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THE SUCCESS OF ECONOMIC POLICIES IN RUSSIA: DEPENDENCE ON CRUDE OIL VS. EXPORT DIVERSIFICATION

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Abstract

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In the light of numerous debates around Russia's dependence on crude oil and the necessity to diversify the Russian economy, the present paper investigates how closely federal budget revenues, structure of export basket and GDP growth in Russia are tied up with crude oil prices (POIL) on the one hand and the real effective exchange rate of ruble (REER) on the other. The study covers the period from 2000:Q1 till 2014:Q4 and employs index analysis along with vector error correction model (VECM) based on Johansen co-integration technique. The calculated REER revealed its significant appreciation, that together with a high share of mineral products in total Russian exports points to Dutch disease presence. The constructed econometric models revealed the existence of long-run relationships among the analyzed indicators. Post-estimation tests proved the validity of the VECMs. According to the obtained results, in order to stimulate "non-oil" exports monetary authorities should depreciate national currency, whilst fiscal burden should be mild towards "non oil" producers. However, the observed dynamics of macroeconomic indicators points to the fact that the Russian economy is still substantially influenced by POIL and this influence is much more stronger than it is exerted by fiscal and monetary regulators. It allows us to conclude that crude oil will continue to play, at least in foreseeable future, a dominant role in further development of the Russian economy.

Keywords: Russia, GDP, fiscal revenues, crude oil price, REER, VECM, co-integration

INTRODUCTION

Russia, being a resource abundant country, has been often considered in a number of scientific papers as a country that continuously struggles with Dutch disease. The latter is referred to as a particular case of the so called "resource curse". Various theories of the "resource curse" advocate different mechanisms that lead to a potentially inefficient use of both natural resources (mainly crude oil and natural gas) and revenues generated from their sale. However, all these theories advocate a joint idea that appropriate government policies are able to correct such imperfections (Polterovich *et al.*, 2008). Among the tools, enabling governments to manage this negative phenomenon, fiscal along with monetary policies and regulation of domestic currency exchange rate in particular can be mentioned. "There is a common perception that oil prices and the real exchange rate have a major impact on Russia's GDP dynamics" (Rautava, 2002). However, "a priori, it is not clear how resource abundance influences macroeconomic indicators" (Polterovich *et al.*, 2008).

In this light the aim of the papaer is to investigate, first, whether Russian economy reveals one of the main symptoms of the Dutch disease, i.e. appreciating real effective exchange rate, and second

– if implementations of fiscal and monetary policies reveal any substantial effect on the Russian economy in comparison to crude oil prices. Blanchard and Perotti (2002) assert that "in contrast to monetary policy, fiscal variables move for many reasons, of which output stabilization is rarely predominant; in other words, there are exogenous (with respect to output) fiscal shocks". "As fiscal decisions are made, they have two sources that cause a lag, before the decisions influence the economy. The decision process itself takes time, and after the decision has been taken, the implementation of it will require even more time. Hence the impulse response from a fiscal policy shock takes time before the effect is fully realized. This assumes implicitly, that the announcement of a decision itself has no, or very little effect on the real economy; i.e. even though financial markets respond to these decisions almost immediately after they have been announced, they do not affect the real macroeconomic variables" (Kuismanen, 2010). With regard to this aspect federal budget revenues seems can serve as an appropriate proxy of fiscal policy implementations since this indicator captures the real practical outcome of the latter in the economy.

Literature Review

According to the research done by Bordoff and Houser in 2014 the share of mineral products in total exports of Russia accounted for 68 % and more than a half of Russian export revenues in 2013 (54 %) were received from oil and petroleum products (Bordoff *et al.*, 2014). Tab. I and Fig. 1 given below illustrate the corresponding figures. Machinery, electronics and other high-tech industries output share accounted for just 7–8 % of national GDP in 2013.

Any resource abundant country seeks to find ways of diminishing their dependence on raw materials (Maitah *et al.*, 2015), as well as corresponding negative consequences of this dependence, such as, for example, Dutch disease. Fiscal policy along with monetary one can serve as one of the effective tools that governments employ to counteract adverse macroeconomic influences (Maitah *et al.*, 2014). The former Minister of Finance in the Russian Federation A. Kudrin asserted that a high tempo of national currency appreciation is dangerous for any economy, and generally governments avoid the policy of "strong" national currencies: "Oil-exporting countries in the period of high commodity prices, despite significant surpluses of current account, seek to prevent the increase of real effective exchange rate (REER) of their currencies; furthermore, they often resort to its reduction (like Kuwait, United Arab Emirates, Kazakhstan)" (Kudrin, 2006). The strongest negative impact of the rapid appreciation of the ruble is perceived by business, since the internal costs start to exceed the costs of similar products producing in other countries. The decrease in price competitiveness is not compensated by the growth of technological efficiency, because appreciation restrains exporting abilities of medium and high technology industries (Maitah *et al.*, 2013; Maitah *et al.*, 2016). "The dependence of the exchange rate policy on oil prices has been especially high after the August crisis in 1998. This can be illustrated by the dynamics of oil prices and REER of rouble" (Kudrin, 2006). In addition, still "in autumn 2001 Russia's prime minister Kasyanov said that a one dollar change in the price of a barrel of oil will change the total income of the Russian economy by USD 2 billion and federal revenues by 1 billion" (Rautava, 2002). Thus, federal budget revenues, being a practical manifestation of fiscal policy, were included into the analysis to investigate whether the latter has had real impacts on the Russian economy.

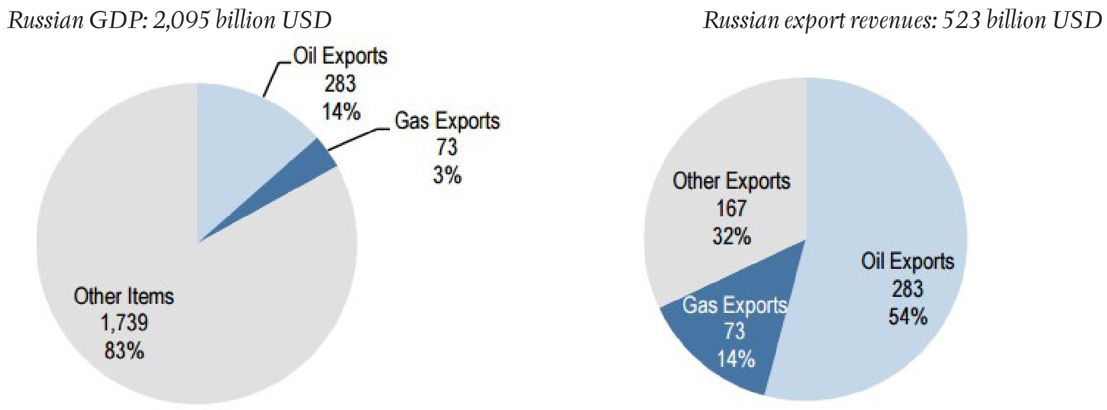
"The impact of the world financial crisis made the Russian monetary authorities to pass new "Basic directions of general state monetary and credit policy for 2009 and for the period of 2010–2011" in late October 2008. The policy of smooth lowering ruble exchange rate ended in March 2009 with achieving the corridor at RUR 38–41 per the USD/EUR basket compared to RUR 29–30 per the basket in September 2008. The mentioned basket consists of USD 0.55 and EUR 0.45. In early 2010 the Russian Federation monetary authorities made the corridor floating and it reached RUR 33.7–36.7 per the basket in April 2010 due to the rise in world prices of Russian major export commodities" (All-Russian Market Research Institute, No date).

Regardless major reform initiatives along with progress in legislation and changes in the business atmosphere, the core question remains actual: how vulnerable is Russia's economic and fiscal situation to changes in world market energy prices and the exchange rate of the Russian rouble? (Rautava, 2002). In this light the present paper via application

I: *The significance of oil and gas exports to the Russian economy, in 2013*

Export Revenues	billion of USD	% of GDP	% of Export Revenues
Crude Oil Export	174	8 %	33 %
Oil Products Export	109	5 %	21 %
Total Oil Export	283	14 %	54 %
Total Natural Gas Exports	73	3 %	14 %
Total Oil & Natural Gas Export	356	17 %	68 %

Source: Bordoff, J. and T. Houser (2014) on the basis of BOFIT, Central Bank of Russia, metals & mining export revenues from Goldman Sachs.



1: *Export of mineral products' contribution to Russian GDP and government revenue in 2013.*
Source: Bordoff, J. & T. Houser (2014) on the basis of BOFIT, Central Bank of Russia, metals & mining export revenues from Goldman Sachs.

vector error correction model (VECM) seeks to contribute to the analysis of the effects rendered by crude oil price and REER of Russian ruble on the structure of Russian exports on the one hand and fiscal revenues on the other.

The rest of the paper is organized as follows: the next section presents a discussion on methodological approaches employed in the present study; section „results and discussion" deals with data analysis along with calculation of REER, then the long-run interrelations among GDP growth in Russia, federal budget revenues, structure of Russian export basket, REER of ruble and price of crude oil are analyzed with the use of Johansen methodology and commented on; the last section presents main conclusions, where significance of the results is discussed.

MATERIAL AND METHODS

A number of models exist to analyze multivariate time series properties and interrelations. Juselius (2014) argues that the most important reason why namely VAR/VECMs are especially useful in a description of macroeconomic time series is the possibility of combining short-run and long-run information in the data by exploiting the co-integration property. According to Sims (1980) VAR models provide a coherent and credible approach to data description, forecasting, structural inference and policy analysis. VARs have good explanation properties when applied to covariance-stationary time series, but encounter some difficulties when applied to nonstationary or integrated processes. Nelson and Kang (1984) showed that when working with non-stationary time series one can get "spurious" regression among analyzed variables. Since that time any investigation of time series is customary to begin with the test for the presence of unit roots (Nelson, 1984). Comprehensive theoretical developments were made by Granger and Engle in their seminal work "Co-integration and error correction: representation, estimation, and testing", in which they discussed the possibility that two or more integrated, non-stationary time series might be cointegrated, so that some linear combination of these series could be stationary even though each series is not (Engle *et al.*, 1987). "If two time series are cointegrated, then the time series of the deviations from the cointegrating linear combination is stationary. Therefore, the cointegrating linear combination defines a long run equilibrium relationship. The existence of this equilibrium must be due to some real economic forces... In error correction models, the direction and the magnitude of the current movement of a variable is a function of its past deviation from the long run equilibrium" (Zivot, 2007). "If series are integrated of order one, I(1), it allows modelling their interrelationship by taking first differences of each series. However, this approach would be suboptimal if it was determined that these series are cointegrated. In that case, the VAR would only express the short-run responses of these series to innovations in each series. If the series are cointegrated, they move together in the long run. A VAR in first differences, although properly specified in terms of covariance-stationary series, will not capture those long-run tendencies" (Baum, 2013). In order to capture and examine long-run component the VAR concept may be extended to the VECM, provided that there is evidence of cointegration among two or more series. "In the case of multiple variables, there is a vector of error-correction terms of length equals to the number of cointegrating relationships, or cointegrating vectors among the series" (Baum, 2013).

Since VAR models have proven to be especially useful for describing the dynamic behavior of economic and financial time series (Juselius, 2014), the present study employs namely this methodology in order to investigate interrelations among GDP growth in Russia, federal budget revenues, structure of Russian export basket, REER of ruble and price of crude oil. Thereby, on the basis of available along with constructed within the present study data, the aim is to examine recent interrelations (from 2000:Q1 till 2014:Q4) among the mentioned variables. Thus, the following parameters will be employed: GDP growth in Russia (GDPG), federal government budget revenues (FR), structure of Russian export basket expressed as a ratio of non-oil exports to oil-exports (ExnExo), the real effective exchange rate of the rouble (REER) and price of URALS crude oil (Poil).

First of all, stationarity of all the time series (both in levels and differences) has to be examined. Taking into account the fact that quarterly data will be used, that implicitly implies the presence of seasonal component, testing for unit roots will be conducted with the use of HEGY test (Hyllberg, 1990). The latter allows for identifying seasonal unit roots. The classical Augmented Dickey-Fuller (ADF) test will be employed as well. Construction of VAR model requires all the series to be stationary (Engle, 1987; Kocenda *et al.*, 2007). Series taken in differences are expected to be stationary, however, in this case we exclude the error correction term, since VAR model in differences, although properly specified in terms of covariance-stationary series, does not capture the long-run tendencies (Welfe, 2013) that are of our main interest. Detection of long-run relationship among analyzed variables has to be done with the use of cointegration analysis. The latter is possible if all the varibles (series) are non-stationary and integrated of the same order I(n). This must be revealed by HEGY or/and ADF tests results. Provided this requirement fulfilled, the long-run relationship can be examined (Bannikov, 2006; Rumánková, 2012). For the purpose of a meaningful analysis estimation of VECM coefficients has to be done on the basis of the equation (1) given below:

$$\Delta X_t = \eta + \alpha\beta' X_{t-1} + \sum_{s=1}^{p} C_s \Delta X_{t-s} + U_t, \qquad (1)$$

where $X_t = (X_{1t}, X_{2t}, \dots, X_{Nt})$ is a *N*x1 vector of the N cointegrated variables, which are supposed to be integrated of the same order (I(n)); $\eta = (\eta_1, \eta_2, \dots, \eta_N)$ – is a Nx1 vector of intercepts; $\beta = (\beta_{(1)}, \beta_{(2)}, \dots, \beta_{(r)})$ is the Nxr cointegrating matrix consisting of the r cointegrating vectors (long-run relationship) and α – is a Nxr matrix of the *r* adjustment coefficients for each of N variables; C_s – are NxN matrixes of autoregressive coefficients, s > p; ( ) – is a VAR or short-term component; $U_t = (U_{1t}, U_{2t}, \dots, U_{Nt})$ is a Nx1 vector of mutually uncorrelated white noise disturbances (Kuwornu, 2012; Bannikov, 2006; Juselius, 2014).

A number of equations in a model equals to the number of variables. Estimation of the model (1) is supposed to be done by feasible generalized least squares (GLS). Estimation of the parameters can be performed with the use of the least squares method applying it separately for each equation, that makes the use of these models very attractive (Lütkepohl, 2004). The residuals will be used to estimate the white noise covariance matrix Σu as:

$$\hat{\Sigma}_u = T^{-1} \sum_{t=1}^{T} \hat{u}_t u_t', \qquad (2)$$

where u_t – is a k-dimensional unobservable zero mean white noise process with positive definite covariance matrix.

Since seasonal component of data may include important information, seasonal adjustment of raw input data is not recommended (Hyllberg, 1990) and for that reason was not applied. The presence of seasonal co-integration investigated in case of existence at least one seasonal root in all analyzed series.

The macroeconomic dynamics crucially depend on the lag order choice, because the statistics of interest are functions of the order of the autoregressive lag polynomial (Kilian, 2001). In order to select the number of lags we rested on information regarding the autocorrelation function of the reduced form of VAR residuals and the likelihood ratio tests (Welfe, 2013). The lag order of the exogenous variables xt, q, has to be prespecified before modeling. The optimal lag order will be chosen in the present study by minimizing the following information criteria (Kantorovich *et al.*, 2003; Lütkepohl *et al.*, 2004):

$$AIC(n) = \log\det(\hat{\Sigma}_u(n)) + \frac{2}{T} nK^2, \qquad (3)$$

$$HQ(n) = \log\det(\hat{\Sigma}_u(n)) + \frac{2\log\log T}{T} nK^2, \qquad (4)$$

$$SC(n) = \log\det(\hat{\Sigma}_u(n)) + \frac{\log T}{T} nK^2, \qquad (5)$$

$$FPE(n) = \left(\frac{T+n^*}{T-n^*}\right)^K \det(\hat{\Sigma}_u(n)), \qquad (6)$$

where *AIC* – Akaike information criterion; *HQ* – Hannan-Quinn information criterion; *SC* – Schwarz information criterion; *FPE* – Final prediction error; is estimated by T–1 , n^* – is the total number of parameters in each equation of the model, *n* – is the lag order of the endogenous variables.

Having chosen the number of lags in the underlying VAR, the second step is to determine the number of cointegrating equations in a vector error-correction model (VECM) as Johansen (1988) suggests. For determining the number of cointegrating equations in a VECM the Johansen's "trace" statistic method will be employed because of multiple time-series analysis. The null hypothesis of the trace statistic is that there are no more than r-cointegrating relations. Restricting the number of cointegrating equations to be r or less implies that the remaining (K – r) eigenvalues are zero. Johansen (1995) derives the distribution of the trace statistic in accord with the following ratio:

$$-T\sum_{i=r+1}^{K}\ln\left(1-\hat{\lambda}_i\right), \quad (7)$$

where T – is the number of observations, λ_i – are the estimated eigenvalues.

For any given value of r, large values of the trace statistic are evidence against the null hypothesis that there are r or fewer cointegrating relations in the VECM (Johansen, 1995).

The VAR along with VECM approach "heavily relies on the existence of reliable and non-interpolated quarterly data over a sufficiently long period of time" (Giordano *et al.*, 2008). The availability of quarterly fiscal variables represents the main constraint for the analysis of fiscal policy with VAR-VECM models. As a result, the period for the analysis was limited to the end of 2014 by the last available data on the official web page of the Federal Treasury of Russia. Thus, the sample period selected for the study runs from 2000:Q1 to 2014:Q4, that is 60 observations.

The sources, where the corresponding data were taken from, are as follows: the Federal State Statistics Service of the Russian Federation (GDP growth), information and analytical portal "Neftetransportnaya territoria" (price of URALS crude oil), the Federal Treasury of Russia (fiscal revenues), the Federal Customs Service of the Russian Federation (export data). The real effective exchange rate of Russian ruble was calculated in this study employing the current methodology of the Central Bank of the Russian Federation. The consumer price index (CPI) will serve in these calculations as a deflator.

According to the methodology of the Russian Federation's Central Bank, while constructing REER to a basket of foreign currencies into account have to be taken those foreign trade-partners' currencies, the weight of which in total foreign trade turnover is not less than 0.5 % (Maitah, *et al.* 2016). The number of these countries over the period under analysis was not the same. Moreover, the vast majority of currencies from these countries accounts for a very insignificant share in Russian currency market. For that reason the calculation and analysis of REER index of Russian ruble will be done in relation to those currencies, which take a dominant position in Moscow Interbank Currency Exchange. Taking into account the fact that payment for the supply of main exported by Russia products is carried out in USD, namely the USD takes the dominating position on the Russian currency market (Maitah *et al.*, 2016). At the same time, the average total share of Euro in currencies turnover of Moscow Interbank Currency Exchange is around 3 %, whereas the share of Euro in the basket of foreign currencies accounts up to 45 %. For these reasons, the construction of REER index in relation to both USD and EUR currencies is seen as worth pursuing. The corresponding weights will be calculated as total turnover of USD/RUR and EUR/RUR in Moscow Interbank Currency Exchange. Formula (8) for calculation is given below (Panilov, 2009):

$$REER_m=\prod_{i=1}^{n}\left(\frac{P_m}{P_m^k}\cdot\frac{NERM_m^k}{NERM_{m-1}^k}\right)^{w_m^k}, \quad (8)$$

where $REER_m$ – monthly real effective exchange rate a basket of EUR-USD currencies; P_m – price index that demonstrates the ratio of inflation rate for the month-m to previous month – (m–1) in Russia; P_m^k – the same index for country-k; $NERM_m^k$ – the monthly average nominal exchange rate of Russian rouble (indirect quotation) to k-currency in month-m; $NERM_{m-1}^k$ – the same for the previous month – (m–1); w_m^k – normalized monthly weight of k-currency; $n = 2$; k – country (USA and EU).

As a result, the list of variables (along with their abbreviations) used in VAR/VECM modeling is as follows (all data were logged): GDP growth (lnGDPG), fiscal revenues of the federal budget (lnFR), real effective exchange rate of Russian rouble (lnREER), price of Urals crude oil (lnPoil) and the structure of Russian export basket expressed as the ratio of "non-oil" exports to "oil" exports (lnExnExo). "Non-oil" implies everything that Russia exports except "oil", that is crude oil, processed oil, natural gas and other types of energy raw materials. Logged values of all the series were used in order to interpret the obtained coefficients as elasticities.

RESULTS AND DISCUSSION

First, in order to complement the list of variables, we need to calculate the real effective exchange rate of Russian rouble. The latter had been initially calculated on a monthly basis and then the received data were transformed, using a geometric mean, into quarterly values to correspond with the rest of the variables. Fig. 2 illustrates graphical representation of the calculations, along with time series of all the collected variables needed for econometric modeling.

Downward slope of the REER index curve corresponds to the REER growth, i.e. the rouble appreciation, and vice versa. In fact, the observed dynamics of REER (together with figures given in Tab. I showing the high share of the resource exports in total export revenues) allows us to conclude that

2: *Analyzed time series: GDP growth in Russia, fiscal revenues, constructed REER* of ruble, Export basket structure and Urals crude oil price***

NOTE:

* – The real effective exchange rate of Russian ruble to a basket of EUR-USD currencies.

** – All series are logged, except the first one titled as REER (this graph depicts initial values of the Index, in %).

Source: Authors' processing of data (in STATA 13.0) taken from: Federal State Statistics Service, The Federal Treasury of Russia, International Financial Statistics of IMF, Statbureau and Moscow Interbank Currency Exchange.

II: *Optimal lag orders suggested by the majority of information criteria*

Series	LnGDPG	LnFR	LnREER	LnExnExo	LnPOIL
In levels	2	3	3	1	3
In first differences	2	2	2	3	2

Source: Author's calculation in STATA/MP 13.0.

III: *The results of HEGY-test [1] for LnExnExo series in levels*

Modif.[2]	Unit root(s)	Test stat.	5 % Critical value	Reject H_0	Conclusion
B	Fr. 0 Fr. ½ JA	0.022 –2.403 9.057	–1.970 –1.920 3.120	No Yes Yes	Conv. unit root (0)
C	Fr. 0 Fr. ½ JA	–1.582 –2.323 8.526	–2.880 –1.950 3.080	No Yes Yes	Conv. unit root (0)
CT	Fr. 0 Fr. ½ JA	–3.435 –2.004 6.697	–3.470 –1.940 2.980	No Yes Yes	Conv. unit root (0)
CTS	Fr. 0 Fr. ½ JA	–2.987 –2.889 9.369	–3.530 –2.940 6.600	No Yes Yes	Conv. unit root (0)
CS	Fr. 0 Fr. ½ JA	–1.029 –1.965 9.825	–3.470 –1.950 2.960	No Yes Yes	Conv. unit root (0)

NOTE:

1) H_0: variable contains a unit root, H_1: variable was generated by a stationary process.

2) Modification of the test: B = basic; C = model with constant; CT = model with constant and trend; CTS = model with constant, trend and seasonal dummies; CS = model with constant and seasonal dummies.

Source: Author's calculation in STATA/MP 13.0.

IV: *The results of ADF-test[1] for LnExnExo data*

Data	Modif.[2]	Test stat.	Critical value	p-value	Reject H_0	Conclusion
In levels	N	–0.363	–1.950	x	No	I(1)
	C	–2.197	–2.924	0.2073	No	
	T	–3.532	–3.492	0.0361	Yes	
First differences	N	–4.456	–1.950	x	Yes	
	C	–4.424	–2.926	0.0003	Yes	
	T	–4.330	–3.495	0.0028	Yes	

NOTE:
1) H_0: variable contains a unit root, H_1: variable was generated by a stationary process.
2) Modification of the test: N = model without constant and trend, C = model with constant, T = model with constant and trend.
Source: Author's calculation in STATA/MP 13.0.

Russian economy does demonstrate the presence of Dutch disease. Among other negative consequences, which the REER appreciation has on the economy, this primarily implies weakening of industrial competitiveness along with further upward pressure on inflation rate in the country. Since exploring any measures that help to avoid and fight Dutch disease symptoms is outside the scope of this study, the rest of the analysis will be mainly focused on the investigation of bonding forces among federal budget revenues, structure of export basket, GDP growth in Russia and crude oil prices and the real effective exchange rate of ruble.

Prior to testing the series for the presence of unit roots, a proper lag order was chosen for each series on the basis of minimum values of sequential modified LR test statistic, final prediction error (FPE), Akaike information criterion (AIC), Schwarz information criterion (SC); Hannan-Quinn information criterion (HQ). The results are given below (see Tab. II).

Then all the series both in levels and in first differences were checked for the presence of unit roots with the use of HEGY and ADF tests. All modifications of the tests were applied to data in order to check the stability of the obtained results. Because of huge massive of the obtained results, Tables III and IV given below provide readers with the results of these test with regard to LnExnExo series only (as an example).

In accord with methodology, if series in levels are non-stationary, but DS-series are integrated of first order I(1), the cointegration test has to be done in order to see whether co-integrating vectors exist in the studied series. According to the obtained above results all the data have proven to be integrated of the same order I(1). Thus, the presence of cointegration can be found among the studied variables. It should be noted that because of multicollinearity problem (REER and POIL are highly correlated variables) two models will be considered instead of one. The first tested model in its analytical form is as follows (see Formula 9):

$$LnFR = LnGDPG + LnExnExo + LnPOIL, \quad (9)$$

The second model will study the existence of a long-run causality running from FR and REER to ExnExo (see Formula 10):

$$LnExnExo = LnFR + lnREER, \quad (10)$$

Prior to modeling the order of lags has to be established for all series of the first model together. The Tab. V given below presents the results of the test on selecting the most appropriate lag order.

Numbers marked with "*" indicate lag order selected by the relevant criterion (each test at 5 % level: LR – sequential modified LR test statistic; FPE – is Final prediction error; AIC – Akaike information criterion; SC –Schwarz information criterion; HQ – Hannan-Quinn information criterion). All calculations were performed in Stata/MP 13.0. As Tab. V shows, the majority of statistic criteria suggest lag 4. In other words, the best VAR lag order is 4, since it provides serially uncorrelated residuals. Now the existence of co-integration can be analyzed. Tab. VI provides readers with the results of this test.

The results of the test indicate that there is one cointegration vector, i.e. one combination of non-stationary series, the restriction of which makes the whole model stationary. The presence of the co-integration emphasizes the fact that correlations among input data do have a long term nature, that allows constructing a VECM model. The results of estimation of VECM parameters are given in Appendix, Tab. A. Overall, the output indicates that the model fits well. The coefficients of FR, GDPG and POIL in the cointegrating equation are statistically significant (except the coefficient of ExnExo, p-value of which slightly exceeds 0.05 level); however, not all their adjustment parameters demonstrate the same result. But, the most important outcome is that the error correction term (ECT), or speed of adjustment towards to equilibrium, of FR is negative in sign and statistically significant (-0.31, p = 0.011). It implies the existence of adjustment towards equilibrium and means that there is a long-run causality running from GDPG, ExnExo and POIL to FR.

Having estimated VECM parameters we have to check stability condition of VECM estimates. For our 4-variable model with 1-cointegrating relationships, the companion matrix will have (4–

V: *VAR Lag Order Selection Criteria*

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	95.7146				2.6e–07	–3.27552	–3.21943	–3.13085
1	231.536	271.64	16	0.000	6.2e–09	–7.55485	–7.27441	–6.83151
2	271.151	79.232	16	0.000	2.7e–09	–8.39827	–7.89348*	–7.09626*
3	280.933	19.563	16	0.241	3.4e–09	–8.17618	–7.44705	–6.2955
4	305.418	48.97*	16	0.000	2.6e–09*	–8.47922*	–7.52573	–6.01986

Source: Author's calculation in STATA/MP 13.0.

VI: *Cointegration test based on Johansen's maximum likelihood method*

maximum rank	parms	LL	eigenvalue	trace statistic	5% critical value
0	52	275.79891	.	59.2385	47.21
1	59	294.43785	0.48607	21.9606*	29.68
2	64	299.79467	0.17413	11.247	15.41
3	67	304.1525	0.14413	2.5313	3.76
4	68	305.41816	0.04420		

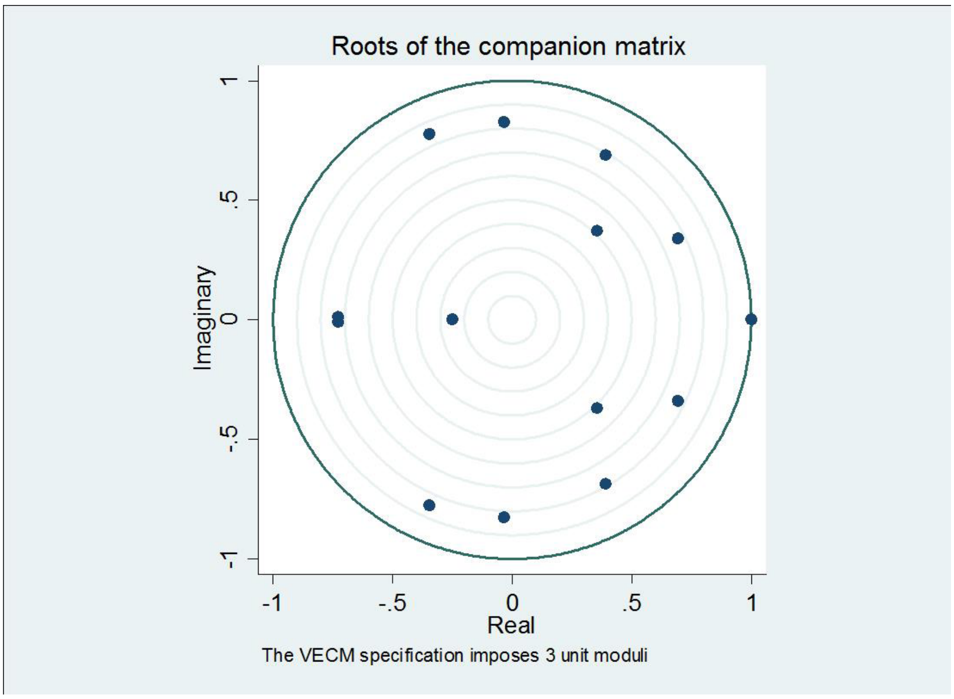
Source: Author's calculation in STATA/MP 13.0.

1) unit eigenvalues. To satisfy the stability condition the moduli of the remaining r eigenvalues should be strictly less than unity. Fig. 3 presents the results (see below).

The Fig. 3 shows that three of the roots are equal to 1, as it should be since (4 – 1 = 3). The figure footer reminds us that the specified VECM imposes exactly 3 unit modulus on the companion matrix. If any of the remaining moduli are too close to one it means that either the cointegrating equations are not stationary or there is another common trend and the rank that was specified in VEC is too high. In our case the remaining moduli are fairly far from one, which implies correct VEC rank and overall stability of VEC estimates.

The next diagnostic that has to be done with respect to the VECM is the test for autocorrelation in the residuals of the model. Tab. VII provides the result of that test.

As Tab. VII shows we fail to reject H0 that there is no autocorrelation in the residuals for any of the lags tested. Thus, the LM test revealed no evidence that our VECM was misspecified.



3: *Fig. 3: Eigenvalues of VECM: roots of the comp. matrix*
Source: Author's calculation in STATA/MP 13.0.

VII: *Lagrange multiplier test for autocorrelation in the residuals of VECM*

lag	chi2	df	Prob > chi2
1	16.0663	16	0.44834
2	12.4097	16	0.71533
3	19.6745	16	0.23524
4	25.3281	16	0.06425

Source: Author's calculation in STATA/MP 13.0.

VIII: *Test for distribution of the error terms*

Equation	chi2	df	Prob > chi2
D_lnfr	3.137	2	0.20832
D_lngdpg	62.241	2	0.00000
D_lnexnexo	2.147	2	0.34185
D_lnpoil	2.522	2	0.28334
ALL	70.047	8	0.00000

Source: Author's calculation in STATA/MP 13.0.

The next diagnostic that has to be done with respect to the VECM is the normality test. In STATA the command *vecnorm* computes and reports a series of statistics against H0 that the disturbances in a VECM are normally distributed. Jarque-Bera statistic was computed for each equation in the model and all equations jointly. The results of the test are provided below in the Tab. VIII (see below).

Judging by low p-values we may reject H0 of normality in corresponding equations except for d_lnfr, d_lnexnexo and d_poil at conventional significance level. According to the theory if the test of Jarkue-Bera fails, it may be an indicator of insufficient number of lags chosen for the model. However, when we increased the lag-order it has not solved the problem of residuals normality (five and six lags were tested and in these cases in addition to unresolved problem of normality problem of autocorrelation appeared). Thus, we can conclude that this is the property of the data and having a limited number of observations (60), we are not able to do much to improve upon this defect. In general, as regards failed Jarque-Bera test and especially in case of close to small data samples, it should be noticed that this is a quite common phenomenon, which will not crucially distort the final results (Sukati, 2013). The very fact that we have no autocorrelation in the residuals and the obtained stationary equilibrium is statistically significant is more important. This means that the obtained estimates of the cointegration relationship between FR, GDPG, EXN_EXO and POIL are valid and can be written in analytical form as:

$$LnFR = 6.59*LnGDPG - 1.13*LnExnExo + + 0.88*LnPOIL.$$

In fact, the long-run error-correction mechanism suggests that in case of 1 % GDP growth fiscal revenues will grow by 6.59 % (p = 0.000), 1 % growth in ratio of "non-oil" export to "oil" export will result in 1.13 % fall of FR (p = 0.073) and in case of 1 % growth of crude oil prices FR will grow by 0.88 % (p = 0.000). The speed of adjustment towards equilibrium is –0.317 and it means that 32 % of disequilibrium will be adjusted within a quarter (because of quarterly data).

In order to check the presence of a long-run causality running from FR and REER to ExnExo the same as above steps were conducted. As a result, one cointegrating vector was identified as well. Having estimated VECM coefficients and conducted post-estimation diagnostics, we can say that among FR, REER and ExnExo do exist a cointegration (ce1 = –0.54, p = 0.000) of the following nature:

$$lnExnExo = -0.08*lnFR + 0.10*lnREER.$$

The speed of adjustment towards equilibrium is here significantly higher than in the previous model and equals to –0.543. Both the error correction term and the obtained coefficients are statistically significant. The long-run error-correction mechanism suggests that in case of 1 % growth of fiscal revenues the structure of Russian export basket will change not in favor of non-oil component of the latter – the ratio ExnExo will fall by 0.08 % (p = 0.000); 1 % growth of REER index, that corresponds to 1 % real depreciation of Russian ruble, will result in 0.10 % growth of ExnExo (p = 0.000). It should be noted that the last coefficient is in accord with economic theory, according to which real depreciation of the national currency positively affects price competitiveness of domestic producers and may stimulate their exporting capabilities.

CONCLUSION

In the present study the dynamics of the selected macroeconomic parameters of the Russian Federation along with crude oil price fluctuations were analyzed to clarify if Dutch disease present in the Russian economy and what are the links among these indicators and the outcomes of economic policies in Russia. The study covers the period from 2000:Q1 till 2014:Q4 and employs index analysis along with multiple time series analysis (construction of VECM based on Johansen co-integration technique). The main question of the analysis was the following one: how closely federal budget revenues, structure of export basket and GDP growth in Russia are tied up with price of crude oil on the one hand and the real effective exchange rate of ruble on the other. The analyzed variables represent Russian macroeconomic environment more broadly than one could expect at first glance, since the REER indicator captures both nominal exchange rate and inflation influences.

At the first stage of the analysis the REER of rouble was calculated being based on the methodology of the Central Bank of the Russian Federation. The obtained results on REER dynamics (see Fig. 2) along with figures reflecting the share of mineral products in total Russian exports (see Tab. I) allow us to conclude that Russian economy does demonstrate one of the main symptoms of Dutch disease. The real appreciation of the ruble at the end of the analyzed period comparing to its beginning achieved approximately 80 %. Appreciation of the real exchange rate of ruble undermines price competitiveness of Russian products and this problem seems to be related to a bad management of oil revenues, which is mainly an issue of fiscal policy than monetary one.

At the next stage of the analysis the existence of interrelations among selected macroeconomic parameters in Russia and crude oil prices was investigated via application of VECM based on Johansen cointegration technique. In order to avoid multicollinearity problem (real effective exchange rate of ruble and price of crude oil are highly correlated variables) two instead of one econometric models were constructed. As a result, the long-run error-correction mechanisms suggest that in case of 1 % GDP growth fiscal revenues will grow by 6.59 %; 1 % growth in ratio of "non-oil" export to "oil" export will result in 1.13 % fall of FR and in case of 1 % growth of crude oil prices FR will grow by 0.88 %; 1 % growth of fiscal revenues will affect, in turn, the structure of Russian export basket not in favor of non-oil component of the latter – the ratio ExnExo will fall by 0.08 %; 1 % growth of REER index, that corresponds to 1 % real depreciation of Russian ruble, will result in 0.10 % growth of ExnExo. Both the error correction terms and the obtained coefficients are statistically significant.

As it is well known and was implicitly confirmed by the model, high oil prices make "oil" exports very attractive and stimulate their increase, that eventually leads to growth of fiscal revenues because of increased amount of money inflow. At the same time, fiscal policy based on a large tax burden negatively affects "non-oil" exports, since no business, except for one connected to hydrocarbons, becomes attractive and beneficial to producers. During the analyzed period Russia has been constantly increasing the volumes of mineral exports and despite the fact that in general "oil" exports positively affect the amount of fiscal revenues, the observed dynamics of GDP growth was in fact negative. It means that further economic growth in Russia is not possible at the expense of its natural resources endowments. The observed over the analyzed period dynamics of macroeconomic indicators reveals that Russian economy is still substantially influenced by crude oil prices. Russia needs to diversify its economy away from oil and gas dependency, because significant volumes of "oil" exports are not favorable to the economy in terms of its strategic development. And according to the obtained results, in order to stimulate "non-oil" exports monetary authorities should depreciate national currency on the one hand, whilst on the other hand fiscal burden should be mild towards to "non-oil" producers. Consequently, Russian government should focus on export-oriented development of non-oil sectors and find an optimum ratio between "oil" and "non-oil" exports so that "oil" revenues would have supported "non-oil" exports. This allows us to conclude that crude oil will continue to play, at least in foreseeable future, a dominant role in further development of the Russian economy.

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Appendix: Vector error correction model

Equation	Parms	chi2	P > chi2
_ce1	3	204.9731	0.0000

Cointegrating equations
Identification: beta is exactly identified

beta		Coef.	Std. Err.	z	P>| z |	[95 % Conf Interval]	
_ce1							
	lnfr	1	.	.	.	.	.
	lnexnexo	1.121523	0.6304215	1.79	0.073	–0.1040802	2.367127
	lngdpg	–6.585504	1.616361	–4.07	0.000	–9.753513	–3.417495
	lnpoil	–0.8805635	0.1582073	–5.57	0.000	–1.190644	–0.570483
	_cons	–9.327595	.	.	.	.	.

Johansen normalization restriction imposed

Equation	Parms	chi2	P>chi2
D_lnfr	1	6.539908	0.0105
D_lnexnexo	1	4.794326	0.0286
D_lngdpg	1	11.39373	0.0007
D_lnpoil	1	0.2219882	0.6375

Adjustment parameters

	alpha	Coef.	Std. Err.	z	P > | z |	[95 % Conf. Interval]	
D_lnfr	_ce1 L1.	–0.3171106	0.1240009	–2.56	0.011	–0.560148	–0.074073
D_lnexnexo	_ce1 L1.	–0.1211985	0.055352	–2.19	0.029	–0.2296865	–0.012711
D_lngdpg	_ce1 L1.	0.0250886	0.0074326	3.38	0.001	0.0105209	0.0396563
D_lnpoil	_ce1 L1.	0.0393587	0.0835365	0.47	0.638	–0.1243697	0.2030872

Source: Author's calculation in STATA/MP 13.0.

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