The Empirical Study of the Efficiency of the Impact of Macroeconomic Variables on National Currency

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Abstract This paper studies the efficiency of the impact of oil price, key interest rate and inflation on the exchange rates in the Russian Federation. The authors researched the effect of oil prices and other economic variables on the currency rate of dollar to ruble. The regression model has accurately shown this interrelation. The impact of macroeconomic variables and close interrelation between the exchange rate of dollar to ruble and oil prices is revealed. Oil price is a dominating factor in a exchange rate mechanism in Russia. When world oil prices are stabilized and sanctions are cancelled, currency fluctuations and uncertainty will be minimized. The monetary policy of Russian Central bank is to become less rigid, but focused on decrease of the inflation rate and on stabilization of national currency rate.

Keywords Impact on national currency • Macroeconomic variables • Exchange rate • Oil prices • Inflation

1 Introduction

Currency declines typically follow a series of political, economic and market forces that combine to pressure the national currency. A strong influence of these macroeconomic variables on the Russian economy considerably changes the settles tendencies in its development. First of all, feedback between ruble/dollar exchange rate and the prices of raw assets is broken. If earlier growth of ruble/dollar exchange rate was followed by fall of an oil price and other leading goods, nowadays there is a relation of opposite nature between oil prices and ruble/dollar exchange rate. This relation isn't so obvious as it has the late effect and is implemented through inflation.

Dependence of an oil price and the rate of inflation is caused by the fact that oil and its products occupy rather essential share in a consumer goods basket. This influence on inflation is wide, because many goods include transport costs.

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The decrease in oil price by 10% leads to decrease of the inflation rate for 0.2–0.3% after a while. Any other goods don't play such important role in inflation. Inflation becomes a subject of the Russian Central bank monetary policy which targets its regulation by a key interest rate. A key interest rate increase promotes decrease of the inflation rate, providing thereby strengthening of the national currency rate.

Fall of an oil price in 2014 to $98.7 led to the growth of a key interest rate of the Central Bank to 17%. It was caused by growth of inflation to 11.36%. In 2015 the key interest rate was reduced to 11%, but continuation of the lowering trend of an oil price and growth ruble/dollar exchange rate provoked growth of inflation to 12.9%.

In 2016 the economy adapted to the low prices of oil due to decrease in a share of oil products in the budget that promoted decrease of the inflation rate to 6.4% (for September). At the same time the key interest rate of the Central Bank was slightly reduced—to the level of 10% while ruble/dollar exchange rate continued to be at the high level—65.09.

Thus, the fall of an oil price, which is observed now, is followed by growth of ruble/dollar exchange rate while this influence can be seen 1–2 months later due change of inflation rate. Therefore, dependence of an oil price and the rate of inflation in pursuing Central bank's policy of targeting has an identical focus towards lowering.

2 Literature Review

Many other countries faced similar problems. Currency crises, which many economics define as a swift decline of more than 20% of a local currency against the dollar, have hit dozens of emerging markets over the past three decades.

That is why the issue of currency regulations is carefully studied by different economists. The issue of market regulation and interbank monetary using a key rate were analyzed in works of Ho and Saunders (1985), Bhattacharya and Gale (1987). But we have to emphasize, that these researches had a weak point regarding the only one index verified.

In works of other scientists, the problems of the monetary market acceleration by inflationary processes control are raised. It was investigated in the works by Acharya and Yorulmazer (2008), Blavarg and Nimander (2002). These scientists had a good approach to the essence of inflation and its influence but unfortunately didn't verify other indexes.

The complex analysis of world financial crisis of 2007–2009 problems and its consequences for economies of the countries and regions are reflected in the works by Freixas and Jorge (2008). However those researches analyzed only Western European countries but have no ideas about the countries of Eastern Europe and Russia.

Acharya and Merrouche (2013) researched the similar problems in British market. They investigated only one market with some territories and sectors but they didn't mention Asian and East European markets.

Several researches were devoted to asymmetric processes in the analysis of information on sizes of inflationary expectations and other parameters for decision-making on regulation of the monetary market, in particular by Ashcraft et al. (2011). They studied only inflation but did not produced the model with relevant indexes which would be closely connected with the kinds of inflation process.

Beaupain and Durre (2013), Finger et al. (2012), Jun et al. (2011) took part in the researches on development of models of factors of influence on national currency rate and of the liquidity of the banking market. They provided the model but it is useful when parameters are not changing during the sensible period of times.

Blokhina et al. (2016) made researches about interrelation between oil prices and national currency rate. They also made a correlation and regression analyses for the situation at the end of 2015 year in Russia.

But all these scientific approaches are in most cases connected with a particular country or region. At the same time, we see that every model contains only one or two factors with the different frames of time, and due to this we have also the problem of comparing one model with another. That is why in our research we will try to analyze the system of factors and we will try to make it more comparable with other researches in this field.

3 Methodology

In this study we used the econometric analysis to reveal the major factors influencing the currency rate of ruble. We would like to revel the correlation between national currency and macroeconomic variables. We took the monthly data from January, 2000 to January, 2016. We made a hypothesis that the currency rate of ruble depends on different macroeconomic variables. We constructed the model showing interrelation between the exchange rate of dollar to ruble and the prices of Brent crude oil, inflation and key interest rate.

The regression model in Table 1 shows that there is a strong correlation between exchange rate USD/RUR and inflation, but the oil prices and exchange rate showed a fable negative correlation. The R-squared statistic measures the success of the regression in predicting the values of the dependent variable within the sample. The R-squared is near 1, it means that regression fits very good. The Durbin-Watson statistic measures the serial correlation in the residuals. In our case DW is less than 2, there is evidence of positive serial correlation. The p-value is the marginal significance level of the F-test. It is zero, so we reject the null hypothesis that all of the regression coefficients are zero. The Akaike Information Criterion is used in model selection for non-nested alternatives, the AIC values in this model are very

Table 1 Convergence of dependent variable USD/RUR and oil prices, inflation after six iterations using the least squares method

Variable	Correlation coefficient	Std. error	t-Statistics	Probability
Oil price	−0.097583	0.017906	−5.449756	0.0000
Inflation	0.722982	0.194189	3.723092	0.0003
R-squared	0.971570	Akaike info criteria	3.778813	
Adjusted R-squared	0.971116	Shwarz criterion	3.846677	
F-statistics	2141.567	Hannan-Quinn criterion	3.806298	
Mean dependent VAR	32.11367	Durbin-Watson criterion	1.814535	
SD dependent VAR	9.322195	p-value	0.000000	

Table 2 Convergence of dependent variable USD/RUR and independent variables-oil prices, inflation, sanctions after seven iterations using the least squares method

Variable	Correlation coefficient	Std. error	t-Statistics	Probability
Oil price	−0.094292	0.017749	−5.312698	0.0000
Inflation	0.647322	0.194189	3.723092	0.0010
Sanctions	4.175028	1.581995	2.639089	0.0000
R-squared	0.972589	Akaike info criteria	3.752736	
Adjusted R-squared	0.972002	Shwarz criterion	3.937567	
F-statistics	1658.749	Hannan-Quinn criterion	3.787093	
Mean dependent VAR	32.11367	Durbin-Watson criterion	2.035556	
SD dependent VAR	9.322195	p-value	0.000000	

big, that it is not good. The Schwarz Criterion (SC) and Hannan-Quinn Criterion are alternatives to the AIC that imposes a larger penalty for additional coefficients.

In Table 2 the equation in general is significant because Prob (F-statistic) is equal 0.000000, that is, the hypothesis of insignificance of the equation is rejected. All variables are significant because Prob (t-statistic) doesn't exceed 1% level, that is, all hypotheses of insignificance of independent variables are rejected. The standard error decreased, that is a good index for this model. But sharp falling of residuals in May, 2015 remained not explained. To solve this task we will enter one more dummy variable which is connected to a policy of interest rates of the Central Bank of the Russian Federation, namely to introduction of a key interest rate. Independent variable is Key rate (Table 3).

The model (Table 3) improved again, the equation in general is significant because Prob(F-statistic) is equal 0.000000, that is, the hypothesis of insignificance of the equation is rejected. All variables are significant because Prob(t-statistic) doesn't exceed 1% significance value, that is, all hypotheses of insignificance of

Table 3 Convergence of dependent variable USD/RUR and independent variables-oil prices, inflation, sanctions, key rate after eight iterations using the least squares method

Variable	Correlation coefficient	Std. error	t-Statistics	Probability
Oil price	−0.088800	0.017431	−5.094250	0.0000
Inflation	0.624019	0.189564	3.291856	0.0012
Sanctions	4.245960	1.548025	2.742824	0.0031
Key rate	−3.211956	0.13756	74.94955	0.0000
R-squared	0.973853	Akaike info criteria	3.715939	
Adjusted R-squared	0.973150	Shwarz criterion	3.817736	
F-statistics	1385.513	Hannan-Quinn criterion	3.757167	
Mean dependent VAR	32.11367	Durbin-Watson criterion	2.064188	
SD dependent VAR	9.322195	p-value	0.000000	

independent variables are rejected. The standard error decreased about 1.53 rubles that is a good index for this model. Let's check model for seasonality.

The equation in general is significant because Prob(F-statistic) is equal 0.000000, that is, the hypothesis of insignificance of the equation is rejected. All variables are significant because Prob(t-statistic) doesn't exceed 1% significance value, that is, all hypotheses of insignificance of independent variables are rejected. The standard error decreased about 1.49 rubles that is a good index for this model.

The conducted correlation regression analyses illustrated an undoubtful efficiency of the impact of macroeconomic variables on national currency. Oil price is a major factor of influence on Russian ruble.

4 Conclusion

Rather complete idea of interrelations between the exchange rate of dollar to ruble, the prices of Brent crude oil, inflation, economic sanctions and change of a key interest rate of the Central Bank was gained. The currency rate of ruble strongly de-pends on the prices of Brent crude oil, inflation and key interest rate. The impact of macroeconomic variables on national currency is very strong. That is why national currency is very sensitive to macroeconomic variables.

High coherency between currency rate and macroeconomic indicators is witnessed across all the countries during financial crisis. The nominal exchange rates have negative relationship with the benchmark oil prices except exchange rate almost in all countries. Despite the fact that the Russian ruble is often called as oil currency, today the movement of the oil price doesn't have such influence on the exchange rate, as before.

Probably, it is connected with many other economic and political variables, which are observed at the global level.

Ruble exchange rate is determined by a ratio of demand for foreign currency and its supply in the foreign exchange market. Any factors (not only dynamics of the world prices for energy carriers) attracting change of a ratio between demand for foreign currency and its supply.

During different periods of time the factors leading to depreciation of ruble were very strong. So, at the end of 2013—the beginning of 2014 interest of the international investors in assets of the countries with the emergent markets, including the Russian assets, considerably decreased. Decisions of the Federal Reserve System of the USA on decrease in purchasing amounts of assets within the program of "quantitative mitigation" (that brings to slower, than earlier, growth of the foreign currency supply), and also signs of delay of economic growth of the countries with the emergent markets became the reasons of it (that led to decline in yield of financial investments to these countries).

Specified factors that reduced the demand for ruble turned out to be more significant in comparison with preserving high prices of oil during this period that caused depreciation of ruble along with depreciation of currencies of other countries with the emergent markets. Additional impact on dynamics of ruble exchange rate in 2014 was exerted by political events. Concerns of investors related to consequences of the geopolitical conflict for the Russian economy led to strengthening of capital outflow, further decrease in demand for ruble and its easing.

Certainly, maintenance of stable ruble exchange rate is a main target of the Central Bank of the Russian Federation, its discharge from problems of regulation of an exchange rate is inefficient now. In May, 2016 despite small world prices for oil the ruble became slightly stronger. It means, the ruble is very sensitive to the oil price and other macroeconomic indicators. Since the beginning of 2016 it has become more and more obvious that Central Bank of the Russian Federation should change the methods of monetary regulation. Monetary policy has to become less rigid, but focused on de-crease of the inflation rate and on stabilization of rate of national currency.

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