AN ESTIMATION OF THE IMPACT OF THE OIL PRICES DECREASE AND THE SANCTIONS ON STRUCTURE AND DYNAMIC OF THE RUSSIAN ECONOMY IN 2014-2015[*]

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Abstract

The study is concerned with empirical issues of the impact of the oil prices decrease and the sanctions on structure and dynamics of the Russian economy in 2014-2015. An estimation of macroeconomic policy implications for the Russian economy in 2014-2015 is also under consideration in the paper. Based on the macroeconometric GE-IO model of the Russian economy we try to estimate short term influence of this shocks on the economy of Russia. Obtained estimates allow us to conclude that the Russian Central Bank's refusal of support a national currency seems to be a right decision in the current conditions.

Key words: monetary policy, sanctions, external shocks, macroeconometric model, Russia, simulation

JEL classification: E120, E170, E270

1. INTRODUCTION

The Russian economy faced with gradual slowdown in 2010-2013. The Russian GDP growth rates decrease from 4.5% in 2010 to 1.3% in 2013. It had formed strong expectations of close to zero growth rates of the Russian GDP in 2014-2015. But situation has considerably changed in the beginning of 2014. Sanctions imposed by the most of OECD countries against Russia with the Ukrainian conflict escalation have two key negative influences on the Russian economy. The first one is related with a significant restriction of access of national state companies and banks to world financial markets. In conditions of a weak of domestic financial market (for example, ratio of M2 to GDP in 2013 is only 43%) with high (for Russia) indebtedness of private sector to foreign creditors (for example, ratio of external private debt to GDP at the beginning of 2014 is 31%) it has considerable negative short-term effect. The second one is related with a restriction of access of the Russian residents to foreign technologies in some

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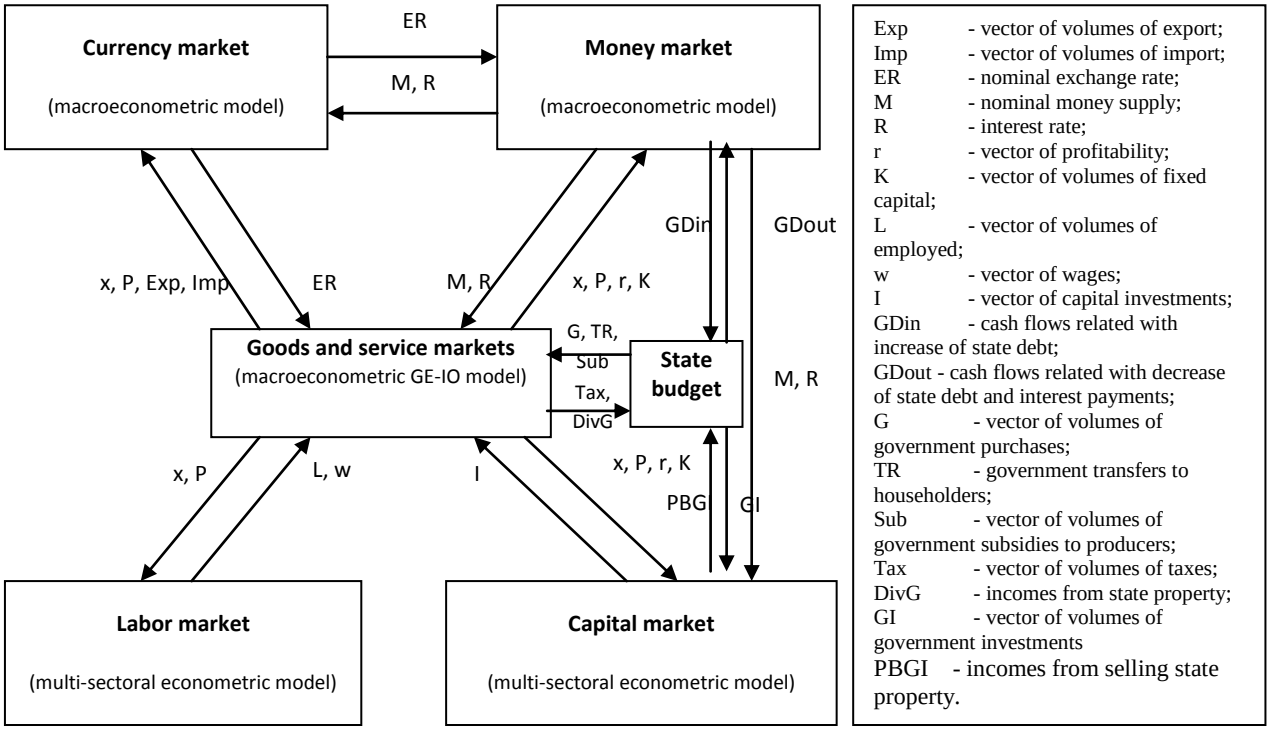
areas sensitive to the Russian economy. Considering a technological backwardness of Russia in the horizontal drilling, engineering and some another fields it could have a negative effect mainly in long-term. A sharp decline of world oil prices in the second half of 2014 has strengthened this negative effects on the Russian economy. As a result the Russian economy suffered from the lack of access to world financial markets has faced with the deep decrease of export revenue and state budget incomes. In same time significant devaluation of the ruble caused by abovementioned shocks gives the Russian economy a gain in competitiveness and new sources for the economic growth which were not available before. All these raise a question what are the real impact of sanctions and oil price decrease on structure and dynamic of the Russian economy in 2014-2015? To get answer on this question we use the macroeconometric GE-IO model of the Russian economy and simulate various scenarios of its development in 2014-2015.

2. MODEL DESCRIPTION

A basic version of the macroeconometric general equilibrium input-output model of the Russian economy with aggregated money and currency markets is described in (Gilmundinov, 2012). The extension of the model is based on the combination of the macroeconometric input-output approach suggested by C. Almon (Almon, 1989), the computable general equilibrium approach suggested by L. Johansen (Johansen, 1974) and the neo-classic and neo-Keynesian macroeconomic models used to describe aggregated markets (see, for example, (Gali, 2008).

The theoretical structure of the extension of the macroeconometric general equilibrium input-output model of the Russian economy with aggregated money and currency markets is shown in Scheme 1. The model includes IO equations for product markets with input-output coefficients to simulate inter-sectoral relations, as well as econometrically estimated equations for aggregate monetary and currency markets and sectoral output elasticities to simulate an intersectoral competition and links between aggregate markets.



Scheme 1. The structure of a macroeconometric GE-IO model with aggregated money and currency markets

In the current version, the core of the model is a macroeconometric GE-IO model with 28 (see equation (1) below). The GE-IO model simulates total outputs for each sector of economy based on the projection of total demand (see equation (2) below) and production capacities (see equation (3) below). Total demand and capacity constraints are based on inward and backward links with macroeconometric models, which describe aggregate markets (the current version has models only for money and currency markets). Links between the GE-IO model and the macroeconometric models of the aggregate markets are based on the endogenization of some key variables of the aggregate markets which influence sectoral variables (interest rate, exchange rate, inflation rates). In the current version of the model we assume only three variables of aggregate markets are linked with total demand (real exchange rate, real wage, and real interest rate).

$$x_{i,t} = \sum_{j=1}^{n} a_{i,j} \cdot x_{j,t} + y_{i,t} \qquad i = 1,\ldots,n \qquad (1)$$

$$Ln(x_{i,t} / x_{i,t-4}) = e_{x_i,ExR\$R} \cdot Ln(ExR\$R_{t-\tau_{x_i}^{ExR\$R}} / ExR\$R_{t-\tau_{x_i}^{ExR\$R}-4}) + \\ + e_{x_i,WR} \cdot Ln(WR_{t-\tau_{x_i}^{WR}} / WR_{t-\tau_{x_i}^{WR}-4}) + e_{x_i,IRR} \cdot Ln(1+IRR_{t-\tau_{x_i}^{IRR}}) + e_i^0 \qquad i = 1,\ldots,n \qquad (2)$$

$$x_{i,t} \le Cap_{i,t} \qquad i = 1,\ldots,n \qquad (3)$$

where

n – number of sectors (n = 28 in the current version);

$x_{i,t}$ – total demand for the product of sector i in quarter t in constant prices;

$y_{i,t}$ – final demand for product of sector i in quarter t in constant prices;

$a_{i,j}$ – coefficients of direct expenditures of sector j for products of sector i, $i, j = 1,\ldots, n$;

$\tau_{x_i}^{ExR\$R}, \tau_{x_i}^{WR}, \tau_{x_i}^{IRR}$ – time lags in influence of changing in real exchange rate, real wage, and real interest rate on total demand for product of sector i estimated by constructing regression equations;

$ExR\$R_{t-\tau_{x_i}^{ExR\$R}}$ – real exchange rate of the Russian ruble to US dollar in quarter $t-\tau_{x_i}^{ExR\$R}$;

$WR_{t-\tau_{x_i}^{WR}}$ – real wage in quarter $t-\tau_{x_i}^{WR}$;

$IRR_{t-\tau_{x_i}^{IRR}}$ – average annual real interest rate (deflated with deflator of GDP) for credits for non-financial sector in quarter $t-\tau_{x_i}^{IRR}$;

$e_{x_i,ExR\$R}$, $e_{x_i,WR}$, $e_{x_i,IRR}$ – elasticity coefficients of total demand for product of sector i to real exchange rate, real wage, and real interest rate, accordingly, estimated by constructing regression equations (see Table 1);

e_i^0 – a constant term of the regression equation for total demand for product of sector i;

$Cap_{i,t}$ – production capacities for total output of sector i in quarter t estimated by constructing of production function.

As it follows from the equations above the current version of the model is mainly the demand-side. More updates for production capacity constraints and other supply-side equations will be presented in the next papers. Notwithstanding this the equilibrium variables of aggregate markets in equations (2) make the model GE type by harmonizing the equilibriums of the different aggregate markets.

To obtain estimates of the model parameters we have estimated a technology matrix $\{a_{i,j}\}_{i,j=1,\ldots,n}$ for the year 2010 and an elasticity matrix $\{e_{i,k}\}_{i=1,\ldots,n; k \in \{0;\ ExR\$R;\ WR;\ IRR\}}$ by constructing multiple regressions using quarterly statistics of Russia from 2003-2010 (see Table

1). The period 2003-2010 was chosen for estimation for two reasons. First the Russian economy's experienced demand constraints during 2003-2010 which are handled well with a demand-side type of model. In the second place, the Russian national accounts had transitioned to a new classification of economic sectors from 2003, as a result sectoral data before 2003 are not comparable with data after 2003.

Table 1. Elasticity coefficients of total demand for the product of sector i to the real exchange rate, real wage, and real interest rate for the main sectors of the Russian Economy (in parentheses time lags are specified, in quarters)

	Real exchange rate (Rub in USD)	Real wage	Real interest rate	Multiple R^2
Agriculture	-0.06 (1)		-0.19 (3)	0.20
Coal	0.95 (0)	-0.58 (0)	1.16 (0)	0.63
Oil		0.26 (0)	0.30 (0)	0.17
Natural Gas	-0.44 (4)	0.53 (0)	-0.28 (0)	0.78
Other minerals	-0.25 (4)		-0.54 (0)	0.30
Food, beverages, etc.	-0.10 (4)	0.41 (0)		0.63
Clothes	-0.30 (4)	0.51 (0)	-0.26 (0)	0.65
Pulp industry	-0.31 (4)	-0.07 (0)	-0.58 (0)	0.83
Oil refinery			-0.20 (0)	0.25
Chemistry industry	-0.39 (4)	-0.06 (2)	-0.60 (0)	0.61
Construction materials	-0.30 (4)	1.20 (0)	-0.67 (0)	0.79
Ferrous metallurgy	-1.10 (3)	0.36 (0)	-0.96 (3)	0.81
Non-ferrous metallurgy	-0.27 (4)	0.46 (0)	-0.47 (0)	0.68
Metal products	-0.45 (4)	0.46 (0)	-0.50 (0)	0.65
Machinery	-0.57 (4)	0.79 (0)	-1.43 (0)	0.62
Other industrial products	-0.11 (4)		-0.56 (0)	0.71
Energy	-0.13 (4)		-0.34 (0)	0.49
Water supply	-0.13 (4)		-0.34 (0)	0.49
Construction	0.15 (4)	0.75 (0)	-0.75 (0)	0.61
Trade	0.06 (3)	0.67 (0)	-0.43 (0)	0.92
Transport		0.41 (0)	-0.40 (1)	0.53
Communication		0.41 (0)	-0.40 (1)	0.53
Finance and Insurance	-0.27 (2)	1.28 (0)	-1.08 (2)	0.86
Real Estate and Consulting	-0.30 (1)	1.02 (0)	-0.79 (1)	0.62
R&D	0.08 (4)	0.47 (0)	-0.20 (0)	0.76
Education		0.14 (0)		0.59
Health, Culture, etc.		0.08 (0)		0.41
Utilities	0.06 (4)	0.30 (0)	-0.33 (0)	0.78

Empty fields imply the absence of statistically significant estimates (level of significance is 10% or more)
Sources: Author's estimations based on official statistics for the Russian economy in 2003-2010

The estimations given in Table 1 can be interpreted as estimates of the competitiveness of sectors in the face of the deterioration of conditions in the corresponding aggregate market. It allows us to use the theory of intersectoral competition to interpret the results of calculations in the model and to explain changes in the structure of the Russian economy.

To construct a model for the aggregate money market we use the well-known Baumol-Tobin model to simulate money demand and a new-Keynesian concept of inflation based on adaptive learning. For the inflation model we assume that inflation expectation include non-monetary factors. Based on quarterly statistics for 2003-2010 we have estimated the following two regressions:

$$\mathrm{Ln}((1+IRN_t)/(1+IRN_{t-4})) = -0.02+0.16*\mathrm{Ln}(P_{t-4}/P_{t-8}) - \\ -0.08*\mathrm{Ln}((M_t/P_t)/(M_{t-4}/P_{t-4})) + 0.16*\mathrm{Ln}(X_{t-5}/X_{t-9}) \quad (R^2 = 80.2\%) \qquad (4)$$

$$\mathrm{Ln}(P_t/P_{t-4}) = 0.146*\mathrm{Ln}(M_t/M_{t-4}) + 0.979*\mathrm{Ln}(P_{t-1}/P_{t-5}) - \\ -0.321*\mathrm{Ln}(P_{t-2}/P_{t-6}) \quad (R^2 = 67.1\%) \qquad (5)$$

where

IRN_t – the average annual interest rate for 1year or less credits for non-financial sector in quarter t;

P_t – GO deflator index in quarter t;

M_t – money supply (M2) in quarter t;

X_t – real GO in quarter t.

The model for the money market allows us to endogenize the interest rate and the inflation rate, and as a result endogenize the links between the aggregate money market and the product market. The money supply is the only exogenous variable in this case.

A model of currency market is based on estimation of currency inflows and outflows in the Russian Balance of payments and allows to simulate dynamic of exchange rate of the Russian ruble to USD. Based on quarterly statistics for 2003-2010 we have estimated following regression:

$$\mathrm{Ln}(ExR\$N_t/ExR\$N_{t-4}) = -0.04+1.20*\mathrm{Ln}(1+dPrivateReserves_t/CurrenceInflows_t) - \\ -0.49*\mathrm{Ln}(1+dCurrenceInflows_t/CurrenceInflows_t) \quad (R^2 = 79.5\%) \qquad (6)$$

where

$ExR\$N_t$ – the average exchange rate of the Russian ruble to USD in quarter t;

$dPrivateReserves_t/CurrenceInflows_t$ – ratio of change in net foreign currency reserves of private sector to total foreign currency inflows in the Russian economy in quarter t;

$dCurrenceInflows_t/CurrenceInflows_t$ – ratio of net foreign currency inflows in the Russian economy to total foreign currency inflows in the Russian economy in quarter t.

To make the exchange rate for the endogenous regression for import of goods and services (7) and normative model for exports of goods and services (8) are constructed:

$$\mathrm{Ln}(1+Im_t/P_t*X_t) = 0.125 + 0.025*\mathrm{Ln}(ExRR_t/ExRR_{t-4}) \quad (PV = 99.7\%) \qquad (7)$$

$$Ex_t = ExNonO\&G_t + OilPrice_t*ExpOilVol_t/dOil_t \qquad (8)$$

where

$ExRR_t$ – real exchange rate of the Russian ruble to the USD.

Im_t – imports of goods and services in rubles in quarter t;

Ex_t – exports of goods and services in rubles in quarter t;

$ExNonO\&G_t$ – non oil&gas exports of goods and services in rubles in quarter t;

$OilPrice_t$ – average actual export price of the Russian oil in USD per barrel in quarter t;

$ExpOilVol_t$ – oil exports in barrels in quarter t;

$dOil_t$ – average share of oil export in total oil&gas export in quarter t.

Flows of capital and financial instruments accounts of the Balance of payments and non oil&gas exports of goods and services are exogenous. For the purpose of macroeconomic forecasting these flows are defined exogenously according to considered scenarios of economic development and macroeconomic policy, historical data and expert estimations.

The regressions above have a good correspondence with the theoretical framework and should show statistical significance for main hypotheses.

3. RESULTS OF SIMULATION OF THE RUSSIAN ECONOMY DEVELOPMENT IN 2014-2015

The macroeconometric GE-IO model of the Russian economy with aggregate money and currency markets described above allows us to estimate the influence of sanctions and oil price decrease on the dynamics and structure of the Russian economy.

A base year for our calculations is 2013. A simulation covers 2014-2015. According to the results of calculations the Russian GDP would have a negative growth rate from -6.3% to -1.5% in 2015. In this paper we concentrate on consideration of the results obtained for a basic variant of the simulation (see table 2). Three scenarios have been assumed for the simulation of the Russian economy. For estimation purposes the sanctions assume additional outflows of capital from Russia in 2014-2015 and growth of nominal interest rates as a result of financial resources shortage. The first scenario "Both shocks" suggests influence of both factors – sanctions and oil price decrease. The second scenario "Only sanctions" suggests influence only sanctions and stable oil prices. The third scenario "No shocks" suggests absence of the sanctions and stable oil prices. The scenarios are invariant to monetary policy and suggest inflation targeting policy of Central bank with target of reduction of inflation rate to 4.0% in 2016.

Table 2. Key indicators for the Russian economy in 2011-2015: results of simulation

	Actual data				Simulation scenarios					
					"Both shocks"		"Only sanctions"		"No shocks"	
	2011	2012	2013	2014	2014	2015	2014	2015	2014	2015
Exogeneous indicators:										
Average export price of the Russian oil, USD per barrel	101.7	103.1	100.6	94.3	94.3	60.0	100.6	100.6	100.6	100.6
Money supply growth rates, %	23.6	18.3	15.2	7.8	7.8	4.0	7.8	4.0	7.8	4.0
Net outflows of transfers, factor incomes, capital and finance instruments, bln of USD	150.8	115.8	145.8	242.0	242.0	276.1	218.7	251.6	113.7	119.4
Real wage growth rate, %	2.8	8.4	4.8	1.3	1.3	-6.5	2.1	0.0	2.5	2.5
Endogeneous indicators:										
Nominal GDP, bln of USD	1903	1998	2076	1874	1874	1483	2017	1899	2146	2174
GDP growth rate, %	4.3	3.4	1.3	0.6	0.5	-3.9	0.7	-1.2	0.9	1.0
Capital investments growth rate, %	10.8	6.8	0.8	-2.7	-4.3	-12.7	-3.6	-7.5	-2.6	-2.8
Average nominal exchange rate, Russian rubles per USD	29.4	31.1	31.8	38.4	38.4	48.9	35.0	38.5	32.7	34.0
GDP deflator growth rate, %	15.9	7.4	5.0	7.2	7.2	5.6	6.0	4.7	5.2	4.0
Average annual nominal interest rate*, %	8.5	9.1	9.5	11.1	11.1	14.2	9.7	11.7	8.2	7.3
Average annual real interest rate*, %	-6.4	1.5	4.2	3.6	3.6	8.1	3.5	6.8	2.9	3.1
International Reserves at the end of year, bln of USD	498.6	537.6	509.6	385.5	385.5	258.6	474.5	430.4	547.2	571.7

* for loans over 1 year for non-finance organizations

Sources: Rosstat, Central Bank of Russia, results of simulation in The macroeconometric GE-IO model of the Russian economy with aggregate money and currency markets

Results of calculations allow us to estimate of the Russian economy's losses from the sanctions and oil decrease. According to the results of our simulation the losses of the Russian GDP because of the sanctions are estimated in 129 bln USD in 2014 and 275 bln USD in 2015. Negative impact of oil prices decrease on the Russian GDP is estimated in 143 bln USD in 2014 and 416 bln USD in 2015. Thus, the role of both factors seems to be considerable for the Russian economy.

Another interesting question is how do this factors affect the Russian economy structure? For this purpose let's look at the figure 1 and the tables 3, 4.

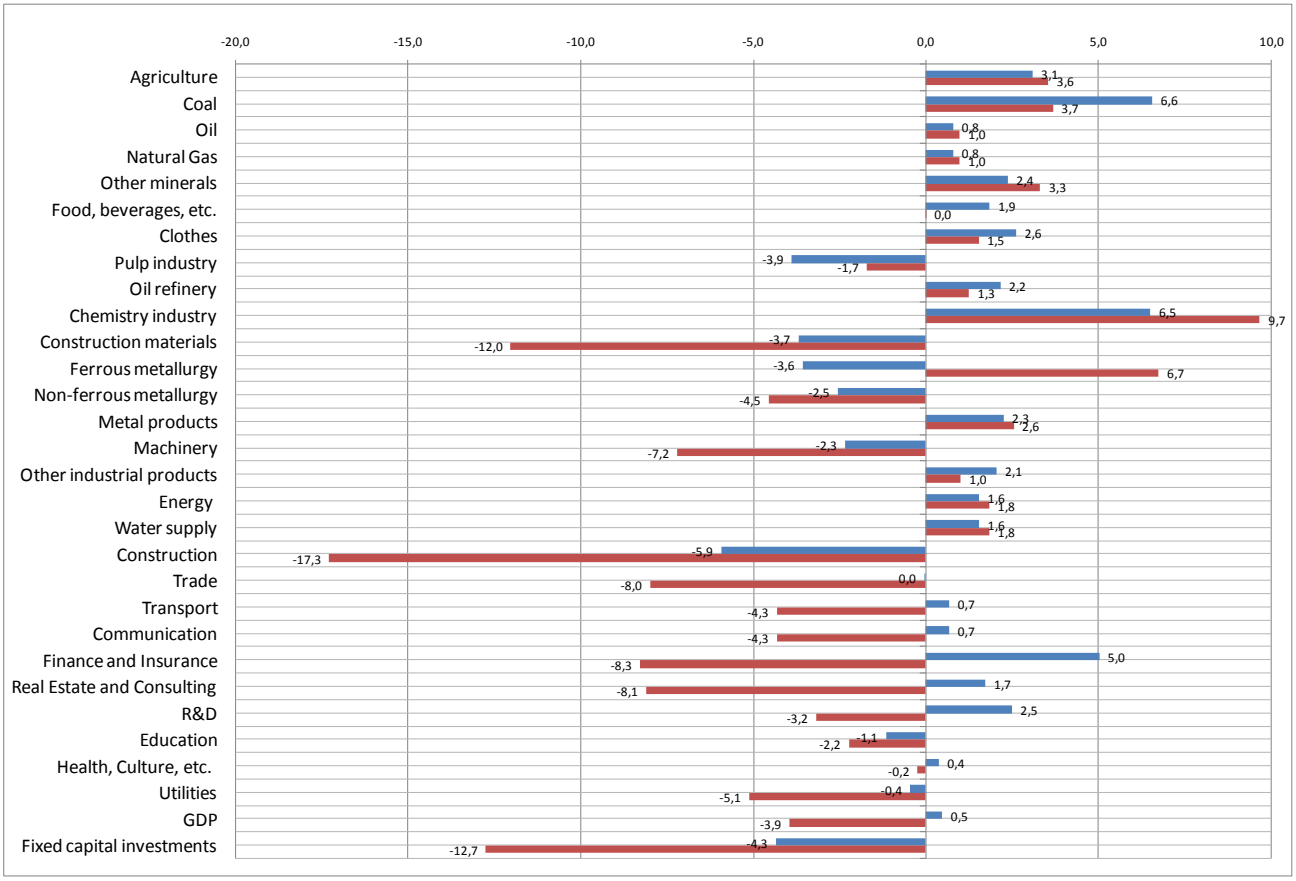


Figure 1. The estimation of influence of the sanctions and oil prices decrease on dynamic of main sectors of the Russian economy in 2014 (blue) and 2015 (red), growth rates of output to the previous year, in constant prices, %

Sources: results of simulation in The macroeconometric GE-IO model of the Russian economy with aggregate money and currency markets

As we could see from the results of our calculations, the worst growth rates expect to be shown by the follows: Construction, Construction materials, Real Estate and Consulting, Finance and Insurance, Trade, Machinery. The main gainers with positive growth rates are Chemistry, Ferrous metallurgy, Extraction, Agriculture, Metal products, Energy. The important conclusion we could make based on obtained results. It seems that the Russian Central Bank made a right decision to refuse from exchange rate control in the end of 2014. It gives to the economy a devaluation effect. Nevertheless impact of decrease of real wages and increase of interest rates caused by considered external shocks affects the Russian economy much more than devaluation.

Table 3. The estimation of influence of the sanctions and oil prices decrease on dynamic of main sectors of the Russian economy in 2014-2015, growth rates of output to the previous year, in constant prices, %

	2014			2015		
	"Both shocks"	"Only sanctions"	"No shocks"	"Both shocks"	"Only sanctions"	"No shocks"
Agriculture	3,1	2,7	2,3	3,6	2,9	2,7
Coal	6,6	3,8	1,6	3,7	2,2	2,4
Oil	0,8	0,8	0,8	1,0	1,0	1,0
Natural Gas	0,8	0,8	0,8	1,0	1,0	1,0
Other minerals	2,4	2,5	2,8	3,3	2,3	2,8
Food, beverages, etc.	1,9	2,2	2,4	0,0	1,9	2,4
Clothes	2,6	3,1	3,4	1,5	3,0	3,5
Pulp industry	-3,9	-3,8	-3,5	-1,7	-3,6	-3,5
Oil refinery	2,2	2,2	2,3	1,3	1,5	2,3
Chemistry industry	6,5	6,5	6,9	9,7	7,2	6,9
Construction materials	-3,7	-2,6	-1,7	-12,0	-5,5	-1,8
Ferrous metallurgy	-3,6	-0,3	2,2	6,7	6,1	3,1
Non-ferrous metallurgy	-2,5	-2,1	-1,6	-4,5	-2,9	-1,6
Metal products	2,3	2,7	3,2	2,6	2,9	3,2
Machinery	-2,3	-1,5	-0,3	-7,2	-4,2	-0,4
Other industrial products	2,1	2,1	2,5	1,0	1,0	2,4
Energy	1,6	1,6	1,8	1,8	1,3	1,8
Water supply	1,6	1,6	1,8	1,8	1,3	1,8
Construction	-5,9	-5,2	-4,4	-17,3	-10,2	-4,7
Trade	0,0	0,6	1,1	-8,0	-2,6	1,0
Transport	0,7	1,1	1,5	-4,3	-1,1	1,4
Communication	0,7	1,1	1,5	-4,3	-1,1	1,4
Finance and Insurance	5,0	4,2	3,8	-8,3	-1,7	4,1
Real Estate and Consulting	1,7	0,5	-0,3	-8,1	-3,9	0,0
R&D	2,5	2,9	3,2	-3,2	0,8	3,1
Education	-1,1	-1,0	-1,0	-2,2	-1,3	-1,0
Health, Culture, etc.	0,4	0,4	0,5	-0,2	0,3	0,5
Utilities	-0,4	-0,1	0,2	-5,1	-2,2	0,1
GDP	0,5	0,7	0,9	-3,9	-1,2	1,0
Fixed capital Investments	-4,3	-3,6	-2,6	-12,7	-7,5	-2,8

Sources: results of simulation in The macroeconometric GE-IO model of the Russian economy with aggregate money and currency markets

Table 4. The estimation of impact of the sanctions and oil prices decrease on dynamic of main sectors of the Russian economy in 2014-2015, change in growth rates of output to the previous year in comparison with "No shocks" scenario, in constant prices, %

	2014			2015		
	Both shocks	Sanctions	Oil prices decrease	Both shocks	Sanctions	Oil prices decrease
Agriculture	**0,8**	**0,3**	**0,4**	**0,9**	**0,2**	**0,7**
Coal	**5,0**	**2,2**	**2,8**	**1,3**	-0,2	**1,5**
Oil	0,0	0,0	0,0	0,0	0,0	0,0
Natural Gas	0,0	0,0	0,0	0,0	0,0	0,0
Other minerals	-0,4	-0,3	-0,1	**0,6**	-0,5	**1,1**
Food, beverages, etc.	-0,5	-0,2	-0,3	-2,4	-0,4	-1,9
Clothes	-0,8	-0,4	-0,4	-1,9	-0,5	-1,5
Pulp industry	-0,3	-0,3	0,0	1,9	-0,1	1,9
Oil refinery	-0,1	-0,1	0,0	-1,0	-0,7	-0,3
Chemistry industry	-0,4	-0,3	0,0	**2,8**	**0,3**	**2,5**
Construction materials	-1,9	-0,9	-1,1	-10,2	-3,7	-6,6
Ferrous metallurgy	-5,8	-2,5	-3,3	**3,6**	**3,0**	**0,7**
Non-ferrous metallurgy	-0,9	-0,5	-0,4	-2,9	-1,2	-1,6
Metal products	-0,9	-0,5	-0,4	-0,7	-0,3	-0,4
Machinery	-2,0	-1,2	-0,8	-6,8	-3,8	-2,9
Other industrial products	-0,4	-0,3	-0,1	-1,4	-1,4	0,0
Energy	-0,3	-0,2	0,0	**0,1**	-0,4	**0,5**
Water supply	-0,3	-0,2	0,0	**0,1**	-0,4	**0,5**
Construction	-1,5	-0,8	-0,7	-12,6	-5,5	-7,1
Trade	-1,1	-0,5	-0,6	-8,9	-3,6	-5,4
Transport	-0,8	-0,4	-0,4	-5,7	-2,5	-3,2
Communication	-0,8	-0,4	-0,4	-5,7	-2,5	-3,2
Finance and Insurance	**1,2**	**0,4**	**0,8**	-12,4	-5,8	-6,6
Real Estate and Consulting	**2,1**	**0,8**	**1,2**	-8,1	-4,0	-4,2
R&D	-0,7	-0,3	-0,4	-6,3	-2,4	-3,9
Education	-0,2	-0,1	-0,1	-1,2	-0,3	-0,9
Health, Culture, etc.	-0,1	0,0	-0,1	-0,7	-0,2	-0,5
Utilities	-0,6	-0,3	-0,3	-5,2	-2,3	-2,9
GDP	-0,4	-0,2	-0,2	-4,9	-2,2	-2,7
Fixed capital Investments	-1,7	-1,0	-0,8	-10,0	-4,8	-5,2

Sources: results of simulation in The macroeconometric GE-IO model of the Russian economy with aggregate money and currency markets

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