (2012), Baillie et al. (2007), Mikhaylov (2018) we chose daily data series.

The study aimed at determining the dependence between oil and GDP. The results graphically show that the connection between the price of crude oil and GDP of the economies of some states. Oil prices are average annual and taken from open sources, which will not allow you to see absolute peak values, since they take into account the average annual price. Data are annual, between 1991 and 2016. First, to test the data in all the received rows to stationary, the Dickey-Fuller test (ADF test) is used for the presence of a Single root based on the model:

$$\Delta y_t = a + \delta y_{t-1} + \beta t + \sum_{i=2}^{p}\varphi_i \Delta y_{t-i+1} + \varepsilon_t \quad (2)$$

Where *α, β, δ, φ* - unknown coefficients of regression, *p* - number of time delayed values, *y* - parameter value, *t* – period.

After the test we get the following results for a number of crude oil prices (Table 3).

4. RESULTS

As the analysis showed that the coefficient for the variable is negative (−0.143518), but the value of the test statistic (−1.448977) modulus does not exceed the critical value, even at the level of 10% significance. Consequently, we can not reject the null hypothesis of non-stationarity. In order to use this series in a regression model, it is necessary to bring it to the form of a stationary one, by constructing a series of first differences of the values of the initial series (Figure 3) like in the papers of Kang et al. (2009) and Mikhaylov (2018).

$$oilPrice = oilPrice_t – oilPrice_{t-1} \quad (3)$$

As can be seen from the lower table of non-stationarity, the value of the test statistic deviates at the level of significance in 10%. Consequently, this series can be used to construct regression

Table 3: ADF test

Null hypothesis: Oil price has a until root Exogenous: Constant Lag length: 1 (fixed)	t-statistic	P*
Augmented Dickey-Fuller test statistic	−1.448977	0.5414
Test critical values		
1% level	−3.737853	
5% level	−2.991878	
10% level	−2.635542	

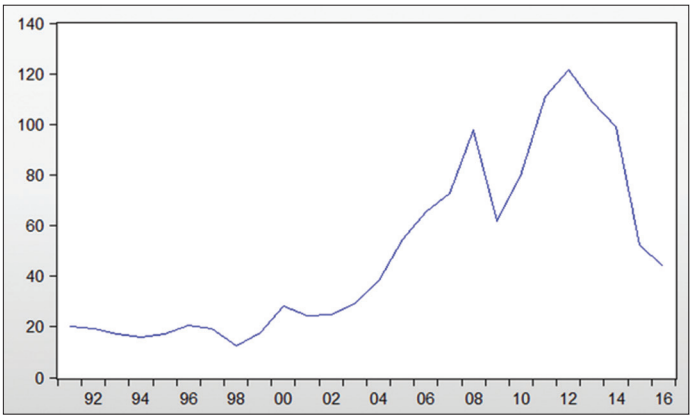
*Mackinnon (1996) one-sided *P* values. Source: Authors' calculation

Table 4: ADF test for a series of first differences in the price of crude oil

Null hypothesis: Oil price delta has a until root Exogenous: Constant Lag length: 1 (fixed)	t-statistic	P*
Augmented Dickey-Fuller test statistic	−2.717067	0.0864
Test critical values		
1% level	−3.752946	
5% level	−2.998064	
10% level	−2.638752	

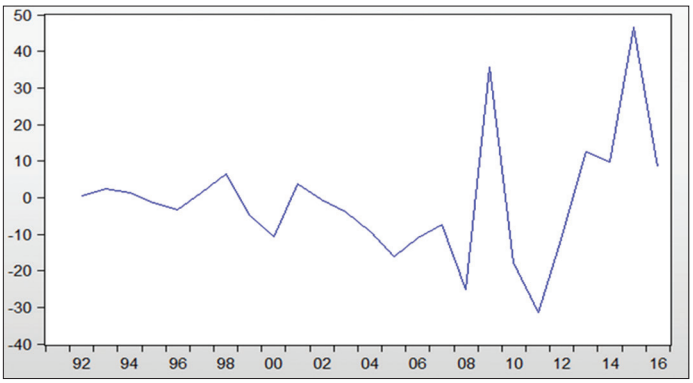
*Mackinnon (1996) one-sided *P* values. Source: Authors' calculation

Figure 2: Average oil price (1991–2016)



Source: Authors' calculation

Figure 3: First differences for a number of oil prices



Source: Authors' calculation

models (Table 4). It was tested by many researchers, such as Kumar and Maheswaran (2013), Mikhailov (2014) and Kang et al. (2011).

Consider the following row - Saudi Arabia's GDP (Figure 4 and Table 5).

As in the case of prices, it is necessary to calculate the series of indicators for the values of the differences (Table 6).

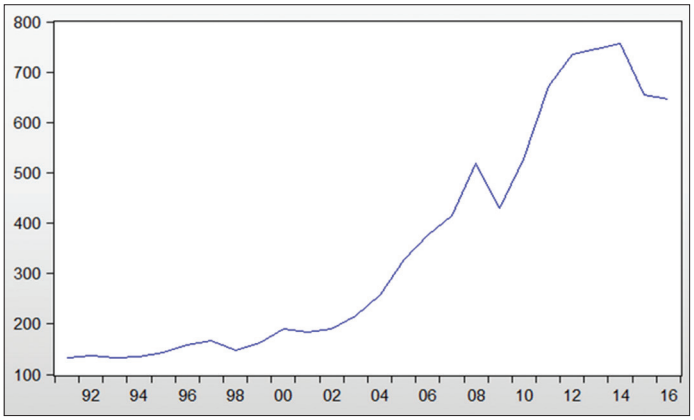
As can be seen from the lower table of non-stationarity, the value of the test statistic deviates at the level of significance in 10%. Consequently, this series can be used to construct regression models. Similar calculations will be made for the GDP of Russia (Figure 5).

The results of the extended Dickie-Fuller test for this series are as follows in Table 7.

Also we can see in the figure below a non-stationary series. Note that the stationary factor managed to bring the number only to the 2nd difference values in Table 8.

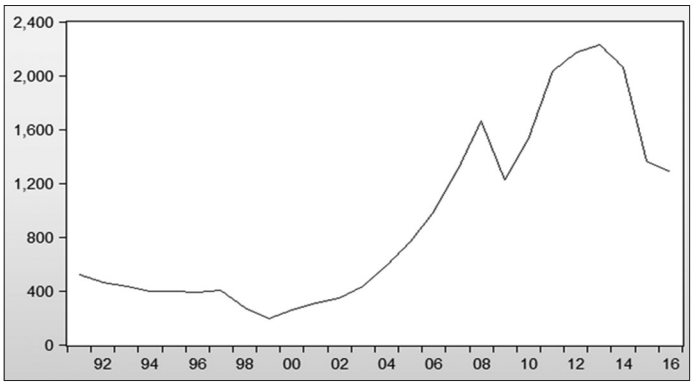
As the analysis showed the coefficient with GDP_US variable is negative (−0.786048), and the test statistic value (−3.315261) modulo exceeds the critical value at the level of significance of 5%. Consequently, we can reject the null hypothesis of non-

Figure 4: Saudi Arabia's gross domestic product (1991–2016)



Source: Authors' calculation

Figure 5: Gross domestic product changes in Russia (1991-2016)



Source: Authors' calculation

Table 5: ADF test for Saudi Arabia's GDP

Null hypothesis: GDP_SA has a until root Exogenous: Constant Lag length: 1 (fixed)	t-statistic	P*
Augmented Dickey-Fuller test statistic	−1.419206	0.8907
Test critical values		
1% level	−3.737853	
5% level	−2.991878	
10% level	−2.635542	

*MacKinnon (1996) one-sided *P* values. Source: Authors' calculation, GDP: Gross domestic product

Table 6: ADF test for a number of first differences (Saudi Arabia's GDP)

Null hypothesis: D (GDP_SA) has a until root Exogenous: Constant Lag length: 1 (fixed)	t-statistic	P*
Augmented Dickey-Fuller test statistic	−2.827400	0.0700
Test critical values		
1% level	−3.752946	
5% level	−2.998064	
10% level	−2.638752	

*MacKinnon (1996) one-sided *P* values. Source: Authors' calculation, GDP: Gross domestic product

Table 7: ADF test for Russia GDP

Null hypothesis: GDP_RUS has a until root Exogenous: Constant Lag length: 1 (fixed)	t-statistic	P*
Augmented Dickey-Fuller test statistic	−1.189577	0.6616
Test critical values		
1% level	−3.737853	
5% level	−2.991878	
10% level	−2.635542	

*MacKinnon (1996) one-sided *P* values. Source: Authors' calculation, GDP: Gross domestic product

Table 8: ADF test for a number of first differences (Russia GDP)

Null hypothesis: D (GDP_RUS2) has a until root Exogenous: Constant Lag length: 1 (fixed)	t-statistic	P*
Augmented Dickey-Fuller test statistic	−5.441733	0.0002
Test critical values		
1% level	−3.769597	
5% level	−3.004861	
10% level	−2.642242	

*MacKinnon (1996) one-sided *P* values. Source: Authors' calculation, GDP: Gross domestic product

Table 9: Correlation matrix of GDP and oil price

	Oil price	GDP_RUS	GDP_SA
Oil price	1.000000	0.963155	0.903183
GDP_RUS	0.963155	1.000000	0.961770
GDP_SA	0.903183	0.961770	1.000000
GDP_US	0.798786	0.829698	0.930551
GDP_CHINA	0.751124	0.867149	0.960975

Source: Authors' calculation

Table 10: Granger test

Hypothesis	Lags			
	1	2	3	4
Oilprice does not Granger Cause GDP_RUS	(0.0897)	4.048 (0.042**)	1.354 (0.312)	0.778 (0.573)
Oilprice does not Granger Cause GDP_SA	0.072 (0.1147)	0.127 (0.881)	0.184 (0.904)	0.609 (0.668)

Source: Authors' calculation

Table 11: Results of regression analysis

Parameter	$price_{oilt}$	(gdp_sa) t
Constant	-	0.016 (0.895)
$(gdp\_us)_t$	0.774 (2.769**)	
Price_oil	-	0.389 (−2.573**)
$(gdp\_eurozone)_t$	1.123 (3.490)	
$(gdp\_japan)_t$	1.078 (1.699)	-

Source: Authors' calculation

stationarity. And use this series to construct a regression. The study of stationary points us to the non-stationary characteristics of the first and second differences. Such results precipitate further research into the use of the first and the other differences in the respective indicators.

The next test will allow us to identify the relationship between indicators (Table 9).

From the correlation matrix, it follows that the dynamics of oil prices in the GDP of countries such as Russia and Saudi Arabia has a tremendous impact (over 90%). GDP of the United States and China is less, but also significant.

The next test - the Granger test will allow us to identify the relationship between the indicators. The Dickey-Fuller and Granger tests utilized by Kang et al. (2011) are used to assess the stationarity of the processes.

That is, we can see the interdependence between all the given indicators, since oil prices affect the GDP of all the enumerated states (Table 10). Growth of 1% of US GDP will lead to an increase of 0.7% in oil prices with a probability of 95%.

An increase of 1% of the price of oil with a lag in 1 year will cause a drop of 0.36% of the USA GDP, with a probability of 95%. Growth of 1% of Eurozone GDP will lead to a 1.12% increase in oil prices, with a probability of 99% (Table 11).

The results show that an increase of 1% of the price of oil will lead to an increase of 0.136% of China's GDP; 0.17% of US GDP, and 0.389% of Saudi Arabia's GDP, with a probability of about 95%.

This study shows that the interdependence between oil prices and GDP exists in all countries and has different degrees of influence. The economies of Saudi Arabia and Russia are heavily dependent on exported energy and therefore fluctuations in oil prices have a negative impact on their GDP. Specific conditions of the economies of these countries, first of all, a large gross share of income from exports, predetermine such dependence.

5. CONCLUSIONS

At the moment, there is a high dependence on world energy prices. The unstable political situation, cartel talks, the development of alternative energy, all this leads to fluctuations in prices for crude oil. Black gold is the main driver of the global economy, and rising prices for it can lead to stagnation and decline of the economy of the importing countries, and vice versa, to increase the exporters' GDP. The study examine the theoretical aspects of oil pricing and to investigate the interdependence between the prices of crude oil and GDP of leading countries. The main focus was on the results of empirical studies, which resulted in a relationship between prices for crude oil and GDP. Gradier tests were performed, Dickie-Fuller extended test (ADF).

Mutual dependence between prices and GDP was observed in all countries. As to minimizing the dependence on oil prices, reducing demand and finding alternative types of energy will make it possible to reform the economies of the countries and make them less vulnerable to fluctuations in oil prices.

This should be a key moment in the reform of the world economy. According to above conclusion several suggestions have been provided;

1. Introduction of a gasoline tax (in countries where it is not yet available) may be actual, although it will lead to an increase in gasoline prices. This will allow consumers and manufacturers to adapt to the new legislation and change their habits.
2. A tax on crude oil. Some researchers are more favorably involved in the introduction of this tax than before the tax on gasoline. The tax will include the import of crude oil and products of oil refining. RAND Corporation has conducted a study in which it proposes to leverage a tax on oil prices. For example, the tax rate will be 10% if the price of oil is at $ 120. US barrel, and 17% if the price is $ 72. US/barrel. Such a policy will maintain high prices and provide the same amount of tax revenues.
3. The end of oil subsidies for oil companies. The best use of subsidies would be to support enterprises that are engaged in the development of renewable energy, innovative sectors of the economy.

In addition, the paper shows that correlation can be predicted using the GARCH model. Structural breaks only distort the skewness in the GARCH model. The results of this paper could be useful for researchers and different types of investors, as they can get support from knowing the correlation between GDP and oil prices if they focus on investment in oil producing countries like Russia and Saudi Arabia.

REFERENCES

Babecky, J., Komarek, L., Komarkova, Z. (2013), Financial integration at times of financial instability. Finance a Uver-Czech Journal of Economics and Finance, 63(l), 25-45.

Baillie, R.T. (1996), Long memory processes and fractional integration in econometrics. Journal of Econometrics, 73, 5-59.

Baillie, R.T., Han, Y.W., Myers, J.R., Song, J. (2007), Long memory models for daily and high frequency commodity futures return. Journal of Futures Markets, 27, 643-668.

Baillie, R.T., Bollerslev, T., Mikkelsen, H.O. (1996), Fractionally integrated generalized autoregressive conditional heteroskedasticity, Journal of Econometrics, 74 (1), 3-30.

Bong-Han, K., Hyeongwoo, K., Bong-Soo L. (2015), Spillover Effects of the U.S. Financial Crisis on Financial Markets in Emerging Asian Countries. Auburn University Working Paper Series.

Chaudhuri, K., Wu, Y. (2003), Random walk versus breaking trend in stock prices, pp. Evidence from emerging markets. Journal of Banking and Finance, 27, 575-592.

Chkili, W., Aloui, C., Nguyen, D.C. (2012), Asymmetric effects and long memory in dynamic volatility relationships between stock returns and exchange rates. Journal of International Financial Markets Institutions and Money, 22, 38-757.

Hillebrand, E. (2005), Neglecting parameter changes in GARCH models. Journal of Econometrics, 129, 121-138.

Inclan, C., Tiao, G.C. (1994), Use of cumulative sums of squares for retrospective detection of changes of variance. Journal of the American Statistical Association, 89, 913-923.

Jayasinghe, P., Tsui, A.K. (2008), Exchange rate exposure of sectoral returns and volatilities: Evidence from Japanese industrial sectors. Japan and the World Economy, 20, 639-660.

Josifidis, K., Allegret, J.P., Beker, P.E. (2009), Monetary and exchange rate regimes changes: The Cases of Poland, Czech Republic, Slovakia and Republic of Serbia. Panoeconomicus, 2, 199-226.

Jung, R.C., Maderitsch, R. (2014), Structural breaks in volatility spillovers between international financial markets: Contagion or mere interdependence? Journal of Banking and Finance, 47, 331-342.

Kang, S.H., Cheong, C., Yoon, S.M. (2011), Structural changes and volatility transmission in crude oil markets. Physica A: Statistical Mechanics and its Applications, 390, 4317-4324.

Kang, S.H., Cho, H.G., Yoon, S.M. (2009), Modeling sudden volatility changes: Evidence from Japanese and Korean stock markets. Physica A*:* Statistical Mechanics and its Applications, 388, 3543-3550.

Kasman, A., Kasman, S., Torun, E. (2009), Dual long memory property in returns and volatility: Evidence from the CEE countries' stock markets. Emerging Markets Review, 10, 122-139.

Kasman, S., Vardar, G., Tunc, G. (2011), The impact of interest rate and exchange rate volatility on banks' stock returns and volatility: Evidence from Turkey. Economic Modelling, 28, 1328-1334.

Kim, B., Kim, H. (2011), Spillover Effects of the U.S. Financial Crisis on Financial Markets in Emerging Asian Countries, Auburn Economics Working Paper #2011-04.

Kim, B., Kim, H., Min, H. (2013), Reassessing the link between the Japanese yen and emerging Asian currencies. Journal of International Money and Finance, 33, 306-326.

Kramer, W., Azamo, B.T. (2007), Structural change and estimated persistence in the GARCH 1,1–model. Economics Letters, 97, 17-23.

Kumar, D., Maheswaran, S. (2013), Detecting sudden changes in volatility estimated from high, low and closing prices. Economic Modelling, 31, 484-491.

Lee, S., Kim, K. (1993), Does the October 1987 crash strengthen the co-movements among national stock markets? Review of Financial Economics, 3, 89-102.

Mikhailov, A.Y. (2014), Faktory razvitiya ekonomiki Rossii v 2015 godu [Factors of development of the Russian economy in 2015]. Voprosy regulirovaniya ekonomiki Questions of economic regulation, 4, 62-69.

Mikhaylov, A. (2018), Volatility Spillover effect between stock and exchange rate in oil exporting countries. International Journal of Energy Economics and Policy, 8(3), 321-326.

Mikosch, T., Starica, C. (2004), Non-stationarities in financial time series, the long range dependence, and the IGARCH effects. Review of Economics and Statistics, 86, 378-390.

Newey, W.K., West, K.D. (1994), Automatic lag selection in covariance matrix estimation. Review of Economic Studies, 61, 631-654.

Sanso, A., Arago, V., Carrion-i-Silvestre, J. (2004), Testing for changes in the unconditional variance of financial time series. Revista de Economia Financiera, 4, 32-53.

Walid, C., Chaker, A., Masood, O., Fry, J. (2011), Stock market volatility and exchange rates in emerging countries: Markov-state switching approach. Emerging Markets Review, 12, 272-292.

Wang, P., Moore, T. (2009), Sudden changes in volatility: The case of five central European stock markets. Journal of International Financial Markets Institutions and Money, 19, 33-46.

Zhao, H. (2010), Dynamic relationship between exchange rate and stock price: Evidence from China. Research in International Business and Finance, 24, 103-112.