The Impact of Oil Shocks on the Ruble Exchange Rate

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Abstract. This paper investigates the impact of oil price shocks on the Russian ruble exchange rate at different time periods during 2002-2019. We apply two-variable linear regression model and vector error correction model for high-frequency (daily) data at intervals depending on monetary policy of the Central Bank of Russia, fiscal rule, crises and international sanctions. The main finding is that the effect of oil price shocks on Russian ruble exchange rate varies greatly according to monetary and fiscal policies. Stabilization monetary and fiscal policy results in weakening of the impact of oil price shocks on the ruble exchange rate (2002-2008). During the period of oil price falling and passive monetary and fiscal policy (2014-2016) the effect of oil price changes on exchange rate was the most intense. Our findings confirm previous empirical results that government play a crucial role for short-term exchange rate equilibrium.

1. Introduction
The real exchange rate is one of the key macroeconomic indicators which characterize the competitiveness of national goods on international markets and impact on the growth rate of industrial production. The period of the 2000s was characterized by fluctuations of Russian ruble exchange rate and more than doubles its depreciation. During this time oil prices were changing dramatically. On the one hand, the reason for it was slowdown in the growth of some advanced and emerging economies, and, on the other, an increase in the supply of energy resources due to production growth in non-oil export countries. Changes in terms of trade due to oil price shocks are one of the fundamental factors determining the long-run exchange rate equilibrium of oil exporters, including Russia [1].

Why do oil price shocks affect the exchange rate? On the one hand, the answer to this question is obvious: the global practice is to use the US dollar for payments on the international energy market, which results in that changes in oil prices affect denominated in dollar exchange rates of exporters and importers. But, in practice, oil exporters and importers exchange rate fluctuations are not the same as changes in oil prices and vary among countries and time periods. Many empirical research argue that the effect of oil shocks on exchange rate depends on the level of international financial integration and fiscal and monetary policies [2], [3].

In the 2000s, The Central Bank of Russia played a key role in currency market regulation: over the past 15 years monetary policy has changed several times. Therefore, the object of this research is to
assess the impact of oil price shocks on Russian ruble exchange rate depending on the current monetary policy. Earlier in economic literature there were no attempts to identify time periods in which the effect of the oil price on Russian ruble exchange rate was strengthened or weakened due to short-term factors. This research fills this gap. In addition, the use of high-frequency (daily) data made it possible to take into account the influence of short-time fluctuations in oil prices and exchange rate.

2. Russian ruble exchange rate and oil prices: literature review

Oil price shocks impact on exchange rate through different channels [4].

The first channel of oil price shocks impact on exchange rate is explained by changes in terms of trade. The effect of this channel is very intense in oil exporting countries. According to [5], [6], [7], [8] prices of traded goods (for oil exporting countries - oil and others energy resources) on international market is fixed and depends on world demand and supply. Prices of non-traded depend on only domestic demand and supply. Economies are small and cannot impact on world prices; therefore prices are exogenous for them. Improvement in the terms of trade means an increase of export price relative to import price. These results in wealth growth of economic agents, which drives up the price of the non-traded good in the domestic economy. Finally, the real exchange rate is strengthening. The other mechanism is a growth of wages in traded goods sector, in particular in oil production. Because of local labour mobility the wage rise can spread to non-traded goods sector, which raises the whole level of prices in the country and make the real exchange rate appreciate.

Another important channel of positive oil price shocks’ impact on exchange rates is through "wealth effects". The increase of oil price increase leads to relocation of wealth from oil-importers to oil-exporters. These results in unbalance of current accounts and capital relocation. The exchange rate adjusts to offset trade balance and capital market [9], [10].

In practice there are some factors reducing the impact of oil price shocks on exchange rate such as global financial integration [11]; composition of foreign assets and investment part of oil export revenue to low-risk foreign assets, which are evaluated in US dollars [12]; monetary policy and accumulation or reduction of foreign currency reserves [3].

Undetermined impact of oil price shocks on exchange rate is confirmed by empirical research. In [13] authors used data to major oil exporters (Russia, Brazil, Mexico, Canada, Norway) and found that oil price shocks significantly affect fluctuations in exchange rates in relation to the US dollar. Authors in [11] made similar conclusions after oil price and exchange rates cointegration investigation of 16 oil exporters. In [14] investigates whether the real oil price has an impact on real effective exchange rates for Norway and Saudi Arabia (1980-2006) and for Russia (1995-2006). The long-term impact of the real oil price on the real exchange rates was found only for Russia. These finding authors explained by incomplete sterilization of oil export revenues in Russia. According to [4], who used monthly data (1986-2011) to 44 advanced and emerging economies, the oil price shocks have no impact on growth of national currency exchange rate in oil exporters. This finding is partially explained by utilization of international reserves for the smoothing oil price shocks.

The bulk of papers discuss factors of Russian ruble exchange rate (e.g. [2], [14], [15], [16], [17], [18], [19]). The most of them used data for the period from the middle of the 1990s to the period of economic crisis in 2008-2009 years. In these papers was showed that oil price, which is a proxy for the terms of trade, is one of the key factors of Russian ruble exchange rate fluctuations: the growth of oil price by 1 % is associated with increase of Russian ruble exchange rate by from 0,16 % [19] to 0,49% [15]. In [20] the estimation of oil price elasticity of ruble exchange rate is 0,161-0,176. The difference in oil price elasticity of ruble exchange rate can be explained by adding fiscal and monetary variables to the model such as growth of currency reserves to import [2], the growth of money supply to GDP ratio [21], accumulation of international reserves [15], [22].

Despite the significance of monetary and fiscal policy discussed above papers didn’t detect periods, when the impact of oil price shocks on Russian ruble exchange rate reinforced or weakened as a result of short-time factors. However, [12] suggested, that the strongest effect of oil price shocks on ruble exchange rate was in 2014-2015 years – the period of rapid depreciation of the ruble. The results in
[23] give evidence of strong dependence of ruble exchange rate from oil prices in this period. That’s the reason why in this paper we test the following hypothesis: there is a difference between time periods in the strength of impact of oil price changes on Russian ruble exchange rate depending on monetary and fiscal policy of Russian government.

3. The evolution of monetary and fiscal policy in Russia

From a theoretical point of view, the Central Bank of Russia (CBR) should choose a monetary regime that maximizes public welfare, depending on the existing characteristics of the economy. A change in these characteristics leads to a change in the optimal monetary regime. Over the past decades in Russia monetary regime has changed several times.

From 2002 to 2008, at the stage of rapid growth in oil prices, the main priority of CBR monetary policy was to prevent the ruble sharp appreciation due to the inflow of foreign exchange revenue from the raw materials export, which was automatically ensured by the acquisition of foreign currency. In August 2008, the volume of international reserves reached a record level of $ 597.5 billion. The accumulated reserves helped to minimize the effects of the negative external shock during crisis: when in August 2008 the oil price was falling and the ruble felt pressure, the CBR immediately began interventions reducing reserves by $ 210 billion over 6 months.

The resumed growth of oil prices in 2009-2011 allowed CBR to revive the conservative policy of reserves accumulation. In 2011 the rise in oil prices stopped and in 2012-2013 CBR foreign exchange interventions was technical. Gold and foreign exchange reserves stood at around $ 500 billion.

A substantial change in the monetary policy occurred in 2014, when the CBR announced the rejection of direct intervention in exchange rate formation and switch over inflation targeting [24]. In response to concerns about the floating ruble exchange rate risks, CBR announced that the exchange rate can be changed not only by interventions, but also by interest rates. Instead of currency purchases depending on the balance of payments liquidity provision / absorption operations became the key mechanism for regulating liquidity in the banking system. These defined CBR reaction to the financial sanctions of Western countries and the fall in oil prices in 2014: from July 2014 to January 2015 CBR sold about 110 billion dollars from its reserves and increase in the key rate dramatically from 7.5% in July to 17% in December 2014. After financial market stabilization CBR started to soft its monetary policy and reduced the key rate (7.25% in August 2019).

On the other hand there are fiscal rules that have been used to reduce the dependence of the Russian economy on oil price fluctuations since 2004. Revenues from oil and gas exports in excess of the cut-off price fill up a so called Stabilization Fund (SF). When prices fall below the cut-off price, the funds are sent to cover the emerging budget deficit. In 2008 the SF was divided into the Reserve Fund and the National Welfare Fund . Under the budget rule, the cut-off price (dollars per barrel of oil) has changed several times: $20 (2004), $27 (2006), $45 (2008), $91 (2013). In 2015 the rule was suspended, in 2017 it resumed at a cutoff price of $40.

The fiscal rule is consistent with the monetary policy of the CBR and serves as an automatic stabilizer in the face of rising world oil prices. However, its effect is asymmetrical, and when the oil price decreases, it increases the pressure on the ruble and helps to weaken it.

4. Data and results

We used exchange data on the Russian ruble exchange rate and the price of Brent crude oil based on the results of daily stock trading at the close from January 2, 2002 to July 31, 2019 (5025 observations) from finam.ru. To test our hypothesis we use two-variable linear regression model (1), which relates the oil price to the ruble exchange rate and describes the long-term relationship, and the vector error correction model (2), which describes the mechanism for correcting deviations from long-term equilibrium:
where \( \ln(USD\text{RUB})_t \) and \( \ln(Brent)_t \) – the logarithms of the US dollar to the Russian ruble and the oil price at time \( t \), respectively, \( \beta_2 \) – Russian ruble exchange rate elasticity coefficient by oil price, \( \gamma_1 \) and \( \gamma_2 \) – coefficients characterizing the correction rate, \( p \) – number of lags, \( \varepsilon_t \), \( u_{1t} \), \( u_{2t} \) – random errors.

We expect \( \gamma_1 \) to be significant, negative and modulo less than unity. It indicates the convergence of the system to equilibrium due to the ruble exchange rate adjustment to the change in oil prices. Since the oil price is formed on the world market and is exogenous with respect to the ruble exchange rate, then \( \gamma_2 \) should be insignificant.

### Table 1. Estimations results.

| Period            | Lag | Vector error correction model (2) | Linear regression model (1) |
|------------------|-----|----------------------------------|----------------------------|
|                  |     | \( \hat{\beta}_2 \) | \( \hat{\gamma}_1 \) | \( \hat{\gamma}_2 \) | \( R^2 \) |
| 02.01.2002-01.08.2008 | 5   | -0.05               | 0.00099***                | -0.005**               | 0.8667 |
| 02.01.2002-01.08.2008 | 10  | -0.17               | 0.0016                    | -0.035***              | -0.165** |
| 02.01.2002-01.08.2008 | 20  | -0.18               | 0.00005                   | -0.046***              | 0.9483 |
| 01.09.2008-25.12.2008 | 5   | -0.14               | -0.116***                 | 0.159                 | 0.9669 |
| 01.09.2008-25.12.2008 | 20  | -0.14               | -0.092***                 | -0.059                | 0.4356 |
| 01.01.2009-31.12.2011 | 5   | -0.24               | -0.015***                 | -0.020                | 0.416*** |
| 01.01.2009-31.12.2011 | 20  | -0.23               | -0.016***                 | -0.020                | -0.416*** |
| 01.01.2012-31.12.2013 | 5   | -0.81               | -0.012*                   | -0.018                | -0.027* |
| 01.01.2012-31.12.2013 | 20  | -1.04               | -0.005                    | -0.024                | -0.416*** |
| 01.01.2012-31.12.2013 | 5   | -3.27               | 0.0007                    | -0.009***             | 0.4356 |
| 01.01.2014-31.12.2016 | 5   | -0.71               | -0.025***                 | -0.027*               | 0.4356 |
| 01.01.2014-31.12.2016 | 20  | -0.70               | -0.021***                 | 0.023                 | 0.4356 |
| 01.01.2014-31.12.2016 | 5   | -0.71               | -0.015                    | -0.028*               | -0.023 |
| 01.01.2014-31.12.2016 | 20  | -0.70               | -0.021***                 | 0.023                 | -0.023 |
| 01.01.2014-31.12.2016 | 5   | -0.028              | -0.050***                 | 0.048                 | 0.4356 |
| 01.01.2014-31.12.2016 | 20  | -0.028              | -0.050***                 | 0.048                 | 0.4356 |
| 01.01.2017-31.12.2017 | 5   | -0.173              | -0.011**                  | 0.006                 | 0.4356 |
| 01.01.2017-31.12.2017 | 20  | -0.173              | -0.011**                  | 0.006                 | 0.4356 |
| 01.01.2018-31.07.2019 | 5   | -0.479              | -0.009**                  | 0.012                 | -0.023 |
| 01.01.2018-31.07.2019 | 20  | 3.730               | -0.0002                   | -0.005**              | 0.0016 |

* - 10, ** - 5, *** - 1-percent level of significance.
All observation period was divided into seven intervals according to changes in monetary policy, fiscal rules, crises and sanctions. The most stable results were obtained for periods 2, 3 and 5.

In the period (1) 2002-2008, the exchange rate elasticity for the oil price was 0.165. In the next period (2), an exciting peak of the 2008 crisis, the exchange rate elasticity drops to 0.12. $\hat{p}_1$ is significant and negative, the correction rate was about 10%, which means a correction of 50% deviation in one week. $\hat{p}_2$ is not significant. Then, in the period (3) 2009-2011, the elasticity returns to its pre-crisis value. Compared to the crisis period, the correction rate decreased to 2% (correction of 50% deviation in a month and a half). $\hat{p}_2$ is not significant.

In the period (4) 2012-2013, $\hat{p}_1$ is insignificant, which calls into question the existence of long-term equilibrium (co-integration). In the period (5), which captures the crisis of 2014-2015, the elasticity of the exchange rate for the price of oil reaches its maximum (for the period under consideration) value of 0.7. The correction speed is 2-3%, which means a correction of 50% deviation in about one month. $\hat{p}_2$ is insignificant, which is consistent with theory.

In periods (6) and (7) of 2017, estimates of the long-term elasticity of the exchange rate for the price of oil are insignificant.

5. Conclusion
In this paper we investigated the effect of oil shocks on the ruble exchange rate at different intervals during 2002 - 2019. We found the significant influence of the monetary and fiscal policy regimes to the impact of oil prices on Russian ruble exchange rate.

During the long-term growth of world oil price the consistency of the fiscal rule and monetary regime can reduce the ruble dependence on oil shocks significantly (periods (1) and (3)). During a period of falling oil prices active foreign exchange support policy of the Central Bank of Russia (if there is a sufficient amount of foreign exchange reserves) this linkage between oil prices and ruble exchange rate of the ruble becoming weaker (period (2)).

At period (4), there is no trend in oil prices and currency interventions are technical. The cut-off price is so high that the fiscal rule has a small effect on the exchange rate stabilization. Under these conditions, the linkage between variables increased.

If the Central Bank of Russia refuses to target the exchange rate during a period of falling world oil prices, the dynamics of the ruble exchange rate is largely determined by the price of oil. This is observed at period (5) and corresponds to the currency crisis.

The results for periods (6) and (7) are difficult to interpret without the control variables. The weak relationship between the ruble exchange rate and the oil price may be explained by other important factors that are not directly related to the oil price in this case, as indirectly indicated by the small value of $R^2$. Factors such as international capital flows, interest rate dynamics, differential productivity, foreign economic sanctions, the volume and structure of external debt, and others, are among them, and can be used in further studies.

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Acknowledgments
The reported study was funded by RFBR according to the research project № 19-010-00716.