

Financial instability in the region: assessment methods and elimination tools



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Abstract. Financial instability is one of the most important factors in the level and sustainability of socio-economic development of territories. However, at present, from the viewpoint of methodology, this concept is developed insufficiently in relation to the elimination and forecasting of economic and financial crisis threats. This problem is especially acute at the regional level. For its solution the article proposes a methodology for assessing the risks of financial instability; it helps to determine the indicators of the current state and development of regional finances that are most liable to volatility in the context of the main institutional sectors (government, business, households); the methodology also helps to forecast the probable maximum change in the indicators in the future with the use of the VaR methodology. The calculations carried out according to the proposed methodology on the example of the Republic of Bashkortostan show that regional finances are most vulnerable to fiscal risk. As a tool to eliminate budget risk the authors give several suggestions on improving the efficiency of interbudgetary transfers that make it possible to increase the degree of financial autonomy of the regions and to act as an effective incentive to their innovation development.

Key words: financial instability; region; indicators; interbudgetary transfers; regional finance.

The financial and economic crisis that has been developing on all the levels of administration, highlights the necessity to solve the most urgent and high-priority tasks such as the detection and study of the causes of the current financial instability and factors that determine it, the development of a methodology and tools for the elimination of risks and the forecast of possible manifestations of negative trends in the future.

Approaches to the assessment of financial instability

At present a relatively small number of publications in Russia deal with the development of models for assessing and forecasting financial volatility; the majority of such works either describe the dynamics of macroeconomic indicators and summarize international experience in the development of a system of indicators that are the signs of a crisis, or they attempt to create their own system of advanced indices (advanced composite index), but with focus on the real sector of the economy and with insufficient attention to the financial component.

However, we think that at present it is advisable to consider two works devoted to the development of tools to forecast financial instability in Russia. They were executed by the Gaidar Institute for Economic Policy (the Gaidar Institute) [16] and by the Center for Macroeconomic Analysis and Short-Term Forecasting [11]; these institutions have developed a system of indicators to forecast financial instability and an early warning system of financial crises, respectively. Their comparative characteristics are presented in *table 1*.

her models, despite the fact that they use various approaches, have an objective

disadvantage at the present stage of economic development: the existing financial and economic crisis is systemic in nature; as a result, the predictive power of the existing models that are built on retrospective data, is limited. This is acknowledged by the authors of some works (in particular [11]).

The grouping of studies aimed to identify financial instability factors makes it possible to select the following groups [16]:

1. Qualitative analysis. It is based on the graphical comparison of the dynamics of fundamental economic performance indicators in the pre-crisis period and during the normal state.

2. Econometric modeling. The essence of this approach consists in the construction of regression models, estimated with the use of logit - and probit-analysis showing the probability of emergence of financial instability from a certain financial-economic indicator during the forecast period.

3. Nonparametric assessment. This approach involves identifying the vulnerability of the financial system to instability, expressed in quantitative form. The work within this approach is organized according to two main directions: the establishment on the basis of different criterion parameters of threshold values of indicators of the possible crisis phenomena of financial character, as well as the development of integrated (combined) indices of financial stability.

Analyzing the advantages and disadvantages of each group, we can conclude that the third group that uses the “signal” approach is the most adequate for assessing financial instability.

Table 1. Comparative analysis of the models for assessing financial instability*

Parameter under comparison	System of indicators predicting financial instability	Early warning system of financial crises
Grouping of existing research methodologies	Qualitative analysis Econometric modeling (estimation of probability of crisis) Nonparametric estimation ("signal" approach)	Methodology for constructing the advance indicators of crisis Methods of macroeconomic stress testing Macroeconomic model (impact assessment of the implementation of medium-term scenarios)
Models under comparison	In general, on the basis of the "signal" approach and, to a lesser extent, with the help of statistical and econometric methods	Includes elements of all the three approaches under consideration ("signal", econometric, stress testing)
Advantages	Evaluation of the forecasting power of each indicator is individual, which allows the variables to be ranked	Application of the integrated approach provides a significant increase in the degree of correlation between the estimated data and the actual data
Shortcomings	Probability of a crisis is determined by a binary function, which does not make it possible to determine the degree of deviation of the indicator from the threshold value Subjectivity in determining the threshold values	Limited forecasting power, i.e. the ability of the model to predict new crises is significantly lower than its ability to predict the events similar to that which occurred previously
<p>* Sources: Ulyukaev A.V., Trunin P.V. <i>Primenenie signal'nogo podkhoda k razrabotke indikatorov-predvestnikov finansovoi nestabil'nosti v RF</i> [Application of the Signal Approach to the Development of Indicators-Precursors of Financial Instability in Russia]. <i>Problemy prognozirovaniya</i> [Issues of Forecasting], 2008, no. 5, pp. 100-109; Solntsev O.G., Pestova A.A., Mamonov M.E., Magomedova Z.M. <i>Opyt razrabotki sistemy rannego opoveshcheniya o finansovykh krizisakh i prognoz razvitiya bankovskogo sektora Rossii na 2012 g.</i> [Experience in Developing Early Warning System for Financial Crises and the Forecast of Russian Banking Sector Dynamic in 2012]. <i>Zhurnal novoi ekonomicheskoi assotsiatsii</i> [The Journal of the New Economic Association], 2011, no. 12, pp. 41-76.</p>		

These models for assessing financial instability, as well as many of the work [11] performed at the Moscow Center for Macroeconomic Analysis and Short-Term Forecasting (CMASF) describes the experience of developing early warning systems for risks of financial crises. The authors identify three stages (phases), which differ by key sources of resources and by intensity of increase in the real volume of loan to the economy:

- 1) the adaptation phase characterized by the reduction in lending to the real sector of the economy and the increase in the provisioning of banking institutions to mitigate the consequences of growth of the loan, currency, operational and other risks;
- 2) the saving phase, at which the key resources are deposits of the population; the increase in savings supports high values of interest rates that have increased during

the adaptation phase, and the decline in consumer spending; at the same time there is an increase in the demand for lending resources of the banking sector on the part of enterprises, people and government;

- 3) the phase of intensive import of capital, when the economy starts to carry out aggressive debt policy, which promotes the increase in the vulnerability of the financial sector and the economy to external shocks.

The work [11] also describes the drawbacks of the model of advanced indicators that predict financial instability; this model is proposed in the paper [16] they consist, first, in the absence of clear quantitative criteria for attributing the event to the concept of financial instability and, second, in the fact whether the model has a not very high predictive power for the crisis period of the end of 2008.

Thus, at present, when forming the system of indicators depending on the goals and objectives it is possible to use three basic approaches [3, p. 56]:

- on the basis of macroeconomic statistics indicators (gross domestic product, national income, investment in fixed capital, etc.), reflecting the socio-economic aspects of development of the society;

- on the basis of construction of relative indicators (shares, points, coefficients, ratings, indices, etc.) used in the analysis of economic activity by many economists and scientists;

- by forming a system of “alarm indicators” (“signal” approach), the main task of which is to warn executive structures of the excess of the current values of the indicator of the system of its limit parameters, which serves as a “signal” to the various structures of international, national, and regional levels concerning the adoption of relevant management decisions.

At the regional level, the methodology developed by A.I. Tatarkin and the group of authors [14] and also by S.N. Yashin, E.N. Puzova [19] should be pointed out as works that investigate financial stability in the framework of the assessment of the region’s economic security. Unlike the methodology developed by S.N. Yashin, which is based on the first approach (macroeconomic indicators), the methodology by A.I. Tatarkin contains the elements of all the three approaches discussed earlier, which gives some advantages [3, p. 62-63]:

- higher level of the hierarchy and more detailed structure of the indicators of the region’s socio-economic development;

- formation of threshold parameters of indicators of the region’s economic security, going beyond which serves as a signal of the onset of the crisis;

- use of score tools for assessing economic security;

- construction of classification of the states of economic security for staged zones (normal, pre-crisis 1, 2, 3, crisis 1, 2, 3);

- presence of interval values of the score estimates of the territorial economic security depending on the degree of crisis in the situation;

- summarizing and presenting a comprehensive assessment of the level of regional economic security.

Methodology of risk assessment

In risk assessment various indicators are used depending on the selected method; they include the following:

- standard deviation;
- variation coefficient;
- *VaR* index and others.

One of the most effective methods for assessing the risks of financial instability is the *Value-at-Risk (VaR)* methodology. The formula for calculating *VaR* is changed depending on the method chosen (more precisely, the technique chosen to estimate probability distribution). First, as a rule, the logarithm of the indicator’s growth is calculated by the formula (1):

$$D_i = \ln \left(\frac{x_i}{x_{i-1}} \right), \quad (1)$$

where D_i is the logarithm of the indicator’s growth in the i -th period;

x_i is the value of the random variable in the i -th period;

x_{i-1} is the value of the random variable in the period previous to the i -th period.

Then the value of *VaR* is calculated by *t* periods ahead according to the formula (2):

$$VaR_i(\alpha, t) = x_i \times (\bar{D} - k_\alpha \sigma) \times \sqrt{t}, \quad (2)$$

where \bar{D} is the mean value of the logarithm of the indicator's growth; k_α is the quantile of the normal distribution corresponding to the probability α ; σ is the standard deviation; *t* is the number of forecast periods.

The volatility, which is determined by the standard deviation formula (3), is often used as an indicator of risk assessment:

$$\sigma = \sqrt{\frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n - 1}}, \quad (3)$$

where \bar{x} is the mathematical expectation; *n* is the number of periods.

Another indicator of risk assessment is the variation coefficient, which, unlike the standard deviation, is expressed in the units of the estimated parameter. The variation coefficient is a relative indicator; due to this fact it is possible to compare the variation coefficients of different indicators with one another. The variation coefficient represents the ratio of the standard deviation to the mathematical expectation (4):

$$K_{var} = \frac{\sigma}{x}, \quad (4)$$

Thus, assessing the risks of financial instability requires a comprehensive approach that takes into account various aspects and parameters of indicators' change. In addition, it is necessary to ensure comparability of risk assessments by various indicators between themselves.

For this purpose there has been developed a method of assessing the risks of financial instability on the example of the indicators that characterize the state and development of regional finance in the Republic of Bashkortostan.

This methodology is based on indicators such as the standard deviation, the variation coefficient, the value of *VaR*.

The algorithm of risk calculation according to the methodology consists in the following:

1. Determination of the values of the indicators showing the status and development of regional finance that are proposed by the Institute of Social and Economic Research of Ufa Science Center of RAS for three economic sectors: social sector, business sector and household sector [1, 4, 15] (*tab. 2*).

In our opinion, this set of indicators makes it possible to assess most comprehensively the level of regional finance by the main sectors of economic activity.

2. Calculation of the standard deviation according to the formula (3).

3. Calculation of the variation coefficient according to the formula (4).

4. Calculation of the mean value of the variation coefficient for each sector (on the example of the social sector) according to the geometric mean formula (5):

$$K_{var(G)} = \sqrt[n]{K_{var(G_1)} \times K_{var(G_2)} \times \dots \times K_{var(G_n)}}, \quad (5)$$

where $K_{var(G)}$ is the variation coefficient for the social sector;

$K_{var(G_n)}$ is the variation coefficient of the *n*-th indicator.

Table 2. Indicators of the status and development of regional finance*

Social sector (G)	Business sector (B)	Household sector (H)
Ratio of budget deficit in the region to GRP (G_1)	Investments in fixed capital to GRP (B_1)	Savings activity of the population (H_1)
Amount of own budget funds per inhabitant (G_2)	Ratio of payables of enterprises and organizations of the region to GRP (B_2)	Investment activity of the population (H_2)
Share of federal transfers in the regional budget (G_3)	Share of overdue debt on loans of enterprises and organizations of the region (B_3)	
Ratio of tax arrears to the total tax revenues in the region (G_4)	Ratio of the net financial result of enterprises and organizations of the region to GRP (B_4)	
Amount of public debt to GRP (G_5)		
Level of monetization in % of GRP (G_6)		
Consumer price index (G_7)		

* Sources: Altuf'eva T.Yu. Osobennosti upravleniya regional'nymi finansami v usloviyakh postkrisisnoi modernizatsii [Specifics of Management of Regional Finance in the Post-Crisis Modernization]. *Innovatsionnye tekhnologii upravleniya sotsial'no-ekonomicheskim razvitiem regionov Rossii: Materialy V Vserossiiskoi nauchno-prakticheskoi konferentsii s mezhdunarodnym uchastiem* [Innovation Management Technology for Socio-Economic Development of Russia's Regions: Materials of the Fifth All-Russian Research-to-Practice Conference with International Participation]. In 3 parts. Ufa: ISEI UNTs RAN, 2013. Part 2. Pp. 108-113; Klimova N.I. Teoretiko-metodicheskie podkhody k formirovaniyu informatsionno – model'nogo kompleksa upravleniya regional'nymi finansami [Theoretical and Methodological Approaches to the Formation of the Informational and Model Complex for Regional Finance Management]. *Innovatsionnye tekhnologii upravleniya sotsial'no-ekonomicheskim razvitiem regionov Rossii: Materialy V Vserossiiskoi nauchno-prakticheskoi konferentsii s mezhdunarodnym uchastiem* [Innovation Management Technology for Socio-Economic Development of Russia's Regions: Materials of the Fifth All-Russian Research-to-Practice Conference with International Participation]. In 3 parts. Ufa: ISEI UNTs RAN, 2013. Part 2. Pp. 129-134; Tyutyunnikova T.I. Vremya kak ekonomicheskii resurs i analiz ego ispol'zovaniya v sektore domokhozyaistv [Time as an Economic Resource and the Analysis of Its Use in the Household Sector]. *Ibidem*. Pp. 151-155.

5. Assessment of the multiple variation coefficient according to the formula (6):

$$K_{\text{var}(C)} = \sqrt[3]{K_{\text{var}(G)} \times K_{\text{var}(B)} \times K_{\text{var}(H)}} \quad (6)$$

where $K_{\text{var}(C)}$ is the multiple variation coefficient for the three sectors; $K_{\text{var}(B)}$ is the variation coefficient for the business sector; $K_{\text{var}(H)}$ is the variation coefficient for the household sector.

6. Calculation of the VaR value for the indicators that are changing according to the normal distribution law (2).

The further testing of the risk assessment methodology on the basis of the indicators proposed above will help to assess the level of exposure of the region to financial instability risks in terms of the sectors.

The *testing* of the risk assessment methodology carried out on the example

of the Republic of Bashkortostan (RB) in 2000–2011 consists of the following stages.

Stage 1. Based on the above algorithm it is necessary at this stage to determine the values of the indicators showing the status and development of regional finance in the three sectors. All the indicators, except for one – the volume of funds per resident – are expressed in relative units and characterized by multidirectional dynamics (*tab. 3*).

Stages 2–4. The results of the calculation of the standard deviation (3), of the mathematical expectation, of the variation coefficient (4) and of the VaR values (2) for each indicator of the status and development of the regional finance and for the economic sectors as a whole are presented in *table 4*.

Table 3. Indicators of the status and development of finance in the Republic of Bashkortostan in 2000–2011*

Indicator	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
<i>Social sector (G)</i>												
$G_1, \%$	0.98	-0.51	-0.30	0.89	0.11	1.17	1.71	0.12	1.23	-0.52	-0.33	-0.55
G_2 , thousand rub.**	8.99	5.24	5.22	6.62	5.60	6.32	8.16	8.23	9.22	7.69	7.52	7.99
$G_3, \%$	13.48	28.70	23.15	19.31	19.58	19.31	18.32	16.25	16.08	22.37	20.67	20.80
$G_4, \%$	41.94	42.37	33.83	37.43	30.69	29.93	23.49	16.59	10.8	11.42	8.62	5.87
$G_{51}, \%$	-	-	-	-	-	-	0.65	0.69	0.51	1.07	1.34	1.21
$G_{61}, \%$	21.08	23.12	34.01	36.71	36.82	36.62	37.32	40.22	34.86	46.67	52.66	47.09
$G_7, \%$	121.6	117.4	114.7	111.1	114.3	110.9	108.9	112.6	112.4	108.3	109.6	106.4
<i>Business sector (B)</i>												
$B_1, \%$	24.46	28.17	25.04	22.55	21.69	22.13	21.33	27.17	27.41	22.86	20.22	19.81
$B_2, \%$	47.72	42.80	41.88	40.00	31.89	30.93	23.26	26.20	21.97	29.41	29.94	31.09
$B_3, \%$	57.7	53	44.1	36.2	29.7	23.1	17.1	9.5	7.8	7.2	5.8	3.7
$B_4, \%$	29.88	23.80	13.10	17.37	12.68	27.75	18.93	15.35	11.11	9.63	17.64	11.54
<i>Household sector (H)</i>												
$H_1, \%$	2.7	3.5	3.9	5.2	4.8	3.9	4.1	4.1	0.3	3.0	4.5	3.1
$H_2, \%$	1.2	2.0	1.0	1.6	1.7	1.4	1.4	1.2	1.4	0.7	0.7	0.9

* Sources: *Regiony Rossii. Sotsial'no-ekonomicheskie pokazateli. 2012: stat. sb.* [Regions of Russia. Socio-Economic Indicators. 2012: Statistics Collection]. Rosstat. Moscow, 2012. 990 p.; Ob'єм i struktura gosudarstvennogo dolga Respubliki Bashkortostan [Volume and Structure of the Public Debt of the Republic of Bashkortostan]. *Ministerstvo finansov Respubliki Bashkortostan* [Ministry of Finance of the Republic of Bashkortostan]. Available at: http://minfinrb.bashkortostan.ru/11/dolg2006_2012.htm

** Adjusted for inflation.

Table 4. Values of the standard deviation, the variation coefficient and the VaR by the indicators and sectors as a whole for 2000–2011*

Indicator	Standard deviation (σ)	Mathematical expectation (\bar{x})	Variation coefficient (K_{var})	Value of VaR for 2012
$G_1, \%$	0.497	0.702	0.708	2.4
G_2 , thousand rub.	1.403	7.234	0.194	4.263
$G_3, \%$	3.907	19.386	0.197	12.574
$G_4, \%$	13.374	24.415	0.548	3.578
$G_{51}, \%$	0.310	0.912	0.340	0.965
$G_{61}, \%$	9.097	37.264	0.244	13.650
$G_7, \%$	4.215	112.350	0.038	4.551
Total for G	-	-	0.241	-
$B_1, \%$	2.851	23.569	0.121	6.045
$B_2, \%$	8.174	33.092	0.247	12.953
$B_3, \%$	19.317	24.575	0.786	2.219
$B_4, \%$	6.642	17.397	0.382	12.940
Total for B	-	-	0.308	-
H_1	1.272	3.592	0.354	8.073
H_2	0.398	1.267	0.315	0.858
Total for H	-	-	0.334	-
$H_{(M)}$	0.738	3.891	0.190	1.839
Total for H_M **	-	-	0.244	-

* Calculated according to the data from table 3.

** H_M – value of K_{var} for sector H without taking into account savings activity (H_1) for 2008.

Step 5 consists in the definition of the multiple variation coefficient. Due to the fact that 2008 witnessed the failure of the savings activity (0.3%) representing the ratio of the volume of savings of households to the money income of the population, it was decided to calculate the multiple variation coefficient with and without taking into account this indicator for 2008 according to the formula (7):

$$\begin{aligned} K_{\text{var}(C)} &= \sqrt[3]{K_{\text{var}(G)} \times K_{\text{var}(B)} \times K_{\text{var}(H)}} = \\ &= \sqrt[3]{0.241 \times 0.308 \times 0.334} = 0.291 \quad (7) \\ K_{\text{var}(C)(M)} &= \sqrt[3]{0.241 \times 0.308 \times 0.244} = 0.263 \end{aligned}$$

where $K_{\text{var}(C)}$ is the multiple variation coefficient for the three sectors; $K_{\text{var}(C)(M)}$ is the multiple variation coefficient for the three sectors excluding savings activity (H_i) in 2008 for sector H .

When the value of the variation coefficient exceeds 33%, the aggregate is considered uneven, if the value is less than 33%, the aggregate is considered homogeneous. The more homogeneous the aggregate (i.e., it is less dispersed in relation to its average value), the more reliable and adequate the results of the statistical analysis built on this aggregate. The value of the multiple variation coefficient for the Republic of Bashkortostan in 2000–2011 was characterized by the homogeneous population and was 29.1% with respect to savings activity (H_i) for 2008 and 26.3% excluding 2008; it proves the reliability of the statistical analysis of the calculated data. The social sector has the lowest value of K_{var} on average across the sectors (24.1%); the volatility of the business sector

is slightly higher (30.8%), but within the limits of homogeneity. The household sector excluding 2008 is also homogeneous with regard to volatility (24.4%). However, taking into consideration the year 2008, the variability is characterized by weak heterogeneity (33.4%), though it is in the borderline condition.

The greatest contribution to the total volatility is made by the indicators of the social sector (the ratio of the region's budget deficit to GRP, the ratio of tax arrears to the total amount of the region's tax revenues, the ratio of the volume of public debt to GRP) and the business sectors (the share of loan arrears of enterprises and organizations in the region, the ratio of net financial result of enterprises and organizations of the region to GRP) and households (savings activity). It should be noted that the indicator "the ratio of tax arrears to the total amount of the region's tax revenues" and "the share of loan arrears of enterprises and organizations in the region" have a steady decreasing trend throughout the whole period, and their high value of volatility (K_{var}) is caused by a large gap between the current positive dynamics in the present and the negative dynamics in the past.

Stage 6. The final sixth stage of the methodology for assessing financial instability risks consists in the calculation of the *VaR* value according to the formula (2) for the indicators that change according to the normal distribution law.

First it is necessary to determine whether the empirical sampling under consideration corresponds to the normal distribution law. To do this it is necessary to apply the

statistical function CHIDIST from the software package MS Excel, which helps to determine the probability $P(\chi^2)$ using Pearson's chi-square (χ^2). The degree of deviation of the actual (empirical) distribution from the theoretical one is determined on the basis of $P(\chi^2)$. When $P > 0.5$, it is considered that the empirical and theoretical distributions are close; when $P \in [0.2; 0.5]$, the coincidence between them is satisfactory; in other cases it is insufficient [18, p. 25].

The calculations in Excel, conducted with the use of the indicators selected for 2000–2011, show that the probability $P(\chi^2)$ by all the indicators varies from 0.78 to 0.99, with 11 degrees of freedom; this allows us to speak about the compliance with the normal distribution law. The next step is to calculate the VaR value according to the formula (2). The results of the calculations are given in table 4. As an example, let us calculate the VaR for the indicator “investments in fixed capital in % to GRP” (B_t). First, the logarithm of the growth of the indicator by years is calculated according to the formula (8):

$$D_{2001} = \ln\left(\frac{x_{2001}}{x_{2000}}\right) = \ln\left(\frac{28.17}{24.46}\right) = 0.141 \quad (8)$$

D for the rest of the period will be: -0.118; -0.105; -0.039; 0.020; -0.037; 0.242; 0.008; -0.181; -0.123; -0.020. The mathematical expectation is:

$$\begin{aligned} \bar{D} = & (0.141 - 0.118 - 0.105 - 0.039 + 0.020 - \\ & - 0.037 + 0.242 + 0.008 - 0.181 - 0.123 - \\ & - 0.020) / 11 = -0.019 \end{aligned}$$

Next, the volatility of the growth logarithm is calculated according to the standard deviation formula (9):

$$\sigma = \sqrt{\frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n-1}} = \sqrt{\frac{0.1512}{11-1}} = 0.123 \quad (9)$$

Then the value of VaR in t periods ahead (in our case, for one year) is calculated according to the formula (10):

$$\begin{aligned} VaR_i(\alpha, t) &= x_i \times (\bar{D} - k_\alpha \sigma) \times \sqrt{t} = \\ &= 0.1981 \times (-0.019 - 2.326 \times 0.123) \times \\ &\quad \times \sqrt{1} = -0.06 \end{aligned} \quad (10)$$

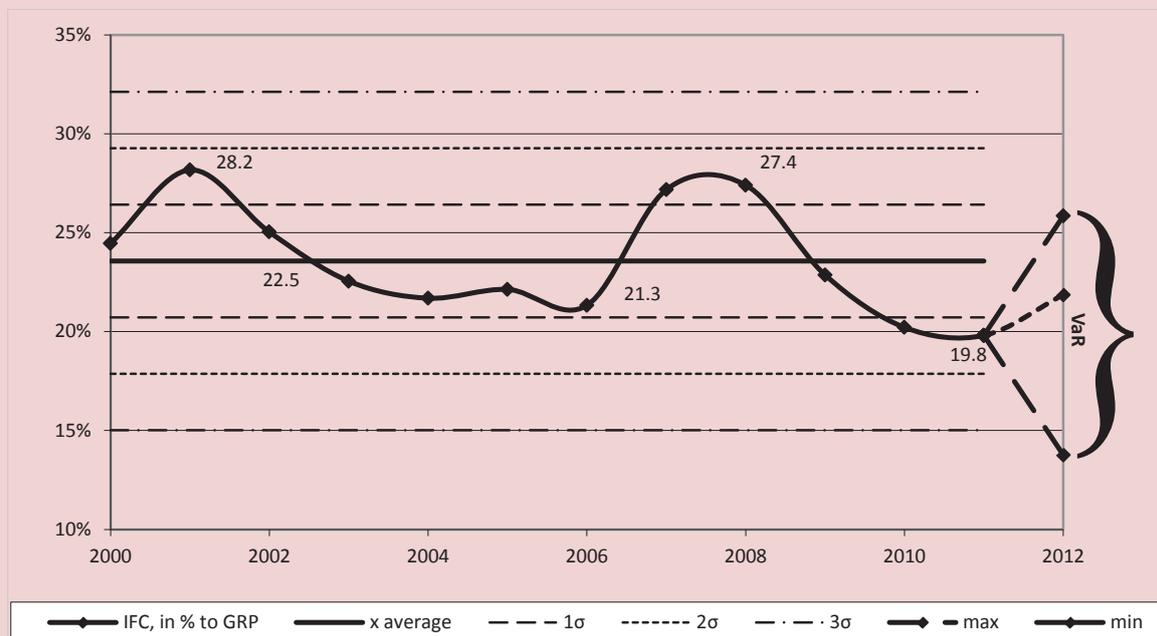
The value of k_α – the quintile of normal distribution, corresponding to the probability α , is taken from the Laplace table of function values. For $\alpha = 99\%$ it is 2.326. Thus, the value of VaR for 2012 is 6.0%, which means that in 2012 with a probability of 99% the indicator of the value of investments in fixed capital in % to GRP will not deviate by more than 6% compared to the level of 2011 (fig. 1).

Another method can be used to verify the correctness of the calculations. By using the statistical function NORMINV in Excel (probability; mean; standard deviation), which returns the normal distribution, the corresponding quantile is calculated. Entering data “=NORMINV(1%; -0.019; 0.123)”, we will get $k_{99} = -0.305$. Then the value of VaR is calculated by the formula (11):

$$\begin{aligned} VaR &= x_i - (x_i \times (1 + k_\alpha)) \\ VaR &= 0.1981 - (0.1981 \times (1 - 0.305)) = 0.06 \end{aligned} \quad (11)$$

The value of VaR is the same in both cases, which proves the correctness of the calculations performed.

Figure 1. Investments in fixed capital as a percentage of GRP of RB for 2000–2011*



* Calculated using the following sources: *Regiony Rossii. Sotsial'no-ekonomicheskie pokazateli. 2007: stat. sb.* [Regions of Russia. Socio-Economic Indicators. 2007: Statistics Collection]. Rosstat. Moscow, 2007. P. 351; *Regiony Rossii. Sotsial'no-ekonomicheskie pokazateli. 2013: stat. sb.* [Regions of Russia. Socio-Economic Indicators. 2013: Statistics Collection]. Rosstat. Moscow, 2013. P. 374.

Another way to assess the degree of risk is to use the three-sigma rule, according to which with the probability of 99.73% the random variable will lie in the interval $\pm 3\sigma$ from the mathematical expectation, which makes it possible to determine for each indicator the values for the most optimistic and pessimistic development scenarios.

For example, for the indicator of investment in fixed capital as a percentage of GRP (B_f) the measure of risk according to the most pessimistic scenario judging by table 4 will be:

$$R_{B_f} = x - 3 \times \sigma = 23.569 - 3 \times 2.851 = 15.0 ;$$

according to the most optimistic scenario it will be:

$$R_{B_f} = x + 3 \times \sigma = 23.569 + 3 \times 2.851 = 32.1 .$$

In addition, the application of the three-sigma rule narrows the range of predicted values of VaR (for example, in figure 1 the lower threshold value of VaR of 13.8% is below the 3σ value defined as being 15%, which makes it possible to raise the lower threshold of VaR).

According to the RB Ministry of Economic Development [5], in 2012 the share of investments in fixed capital in GRP in RB was 21.9%, which fits into the range forecasted by the VaR method (19.8 ± 6.0).

The above calculations show that this technique makes it possible to assess the risks of financial instability in the region in terms of sectors, to determine which

indicators have the greatest contribution to the change of the total volatility, and, hence, instability of finance in the region, to forecast the maximum possible changes in the indicators with the normal distribution, depending on the level of the confidence interval.

Inter-budget transfers as a tool to reduce financial instability in the regions

The analysis of the indicators showing the status and development of regional finance in the Republic of Bashkortostan shows that the most volatile index is the ratio of the region's budget deficit to GRP (G_7). Inter-budget transfers are a tool to reduce financial instability in the form of budget risk at the state level; they aim to provide financial assistance to the regions and to ensure the alignment of their level of socio-economic development.

However, if there is a high proportion of financial assistance from upline budgets in the revenues of territorial budgets, the degree of financial autonomy of the regions reduces.

At the same time, the state of the region depends not only on additional cash receipts, but also on the structure and quality of these investments. The solution of the current financial challenges involves the change of approaches to the use of traditional tools, which are inter-level transfers.

Until now, the main purpose of their distribution was to overcome the spatial polarization of the regional economy, the elimination of vertical and horizontal fiscal imbalances.

However, recently, the emphasis in financial support has been increasingly

shifting to the promotion of its catalytic function. In this regard, inter-budget transfers at the regional level should be used not as tools for implementation of the policy of "plugging holes" in the regional and local budgets but as effective tools to create conditions for the formation of points of growth in the regional economy.

The high centralization of revenues in the federal center and, at the same time, the excessive load of expenditure commitments that falls on the regional and municipal entities require updating the system for allocation of inter-budget transfers from the federal center, the transition to the principle of the systemic allocation of financial support based on the introduction of improved techniques of budget regulation.

The close relationship between the region's tax potential and inter-budget transfer regulation requires the improvement of inter-budget relations in order to create genuine self-sufficiency of the region's budgets.

The analysis (*tab. 5*) carried out on the materials of the Volga Federal District regions has revealed that five out of fourteen regions transfer more than half of the taxes, duties and mandatory payments (range from 49.1 to 66.1%) to the federal budget.

At the same time, the return of financial resources from the federal budget in six regions exceeds the amount of centralized funds (in 1999 – only three regions) and ranges from 162.1 to 447.9%, which indicates significant dependence of the regions on the receipts of funds from the federal center.

Table 5. Counter flows by the levels of the budgetary system in 2011, %*

Region	Receipt of taxes, levies and other mandatory payments, in % to the total volume of receipts		Share of transfers from the taxes allocated by the regions in the federal budget, %	Budget security, thousand rub.	For reference: the share of transfers in the consolidated budget of the constituent entity of the Russian Federation, %
	in the federal budget	in the consolidated budget of the subjects of			
Volga Federal District	47.8	52.2	39.9		
Republic of Bashkortostan	45.1	54.9	31.7	33.3	20.8
Republic of Mari El	18.7	81.3	447.9	31.2	45.9
Republic of Mordovia	28.3	71.7	340.3	41.0	53.6
Republic of Tatarstan	56.7	43.3	37.2	50.4	31.2
Udmurt Republic	64.6	35.4	25.9	34.9	29.6
Chuvash Republic	32.5	67.5	162.1	29.9	39.1
Perm Krai	49.1	50.9	15.5	41.2	12.8
Kirov Oblast	22.5	77.5	263.9	36.1	37.7
Nizhny Novgorod Oblast	29.0	71.0	59.9	37.9	19.6
Orenburg Oblast	66.1	33.9	15.1	38.4	20.1
Penza Oblast	24.1	75.9	289.0	34.6	39.6
Samara Oblast	49.1	50.9	15.5	40.9	13.8
Saratov Oblast	34.0	66.0	80.4	30.2	27.3
Ulyanovsk Oblast	25.3	74.7	166.4	31.1	31.8

* Compiled by: *Sotsial'no-ekonomicheskoe polozhenie federal'nykh okrugov. 2011: stat. Byulleten'* [Socio-Economic Situation in the Federal Districts. 2011: Statistics Bulletin]. Rosstat. Moscow, 2011. Available at: http://www.gks.ru/bgd/regl/b11_20/IssWWW.exe/Stg/4-kw/p/06-02.htm; *Finansy Rossii. 2012: stat. sb.* [The Finances of Russia. 2012: Statistics Collection]. Rosstat. Moscow, 2012. P. 54; *Regiony Rossii. Sotsial'no-ekonomicheskie pokazateli. 2012: stat. sb.* [Regions of Russia. Socio-Economic Indicators. 2012: Statistics Collection]. Rosstat. Moscow, 2012. P. 829.

Proposals to increase the efficiency of inter-level transfers

1. *Subventions* are allocated to the Russian Federation subjects for financing the expenditure commitments of the subjects in order to implement the delegated powers of the federal authorities, stipulated by normative legal acts according to the established procedure. Frequent changes in the funding requirements reduce the quality of execution of budget powers delegated to the regional and municipal level, as well as the interest of the regions and municipalities in the most efficient execution of somebody else's powers.

Therefore, it is advisable to review the current system of delineation of powers by transferring part of them to the regional level, with the simultaneous increase of the territories' own financial resources through the allocation of additional deductions from regulatory taxes to regional budgets; this will lead to greater financial autonomy of the regions.

In order to reduce the number of different subventions, it is advisable to shift to the provision of consolidated block subventions. All these measures will reduce the number of subventions in inter-budget transfers.

2. *Block transfer* is a consolidated subsidy (subvention) to finance a specific industry, used in several directions, but this subsidy can be also used for the modernization of the industry as a whole. Thus, the Ministry of Finance in 2014 proposed to reduce the number of subsidies from 90 to 42 and to equalize them with the number of state programs. A.G. Siluanov, the Minister of Finance of the Russian Federation, provided the following figures: "...At the end of 2012 there remained 242 billion rubles of subsidies and subventions, out of which 165 billion rubles – for investment purposes" [2]. At the same time, the Ministry of Finance proposed to increase the incentive transfers up to 11 billion rubles to the federal subjects for the development of fiscal capacity.

3. In order to strengthen the incentive function of transfers it has been proposed to change the practice of budget subsidizing for the system of *grant support*. The calculation of equalization grants in the allocation of the compensation sums in the revenue part of the regional budget use the formulas that take into account the specifics of economic and socio-demographic characteristics of the region (the calculations are based on the weight-average and specific per capita indicators). A formalized approach of the calculations eliminates the influence of interested parties and a long way of endorsement. An alternative is the introduction of incentive grants as an additional source of co-financing of the funds that the region is lacking.

4. *Program-target planning* can be used along with the grant funding; it focuses financial resources on the solution of priority socio-economic issues and increases

the efficiency of budget expenditures. Thus, the budget expenditures should be covered with the funds concentrated in the framework of implementation of the state and long-term programs. Spending powers of the federal budget in 2014 were formed by 90% on a program basis. The plans for execution of major events for 2013 on the implementation of the "Strategic Map of the Treasury of Russia for 2013–2017" [13] in paragraph 3.4 provide for "...the implementation of a new mechanism for providing inter-budget subsidies, subventions and other inter-budget transfers that have target purpose from the federal budget to the budgets of the Russian Federation subjects (local budgets)". The programs are implemented by attracting the transfers, which are distributed mainly in the regions that occupy leading positions according to factors such as investment and innovation advantage and potential growth points.

5. The procedure for allocation of investment subsidies should be identical to the mechanism of allocating targeted transfers. Attraction of foreign investors in the co-financing of the investment project in the region will help to save local budget funds. The subsidizing of capital construction objects is also promising in the medium-term budget planning for a period of not less than three years with the mandatory coverage of operating costs of a new facility at the expense of own funds. The distribution of subsidies should be carried out taking into account the socio-economic condition of clusters and the quality of investment programs for development of infrastructure facilities belonging to regions that have potential growth points. The distribution of subsidies

within the cluster is carried out according to individual integrated assessment and the number of population. The list of documents required and conditions of the subsidies provision are specified in [7].

Thus, the transfers do not only support the budget balance or fulfill the federal powers of the center assigned to the region through the mechanism of subventions. They stimulate further development

through the mechanism of subsidizing national and inter-regional innovation projects, which is especially important in the period of post-crisis growth, by acting as an effective mechanism of reducing financial instability and comprehensive modernization of the finance management system on the principles of balance, effectiveness, efficiency and transparency.

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