Bank of Russia
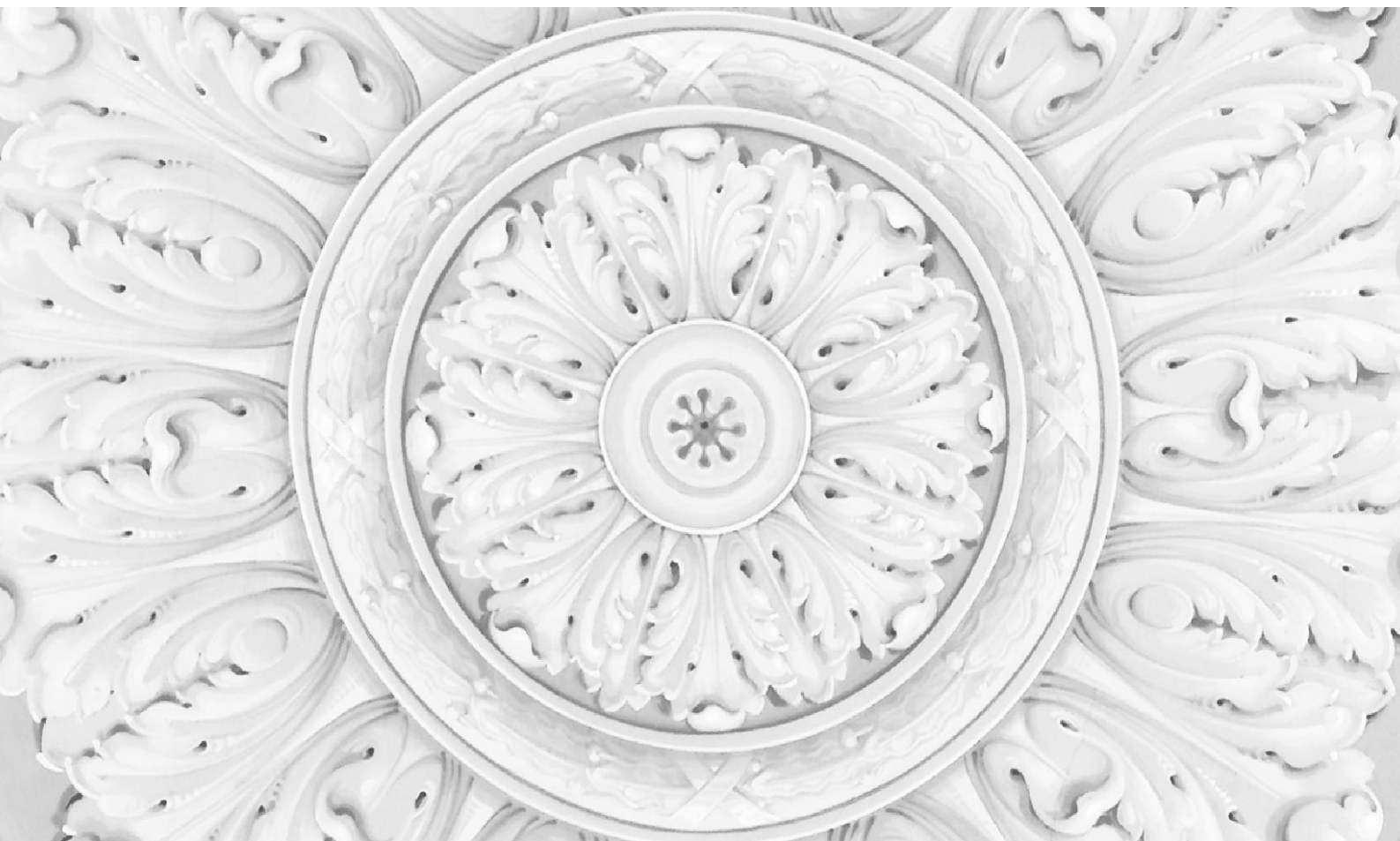Central Bank of the Russian Federation

WORKING PAPER SERIES

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Measuring Debt Burden

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Abstract

We analyse two debt burden measures – credit-to-GDP and debt service ratio. For that purpose we calculate equilibrium debt ratios on the basis of fundamental macroeconomic indicators and compare them with international data. We conclude that the current value of this ratio in Russia is likely to be close to the equilibrium or exceed it.

CONTENTS

INTRODUCTION

Adequate debt burden measurement and benchmarking is a necessary condition for an efficient policy implementation by a central bank. This is conditioned by a number of factors.

First, debt burden indicator is an important measure of banking system stability and can serve as a leading indicator of banking crises (Drehmann and Juselius, 2012). Debt level is also a factor that amplifies fluctuations in the real sector of economy, especially in unfavourable periods (Jorda et al., 2013; Aizenman et al., 2013). Thus, the analysis of changes in debt burden indicator is directly related to a central bank's objectives to maintain financial and macroeconomic stability.

Besides, the situation in advanced economies after the crisis of 2008 has shown that substantial accumulated debt can be considered as a factor weakening the effect of monetary and fiscal stimulus (Lo and Rogoff, 2015; Schäuble, 2015), because if debt burden is high, lower interest rate does not encourage lending. Thus, debt burden shall be taken into account in decision making on monetary policy.

This paper provides a brief review of main approaches to debt burden measurement applied in the Bank of Russia. The first section provides an analysis of the credit-to-GDP ratio. The second section examines the debt service ratio. The third section briefly reviews cross-industry debt distribution in Russia.

1. CREDIT-TO-GDP RATIO

The private sector credit-to-GDP ratio is a standard indicator for debt burden. In Russia this ratio is considerably lower than in advanced economies (Chart 1). Nevertheless, current debt values of developed countries cannot be regarded as an optimal level. Some empirical researches (e.g., Arcand et al., 2012; Cecchetti and Kharroubi, 2012) show that the credit-to-GDP ratio exceeding a threshold of 90-100% of GDP negatively impacts the economic growth. However, in Russia the credit-to-GDP ratio remains considerably below this level. Meanwhile, in Russia this debt burden indicator is supposed to have exceeded the median value of the respective indicator for a panel of emerging market economies in 2013 (including countries with comparable economic and financial development level. Chart 2).

Chart 1. The credit[1]-to-GDP ratio in Russia, advanced economies[2] and emerging markets[3] (median values and 25th/75th percentile bands, %)

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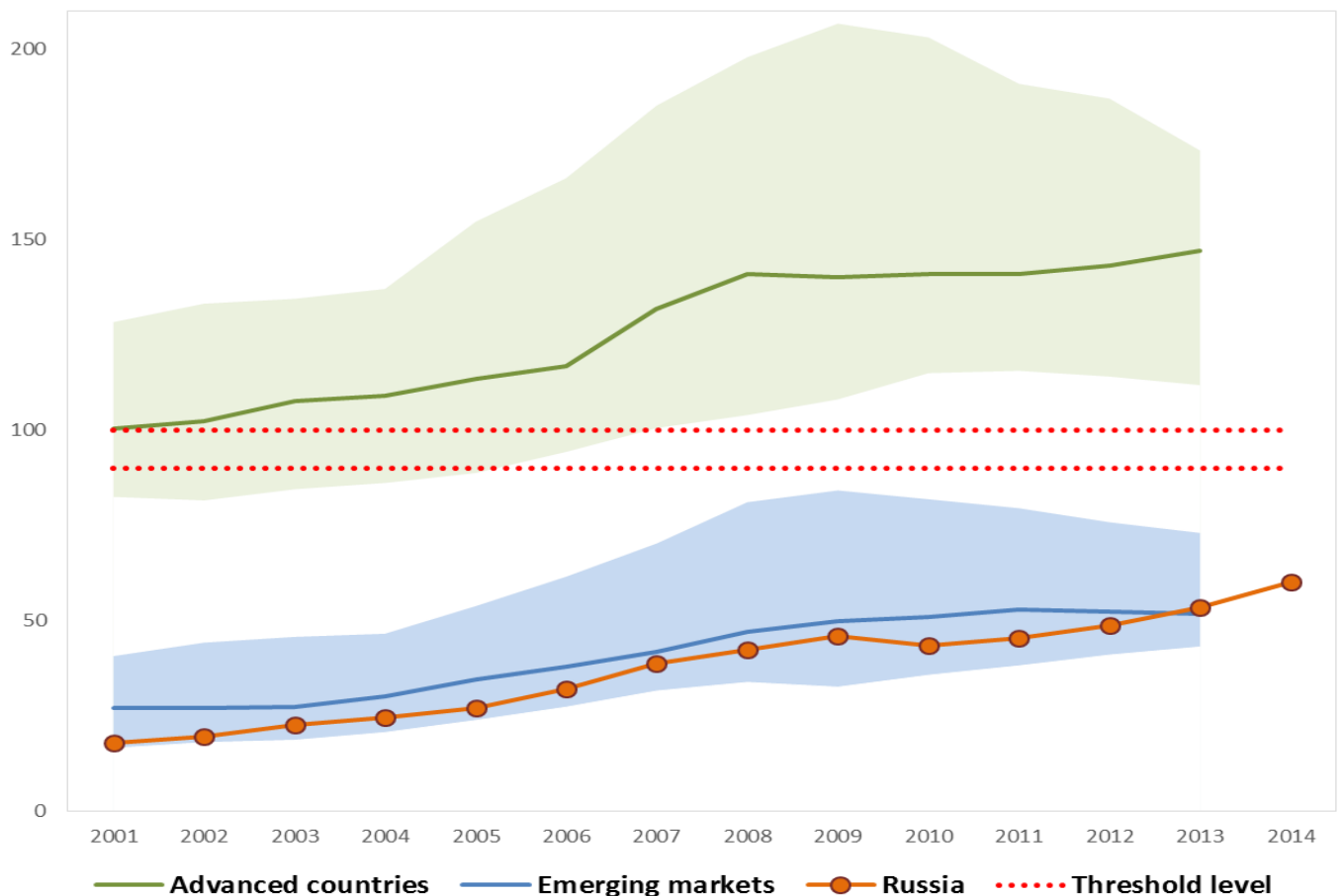
[1] Credit is represented by banks' claims on the private sector. Data source is IMF IFS database.
[2] Australia, Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, Portugal, Spain, Sweden, USA.
[3] Armenia, Azerbaijan, Belarus, Bolivia, Bosnia and Herzegovina, Brazil, Bulgaria, Chili, China, Columbia, Croatia, Czech Republic, Ecuador, El Salvador, Estonia, Georgia, Hungary, Indonesia, Kazakhstan, Korea, Latvia, Lithuania, Macedonia, Malaysia, Mexico, Moldova, Morocco, Pakistan, Paraguay, Peru, Philippines, Poland, Qatar, Romania, Serbia, Slovenia, South Africa, Thailand, Turkey, Ukraine, Uruguay, Venezuela.

Thus, the observed increase in the credit-to-GDP ratio in Russia generally seems to be natural. However, the rate and the path of this growth a priori cannot be considered as equilibrium.

Chart 2.   The credit-to-GDP ratio in Russia and certain comparable emerging markets
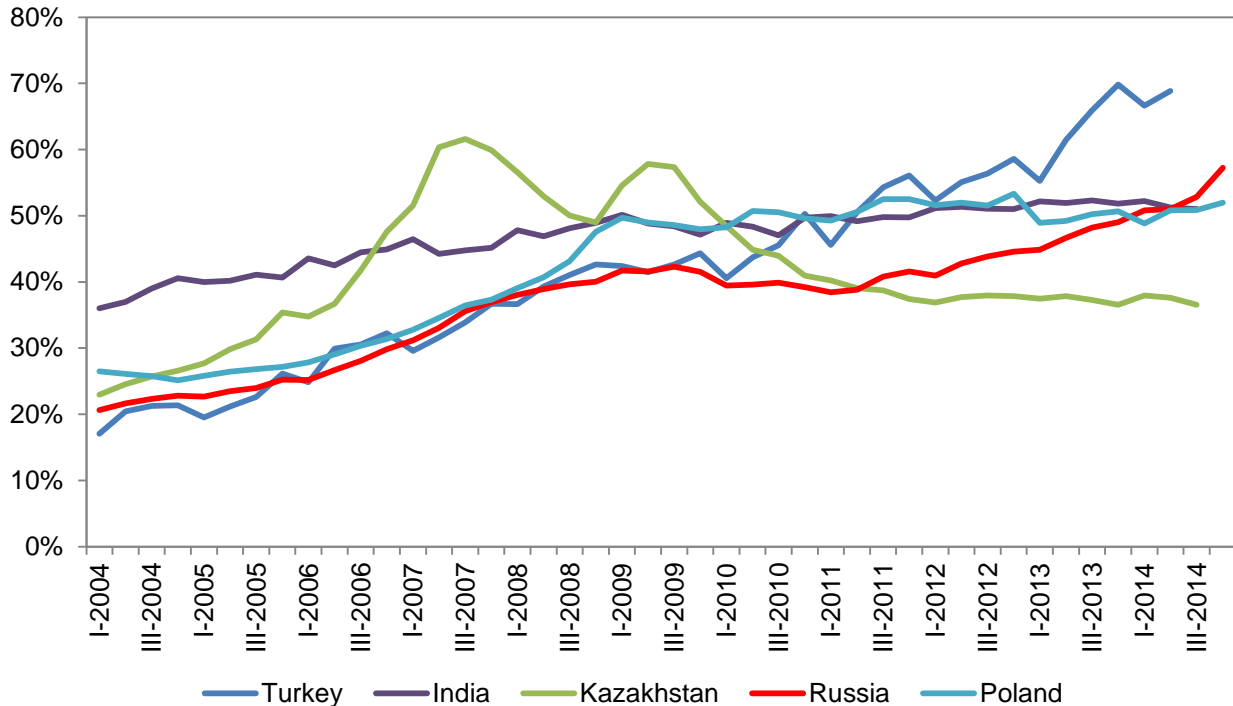
1.1 Equilibrium debt level: estimates based on Russian data

Several approaches can be applied to estimate the equilibrium path of debt ratio. First, the relationship between credit-to-GDP ratio and some fundamental factors may be estimated basing on the observed data. An equilibrium debt level can be calculated on the basis of this relationship (Chart 3). In this case, we calculated an equilibrium (external and domestic) debt of the private sector determined by the observed real GDP and price growth rate (the respective cointegration relationship is reported in Deryugina et al. (2015)). The calculations show that the credit-to-GDP ratio was slightly above the equilibrium level in 2013. Considerable growth of foreign currency denominated debt due to the ruble depreciation resulted in 2014 in the largest debt overhang value in the past years.

Chart 3.   The debt[4]-to-GDP ratio in Russia (confidence band calculation is based on two standard forecast errors)
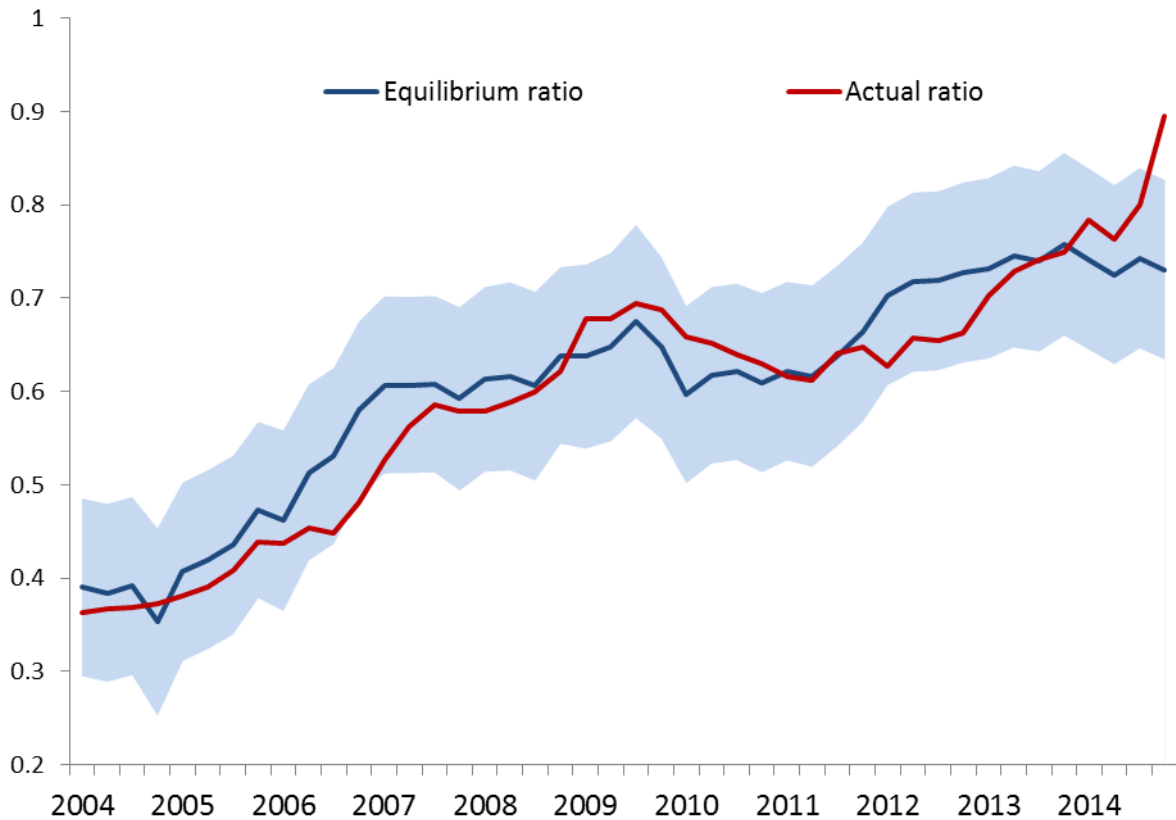
1.2 Equilibrium debt level: estimates based on advanced economies data

Out-of-sample estimation is an alternative approach to calculating equilibrium debt level. This concept (see e.g. Egert et al., 2006) presumes that the parameterisation of the relationship between debt and fundamentals obtained on the basis of emerging markets data can be biased. This effect occurs as, basing on the in-sample econometric estimates, the accelerated growth of the credit-to-GDP ratio, that is in fact a convergence to the equilibrium level, can be regarded as normal even after reaching this level (Chart 4).

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[4] Liabilities to domestic banks and foreign debt of private non-banking sector.

Chart 4.   Changes in the credit-to-GDP ratio and fundamental factors in advanced economies and emerging markets
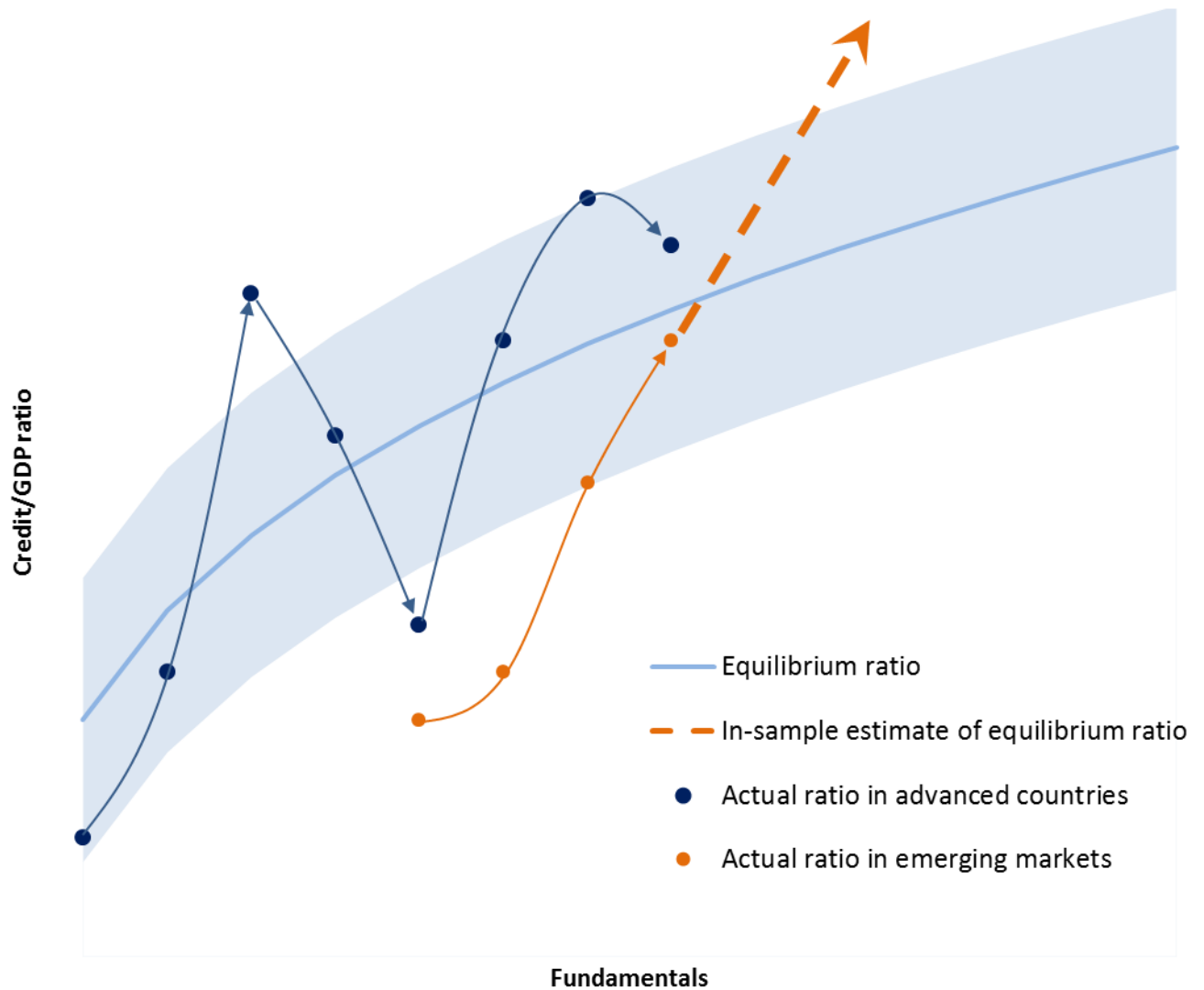
To solve this issue it may be appropriate to parametrize the relationship between credit and main macroeconomic variables on the basis of more balanced data on advanced economies and to apply the acquired model to calculate the equilibrium credit-to-GDP ratio for a specific emerging market. The outcome of this calculation[5] is shown in Chart 5.

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[5] We used a specification (7) from Egert et al. (2006) estimated by FE_OLS technique for OECD countries.

Chart 5.   The credit[6]-to-GDP ratio in Russia (confidence range calculation is based on maximum and minimum country fixed effects)
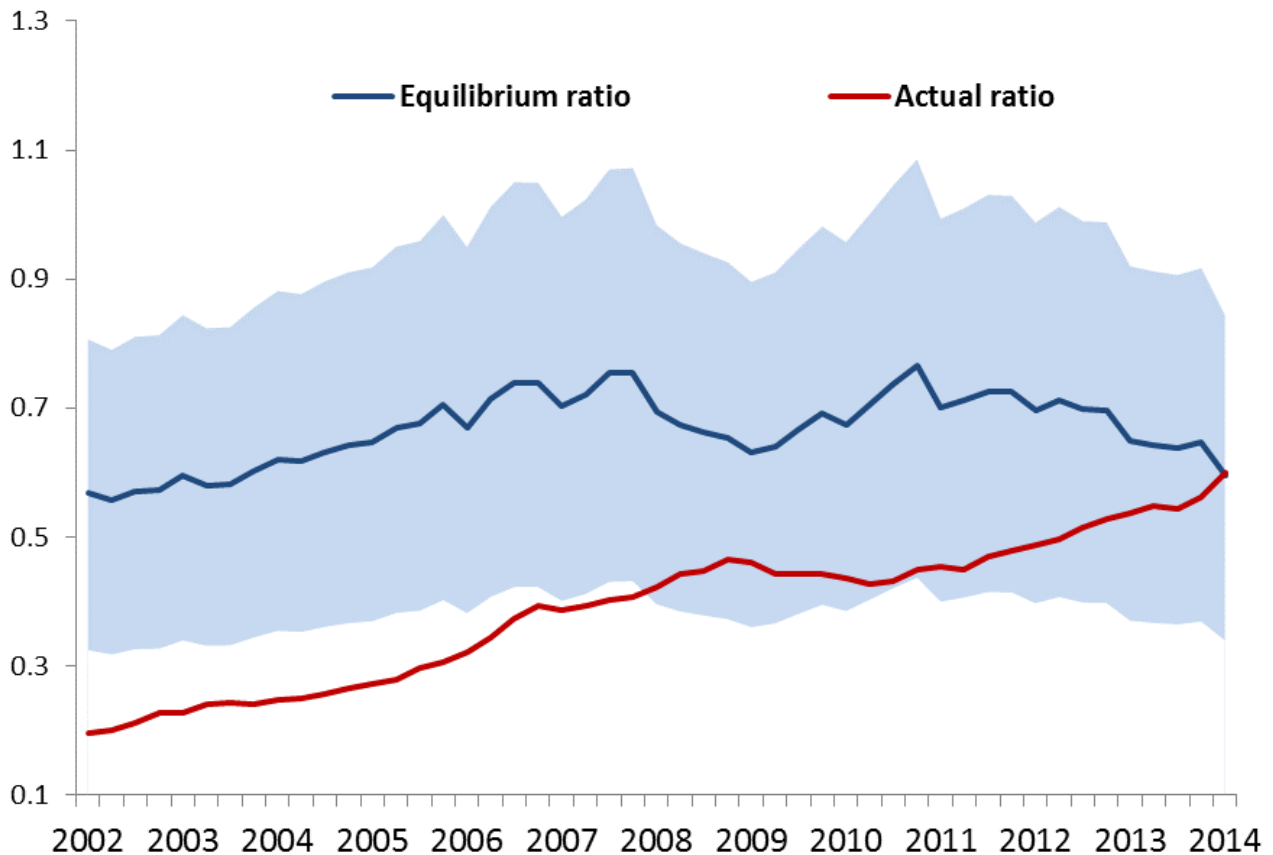
The resulting range is characterised by a large confidence band. However, it is possible to claim that in 2012-2014 fast growth of the actual credit-to-GDP ratio was not accompanied by the respective increase in the equilibrium level. As a result, in 2014 the actual credit-to-GDP ratio reached the median estimate of the equilibrium level and slightly exceeded it.

2. DEBT SERVICE RATIO

The credit-to-GDP ratio takes the key place as a debt burden indicator in the economy in researches aimed at revealing financial stability risks. Meanwhile, a research conducted by Drehmann and Juselius, 2012, shows that another efficient leading indicator is a ratio of current debt service payments to revenues or the *Debt Service Ratio (DSR)*.

The DSR is calculated as a ratio between accumulated debt service payments, including both partial debt redemption and interest payments, and the current revenues. In practice, it is complicating to calculate the DSR using data on actual payments due to the insufficiency of balance sheet data, therefore an estimated ratio can alternatively be calculated with simplified as-

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[6] Credit is represented by credit institutions' exposures to non-financial organisations and households.

sumption of even distribution of debt service payments over the life of a credit (annuity payment) using the following formula:

$$DSR_t = \frac{i_t * D_t}{(1-(1+i_t)^{-s_t})*Y_t} \tag{1}$$

where D denotes an aggregate credit stock, i denotes the average interest rate on the stock, s denotes the average remaining maturity, and Y denotes the current income.

Due to its design, the DSR accounts for more information on the financial situation in the economy than the credit-to-GDP ratio. It shows what nonlinear effects interest rates and loan maturity have on debt burden build-up, and how they can impact loan supply and demand.

In terms of loan supply the micro level illustration can be used. E.g., when a bank extends a mortgage loan to an individual, it can use the DSR calculation to determine a credit limit: the bank will be ready to provide the borrower with the amount that produce a ratio of the future annual payments calculated with account of the interest rates and loan maturity (i.e., the DSR) up to 30-50% of his current income. This would provide for an acceptable level of borrower's debt burden and restrict the risk of non-payment for the bank.

Irrespective of the use of such limits by banks, the DSR can be an important indicator for borrowers. Presumably, economic agents decide on the borrowing trying to optimise their current debt service payments rather than considering the total debt, ensuring the persistence of desired consumption expenditures. In this case, amid persistently reducing interest rates or extending loan maturity in the economy, borrowers may seek to keep the DSR unchanged and will be able to increase their borrowings both in absolute term and relative to the income (credit-to-GDP).

The DSR analysis can largely explain considerable and persistent differences in the credit-to-GDP ratio in emerging markets and advanced economies. The latter have a long history of persistently low inflation rates and advanced financial systems, and respectively lower nominal interest rates and considerable lending horizons. This makes persistently high credit-to-GDP ratio normal for them while their current debt burden estimated through the DSR can be generally comparable to that of emerging markets (Chart 6).

Chart 6.   Sample calculation: change in credit-to-GDP with DSR fixed at 25% depending on the interest rate level and loan maturity
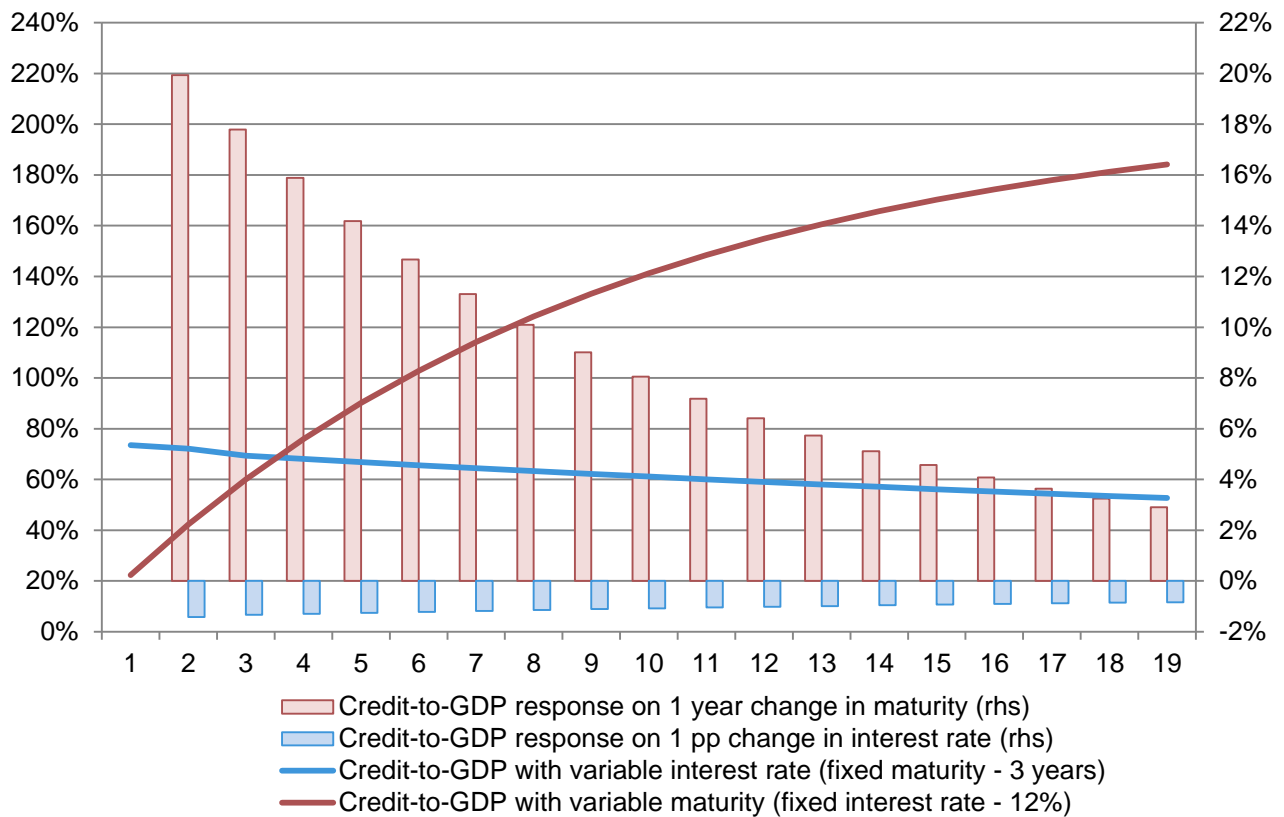
Thus, the transition from the analysis of the credit-to-GDP ratio to the DSR can facilitate intertemporal and cross-country comparison of debt burden level. The research by Drehmann and Juselius, 2012, based on the data analysis for 27 countries (cover mainly advanced economies but also some emerging markets) over a relatively long period, shows that the DSR dynamics is quite homogenous across countries. Meanwhile, the authors conclude that the DSR (even calculated with some simplifying assumptions using the GDP as an income indicator) is a good early warning indicator of financial crises that usually outperforms the credit-to-GDP ratio.

Thus, the information on the DSR dynamics can be very useful in terms of a central bank's decision making on financial stability measures. The DSR estimate supplements the analysis of the credit-to-GDP ratio and can be used in the analysis of interest rate and credit channel of monetary transmission in the economy.

2.1 DSR dynamics in Russia

In order to supplement the analysis of debt burden in the Russian economy presented in the first section, the DSR was calculated using the technique proposed by Drehmann and Juselius, 2012.

The credit-to-GDP ratio was provided by the banking sector statistics in terms of non-financial organisation and household lending (in rubles and foreign currency). We also used the balance of payment data on the external debt of other sectors.

The analysis did not take the public debt into account. It was justified either by the persistently low net credit to the general government from banks in Russia, or the aim to get results, methodologically comparable with previously conducted researches on other countries. The assessment of the public sector debt burden can be a subject of a separate research, but we believe that it is currently not of high importance in Russia.

The average loan maturity was estimated with account of the available statistics, similar to the research by Drehmann and Juselius, 2012. Weighted average loan maturity was calculated on the basis of lending data segmented by maturity ('less than 1 year', 'from 1 to 3 years', 'more than 3 years'), the average loan maturity in the segment 'more than 3 years' was considered to be 5 years[7]. An indicator smoothed over 8 quarters was used for the calculation of DSR. The average term of external borrowings was supposed to be invariable during the whole observation period at the 5 year level (in line with similar indicators for comparable emerging markets).

Due to the unavailability of statistical data on the average interest rates on the accumulated debt, we used information on the average interest rates on newly issued loans averaged for the previous 8 quarters (that corresponds to the average loan maturity over the period under research). Interest rates on the external debt were estimated on the basis of the Russian balance of payments statistics (with account of external debt and debt payments in the current account of the balance of payments).

The obtained results were compared with similar indicator dynamics for a panel of 21 emerging market economies, including countries of the CIS, Central and Eastern Europe, Asia and Latin America. The estimates provided in the charts below enable us to make a cross-country comparison and draw conclusions on the Russian debt burden.

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[7] That corresponds to the latest balance sheet data on loan terms available as of 2009.

Chart 7. DSR in Russia calculated with account of external and domestic credit to the private sector excluding banks (non-financial organisations and households)
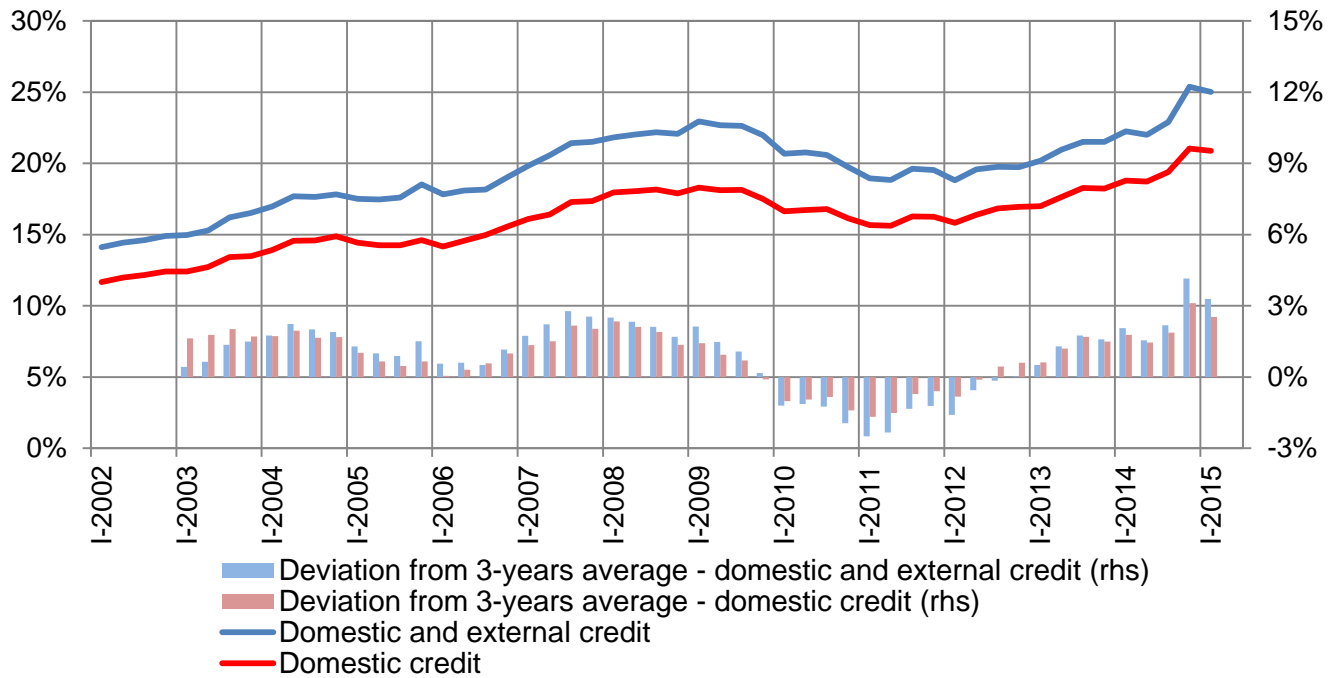
For 1Q 2015 - preliminary estimates

Chart 8. DSR (year average) for the domestic debt for Russia and a panel of emerging market economies[8]

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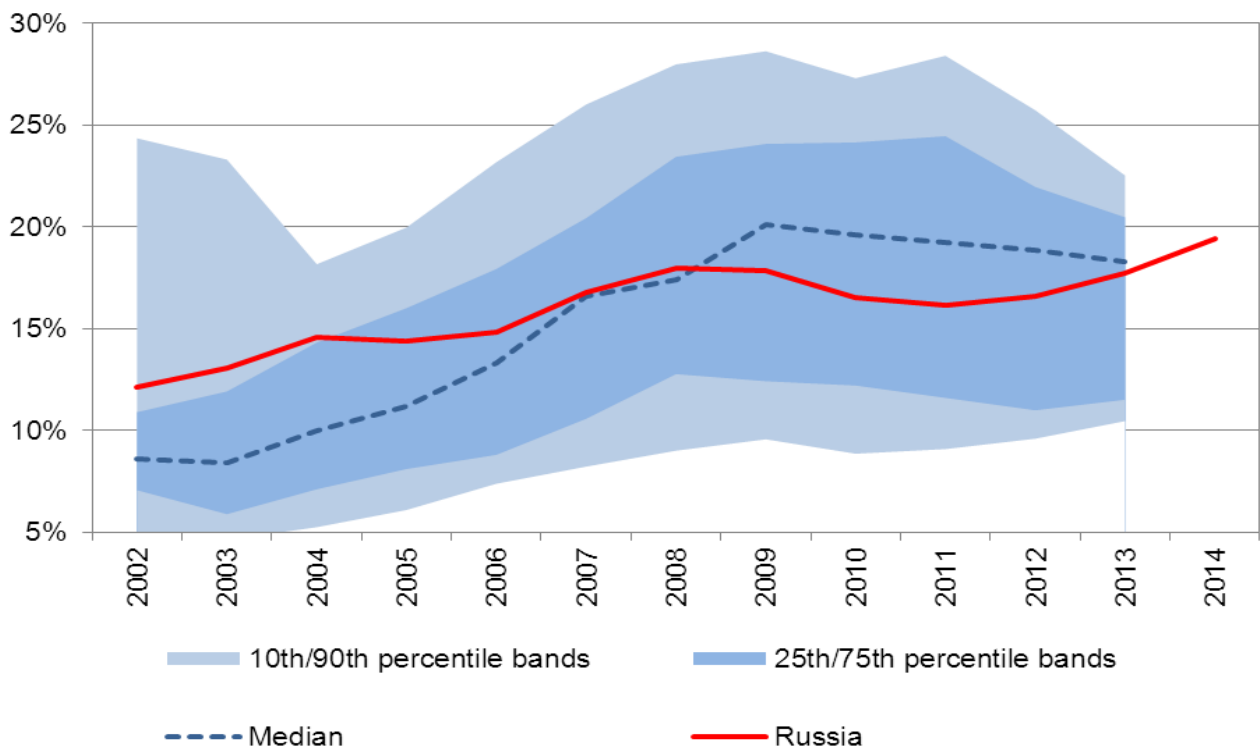
[8] The panel of emerging market economies comprises 18 countries for which the respective statistics was available: Argentina, Mexico, Columbia, Chili, Poland, Czech Republic, Hungary, Slovenia, Macedonia, Estonia, Lithuania, Belarus, Moldova, Azerbaijan, Georgia, Kazakhstan, India, and South Korea. Statistical data from central banks and IMF were used in the calculation. Calculation of average loan maturity was based on the data from central banks and was supposed to equal to 3 years where data availability was restricted.

The DSR for the Russian economy is largely comparable with the indicators of the peer countries. The DSR shows an upward trend that can be explained, in particular, by the development of financial intermediation and gradual growth in the share of economic agents having access to financial services.

The DSR analysis with account of the external credit does not introduce considerable changes. It is noteworthy that the DSR for the external debt is considerably lower than that for the domestic one, persistently accounting for 1/6 of total debt burden estimated by the DSR (this share is higher in case the credit-to-GDP ratio is applied as rates and terms of external lending are not taken into account). Meanwhile, the DSR for the external debt is higher for Russia than for many comparable countries. This can be explained by high openness of the Russian economy, its sectoral structure (largest global drilling and mining companies) and the effect of long persistence of managed exchange rate.

Chart 9. DSR (year average) for the external debt of the private sector (other than direct investments) for Russia and a panel of emerging market economies[9]
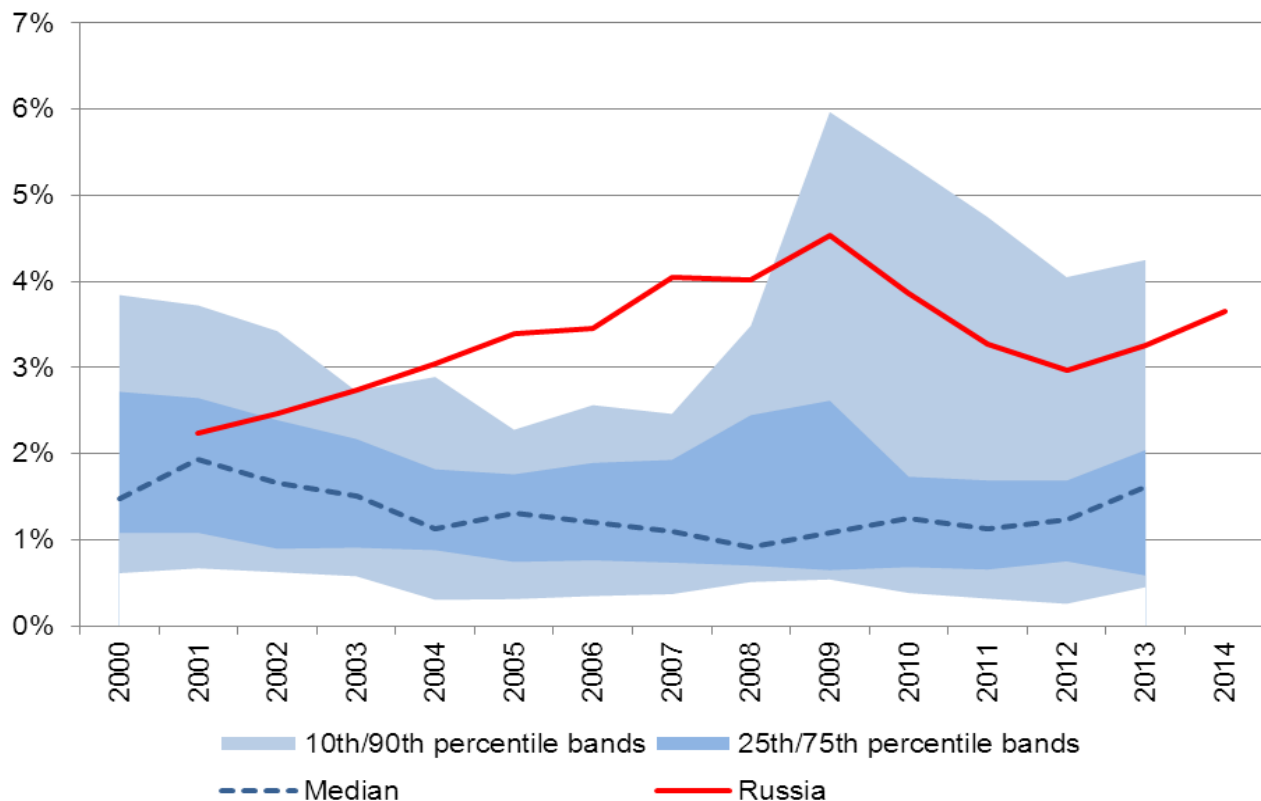

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[9] The panel of emerging market economies comprises 18 countries for which the respective statistics was available: Argentina, Brazil, Mexico, Peru, Venezuela, Columbia, Turkey, Hungary, Bosnia and Herzegovina, Macedonia, Romania, Belarus, India, Malaysia, Philippines, Indonesia, Thailand, China, and South Africa. The calculation of ratio between the external debt of the private sector and the GDP was based on the World Bank statistics available up to 2013.

Like in most peer countries, rapid increase of the DSR is observed in 2007-2008, that corresponds to the boom in the global financial markets before the crisis. Afterwards, the DSR levels adjust and approach medium-term trend levels.

The second half of 2014 saw the second episode of considerable DSR increase for Russia. This time the DSR changed more rapidly than in 2007-2008. The DSR exceeded historical peaks reached in 2009 and hit the levels defined in Drehmann and Juselius, 2012, as signalling (for most countries) higher financial stability risks (from 20-25% for the DSR for domestic loans).

The analysis of possibilities to use the DSR as an early warning signal ahead of financial crises conducted in Drehmann and Juselius, 2012, also showed that the DSR growth against the long-term rolling average has a good signalling capacity. Thus, in 2/3 of cases it exceeds the threshold value of 4-6 percentage points 1-2 years before a financial crisis.

By late 2014, the DSR for the domestic debt calculated for the Russian economy increased against a 3-year rolling average by approximately 3 percentage points, the DSR of the total domestic and external debt – by slightly more than by 4 percentage points. According to preliminary estimates, these indicators are expected to decrease slightly in 2015 Q1.

Additional DSRs were calculated for non-financial companies and households. Gross profit and the labour incomes (GDP statistics on revenue categories) were used as approximation of revenue indicator of these sectors. The external credit was referred to the corporate sector debt. The following conclusions can be made based on the analysis of obtained results.

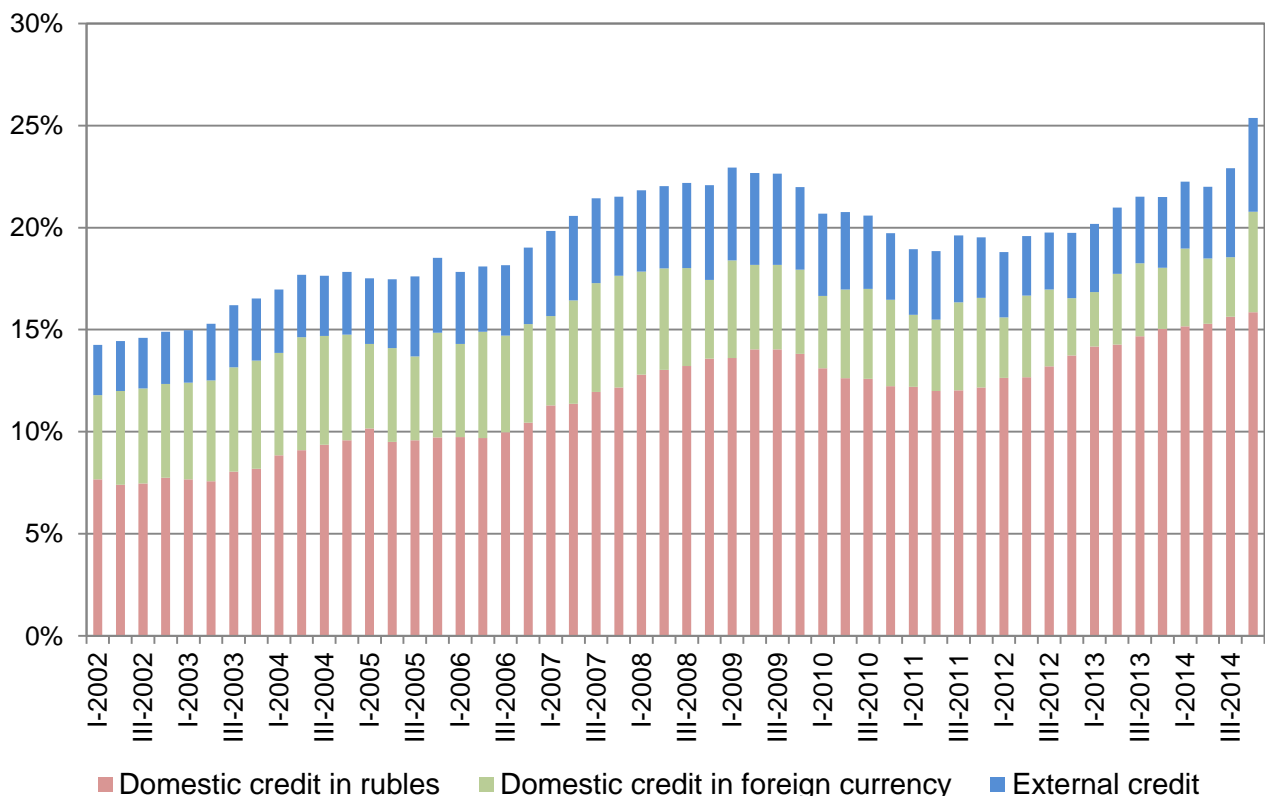**Chart 10.**   The DSR calculated for households and non-financial companies of the real sector
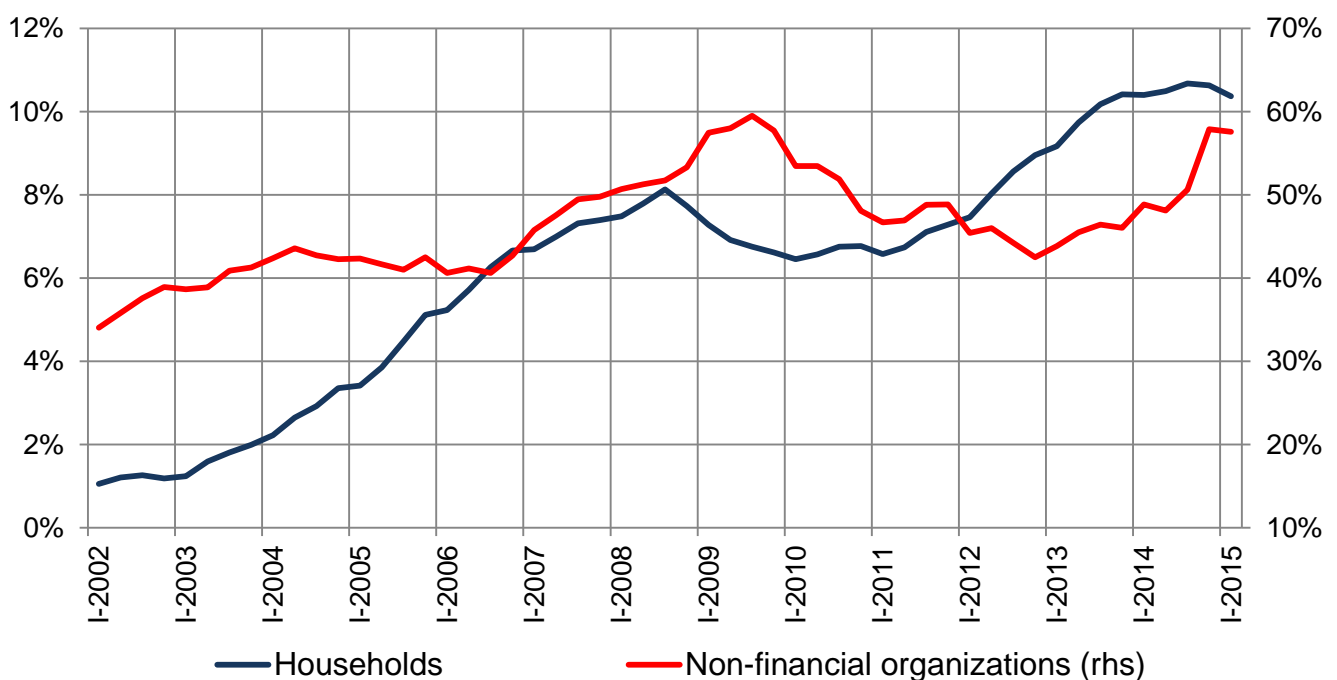
For 1Q 2015 - preliminary estimates

The household sector DSR is considerably lower, has a steeper trend and lower fluctuation range than the DSR of companies of the real sector that generally corresponds to the results for advanced economies[10]. Household debt burden adjusted and started growing earlier after the crisis of 2008, and did not undergo considerable changes in the last quarters of 2014 remaining at the level close to the medium-term trend. Meanwhile, the DSR of the corporate non-financial sector showed an abrupt growth in 2014 Q4 approximating the maximum values reached in 2009. This growth was largely conditioned by the ruble depreciation that accelerated in November-December 2014 amid the fall of global oil prices and the impact of external financial sanctions against Russian companies and banks.

To illustrate the contribution of various factors in the DSR, presented below is the DSR structure by loan types and decomposition of quarterly change of the aggregate DSR (Charts 11 and 12). It can be seen that the situation in 2014 differs considerably from the previous DSR increase in 2007-2008, it did not bear any signs of a credit boom and was primarily determined by dramatic changes in external conditions.

Chart 11.   DSR structure by loan types of credit

Legend: Domestic credit in rubles ■ Domestic credit in foreign currency ■ External credit ■

Chart 12.   Contribution of separate factors in change of the DSR for Russia, p.p. year-on-year

Credit-to-GDP

Maturity and other factors

Domestic interest rate

Revaluation of foreign currency credits

Change in DSR
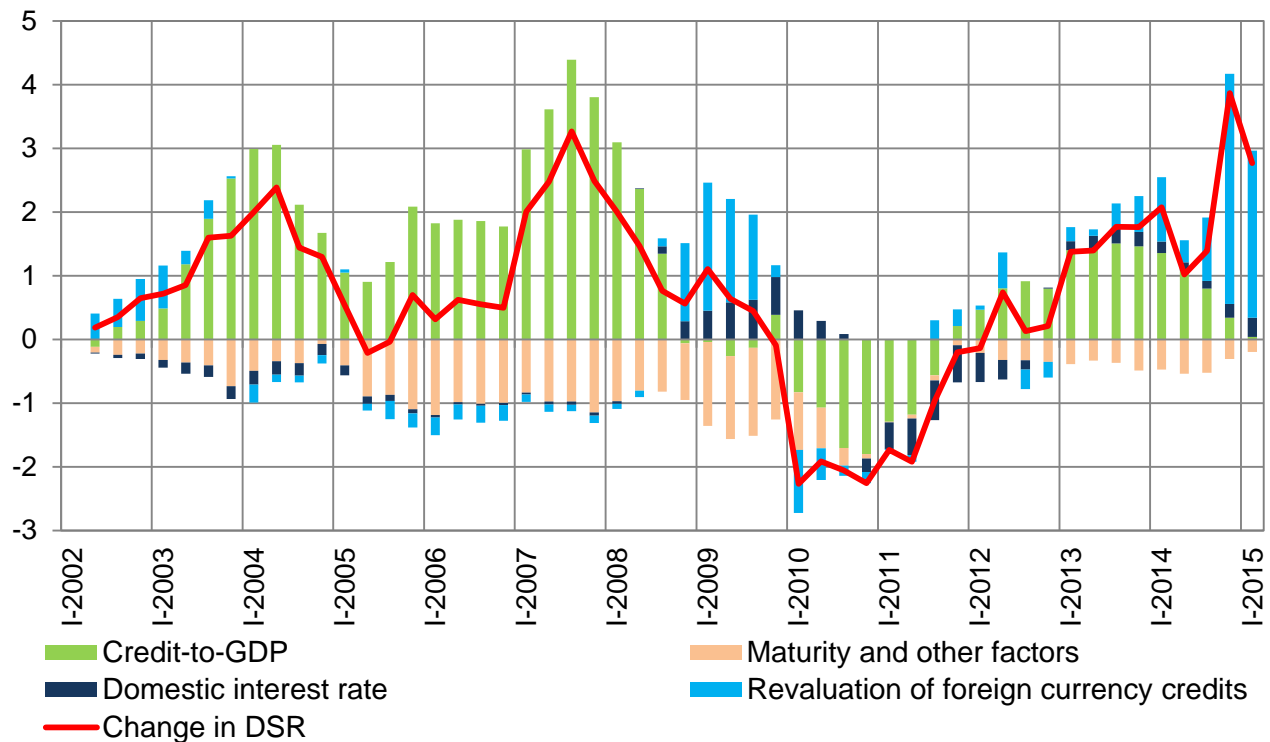
*For 1Q 2015 - preliminary estimates*

The analysis of decomposition of DSR growth bears important additional information that can be taken into account in decision making of a central bank. Aghion et al., 2000 present the theoretical model that accounts for the impact of debt service indicators on borrowers' financial balances and economic activity and show how an external shock can result in currency crisis and recession in the economy with considerable currency debt. Besides, it is pointed out that if the sensitivity of domestic credit to interest rates fluctuations is relatively small (that is mostly typical of emerging markets), the optimal monetary policy response would be to increase interest rates. This measure will be aimed at preventing currency crisis and in these particular circumstances the aggregate debt burden may decrease (due to the smaller scale of the devaluation and the respective revaluation of debt denominated in foreign currency) rather than increase (due to the contribution of interest rates).

Irrespective of DSR growth factors, its upward trend is an alarming signal indicating increasing risks of deterioration of Russian borrowers' financial standing and aggravating problems with debt servicing. In this case, slower lending growth providing for debt burden easing would be natural. Within the Bank of Russia baseline forecast (Monetary Policy Report, June 2015) gradual return of the DSR to the medium-term trend is likely to be observed in 2015-2016. Meanwhile, considering the scope of the required adjustment of the aggregate debt burden, even accelerated redemption of a part of corporate external debt due to the external sanctions should not result in a speed up of domestic credit demand growth.

3. CROSS-INDUSTRY DEBT BURDEN

In addition to the aggregate analysis, debt burden in different industries can be considered[11]. In this case our objective was not assessing absolute debt burden values in different industries but rather their comparison. In Russia, debt burden values differ considerably depending on the type of economic activity: indicators in metallurgy, chemical industry, retail trade, agriculture, and particularly in machinery exceed considerably the respective values in other industries. Admittedly, due to the peculiarities of various industries' operations their debt burden should not be homogenous (see e.g. MacKay and Phillips (2005)). However, comparison of debt burden correlation with similar indicators of foreign companies does not indicate that the increased debt burden is natural for these industries (maybe except for the metallurgy). Level of debt burden in machinery and retail trade is especially high exceeding foreign indicators even in absolute terms. As high debt burden objectively constrains lending from both demand and supply sides, these industries are least likely to be able to rely external funding to finance their operations in the short term.

Chart 13. Debt burden[12] of the median company by industries in Russia and abroad

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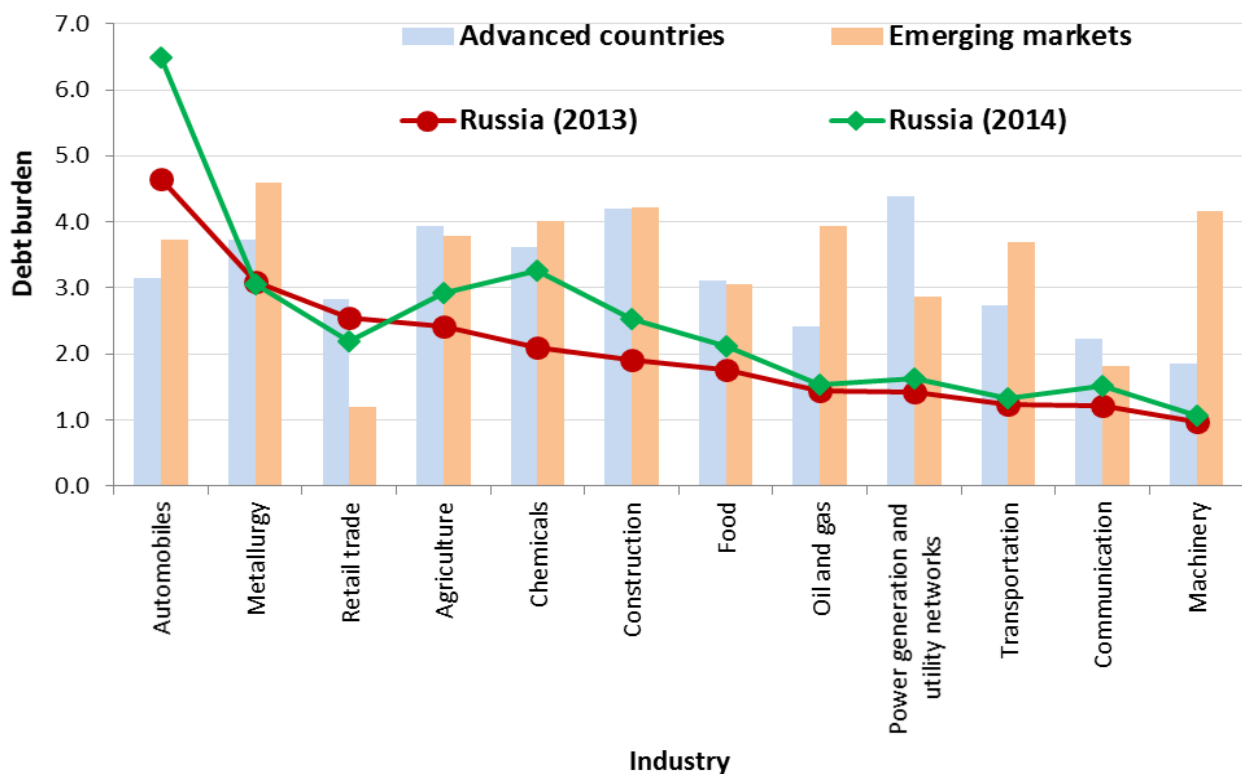
[11] The reported results are preliminary and should be interpreted with caution due to the limited number (approx. 320) of Russian companies in the panel. Besides, companies whose reports are available may not be representative for some industries. Alternative estimates based on larger Orbis database are provided by the IMF (2015). The outcomes of this research also indicate considerable debt burden-related risks in some industries of the Russian economy.

[12] Debt to EBITDA ratio. Data for Russian companies are taken from the companies' annual reports for 2013 and 2014 provided by Bloomberg. For foreign companies the latest data available as of May 2014 are used.

CONCLUSION

Relatively rapid lending growth in 2013-2014 (amid slower growth of real activity) and foreign currency denominated debt increase due to the ruble depreciation resulted in considerable growth of debt burden in Russia. Standard approaches show that the current credit to GDP ratio in Russia is likely to exceed the equilibrium level. The debt service ratio also indicates higher risks to financial stability largely related to foreign currency denominated debt of the corporate sector.

Judging by the obtained results we can conclude that in the short term high debt burden may predetermine slower credit growth even in case of monetary policy easing while the real sector undergoes deleveraging. These processes are primarily supposed to be typical of machinery, metallurgy, retail trade, agriculture and chemical industry.

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