Burakov, Dmitry

Article

Oil prices, economic growth and emigration : an empirical study of transmission channel

International Journal of Energy Economics and Policy

International Journal of Energy Economics and Policy

ISSN: 2146-4553

available at http: www.econjournals.com

International Journal of Energy Economics and Policy, 2017, 7(1), 90-98.

Oil Prices, Economic Growth and Emigration: An Empirical Study of Transmission Channel

Dmitry Burakov*

Financial University under the Government of Russian Fedeation, Russia. *Email: dbur89@yandex.ru

ABSTRACT

In this paper, we set ourselves a task to test a hypothesis of transmission channel of oil shocks to migration decisions of the population. According to the hypothesis, oil prices' shocks have a direct impact on economic growth (assuming the economy's dependence on oil export's revenues) and indirectly affect migration trends according to a classical migration theory in Heckscher-Ohlin paradigm. The hypothesis is tested on the example of Russia for the period from 1990 to 2015. To detect long-term relationship between sampled variables we use vector error correction model models; for testing presence of short-run dependencies, we use Wald test. Structural and dynamic responses to shocks in short run are tested by variance decomposition and impulse response functions. In result, we are able to confirm the hypothesis. On the one hand, existence of a long-term relationship between oil prices, economic growth and emigration is established. In the short-run, we find direct causality between oil prices and economic growth, as well as between economic growth and emigration. Thereby, existence of transmission in form of indirect channel of oil prices' shocks on migration decisions of households is confirmed.

Keywords: World Oil Prices, Economic Growth, Migration, Transmission Channel, Acceleration
JEL Classifications: F22, O1, O47, Q41, Q43

1. INTRODUCTION

Stagnant processes in both developed and developing economies characterize the current situation in the world economy. One of the main attributes of the current stagnation is reduced consumption, and consequently low growth rates of production. In the current technological wave, the main source of raw materials is the oil. Economic downturn leads to reduced demand for raw materials and oil in particular. This, in turn, leads to a reduction in world prices and production volumes, ceteris paribus. Depending on the structure of national economies, the role of exports of raw materials and finished products may vary. For example, for a number of countries-exporters of oil, a decline in world energy prices has become a significant shock that led to the loss of stability of economic development (e.g., Saudi Arabia, Venezuela, and Russia). For others, a shock in oil prices leads to an insignificant decline in gross domestic product (GDP) (e.g., the Netherlands). The differences in the models of organization of national reproduction play a significant role in explaining the response of GDP to oil price shocks. The Dutch case specifics lie in the fact that oil rent is a part of national income, 95% of which is absorbed in the sovereign funds (including pension funds) and by doing so, oil rent does not flow into the economy, leading to formation of imbalances in various sectors. However, in the case of economic systems that depend on resource rents, oil prices' dynamics is becoming a significant source of instability. For example, in case of Russia, nearly 50% of federal budget's revenues arise from oil and gas revenues. These funds compose a significant part of Russian budget. Moreover, given the fact that about 25-30% of the economically active population is employed in the public sector, the impact on national GDP seems linear.

Quite a large number of studies is devoted to finding the relationship between energy prices and national GDP (summary is presented in the next section). However, quite little attention in research is paid to the question of dynamics of energy prices and its impact on migration decisions of population. The solution to problem of causal linkages depends on many factors. First, the ambivalence of the result depends on the structure of national economy and s share of exports of energy resources in GDP. The higher the dependence of national economy on oil rent, the higher the probability of influence on GDP. Second, the effect of oil prices shock depends on characteristics of the national budget. If oil revenues make up a substantial part of budget revenues, a possibility of influence on the national income increases. Thirdly, the effect depends on the share of employment in the public sector, and, as a consequence, dependence on oil prices. The salaries of public sector employees depend on oil revenues - a fall (rise) in public sector salaries might affect willingness to migrate. These aspects reveal only one side of the issue of migration processes in the national economy.

It should be noted that in this case, migration processes are considered only in the prism of neoclassical migration theory (Heckscher-Ohlin approach), according to which migration is the result of perception and consideration of only economic variables when making decisions (e.g., level of income). In addition to neoclassical migration theory, others take into account social and institutional factors. However, in this study we will consider the validity of this effect in the framework of neoclassical migration theory.

Thus, we can assume that dynamics of oil prices can have a direct impact on national GDP ceteris paribus and indirectly affect migration processes, thereby affecting the stability of the national economic system. In other words, we assume that the energy market in general and dynamics of oil prices in particular (applying a number of before mentioned assumptions) serve as a source of primary negative shock transmission to GDP and a further distribution, in particular in migration decisions. This relationship can be called oil price shocks transmission channel. Taking into account dependence of Russian model of economic development (as well as a number of other countries-exporters of oil) on energy rents, the study of the specifics of its impact on individual elements of socio-economic processes seems actual in modern conditions.

2. LITERATURE REVIEW

The state of contemporary studies on the relationship between energy sector and national GDP can be described as quite advanced. There is a large number of studies, revealing various mechanisms and channels of relationship between dynamics of oil prices and national GDP and its component parts (a summary is presented in Table 1). Thus, most researchers using different methods and econometric models have come to conclusion about existence of a positive and statistically significant relationship between GDP and oil prices in the short run. Differences in responses of GDP to an oil price shock depends on structure of the national economy. In case of oil exporting country, positive (negative) price shock leads to a certain growth (contraction) of GDP. In case of importing country, the effect is reverse in most cases. Unlike established and well-known facts about the nexus between GDP and oil prices, we set ourselves a task to test the hypothesis of an indirect transmission channel of negative oil price shocks on decisions about migration.

To test this hypothesis it is necessary to refer to the literature review on the relationship between propensity to emigrate and economic growth. Today there is no unified economic theory of migration. A detailed overview of various theoretical approaches is presented in a brilliant overview study conducted by Kurekova (2011). The starting point in the neoclassical theories of migration is an approach laid out by Heckscher (1919) and Ohlin (1933). According to neoclassical approach, a primary and dominant incentive to migrate is a combination of economic factors such as rate of pay, level and pace of economic growth, efficient use of factors of production in the national economy. Then, trade balance, GDP per capita under condition of an open economy bring to life the mechanism of economic immigration and emigration. Research experts in this area in the last decade have showed that in addition to economic factors, an important role is played by social, institutional, and behavioral factors (e.g., Jennissen, 2004), but the core of the decision making process on emigration is still considered to be of economic nature. An overview of main empirical studies upon neoclassical migration theory are presented in Table 1.

Unfortunately, a majority of studies on the problems of emigration takes into account such factors as remittances, foreign direct investments, etc. However, almost no research is devoted to finding a nexus between oil prices and willingness to emigrate. With exception of a few reports presented by Middle East research centers and devoted to linkages between remittances' volumes and changes in oil prices, no research is devoted to studying the abovementioned nexus.

In our study, we confine ourselves to consideration of only economic factors of emigration, because according to our hypothesis, a change in national GDP may have a significant impact on propensity to migrate. This thesis is empirically well confirmed by various researches in the field.

When building a hypothesis of oil shock's transmission channel in migration process, one should start from the following assumptions. First, an existence of this transmission channel is valid for countries-exporters of oil. Second, this channel can take place in case of GDP'S dependency on oil rent. Third, it's logical to assume that in a national economy must exist a relationship between oil prices, GDP and migration processes in the long term. The effect of the transmission channel can then be described as follows. In the long/short run, a rise (fall) in world oil prices increase (decrease) national GDP. This assumption seems very plausible, given the results of previous studies. Growth (decline) of national GDP in turn leads to an increase (reduction) of emigration from the exporting country due to the growth (decline) of households' income. In this case, we assume that there is an inverse relationship between emigration and GDP. The outflow (inflow) of human and financial capital from the exporting country in similar to Boubtane et al. (2013; 2016) manner leads to a reduction (growth) of the national GDP.

Thus, our study focuses on the long-term and short-term relationship between oil shocks, national GDP and propensity to emigrate from the country-exporter of oil, and secondary acceleration of the negative oil shock in GDP due to the initial shock In contrast to the study conducted by Ito (2008) for the first part of our hypothesis, we use data for the period from 1990 to 2015 that allows to update the results.

Table 1: Summary of relevant literature

Author	Sample	Method	Oil prices-economic growth
Berument et al. (2010)	MENA countries/oil prices-output growth	VAR setting	Net exporters -positive in short-run; importers-negative
Jiménez-Rodríguez and Sánchez (2005)	OECD countries/oil prices-GDP growth	Multivariate VAR analysis	Exporters-nonlinear positive in short-run; importers-negative in short-run, excl. Japan
Prasad et al. (2007)	Fiji Islands/oil prices-GDP growth	VAR model	Importers - insignificant due to inelasticity of oil demand
Hassan and Abdullah (2015)	Sudan/oil revenue-service GDP	VAR model	Relationship-positive in short run
Cunado and Perez de Gracia (2003)	Eurozone/oil prices-production index	VECM	Importers: Oil price-inflation - positive in long-run, oil price - output - positive in short run
Cunado and Perez de Gracia (2005)	Asian region/oil prices-economic activity, inflation	Regression analysis	Significantly positive in short-run
Farhani (2012)	USA/oil prices-GDP growth	Simple linear regression model, dynamic regression model, VAR	Oil prices-GDP growth - negative in the short run; variables are related in long run
Shaari et al. (2013)	Malaysia/oil prices-output in economic sectors	VECM	Oil prices - sectoral output - related in long run; oil prices - output in agriculture, construction - important in short run
Ito (2008)	Russia/oil prices-real GDP growth	VECM	Oil prices-GDP growth - cointegrated in the long-run, short-run - important
Altay et al. (2013)	Turkey/oil prices-output, unemployment	VECM	Oil prices affect output and employment in short-run
Al-Mawali et al. (2016)	Oman, oil sector revenue-GDP growth	VAR model	Oil sector revenue - GDP growth - significant in short run
Author	Sample	Method	Economic Growth-Migration
Mihi-Ramirez et al. (2016)	Baltic, Scandinavian countries/trade balance, FDI, remittances	Panel VECM	Emigration-remittances - positive significant in short-run. No long-run relationship observed
Jennissen (2004)	Netherlands/migration-GDP per capita	VAR	Significant in short-run
Aubry et al. (2012)	Migration-FDI, trade	Regression analysis	Migration affects grade and FDI
Boubtane, et al. (2013)	OECD countries/immigration-unemployment, economic growth	Panel Granger causality testing	GDP growth causes immigration
Boubtane et al. (2016)	OECD countries/immigration-economic growth (GDP)	Dynamic panel model, SYS-GMM	significant in short-run, migration growth positively affects GDP per capita, migration growth positively affects GDP per worker

GDP: Gross domestic product, VAR: Vector autoregression, VECM: Vector error correction model

3. MATERIALS AND METHODS

3.1. Research Methods

To test the hypotheses about the relationship between oil prices, GDP and emigration processes we use econometric techniques to analyze time series. The algorithm of the ongoing study is determined by several key stages. First and foremost, one should test sampled variables on stationarity or order of cointegration, since the time series must have the same order, as can be seen from Equation (1). Secondly, it is necessary to determine presence/absence of correlation in long term between the variables in the equation. To check this assumption we use a Johansen cointegration test. In a case of a long-term relationship on the one hand and condition of stationarity of sampled time series in the first order I(1) on the other, it is possible to use vector error correction model (VECM) model. In case of confirmation of the presence of cointegration between the variables of the sample, residuals of the equilibrium regression can be used to estimate error correction model. Also based on VECM model it is possible to identify short-term relationships between sampled variables. For this purpose, we use the Wald test. To determine structural and dynamic aspects of the response to initial shock we the variance decomposition and impulse response functions. The final stage of constructing a model is to conduct diagnostic tests to determine validity of the model. These include testing for heteroscedasticity, serial correlation, normality and stability of the model.

3.1.1. Unit root test

For the analysis of long-term relationships between the variables, Johansen and Juselius (1990) admit that this form of testing is only possible after fulfilling the requirements of stationarity of the time series. In other words, if two series are co-integrated in order d (i.e., I(d)) then each series has to be differenced d times to restore stationarity. For d = 0, each series would be stationary in levels, while for d = 1, first differencing is needed to obtain stationarity. A series is said to be non-stationary if it has non-constant mean, variance, and auto-covariance over time (Johansen and Juselius, 1990). It is important to cover non-stationary variables into stationary process. Otherwise, they do not drift toward a long-term equilibrium. There are two approaches to test the stationarity: Augmented Dickey and Fuller (ADF) test (1979) and the Phillips-Perron (P-P) test (1988). Here, test is referred to as unit-root tests as they test for the presence of unit roots in the series. The use of these tests allows to eliminate serial correlation between the variables by adding the lagged changes in the residuals of regression. The equation for ADF test is presented below:

$$\Delta Y_t = \beta_1 + \beta_2 t + aY_{t-1} + \delta_3 \sum \Delta Y_{t-1} + \varepsilon_t \quad (1)$$

Where ε_t is an error term, β_1 is a drift term and $\beta_2 t$ is the time trend and Δ is the differencing operator. In ADF test, it tests whether a = 0, therefore the null and alternative hypothesis of unit root tests can be written as follows:

Ho: a = 0 (Y_t is non-stationary or there is a unit root).

H1: a < 0 (*Yt* is stationary or there is no unit root).

The null hypothesis can be rejected if the calculated t value (ADF statistics) lies to the left of the relevant critical value. The alternate hypothesis is that a < 0. This means that the variable to be estimated is stationary. Conversely, we cannot reject the null hypothesis if null hypothesis is that a = 0, and this means that the variables are non-stationary time series and have unit roots in level. However, normally after taking first differences, the variable will be stationary (Johansen and Juselius, 1990). On the other hand, the specification of P-P test is the same as ADF test, except that the P-P test uses nonparametric statistical method to take care of the serial correlation in the error terms without adding lagged differences (Gujarati, 2003). In this research, we use both ADF and P-P test to examine the stationary of the sampled time series.

3.1.2. Johansen co-integration test

With all the simplicity of use of the test for the presence of unit root, there are some restrictions hidden in the very mechanism of the test. The assumption of linearity must be fullfilled for building a linear model for estimation by the ordinary least squares method. In order to eliminate these problems, Johansen (1988) proposed a new method based on vector autoregression model (VAR). First, it is necessary to build a VAR model.

$$y_t = A_1 y_{t-1} + \ldots + A_p y_{t-p} + Bx_t + \epsilon_t$$

In which each component of y_t is non-reposeful series and it is integrated of order 1. x_t is a fixed exogenous vector, indicating the constant term, trend term and other certain terms. ε_t is a disturbance vector of *k* dimension.

After doing the calculus of finite differences, we can get,

$$\Delta y_t = \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + Bx_t + \epsilon_t$$

$$\Pi = \sum_{i=1}^{p} A_i - I, \qquad \Gamma_i = -\sum_{j=i+1}^{p} A_j$$

We can obtain the I(0) process after doing the transformation of the finite difference of I(1) process. As a consequence, when $\prod y_{t-1}$ is the vector of I(0), y_t is a stationary process.

Once we ensure stationary of sampled variables and confirm existence of cointegration, one can move to building VECM.

3.2. Materials and Data Processing

The basis for conducting statistical study includes annual values of world oil prices (Brent), absolute values of the national GDP of Russia and absolute values of emigration. To obtain smoothed time series and remove the seasonal fluctuations in oil prices we use statistical methods of filtering and averaging, if necessary, because not all variables are available in monthly or quarterly form. The sampling period includes the values from 1990 to 2015. All variable values of the sample are obtained from official statistical sources. Oil prices data is derived from statistical data of Energy Information Administration of USA. The data on Russia's GDP and the volume of emigration from Russia is obtained from the database of the Federal service of state statistics of Russia (www.gks.ru).

To conduct the study of testing the hypothesis, we build two VECM. The first model allows determining presence/absence of long-term and short-term relationship between GDP, oil prices and emigration (direct transmission of oil shocks to GDP). The second model allows determining an indirect transmission of oil shocks to emigration decisions of population. The structure and scale of primary and secondary impacts of shocks on sampled variables is determined by use of variance decomposition and impulse response functions.

4. RESULTS AND DISCUSSION

The first step in testing hypotheses is to test variables for the presence of unit root. For this, we use standard tests - ADF and P-P test. Results of unit root testing are presented in Table 2.

As can be seen from the test results of the variables for the presence of unit root in their differentiation to the first order, we can reject the null hypothesis of unit root in each of the variables. Thus, the condition of stationarity at I(1) is performed, which gives us reason to test variables for cointegration. However, it is necessary to determine the optimal time lag.

Building a VAR model involves determining the optimal number of lags. In our case, the Akaike information criterion equals 1. Consequently, we built models based on the use of time lag of 1 year to determine the relationship in the short run. The results of the diagnostic testing of VAR model for heteroscedasticity of residuals, autocorrelation, serial cross-correlation, and stability are presented in Table 3. As can be seen from Table 3, the model is stable, heteroscedasticity and serial correlation of residuals in the model are absent.

The model is used to determine the level of sensitivity of control variables (GDP in Model 1 and Emigration in Model 2) to shocks in oil prices in the short run and we use it to test for stable long-run relationship, applying Johansen cointegration test. Results of Johansen co-integration test are presented in Table 4.

Johansen test results show the presence of cointegration between a number of equations, which allows presuming the existence of a long-term relationship between them. Starting from the results of the cointegration test, we can proceed to the construction of VECM models to reveal presence or absence of long-term and short-term relations between variables.

The first model shows the relationship between GDP and explanatory variables (oil prices and emigration). The model equation is presented below:

D(GDP)=C(1)*(GDP(−1)+0.000133160700652*BRENT_OIL(−1)+8.80798665388E−08*EMIGRATION(−1)−0.282907116424)+C(2)*D(GDP(−1))+C(3)*D(BRENT_OIL(−1))+C(4)*D(EMIGRATION(−1))+C(5)

The results of Model 1, showing the relationship between GDP, oil prices and emigration are presented in Table 5. As can be seen from the Table 5, the value of error correction term C (1) is negative in sign and statistically significant. This suggests the existence of long-run relationship between the variables of the sample. In other words, we can assume that GDP, oil prices and emigration have similar trends of movement in the long term.

To identify short-term relationship between the variables we refer to the Wald test results. This test allows to determine the interrelationship between variables in the short term. In other words, under the null hypothesis of this test, the response of error correction term to explanatory variables equals zero, i.e., the sensitivity of resulting variable to changes (shocks) in explaining are not observed. Results of Wald test for Model 1 are presented in Table 6.

As can be seen from the results of the Wald test in the short term there is a relationship between GDP and oil prices. Moreover, this relationship is direct. The fall in oil prices reduces GDP, and vice versa. In case of emigration, the hypothesis of short-term impact of emigration on GDP is not confirmed, as can be seen from the results of the Wald Test. Overall, the obtained results are consistent with existing empirical and theoretical results of the previous studies. In order to reinforce the thesis of the existence of relationship between GDP and oil price shocks we refer to the results of variance decomposition and impulse response functions (Figures 1 and 2).

As can be seen from Figure 1, the structural response of GDP to a shock in oil prices reaches maximum values in the short run and allows to explain up to 20% of GDP variance, while emigration processes explain only up to 10% of the changes in national GDP.

The analysis of impulse response functions also confirm existence of significant dependence of Russia's GDP on negative oil shocks, in both short and long run. The dependence on emigration is of statistically insignificant character.

Table 2: Results of individual unit root test

Variables in:	ADF Statistic	probability**	PP Statistic	probability**
Levels				
Intercept	5.85291	0.4399	4.90101	0.5566
Intercept and trend	2.74693	0.8399	2.72891	0.8420
First-difference				
Intercept	36.2211	0.0000**	37.6465	0.0000**
Intercept and trend	17.4725	0.0077**	34.6647	0.0000**

**Denotes statistical significance at the 5% level of significance. ADF: Augmented Dickey and Fuller, PP: Phillips-Perron

Table 3: Results of unrestricted VAR model diagnostic testing

Type of test	Results		
VAR residual serial correlation LM test	Lags	LM-statistic	P-value
	1	15.83227	0.0736**
	2	32.8114	0.0043
Stability condition test	All roots lie within the circle VAR satisfies stability condition		
Heteroscedasticity (white test)	0.4659*		
VAR residual cross correlation test	No autocorrelation in the residuals		

**Denotes acceptance of null hypothesis (Ho: There is no serial correlation), *denotes acceptance of null hypothesis of homoscedasticity. VAR: Vector autoregression

Figure 1: Variance decomposition (Model 1)

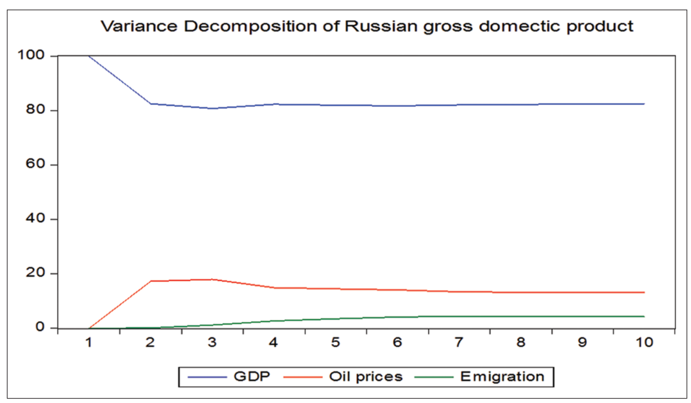


Table 4: Results of Johansen co-integration test

Hypothesized No. of CE (s)	Eigenvalue	Trace statistics	0.05 critical value	Probability
None*	0.624421	34.80952	29.79707	0.0122*
At most 1	0.300230	11.30667	15.49471	0.1933
At most 2	0.107838	2.738575	3.841466	0.0979

Trace statistics indicate 1 cointegrating equation at the 0.05 level. *Denotes statistical significance at the 5% level of significance

Table 5: Results of VECM (1)

Coefficient number	Coefficient meaning	Standard error	t-Statistic	Probability
C (1)	−0.404166*	0.184302	−2.192954	0.0410*
C (2)	0.065589	0.235092	0.278992	0.7833
C (3)	−0.002111	0.001022	−2.065126	0.0428*
C (4)	4.31E-08	3.08E-08	1.401057	0.1773
C (5)	0.006457	0.010912	0.591686	0.5610

*Denotes statistical significance. VECM: Vector error correction model

Table 6: Wald test results for short run relationship (Model 1)

Test statistic	Value	df	Probability	Test statistic	Value	df	Probability
t-statistic	−2.0651	19	0.0428*	t-statistic	1.401057	19	0.1773
F-statistic	4.2647	(1, 19)	0.0428*	F-statistic	1.962960	(1, 19)	0.1773
Chi-square	4.2647	1	0.0389*	Chi-square	1.962960	1	0.1612
Null hypothesis: C (3)=0				Null hypothesis: C (4)=0			

*Denotes statistical significance and rejection of Ho: No short-run relationship

Table 7: Results of diagnostic testing (Model 1)

Heteroscedasticity test: Breusch-Pagan-Godfrey				P-value
F-statistic	7.297560	Probability F (6, 17)		0.3105
Obs*R^2	7.538671	Probability Chi-square (6)		0.2739
Scaled explained SS	4.464143	Probability Chi-square (6)		0.6141
Heteroskedasticity test: ARCH				
F-statistic	2.135327	Probability F (1, 21)		0.9425
Obs*R^2	0.005833	Probability Chi-square (1)		0.9391
Breusch-Godfrey serial correlation LM test				
F-statistic	2.100958	Probability F (1, 18)		0.7543
Obs*R^2	0.133860	Probability Chi-square (1)		0.7145
AC/PAC				
Lag	AC	PAC	Q-Statistics	Probability
1	−0.015	−0.015	0.0065	0.936
2	0.151	0.151	0.6548	0.721

AC: Autocorrelation, PC: Partial correlation

The final stage of the analysis of Model 1 is to determine the extent of its validity. For this, it is necessary to conduct some diagnostic tests, including tests for heteroscedasticity of the residuals, serial correlation, stability and normality of the model. The results of these tests are presented in Table 7.

As can be seen from Table 7, the model is characterized by the fulfillment of all requirements - homoscedasticity and absence of serial, auto and partial correlation. In Figures 3-5 we present test results for normality and stability (CUSUM and CUSUM square test).

As can be seen from the data of Figures 3-5, the model meets the requirement of normality and stability that allows us to proceed to the analysis of the results of the second model reflecting the relationship between emigration, GDP and oil prices.

The second model shows the relationship between emigration and explanatory variables (oil prices and GDP). The model equation is presented below:

D(EMIGRATION)=C(1)*(EMIGRATION(−1)+11353332.3709*GDP(−1)+1511.81769324*BRENT_OIL(−1)−3211938.52286)+C(2)*D(EMIGRATION(−1))+C(3)*D(GDP(−1))+C(4)*D(BRENT_OIL(−1))+C(5)

The results of Model 2, showing the relationship between emigration, oil prices and GDP are presented in Table 8. As can be seen from the Table 8, the value of error correction term C(1) is negative in sign and statistically significant. This suggests the existence of long-run relationship between the variables of the sample. In other words, we can assume that GDP, oil prices and emigration have similar trends of movement in the long run.

Figure 2: Response of gross domestic product to shocks in oil prices and emigration (Model 1)

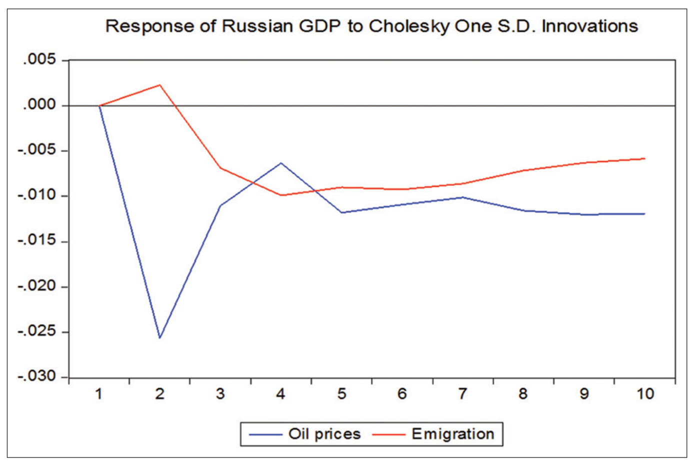
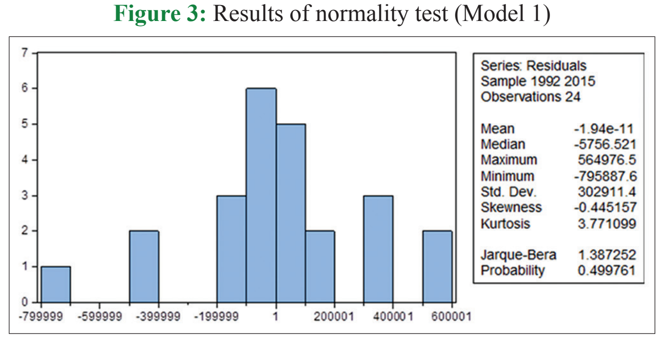


Figure 3: Results of normality test (Model 1)



To identify short-term relationship between the variables we refer to the Wald test results, presented in Table 9.

As can be seen from the results of the Wald test (Table 9), existence of relationship between the volume of emigration from the country and the national GDP in the short run is confirmed. This result indirectly supports existing research in part of identified dependencies between migration processes and dynamics of GDP (for example, Boubtane et al., 2013; 2016). Thus, we can assume that there are both long-term and short-term relationship between GDP growth and emigration decisions of the population. We articulate the explanation for the existence of this linkage trhough dependence of incomes of state budget from oil rents, given a significant dependence of income and employment of households from the public sector. The reduction of income, loss of jobs according to neoclassical migration theory serves as a powerful stimulus to emigration.

In order to reinforce the thesis of relationship between emigration and GDP let us refer to the results of variance decomposition and impulse response functions (Figures 6 and 7). As can be seen from the results of variance decomposition, a negative shock to GDP allows us to explain almost 40% of changes in the movement of emigration flows. In this case, directly, a shock in oil prices explains only 5% of emigration changes. We should also mention a trend towards strengthening the role of GDP shock to emigration process. The maximum values it reaches only in the medium term. In other words, the impact of GDP shock on the propensity to migrate is cumulative, increasing with time.

If we turn to data of Figure 7, reflecting a dynamic picture of emigration reaction to shocks in GDP and oil prices, we can note the following. First, GDP growth in one standard deviation leads to a reduction in the volume of emigration from the country in connection with the increase of wages, an increase in the overall standard of living of the population. The reaction of emigration on oil shock presented in Figure 7 is statistically insignificant and cannot be considered as a valid result.

Thus, the analysis of variance decomposition and impulse response functions also confirm existence of dependency of emigration on domestic GDP.

The final stage of the analysis of Model 2 is to determine the extent of its validity. For this, it is necessary to conduct diagnostic tests, including tests for heteroscedasticity of the residuals, serial correlation, stability and normality of the model. The results of these tests are presenteTable 10.

Table 8: Results of VECM (2)

Coefficient number	Coefficient meaning	Standard error	t-statistic	Probability
C (1)	−0.268985	0.105025	−2.561163	0.0191*
C (2)	0.792915	0.199255	3.979408	0.0008
C (3)	−0.3034862	0.152097	1.995337	0.0305*
C (4)	−4341.481	6614.362	−0.656372	0.5195
C (5)	12605.40	70599.00	0.178549	0.8602

*Denotes statistical significance. VECM: Vector error correction model

As can be seen from Table 10, the model is characterized by fulfillment of all requirements, including homoscedasticity and absence of serial correlation. In Figures 8-10, results for normality and stability tests (CUSUM and CUSUM square test) are presented.

As can be seen from the data of Figures 8-10, the model meets the requirement of normality and stability that allows us to accept the stated hypothesis of oil shocks' transmission channel.

Figure 4: Results of CUSUM test (Model 1)

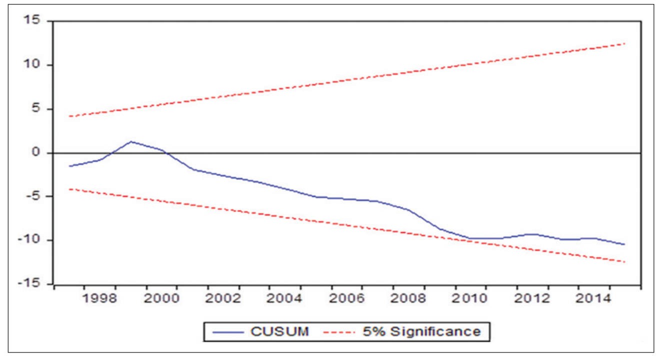


Figure 5: Results of CUSUM square test (Model 1)

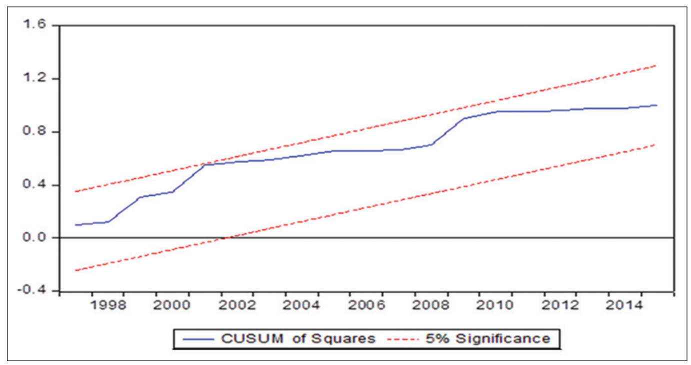


Figure 6: Variance decomposition (Model 2)

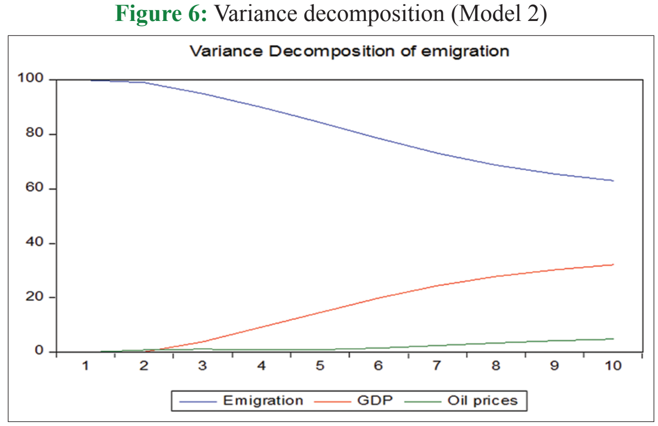


Table 9: Wald test results for short run relationship (Model 2)

Test statistic	Value	df	Probability	Test statistic	Value	df	Probability
t-statistic	1.995337	19	0.0305*	t-statistic	−0.656372	19	0.5195
F-statistic	3.981371	(1, 19)	0.0305*	F-statistic	0.430824	(1, 19)	0.5195
Chi-square	3.981371	1	0.0160*	Chi-square	0.430824	1	0.5116
Null hypothesis: C (3)=0				Null hypothesis: C (4)=0			

*Denotes statistical significance and rejection of Ho: No short-run relationship

Table 10: Results of diagnostic testing (Model 2)

Heteroscedasticity test: Breusch-Pagan-Godfrey				P-value
F-statistic	7.336649	Probability F (6, 17)		0.2948
Obs*R^2	7.692977	Probability Chi-square (6)		0.2615
Scaled explained SS	6.680380	Probability Chi-square (6)		0.3514
Heteroskedasticity test: ARCH				
F-statistic	2.209419	Probability F (1, 21)		0.6519
Obs*R^2	0.227099	Probability Chi-square (1)		0.6337
Breusch-Godfrey serial correlation LM test				
F-statistic	1.155158	Probability F (1, 18)		0.6983
Obs*R^2	0.205110	Probability Chi-square (1)		0.6506
AC/PAC				
Lag	AC	PAC	Q-statistic	Probability
1	0.099	0.099	0.2639	0.607
2	0.134	0.125	0.7698	0.681

AC: Autocorrelation, PAC: Partial correlation, ARCH: Autoregressive conditional heteroskedasticity

Figure 7: Response of emigration to shocks in oil prices and gross domestic product (Model 2)

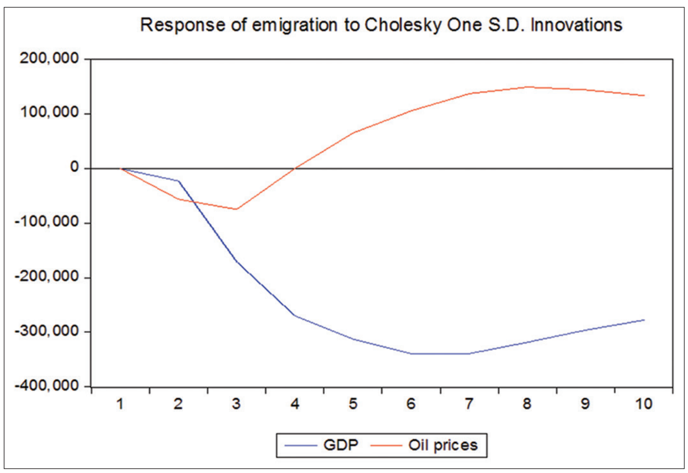


Figure 8: Results of normality test (Model 2)

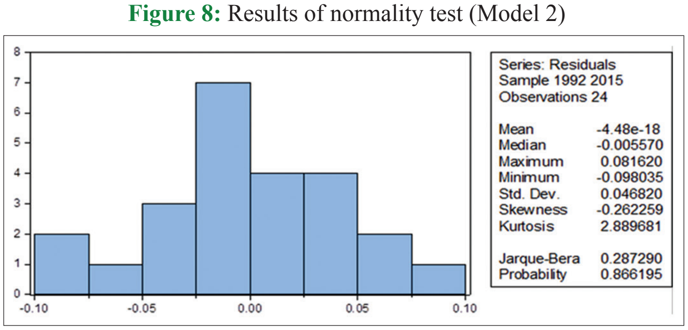


Figure 9: Results of CUSUM test (Model 2)

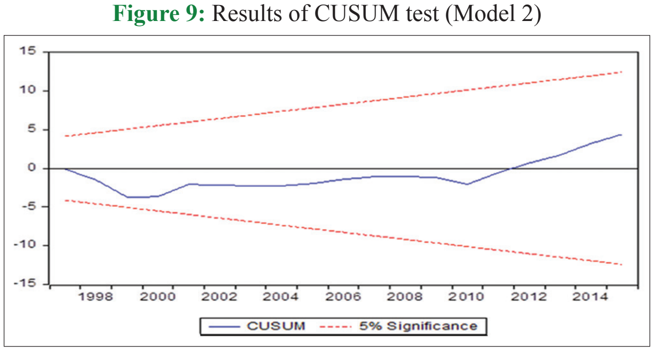
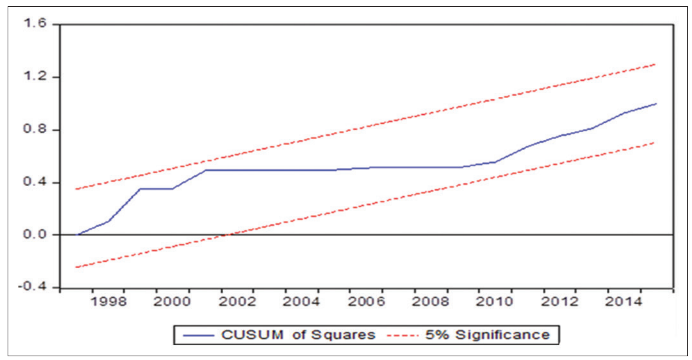


Figure 10: Results of CUSUM square test (Model 2)



5. CONCLUSION

This study focuses on the analysis of the relationship between oil prices, national GDP and emigration processes. According to the hypotheses, there is a transmission channel of negative oil shocks in the national GDP, and that, in turn, has an impact on emigration decisions of the population. This hypothesis is intended to reflect long-term and short-term aspects of the relationship between the variables. The validity of this hypothesis holds for the countries - exporters of oil, revenues of which significantly depend on oil rents on the one hand, and employment from the public sector on the other. It is assumed that a negative oil shock leads to a fall in national GDP and a decline in GDP through the reduction of employment and wages leads to an increased propensity of population to emigrate. This study allows confirming our hypothesis.

Moreover, obtained results of the study directly and indirectly confirm existing empirical studies on the relationship between economic growth and oil prices, as well as between economic growth and population migration. Thus, when carrying out state policy in the field of economic growth and employment, it is necessary to consider not only the direct effects of negative oil shocks, but also an indirect impact on migration processes, leading to the outflow of human capital and decrease of potential labor productivity, which has a negative impact on the national economy.

REFERENCES

Al-Mawali, N., Hasim, H., Al-Busaidi, K. (2016), Modelling the impact of the oil sector on the economy of sultanate of Oman. International Journal of Energy Economics and Policy, 6(1), 120-127.

Altay, B., Topcu, M., Erdogan, E. (2013), Oil price, output and employment in Turkey: Evidence from vector error correction model. International Journal of Energy Economics and Policy, 3(Special Issue), 7-13.

Aubry, A., Kugler, M., Rapoport, H. (2012), Migration, FDI and the Margins of Trade. Boston: Center for International Development, Harvard University; Barilan University and University of Lille.

Berument, M., Ceylan, N., Dogan, N. (2010), The impact of oil price shocks on the economic growth of selected MENA1 countries. The Energy Journal, 31(1), 149-176.

Boubtane, E., Coulibaly, D., Rault, C. (2013), Immigration, unemployment and GDP in the host country: Bootstrap panel Granger causality analysis on OECD countries. Economic Modelling, 33(C), 261-269.

Boubtane, E., Dumont, J.C., Rault, C. (2016), Immigration and economic growth in the OECD countries 1986-2006. Oxford Economic Papers, 68(2), 340-360.

Cunado, J., Perez de Gracia, F. (2003), Do oil price shocks matter? Evidence for some European countries. Energy Economics, 25(2), 137-154.

Cunado, J., Perez de Gracia, F. (2005), Oil prices, economic activity and inflation: Evidence for some Asian countries. The Quarterly Review of Economics and Finance, 45(1), 65-83.

Dickey, D., Fuller, W. (1979), Distribution of the estimators for autoregressive time series with a unit root. Journal of American Statistical Association, 74, 427-431.

Farhani, S. (2012), Impact of oil price increases on U.S. economic growth: Causality analysis and study of the weakening effects in relationship. International Journal of Energy Economics and Policy, 2(3), 108-122.

Gujarati, D. (2003), Basic Econometrics. 4th ed. London: McGraw-Hill.

Hassan, K., Abdullah, A. (2015), Effect of oil revenue and the Sudan economy: Econometric model for services sector GDP. Procedia – Social and Behavioral Sciences, 172, 223-229.

Heckscher, E. (1919), The effect of foreign trade on the distribution of income. Ekonomisk Tidskrift, 21, 497-512.

Ito, K. (2008), Oil prices and macroeconomy in Russia. Economics Bulletin, 17, 1-9.

Jennissen, R.P.W. (2004), Macro-Economic Determinants of International Migration in Europe. Amsterdam: Dutch University Press.

Jiménez-Rodríguez, R., Sánchez, M. (2005), Oil price shocks and real GDP growth: Empirical evidence for some OECD countries. Applied Economics, 37(2), 201-228.

Johansen, S. (1988), Statistical analysis of co-integration vectors. Journal of Economics Dynamic and Control, 12, 231-254.

Johansen, S., Juselius, K. (1990), Maximum likehood estimation and inference on co-integration with applications to the demand for money. Oxford Bulletin of Economics and Statistics, 52, 169-210.

Kurekova, L. (2011), Theories of migration: Conceptual review and empirical testing in the context of the EU East-West flows. Interdisciplinary Conference on Migration. Economic Change, Social Challenge. April 6-9, University College. London: Central European University.

Mihi-Ramirez, A., Cuenca-Garcia, E., Miranda-Martel, M. (2016), Is there a causality between emigration and other mobility factors? A panel VAR model approach for Baltic and Scandinavian countries. Engineering Economics, 27(3), 325-333.

Ohlin, B. (1933), Interregional and International Trade. Cambridge, MA: Harvard University Press.

Phillips, P.C.B., Perron, P. (1988), Testing for unit root in time series regression. Biometrica, 5, 335-346.

Prasad, A., Narayan, P.K., Narayan, J. (2007), Exploring the oil price and real GDP nexus for a small Island economy, the Fiji Islands. Energy Policy, 35(12), 6506-6513.

Shaari, M., Pei, T.L., Rahim, H.A. (2013), Effects of oil price shocks on the economic sectors in Malaysia. International Journal of Energy Economics and Policy, 3(4), 360-366.