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Do Oil Price Shocks Matter for Competition: A Vector Error Correction Approach to Russian Labor Market

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ABSTRACT

In this article we test the hypothesis about the impact of oil prices shocks on the competition in the labor market on the example of oil-exporting country. According to the hypothesis of the study, positive (negative) oil price shock leads to an increase (fall) in the demand for labor, which, in turn, leads to growth (slowdown in growth) of wages adjusted for inflation given wages inelasticity in the short term. Based on data for 1990-2016 we study a case of Russia, using vector error correction model. In the result we come to conclusion that a positive oil price shock leads to an increase of the aggregate level of wages in the economy and employment growth. A negative oil price shock leads to a slowdown in the growth of the aggregate level of wages and to an increase in the average level of unemployment.

Keywords: Oil Prices, Employment, Competition, Labor, Human Capital
JEL Classifications: Q41, E24, F16, C12

1. INTRODUCTION

In modern conditions of instability, maintaining economic growth is one of the key tasks for the development of the national economy. From the point of view of the theory of the international economy, the movement of factors of production, the presence of barriers to entry and exit from the markets are very important. Also important is the degree of openness of the economy, its sensitivity to international capital flows. In addition, important is the sectoral structure of the national economy. In this regard, it is logical to assume that the sensitivity of export-oriented countries to shocks in world markets and policies in the partner countries can have a significant impact on the stability of economic growth. Thus, it can be assumed that economic growth for export-oriented countries, the state of internal markets is in a significant dependence from the international flows of goods, capital and assets.

The above features describe well the structure and features of development of the Russian economy. First, the Russian economy is heavily dependent on world oil prices, given its export status. Second, about half of the revenues of the federal budget of the Russian economy are sources of oil and gas rents. Thirdly, about 30% of the economically active population are public servants. Starting from the processes of multiplication of revenues, in the spirit of Keynes, it is logical to assume that changes in world oil prices should have a significant impact on many macroeconomic variables of the Russian economy. On the one hand, a positive shock in oil prices should lead to faster economic growth, ceteris paribus, and that happened in Russia during the oil boom of 2006-2008. This boom was characterized by growth in real disposable incomes, increasing consumption, investment, output of the major sectors of the economy. On the other hand, the negative oil price shock should lead to the opposite result that is clearly seen in the last few years - falling employment, falling consumption, eating up savings, reducing revenues to the budget, reducing government programs to support science, education, reduced investment due to uncertainty and negative expectations.

In other words, empirical observations confirm the importance of oil prices as the factor of economic growth of the Russian economy. To date, quite a lot of research is devoted to testing hypotheses about the impact of oil prices on various sectors, industries and markets of the national economy, whether a country is importer or exporter of oil. In this case, rather little attention is paid to the study of the influence of oil prices shocks not only on the static state of the individual elements of the system, but on the processes taking place in these markets, in these industries. One such process is the competition that determines the sensitivity of demand and supply to changing exogenous and endogenous conditions. Given the dependency of Russian economy on oil prices, it is logical to assume that the impact is not only on the level of income of households or companies, but also on their willingness to take risks, their willingness to compete.

In this regard, we have set ourselves the question: Do oil price shocks affect competitive pressure on individual markets. One of the most important markets for any economy is the labor market and human capital. Labor, being one of the main factors of production, can serve as a kind of indicator for other sectors and markets. In this regard, this study focuses on testing hypotheses on the impact of oil price shocks on the competition in the Russian labor market. In light of the need to ensure sustainable economic growth, it is necessary to understand the existing economic ties and to develop public policies.

2. LITERATURE REVIEW

Unfortunately, number of studies that examine the impact of oil price shocks on the level of competition in different markets and in some sectors tends to zero. For example, a lot of studies are devoted to analysis of domestic market competition producers of oil and the influence of positive and negative oil price shocks on the competitive position of individual firms (e.g., Gupta, 2016). Quite a lot of literature devoted to the study of the relationship of oil prices and macroeconomic variables: Employment, migration, stock returns, costs and budget restrictions of households, economic growth, dynamics of export and import flows, international movement of capital, impact of oil prices on monetary policy, etc. A brilliant literature review on this issue is presented in the paper by Ozturk (2010).

In our case, the closest for the subject, are the studies devoted to the relationship between oil prices and the labor market, including employment/unemployment issue. A brief overview of the literature on the subject of the study is presented in Table 1.

As can be seen from the overview given in Table 1, most of research confirms the statistical significance of oil price shocks on various macroeconomic variables, especially on employment, economic growth and wage levels. In some cases, an important role is played by the status of the national economy. If the country is a net importer of oil, the reaction to the rise in oil prices is more likely to be negative. If the country is an oil exporter, the additional income leads to economic growth, growth of wages and the multiplying effect in other sectors of the economy.

It is also important to note that strong evidence of the relationship between oil prices, employment and income level are still not revealed. The same is true for the impact of changes in oil prices on the level of competition in the national economy. Our study aims to enrich existing knowledge by testing hypothesis of dependence of oil exporting country's labor market from oil price shocks. Second, we assume that oil price shocks may have a significant impact in the short term on the competition in the labor market.

3. MATERIALS AND METHODS

3.1. Research Methods

To test the hypothesis about relationship between shocks in oil prices, employment and competition in the Russian labor market, 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). In case of confirmation of 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 it is possible to identify short-term relationships between sampled variables. For this purpose, we use the Wald test. To determine causal linkages between variables we use Granger causality test. 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 Juselieus (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

Table 1: Literature review

Author	Sample	Methodology	Results of the study
Altay et al. (2013)	Turkey, oil prices – employment nexus	VEC approach	Oil prices, income and employment are related in the long-run. Oil prices and income cause changes in employment in the short-run
Carruth et. al (1998)	USA, post-war period; Real oil prices-real interest rates - unemployment		Oil price shocks and shocks in real interest rates affect unemployment rate in the short-run
Keane and Prasad (1996)	USA, oil prices – employment – real wages	Panel data analysis, OLS	Oil price increase leads to negative response in employment in short-run, in the long-run – positive. Oil price changes cause changes in employment and relative wages across industries
Hooker (1996)	USA, 1948-1994 with structural breaks, oil prices – unemployment – economic growth	Granger causality test	Oil price changes cause economic growth and changes in unemployment
Gil-Alana (2003)	Australia, oil prices – unemployment, 1954-1995	Cointegration approach	Oil prices and unemployment are cointegrated, the first causing the last
Ewing and Thompson (2007)	USA, oil prices – unemployment	Cyclical estimates, filtering analysis, correlation analysis	Oil price changes significantly affect unemployment, inflation, output and stock market index
Dogrul and Soytas (2010)	Turkey, 2005-2009, interest rate, oil price and unemployment nexus	Toda-Yamamoto causality test	Oil prices significantly cause unemployment
Ahmad (2013)	Pakistan, 1991-2010, interest rate, oil price and unemployment nexus	Toda-Yamamoto causality test	Oil prices significantly cause unemployment (precautionary demand)
Tarek et al. (2017)	Saudi Arabia, 1980-2015, oil price-employment level	ARDL approach	Oil price positively influence employment. Effects of positive and negative oil shocks on employment are asymmetric
Burakov (2016)	Russia, 1990-2015, oil prices – economic growth – emigration nexus	VEC approach	Oil prices, economic growth and emigration for oil exporting country are cointegrated in the long-run, oil price shocks causing changes in economic growth, income and migration decisions
Hoag and Wheeler (1996)	Impact of oil prices on employment on industrial level, USA (Ohio), micro-level analysis	VAR analysis	Oil price shocks significantly impact employment in mining industry

VEC: Vector error correction, OLS: Ordinary least square, ARDL: Autoregressive distributed lag, VAR: Vector autoregression

whether a = 0, therefore the null and alternative hypothesis of unit root tests can be written as follows:

H_0: a = 0 (Y_t is non-stationary or there is a unit root).
H_1: a < 0 (Y_t 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 stationarity of the sampled time series.

3.1.2. Johansen co-integration test

To test for presence of cointegration we apply the Johansen test using non-stationary time series (values in levels). If between variables does exist a cointegration, the first-best solution would be using VECM model. An optimal number of lags according to Akaike information criterion for providing Johansen test is determined in vector autoregression (VAR) space. To conduct Johansen test, we estimate a VAR model of the following type:

$$y_t = A_1 y_{t-1} + \ldots + A_p y_{t-p} + Bx_t + \epsilon_t \quad (2)$$

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.

We can rewrite this model as:

$$\Delta y_t = \prod y_{t-1} + \sum_{i=1}^{p-1} V_i \Delta y_{t-1} + Bx_t + \epsilon_t \quad (3)$$

Where,

$$\prod = \sum_{i=1}^{p} A_i - I \, , \quad \vee_i = - \sum_{j=i+1}^{p} A_j \qquad (4)$$

If the coefficient matrix ∏ has reduced rank r < k, then there exist k × r matrices α and β each with rank r such that ∏ = αβ' and $\beta' y_t$ is I(0). r is the number of cointegrating relations (the cointegrating rank) and each column of β is the cointegrating vector. The elements of α are known as the adjustment parameters in the VECM. Johansen's method is to estimate ∏ matrix from an unrestricted VAR and to test whether we can reject the restrictions implied by the reduced rank of ∏ (Johansen, 1988).

3.1.3. VECM

Granger (1988) suggested the application of VECM in case if the variables are cointegrated in order to find short-run causal relationships. VECM, therefore, enables to discriminate between long-run equilibrium and short-run dynamics. In this sense, we employ following VECMs to estimate causal linkages among the variables:

$$\Delta \ln l = a_0 + \sum_{i=1}^{k} a_1 \Delta \ln l_{t-i} + \sum_{i=1}^{n} a_2 \Delta \ln s_{t-i} + \sum_{i=1}^{m} a_3 \Delta \ln y_{t-i} + \lambda ECT_{t-1} + v_1$$

$$\Delta \ln s = \beta_0 + \sum_{i=1}^{k} \beta_1 \Delta \ln s_{t-i} + \sum_{i=1}^{n} \beta_2 \Delta \ln l_{t-i} + \sum_{i=1}^{m} \beta_3 \Delta \ln y_{t-i} + \phi ECT_{t-1} + v_2$$

$$\Delta \ln y = \eta_0 + \sum_{i=1}^{k} \eta_1 \Delta \ln y_{t-i} + \sum_{i=1}^{n} \eta_2 \Delta \ln l_{t-i} + \sum_{i=1}^{m} \eta_3 \Delta \ln s_{t-i} + \chi ECT_{t-1} + v_3$$

Where, l – international oil prices (Brent), s – employment rate in Russia, y – aggregate real wages in Russia (Granger, 1988).

Providing regression analysis of the sampled variables by modeling VECM allows us to determine the existence of substantial and statistically significant dependence not only on the values of other variables in the sample, but also dependence on previous values of the variable.

However, VECM must meet the requirements of serial correlation's absence, homoscedasticity of the residuals and to meet the requirement of stability and normality. Only in this case the results can be considered valid.

3.2. Materials and Data Processing

We test a hypothesis of relationship between oil prices shocks, employment rate and competition in labor market on example of Russian data for the period 1990-2016. The base period is 1 year. Unfortunately, use of monthly and quarterly values of variables for the analysis is hindered due to availability of only yearly data for employment rate. Moreover, for Brent oil prices we use aggregate yearly values. Using VECM, we set ourselves a task to determine sensitivity of Russian's labor market to shocks in international oil prices.

To assess the level of competition in the labor market, we use aggregate real wages for several reasons. First, the elimination of inflationary components allows you to determine whether wage growth manifestation increased demand from employers. For these purposes, the indexing of wages must be eliminated, otherwise the results of the analysis may be incorrect. Second, given the degree of the elasticity of labor market in Russia, as well as the degree of its backwardness, it is necessary to understand that one of the key factors of influence on labor is wages, not additional bonuses in the form of insurance and services. In this regard, for the case of Russia, the use of real wages as an indicator of competitive pressure in the labor market is seen as valid. The use of indexes of the labor market or vacancies is constrained by their inadequate temporal coverage.

Data on employment rate and aggregate real wages is obtained from Federal Service of State Statistics (www.gks.ru). Data on world prices of oil is obtained from the statistical database of NASDAQ (www.nasdaq.com).

To conduct time-series analysis, all variables were transformed into logarithms. To identify and formally assess the relationship between variables, we use simple correlation analysis. To study sensitivity and causal linkages between the variables in the sample in short-and long-run, we turn to regression analysis, which involves the construction of VECM of certain type based on stationary time series, testing the model for heteroscedasticity of the residuals, autocorrelation as well as stability and normality. Based on the model, we study causal linkages between variables in the short run by applying Granger causality test in VEC domain.

4. RESULTS AND DISCUSSION

The first step in testing the hypothesis is to test the variables for the presence of correlation. We use simple correlation analysis and imply Pearson statistical significance test. Results of correlation analysis ate presented in Table 2.

As can be seen from the results of the correlation analysis, the relationship between most variables is statistically significant and the correlation coefficients are significant. For example, the correlation between oil prices and employment is a positive, direct growth in oil prices leads to an increase in employment in Russia and vice versa. At a confidence interval of 5%, the value of the

Table 2: Results of correlation analysis

Variable	Employment level	Agregate real wages	Oil prices (Brent)
Employment level	1		
Agregate real wages	−0.710930 [0.002021]	1	
Oil prices (Brent)	0.884071 [0.00347]	0.643204 [0.0093]	1

correlation coefficient is 0.88. The explanation to this observation, in our opinion, lies in the presence of indirect depending on the level of employment from oil prices. The price increase leads to an increase in government revenue and expenditure, growth of household incomes and thus consumption and, consequently, employment. In the period of crisis, the relationship is also direct. The falling oil price reduces income, consumption, investment, and the need for workers.

The same is true for the relationship between the real wage and the level of oil prices. From the results of correlation analysis, we can see that the relationship between oil prices and real wages is a direct and statistically meaningful. A positive shock in oil prices leads to an increase of the aggregate level of real wages and vice versa. In other words, higher wages from the oil shock does not lead to short-term inflationary spike in wages, but is fundamental and contributes to economic growth.

Some noteworthy results of correlation analysis of relationship between real wages and employment. Correlation analysis shows that between them there was an inverse relationship, while the relationship is statistically significant. It turns out that a positive shock in wages leads to a reduction of employment in the economy as a whole. A possible explanation for this empirical features may lie in the fact that the increase in wages is associated with the intensification of economic growth, increase of requirements to quality of human capital by the employer upon reduction of the need for less skilled labor force. In other words, a positive shock to wages is associated with more labor-intensive works in the automation of routine processes, i.e., the reduction of capital intensity of production. A vivid example is the optimization and automation of routine business processes at enterprises and in commercial banks, the spread of robotic manufacturing. The released funds are directed on increase of salaries of the remaining employees.

However, unconditional acceptance of the results of correlation analysis is impossible due to possible existence of serial correlation, problem of multicollinearity. In this regard, it is necessary to turn to more qualitative techniques of analysis.

The second step in testing hypotheses is to test variables for the presence of unit root. For this purpose, we use standard tests - ADF and P-P test. Results of unit root testing are presented in Table 3.

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 a model 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 4. As can be seen from Table 4, 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 to shocks in US monetary policy 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 5.

Johansen test results show the presence of cointegration between a number of equations, which allows presuming the existence of

Table 3: Results of individual unit root test

Variables	ADF		PP	
	Statistic	P**	Statistic	P**
Levels				
Intercept	5.129	0.527	6.426	0.3772
Intercept and trend	9.210	0.162	11.285	0.0881
First-difference				
Intercept	31.794	0.0000**	39.614	0.0000**
Intercept and trend	22.476	0.0010**	40.120	0.0000**

**Denotes statistical significance at the 5% level of significance. ADF: Augmented Dickey and Fuller

Table 4: Results of unrestricted VAR model diagnostic testing

Type of test	Results		
	Lags	LM-statistics	P value
VAR residual serial correlation LM test	1	8.401216	0.4943
	2	10.18585	0.3357
Stability condition test	All roots lie within the circle		
	VAR satisfies stability condition		
Heteroscedasticity (White test)	0.2908*		
VAR residual cross correlation test	No autocorrelation in the residuals		

**Denotes acceptance of null hypothesis (H_0: There is no serial correlation). *Denotes acceptance of null hypothesis of homoscedasticity. VAR: Vector autoregression

Table 5: Results of Johansen co-integration test

Hypothesized number of CE(s)	Eigenvalue	Trace statistics	0.05 critical value	P*
None*	0.945095	65.18204	29.79707	0.0285*
At most 1	0.423298	10.36705	15.49471	0.2535
At most 2	0.131256	2.110610	3.841466	0.1463

Trace statistics indicate 1 cointegrating equation at the 0.05 level. *Denotes statistical significance at the 5% level of significance a long-term relationship between them. Starting from the results of the cointegration test, we can proceed to the construction of VECM model to reveal presence or absence of long-term and short-term relations between variables.

The results of the model, showing the relationship between Bank of Russia's key rate, oil prices and US effective federal funds rate are presented in Table 6.

As can be seen from the Table 6, 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 obtained evidence that between world oil prices, level of employment and aggregate real wages in Russia there is cointegration, so that they have similar trends of movement in the long term.

The C (1) shows speed of long run adjustment. In other words, this coefficient shows how fast the system of interrelated variables would be restored back to equilibrium in the long run or the disequilibrium would be corrected. Given statistical significance at 5% level (P < 5%) and negative meaning, the system of variables corrects its previous period disequilibrium at a speed of 45.28% in 1 year (given optimal lag meaning of 1 year for ECM). It implies that the model identifies the sizeable speed of adjustment by 45.28% of disequilibrium correction in 1 year for reaching long run equilibrium steady state position.

High speed of adjustment of relations between variables towards equilibrium is quite understandable. Considering the above mentioned fact about the dependence of the Russian economy on oil rents, as well as the fact that a significant proportion of economic active population employed in the public sector, it is not surprising that shocks in oil prices have an impact on the main source of salary costs - the budget. In the case of reduced income from oil exports, reduced costs on wages and staffing optimization is performed.

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 the model are presented in Table 7.

As can be seen from the results of the Wald test in the short term there is a relationship between changes in world oil prices and changes in real wages. Moreover, this relationship is direct. Based on the results of the Wald test, we can detect statistically significant causality running from world oil prices to aggregate real wages with rate of adjustment towards equilibrium of 6.5% in t−1. In other words, a rise (decline) in oil prices leads to a rise (fall) in aggregate real wages.

The second result shows presence of causality running from employment rate to real wages with the speed of adjustment towards equilibrium at 8.49%. So, the results of Wald test show that employment rate in the short term has the potential to impact real wages. Thus, an increase in the employment rate leads to an increase in the real wages. This causality, in our view, stems from oil prices dynamics. The increase in oil prices leads to an increase of household wealth and growth in the marginal propensity to consume. This, in turn, leads to a rise in demand for resources in the labor market, exacerbating the competition between employers, which leads to increased requirements on the part of the employer to skills of employees. More qualified employees get higher pay levels.

Overall, the obtained results are consistent with existing empirical and theoretical results of the previous studies.

The final stage of the analysis of the model 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 8.

Table 6: Results of VECM

Coefficient number	Coefficient meaning	Standard error	t-statistic	P
C (1)	−0.452843	456.054	3.014262	0.0344*
C (2)	−0.425551	0.34283	4.241288	0.2428
C (3)	0.065061	258.762	2.505478	0.0231
C (4)	−0.084960	211.895	2.248346	0.0403
C (5)	891.1355	334.053	2.667644	0.0236

*Denotes statistical significance. VECM: Vector error correction model

Figure 1: Results of normality test

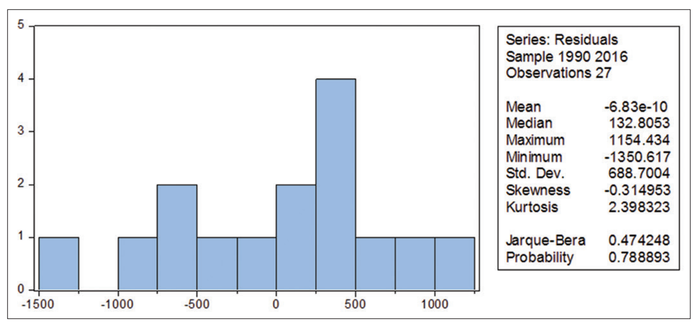


Figure 2: Results of cumulative sum test

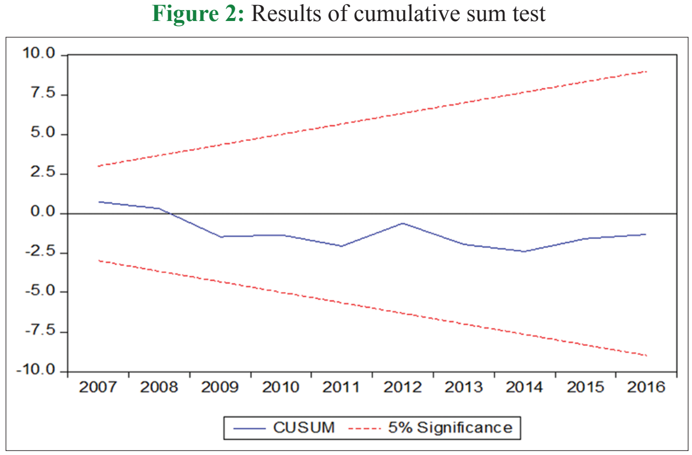


Table 7: Wald test results for short run relationship

Test statistic	Value	df	P	Test statistic	Value	df	P
t-statistic	1.505478	10	0.0254*	t-statistic	−1.24834	10	0.0419
F-statistic	2.266465	(1,10)	0.0254*	F-statistic	1.558369	(1,10)	0.0419
Chi-square	2.266465	1	0.0019*	Chi-square	1.558369	1	0.0081
Null hypothesis: C (3)=0 (world oil prices)				Null hypothesis: C (4)=0 (employment rate)			

*Denotes statistical significance and rejection of H_0: No short-run relationship

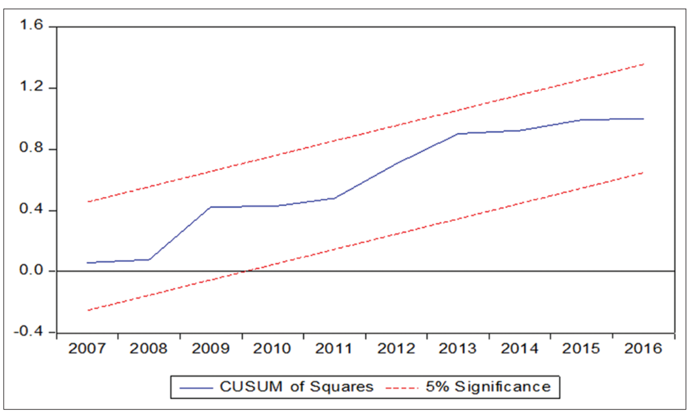
Table 8: Results of diagnostic testing

Test Type	Value	Probability characteristic	P value
Heteroscedasticity test: Breusch-Pagan-Godfrey			
F-statistic	3.893235	P F (6,17)	0.1404
Obs*R^2	11.17340	P Chi-square (6)	0.1832
Scaled explained SS	3.472005	P Chi-square (6)	0.7477
Heteroskedasticity test: ARCH			
F-statistic	0.457949	P F (1,12)	0.5114
Obs*R^2	0.514635	P Chi-square (1)	0.4731
Breusch-Godfrey Serial Correlation LM test			
F-statistic	2.140064	P F (2,8)	0.4081
Obs*R^2	3.011095	P Chi-square (2)	0.2219
Autocorrelation/partial correlation			

Lag	Autocorrelation	Partial autocorrelation	Q-statistics	P
1	−0.008	−0.008	0.0013	0.972
2	−0.369	−0.369	2.66736	0.263

ARCH: Autoregressive conditional heteroskedasticity

Figure 3: Results of cumulative sum square test



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 1-3 we present test results for normality and stability (cumulative sum [CUSUM] and CUSUM square test).

As can be seen from the data of Figures 1-3, the model meets the requirement of normality.

5. CONCLUSION

This study focuses on testing hypotheses on the impact of oil price shocks on competition in the labor market on the example of oil-exporting countries. On the example of Russia for the period 1990-2016 we conducted a study on the relationship between oil prices, employment in the Russian economy and the aggregate level of real wages. The methodological basis of the study is the VECM. The hypothesis of the study states that in terms of the dependence of the Russian economy on oil rents, there must be a long-term relationship between world oil prices, levels of employment and real wages. The results of the VECM confirm this hypothesis.

The results of the Wald test also confirm the existence of short term dependency between the variables of the sample. First, the shock of oil prices in the short term has a direct impact on employment. This fact is substantiated by the transmission of positive or negative oil price shock on the behavior of households, firms and states in part the expected income and plans expenditure. This, in turn, leads to the multiplier of income between the sectors of the economy and leads to an increase in the demand for labor. Secondly, the shock to employment leads to growth of aggregate real wages of the population. This observation is substantiated by the fact that the increase in the demand for labor by employers sharpens competitive pressures in the labor market and leads to increased requirements for employees, covered by an increased offer on wages.

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