Investment in Russia: influence of key macroeconomic shocks

Elena Sholomitskaya[1]

March 2016

The goal of this work is to examine the impact of several structural short- and middle-term shocks on Russian fixed capital investment growth during 2003-2016 years. We consider the relationship between investment, GDP, domestic loans to non-financial corporations, the interest rate on these loans, external debt of Russian companies and the real exchange rate within the framework of sign restricted SVAR. Four most relevant in our opinion shocks were selected: terms of trade shock, shock of foreign funding (access to global capital markets), monetary policy and demand shocks (fiscal policy, public investment expenditures). Results are the following. External shocks are most important for Russian investment. The reduction of access to global financial markets after the US and EU imposing sanctions on Russia in 2014 had large negative influence on investments. We conclude that operational measures of economic policy are unlikely to substantially improve the situation. Lifting of economic sanctions against Russia could support investment, but only in the short-term period. In the long run reforms are necessary in order to decrease dependence on external factors.

Key words: investments, internal shocks, external shocks, sanctions, sign restricted structural vector autoregression.

JEL Classification: C32, C52, E22, F51.

1. Introduction

Stagnation and decline in Russian fixed capital investment after 2013 have been one of the most discussable issues. As the World Bank experts note in their report, "*the main risk that threatens the medium-term forecast of Russian economic growth is maintaining low level of investment*" (World Bank, 2015). It is noteworthy that the decline investment began before the sharp drop of oil prices, as well as before the emergence of geopolitical tensions and the introduction of economic sanctions against Russia by Western countries. The deterioration of the terms of trade and impose of sanctions uncovered accumulated problems much faster, and simultaneous influence of several factors contributed to the reduction of investment demand.

The goal of this paper is to investigate the contribution of structural shocks to the investment dynamics over the period from 2003 to 2016. As noted by Gurvich and Prilepsky (2016), as well as Shirov et al. (2015), investments are significantly influenced by sanctions against Russia, and one of the main conduits – external financing of Russian corporations from abroad – is given special attention in our work. We want to consider the relationship between investment, output (GDP), real interest rate, loans to non-financial corporations from the Russian banking

[1] Elena Sholomitskaya – Doctoral School of Economics, Laboratory for Research in Inflation and Growth, National Research University Higher School of Economics; esholomitskaya@hse.ru

sector, external corporate debt and the real ruble exchange rate, as well as oil prices within a sign restricted structural vector autoregressive model (SR-SVAR).

We try to assess the impact of two external and two internal shocks in our work: terms of trade shock, shock of access to global capital markets, monetary policy shock and demand shock in the form of public investment expenditures.

The structure of the work is as following. A review of the existing literature on the topic is given in Section 2. Section 3 is devoted to the description of the model, the econometric approach and the data used. In Section 4 we identify the shocks. The results of the model estimation are presented in Section 5, and section 6 concludes.

2. Literature review

VAR models are quite popular tools for the academic and practical macroeconomic analysis and, apparently, investments. In the academic community, a lot of efforts was devoted to develop different approaches that helps to identify structural (underlying and unrelated each to others) shocks, and the use of sign restricted SVAR became widespread during last decade. Among the most traditional structural shocks examined in the academic literature are monetary and fiscal policy shocks, financial distress, credit supply, terms of trade, and technological shocks as well as preferences shock. The impact of monetary policy and demand shock on various macroeconomic indicators using SR-SVAR is analyzed, for example, in (Uhlig, 2005), (Mountford, Uhlig, 2005), (Enders et al., 2008), (Vargas-Silva, 2008), and others.

Malik and Souza (Malick, Sousa, 2013) were using SR-SVAR to assess the impact of changes in financial conditions in the euro area as well as monetary policy shock. The same authors provided a similar study on the role of monetary policy in developing countries, including Russia (Malick, Sousa, 2012). The importance of external conditions is confirmed in the work done for the Australian economy, where the shock of terms of trade is considered in the form of three separate shocks, depending on the causes that generate them (Jaaskela, Smith, 2011).

Examples of studies using this econometric method for the Russian economy are (Deryugina, Ponomarenko, 2011) and (Deryugina et al., 2015), in which authors analyze the impact of monetary shocks, credit supply and demand shocks on the dynamics of credit aggregates. The work of Vashchelyuk, Polbin and Trunin (2015) is devoted to the monetary policy shock. The effect of this shock, together with others, was considered also by Lomivorotov (2014).

3. Model and data

We give a brief description of the technical part, since it is already a well-established econometric approach, see, for example, (Fry, Pagan, 2011), (Uhlig, 2005). The reduced-form VAR model is $y_t = A_1 y_{t-1} + u_t$, where y_t is $k \times 1$ vector of endogenous variables, and error term vector u_t can be represented as linear combination of uncorrelated error terms – structural shocks ε_t: $u_t = B\varepsilon_t$, where ε_t is diagonal matrix. If structural shocks variance-covariance matrix is normalized, then $\Omega = E(u_t u_t^T) = BE(\varepsilon_t \varepsilon_t^T)B^T = BB^T$.

The sign restrictions algorithm explores the following. Let $\hat{\varepsilon}_t = Q\varepsilon_t$, where Q – orthogonal matrix. Then $u_t = BQ^T Q\varepsilon_t = \hat{B}\hat{\varepsilon}_t$, hence we have new structural shocks set, while their properties are the same: $E(\hat{\varepsilon}_t \hat{\varepsilon}_t^T) = Q\varepsilon_t \varepsilon_t^T Q^T = E(\varepsilon_t \varepsilon_t^T)$. The matrix that would satisfy the sign restrictions is

to be found (signs of the responses of variables to structural shocks). The imposition of restrictions also makes shocks distinguishable.

A set of orthogonal matrices, which satisfy sign restrictions, is formed as a result of generating a set of random matrices. In this study we examine seven variables and four shocks. The variables in the model are:

1) Investment in fixed assets, volume index (*INV*);

2) GDP, volume index (*GDP*);

3) Non-financial corporations' loans from the Russian banking sector, in rubles, in real terms by dividing by the GDP deflator (*L_lc*, *local loans*);

4) Non-financial corporations' external debt in US dollars, deflated by the inflation rate in the USA (*L_fx*, *foreign loans*);

5) Real interest rate for three-month interbank loans, obtained by dividing the nominal rate by the corresponding annual rate of consumer inflation (*i_rate*);

6) Real exchange rate of the ruble to the basket of dollar and euro. Reduction is for real weakening of the ruble, and the increase is for real strengthening (*reer*);

7) Oil price (price of futures for Brent crude oil), in US dollars, exogenous to all other variables (*oil*).

Data sources are Rosstat and Bloomberg. Time series, except the interest rate, are seasonally adjusted and in the form of the first differences.

Before differencing we checked our time series for non-stationarity, and it was confirmed for all of them (except the interest rate). The Johansen test showed the presence of cointegration, but we estimate the VAR model in differences. The unit-root test showed that our VAR-model in the levels is unstable, i.e. contains roots outside the unit circle. The instability of the model implies the need to estimate the VECM-model, which seems to be irrelevant for us for a number of reasons. First, the period under consideration is rather short even for estimating the parameters of the VAR with seven variables, and VECM requires an estimation of several additional parameters, which may worsen the statistical properties of our results. Second, even during a short period Russian economy is likely to have witnessed changes in structural interconnections between macroeconomic variables, and this can also lead to inconsistent estimates of the VECM model (see, e.g., Ca'Zorzi et al., 2007).

Our model contains one lag (which is analogous to two lags for the case of levels). We use quarterly data for the period from 2003:1 to 2016:1, so time series contains 53 points. The number of matrices, which satisfy our sign restrictions, is 200. The estimation is done with IRIS Toolbox, an open source package for macroeconomic modeling and forecasting in Matlab.

4. Identification of structural shocks

Four shocks, which, in our opinion, may have significant impact on the investment dynamics are:

1) Terms of trade shock, i.e. the shock of oil prices;

2) Shock of foreign funding (access to global capital markets) in the form of changes in the size of non-financial corporations' external debt. This shock is similar to the shock of the external risk premium to some extent, but we want to expand it by including non-price constraints to foreign financing, i.e. sanctions;

3) Monetary policy shock, i.e. the shock of a short-term interest rate;

4) Demand shock in the form of public investment and infrastructural budget expenditures. We identify it as a shock, affecting exactly the investment in the same quarter.

Since we use the oil price, which is completely exogenous, we impose restrictions on the coefficients in the equation for it (zeros everywhere except for lags of the oil itself) before imposing other sign restrictions, which are presented in Tab. 1.

Tab. 1. Sign restrictions

	reer		*i_rate*		*L_lc*		*L_fx*		*GDP*		*INV*	
quarter	1	2	1	2	1	2	1	2	1	2	1	2
Terms of trade deterioration	–	–			–			–	–	–		–
Reduction of **foreign funding**	–		+	+	+		–	–		–		–
Monetary policy tightening	+		+	+		–				–		
Negative **demand shock** (reduction of budget investment expenditures)	+		–		+						–	

Empty cell means no imposed restriction.

Terms of trade shock is identified as resulting in the exchange rate changes, also directly affects GDP and investment within six months. Negative external shock reduces both internal and external borrowing.

Shock of foreign funding leads to external debt adjustment and influences the exchange rate. Changes in the external risk premium are transmitted to internal interest rate.

Monetary policy shock affects the interbank interest rate, the exchange rate (monetary tightening in the short term leads to the strengthening of the national currency), domestic loans and finally, output.

Demand (public investment spending) shock is identified through an instantaneous impact on the investment, and like other shocks leads to changes in the interest rate (growth in response to the expected deficit) and the exchange rate: a weakening in response to the expected deficit and waste of reserve funds, or strengthening in case of reserve fund accumulation. The negative influence of the demand shock on domestic credit stems from the assumption that companies, receiving more budget financing, are less in need of borrowed funds and vice versa.

An important aspect of shocks identification is that at least in one sign each of them must differ from all others, otherwise shocks with the same signs of influence on the same variables will be indistinguishable. The shock of foreign funding and the terms of trade shock are very similar, but our hypothesis is that the negative shock of foreign funding leads in the short run to the growth of domestic loans with the refinancing aim (and the decrease of domestic loans for oil price shock).

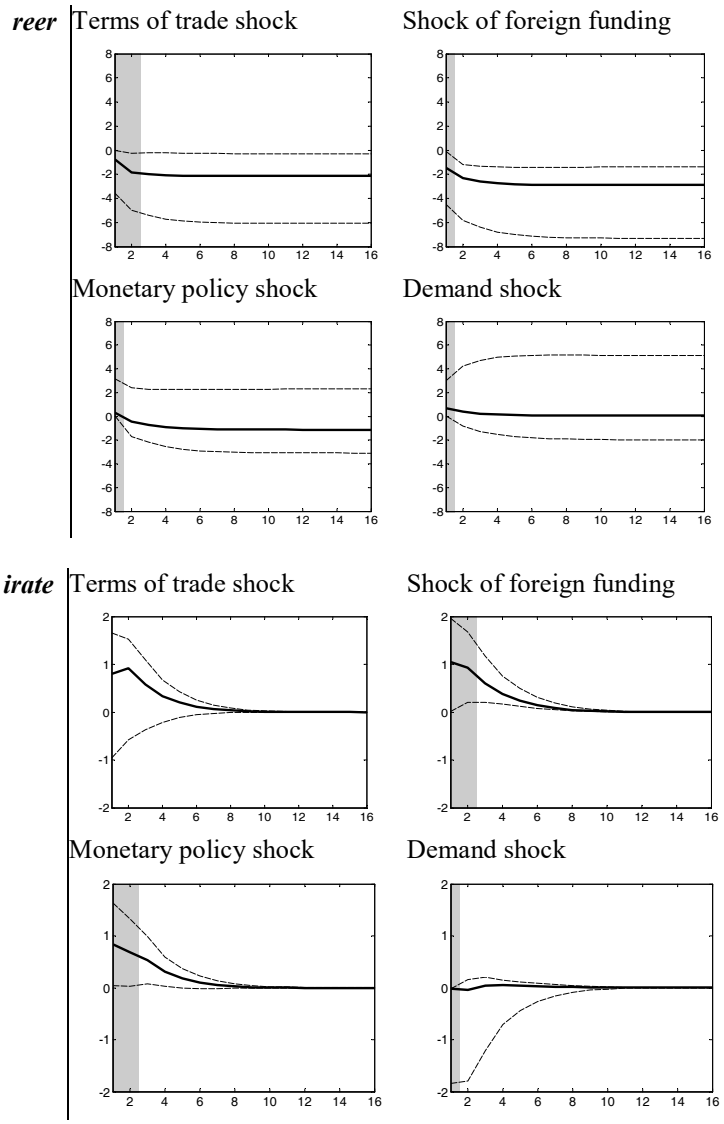
5. Estimation results

The results we would like to present are the cumulative impulse responses functions to selected structural shocks (fig. 1), and the decomposition of changes in investment (fig. 2). Cumulative responses are better to express our findings, since the model is estimated in first differences.

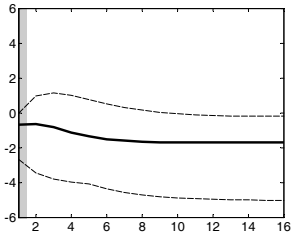
The real effective exchange rate is strongly influenced by external shocks and much smaller by monetary policy shock. The real interest rate reacts similarly to external and monetary policy shocks. Strong reaction to the foreign funding shock means that growth of the external country risk premium is quickly transmitted into a risk premium and the credit price at domestic market.

Fig. 1. Cumulative impulse response functions (change in % in response to one standard deviation of shock, quarters along the horizontal axis).

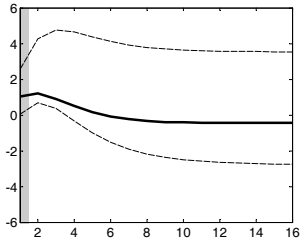
Negative shocks are considered. The solid line designates the median vector of the impulse response, dotted lines are 5% and 95% quantiles. Shaded area refers to periods for which sign restrictions are imposed (Tab. 1).



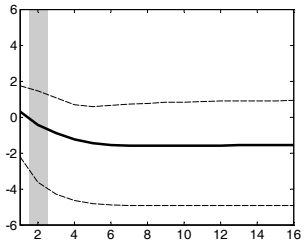
L_lc Terms of trade shock



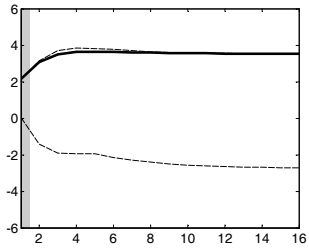
Shock of foreign funding



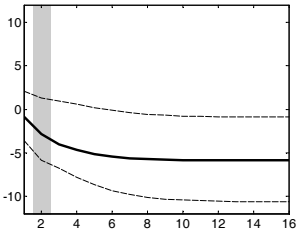
Monetary policy shock



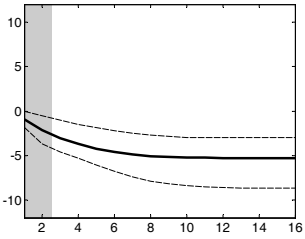
Demand shock



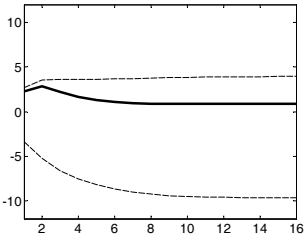
L_fx Terms of trade shock



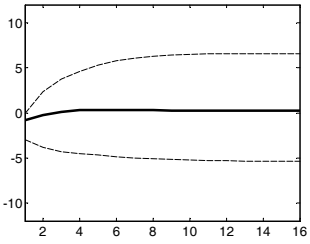
Shock of foreign funding

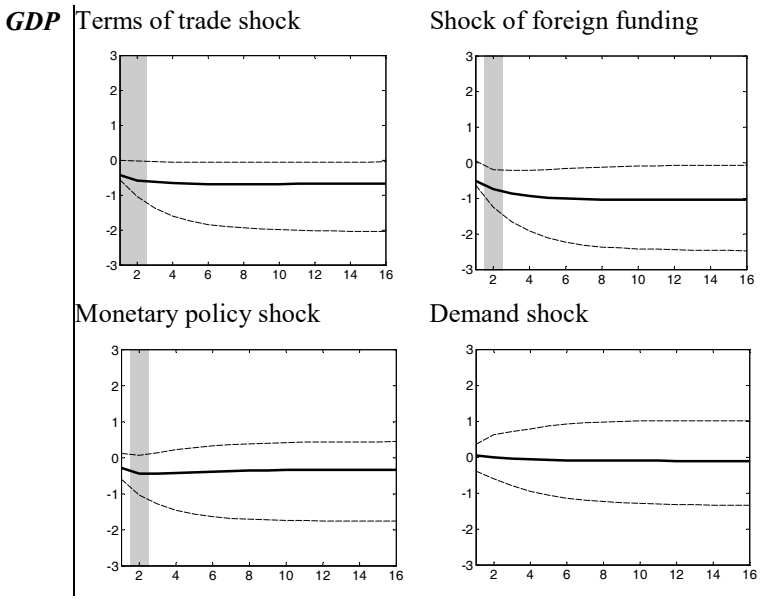


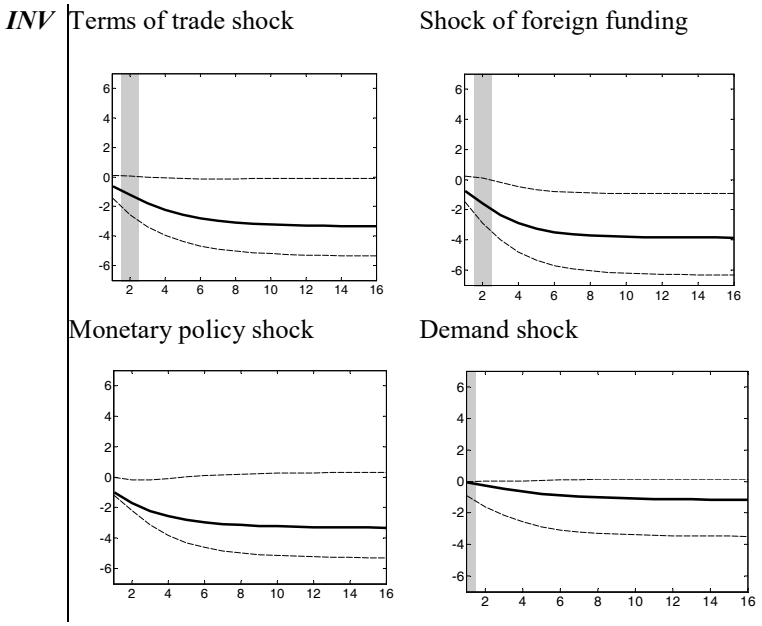
Monetary policy shock



Demand shock







The domestic credit to non-financial corporations increases in case of negative terms of trade shock. Therefore, the hypothesis that contraction of access to external financing leads to increase of demand on domestic loans is confirmed. Monetary policy also affects lending. The hypothesis concerning the influence of budgetary policy was also confirmed.

External loans react to external shocks predictably negatively. Monetary policy tightening (real interest rate increase) results in the expansion of lending abroad.

The output depends more on external shocks and, to a lesser extent, on monetary policy, while the impact of the demand shock impact is negligible. The profile of investment responses is similar to the output response profile in general.

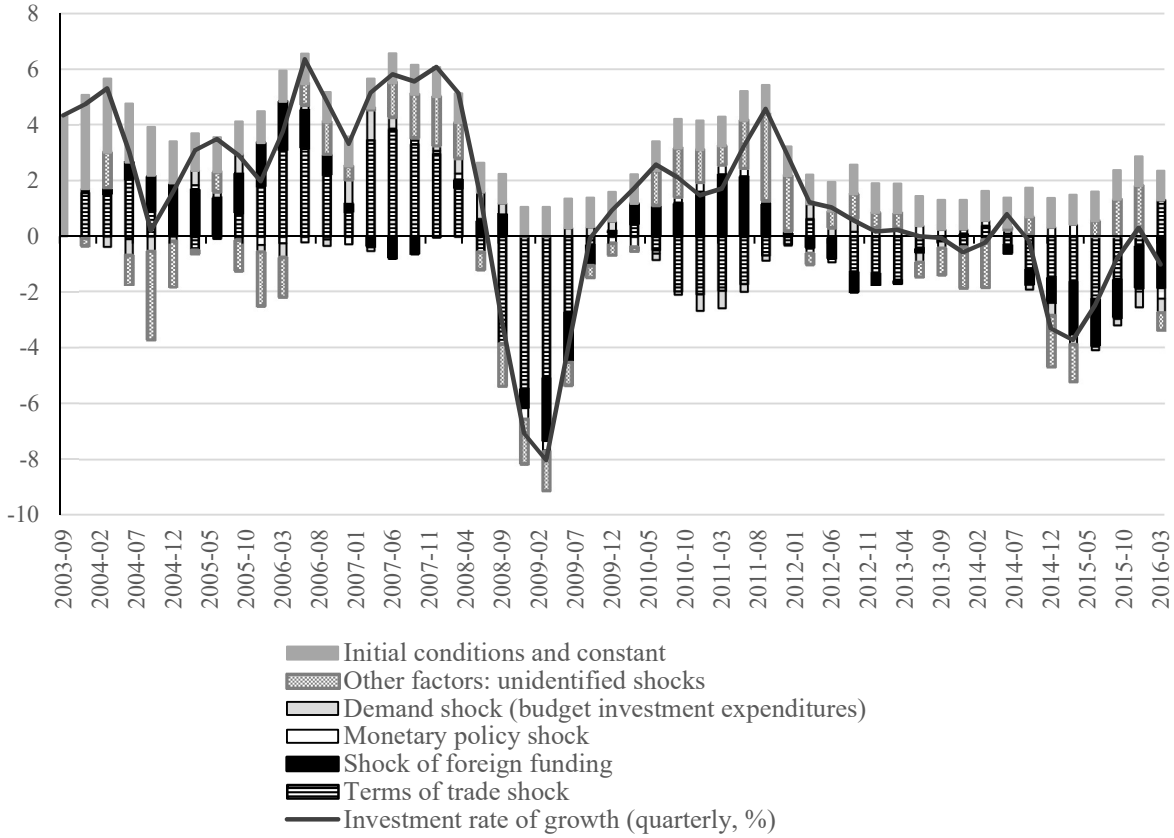
The key interest of our study is investment therefore we analyzed investment growth in details as well using its model decomposition (fig. 2). The decomposition is based on the median model chosen for

all iterations and all shocks. It includes the contribution of initial conditions, identified and unidentified shocks. Let us now turn to the interpretation of the identified shocks.

First, the terms of trade shock expectedly leads to the growth of investment. In the period from 2004 to early 2008, the positive shock of oil prices strongly supported investment demand, second price increase (in 2009) didn't affect it significantly, but since 2010 the situation has changed: despite high energy prices, the contribution of terms of trade to investment growth was negative. We can interpret model results as following: investment slowed down in the absence of permanent high oil prices growth, since the economy get used to this permanent growth as a stimulus.

The foreign financing is also very important for investment. The opening of access of Russian corporations to the international capital market in the early and mid-2000s substantially accelerated investment growth till 2007. In 2008-2009, fall in investment was partially explained by external financing shock, and the subsequent financing recovery contributed to around a half of the change in investment. The closure of this channel as a result of the sanctions has cut investments largely.

Fig. 2. Decomposition of investment dynamics



The effect of monetary policy is surprisingly insignificant. We'd like to comment on the transition of the influence of monetary policy from the positive to the negative zone in 2015-2016. Apparently, this is due to the slowdown in inflation, which outpaced the Bank of Russia's decline in its key rate. In fact, despite the softening of the policy in nominal terms, it became tougher in real terms.

The fourth shock we examined is the demand shock in the form of public investment spending, and its impact was barely noticeable in the post-2011 period. The introduction of this shock into the model was an attempt to capture that certain factor that seriously "pulls" upward in a number of periods. An attempt to explain this effect by budget incentives has not been successful, so this issue remains open for future research.

6. Conclusion

The paper provides an analysis of investment growth in Russia within period from 2003 to early 2016 using sign-restricted SVAR model. Our estimates show that the Russian economy is strongly affected by external shocks, and those are not only commodity prices (e.g. oil), but as well conditions of access to global capital markets. The geopolitical tensions and sanctions became important factors that caused drop in investment after 2014. The difficulty here is that it is practically impossible to compensate those factors influence by operational measures of economic policies: the terms of trade shock is purely exogenous, and the shock of foreign funding after 2014 lies in the sphere of politics. Thus structural reforms are necessary to decrease high dependence on external factors and provide sustainable growth in future.

References

Ca'Zorzi, M., Hahn, E., Sánchez, M. (2007). Exchange rate pass-through in emerging markets. ECB Working Paper No 739.

Deyugina, E., Kovalenko, O., Pantina, I., Ponomarenko, A. (2015). Identifikatsiya faktorov sprosa i predlozheniia kreditov v Rossii. [Identification of credit demand and supply factors in Russia]. Seria dokladov ob ekonomicheskih issledovaniyah Banka Rossii (Electronic resource), (3), 1-38.

Deryugina, E. B., Ponomarenko, A. A. (2011). Identifying structural shocks behind loan supply fluctuations in Russia. BOFIT Discussion Papers 20/2011, Bank of Finland, Institute for Economies in Transition.

Enders, Z., Müller, G. J., Scholl, A. (2011). How do fiscal and technology shocks affect real exchange rates? New evidence for the United States. Journal of International Economics, 83(1), 53-69.

Fry, R., Pagan, A. (2011). Sign restrictions in structural vector autoregressions: A critical review. Journal of Economic Literature, 49(4), 938-960.

Gilchrist, S., & Himmelberg, C. (1999). Investment: fundamentals and finance. In NBER Macroeconomics Annual 1998, volume 13 (pp. 223-274). MIT Press.

Gurvich, E., Prilepskii, I. (2016). Vliyanie finansovih sanktsii na rossiiskuyu ekonomiku [The impact of financial sanctions on the Russian economy]. Voprosy Economiki, (1), 5-35.

Jääskelä, J. P., & Smith, P. (2013). Terms of trade shocks: What are they and what do they do?. Economic Record, 89(285), 145-159.

Lomivorotov, R. (2014). Vliyanie vneshnih shokov i denezhno-kreditnoi politiki na ekonomiku Rossii [Impact of External Shocks and Monetary Policy on Russian Economy]. Voprosy Economiki, (11), 122-139.

Mallick, S. K., & Sousa, R. M. (2012). Real effects of monetary policy in large emerging economies. Macroeconomic Dynamics, 16(S2), 190-212.

Mallick, S. K., Sousa, R. M. (2013). The real effects of financial stress in the Eurozone. International Review of Financial Analysis, 30, 1-17.

Mitra, P. (2006). Has government investment crowded out private investment in India?. The American economic review, 96(2), 337-341.

Mountford, A., Uhlig, H. (2009). What are the effects of fiscal policy shocks? Journal of applied econometrics, 24(6), 960-992.

Shirov, A., Yantovskii, A., Potapenko, V. (2015). Evaluation of the potential effect of sanctions on the economic development of Russia and the European Union. Studies on Russian Economic Development, 26(4), 317-326.

Uhlig, H. (2005). What are the effects of monetary policy on output? Results from an agnostic identification procedure. Journal of Monetary Economics, 52(2), 381-419.

Vargas-Silva, C. (2008). Monetary policy and the US housing market: A VAR analysis imposing sign restrictions. Journal of Macroeconomics, 30(3), 977-990.

Vaschelyuk, N., Polbin, A., Trunin, P. (2015). Otsenka makroekonomicheskih effektov shoka DKP dlya rossiiskoi ekonomiki [Estimation of the Monetary Policy Shock`s Influence on the Russian Economy]. HSE Economic Journal, 19(2), 169-198.

World Bank. Report on Russian economy. (2015). Vol. 33.