Section: Economics and Manufacturing
Some Approaches to the Selection of Regional Financial Instability Determinants

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Abstract. Financial instability assessment and forecasting at the regional level involves selecting key indicators, the list of which will differ depending on the specifics of the region's activities. In order to solve the problem set, it is necessary to identify the most volatile indicators, set correlations between economic indicators through building linear regression models using the least squares and co-integrated regression methods. It is also necessary to identify indicators that help predict recessions in the economic system of a region through the use of binary choice models.

1. Introduction
The financial instability of economic systems is determined by the researchers based on the selection of economic indicators signaling instability when reaching certain limit values. This approach is described in the works by A. V. Ulyukayev, P. V.

Trunin [1], Ya. A. Kabakov [2], Ye. A. Fyodorova, F. Yu Fyodorov [3, 4]

Financial instability is often defined as the volatility of economic indicators. This approach is used in the works by P. A. Ivanov and G. R. Sakhapova [5], A. A. Pestova [6]. In this case, the volatility criterion of an indicator is the value at risk.

The problems of selecting economic indicators for the assessment of financial instability are described in the works of M. Yu. Malkina [7], Ye. A. Fyodorova, L. Ye. Khrustova [8], K. Kh. Zoyidov, K. S. Yanauskas, N. L. Pirogov [9,10], A. A. Voronov [11], O. I. Karepina, O. A. Korochentseva [12], V. A. Sadovnichiy, A. A. Akayev [13]

The necessity of the financial instability study at the regional level is justified in the works by M. Yu Malkina [14], Z. Sh. Ivanova, S. A. Makhosheva [15], R. M. Sadykov, Yu. V. Migunova [16].

It is obvious, that sets of key indicators for financial stability assessment varies depending on each individual region.

2. Setting the research objective
The subject matter of the research is represented by ten economic indicators from seven regions of Russia (and their dynamics from 2004 to 2017). The analyzed data were received from the Ministry of Finance of the Russian Federation [17], and the Government Committee on Statistics of the Russian Federation [18].
In order to identify the key factors of financial instability, we used such methods as the linear regression model, co-integrated model by Engle-Granger, and logit-models.

3. Theoretical part

At the first stage, we calculated variance factors for each region, using the selected ten indicators, and we identified the most volatile of them. In Table 1, the + signs mark the most volatile indicators with variance factors of 50% or more for each of the regions.

Besides, using the calculations of the consolidated variance factor, we identified the regions with heterogeneous data population. These regions in Table 1 are marked yellow.

| Economic indicators                   | Central Federal District | Volga Federal District | Southern Federal District | North Caucasian Federal District | North-western Federal District | Siberian Federal District | Far Eastern Federal District |
|---------------------------------------|--------------------------|------------------------|---------------------------|---------------------------------|-------------------------------|---------------------------|-----------------------------|
| Per capita gross domestic product     |                          |                        |                           | +                               |                               |                           |                             |
| Per capita income                     |                          |                        |                           |                                 |                               |                           |                             |
| Public debt                           |                          |                        |                           | +                               | +                             | +                         | +                           |
| Unemployment level                    |                          |                        |                           | +                               | +                             | +                         | +                           |
| Fixed capital investments             |                          |                        |                           | +                               | +                             | +                         | +                           |
| Balanced financial result             |                          |                        |                           | +                               | +                             | +                         | +                           |
| Consumer price index                  |                          |                        |                           | +                               | +                             | +                         | +                           |
| Overdue salaries payable Federal revenues |                      |                        |                           | +                               | +                             | +                         | +                           |
| Corporate and retail deposits         |                          |                        |                           | +                               | +                             | +                         | +                           |

During the next stage, we aimed to analyze the correlations between the economic indicators using the Gretl free-access econometrics package. Table 2 shows indicators influencing the per capita gross regional product with a five-percent significance level.

When developing regression equations, some regions did not have any significant variables, however, their determination factor was over 90% and their p-values were lower than the significance level. This situation indicates multicollinearity among regressors. In order to eliminate multicollinearity, we excluded excessive variables using the bilateral p-value at the level of 5%.
### Table 2. The analysis of economic indicator correlations through building a linear regression model.

| Economic indicators | Central Federal District | Volga Federal District | Southern Federal District | North Caucasian Federal District | Northwestern Federal District | Siberian Federal District | Far Eastern Federal District |
|---------------------|-------------------------|------------------------|---------------------------|---------------------------------|-------------------------------|---------------------------|----------------------------|
| Per capita gross domestic product | +                      | +                      | +                         | +                               | +                             | +                         | +                          |
| Per capita income   | +                      |                        |                           |                                 |                               |                           |                            |
| Public debt         | +                      |                        |                           |                                 |                               |                           |                            |
| Unemployment level  | +                      | +                      | +                         |                                 |                               |                           |                            |
| Fixed capital investments | +                     |                        |                           |                                 |                               |                           |                            |
| Balanced financial result | +                   |                        |                           |                                 |                               |                           |                            |
| Consumer price index |                        |                        |                           |                                 | +                             | +                         | +                          |
| Overdue salaries payable |                        |                        |                           |                                 | +                             | +                         | +                          |
| Federal revenues    | +                      |                        |                           |                                 |                               |                           |                            |
| Corporate and retail deposits | +                  |                        |                           |                                 | +                             |                           | +                          |

At the next stage, we analyzed determinant graphs and assumed a false correlation in the time series of indicator values. We eliminated the false correlation using the first-order difference method. The results are presented in Table 3.

### Table 3. The analysis of correlations between economic indicators after the elimination of false correlation.

| Economic indicators | Central Federal District | Volga Federal District | Southern Federal District | North Caucasian Federal District | Northwestern Federal District | Siberian Federal District | Far Eastern Federal District |
|---------------------|-------------------------|------------------------|---------------------------|---------------------------------|-------------------------------|---------------------------|----------------------------|
| Per capita gross domestic product | +                      | +                      | +                         | +                               | +                             | +                         | +                          |
| Per capita income   | +                      |                        |                           |                                 |                               |                           |                            |
| Public debt         | +                      |                        |                           |                                 |                               |                           |                            |
| Unemployment level  | +                      | +                      | +                         | +                               | +                             | +                         |                            |
| Fixed capital investments |                        | +                      | +                         |                                 |                               |                           |                            |
| Balanced financial result | +                   |                        | +                         |                                 | +                             |                           | +                          |
The methods of nonstationary time series reduction to stationary series always involve the partial loss of the initial data, which leads to the reduction of certainty of conclusions and economic situation forecasts.

The analysis of nonstationary time series can be conducted using the multidimensional co-integrated Engle-Granger model. The economic indicators identified during the analysis are shown in Table 4.

**Table 4.** The correlation analysis for economic factors using the Engle-Granger model.

|                      | Central Federal District | Southern Federal District | North Caucasian Federal District | Far Eastern District |
|----------------------|--------------------------|---------------------------|----------------------------------|----------------------|
| Per capita gross domestic product | +                        | +                         | +                                | +                    |
| Per capita income    | +                        | +                         |                                  | +                    |
| Public debt          | +                        | +                         |                                  | +                    |
| Unemployment level   |                          |                           |                                  |                      |
| Fixed capital invest- |                          |                           |                                  |                      |
| Balanced financial result |                          |                           |                                  |                      |

|                      |                          |                           |                                  |                      |
|----------------------|--------------------------|---------------------------|----------------------------------|----------------------|
|                     |                          |                           |                                  |                      |
| Consumer price index |                          |                           |                                  |                      |
| Overdue salaries     |                          |                           |                                  | +                    |
| Federal revenues     |                          |                           |                                  | +                    |
| Corporate and retail deposits | +                    |                           |                                  | +                    |

There were no significant correlations found between the indicators from Volga, Northwestern, and Siberian Federal Districts. In the Far Eastern Federal District, some correlations were found between individual determinants with the significance level of 10%.

To promote further search of correlations between the regional economic indicators, we used the logit model, which is widely used for predicting economic recessions.

The results of indicator correlations analysis using the logit model are presented in Table 5.
Table 5. Key indicators for recession forecasting using logit-models.

| Economic indicators          | Central Federal District | Volga Federal District | Southern Federal District | North Caucasian Federal District | North-western Federal District | Siberian Federal District | Far Eastern Federal District |
|-----------------------------|--------------------------|------------------------|---------------------------|----------------------------------|-------------------------------|--------------------------|-------------------------------|
| Per capita gross domestic product | +                        | +                      | +                         | +                                | +                             | +                        | +                             |
| Per capita income           | +                        | +                      | +                         |                                  |                               | +                        | +                             |
| Public debt                 | +                        | +                      | +                         |                                  |                               | +                        |                               |
| Unemployment level          | +                        | +                      | +                         |                                  |                               | +                        |                               |
| Fixed capital investments   | +                        | +                      | +                         |                                  | +                             | +                        | +                             |
| Balanced financial result   |                          |                        |                           |                                  |                               |                          |                               |
| Consumer price index        |                          | +                      | +                         | +                                | +                             | +                        | +                             |
| Overdue salaries payable    |                          |                        | +                         | +                                | +                             | +                        | +                             |
| Federal revenues            |                          | +                      | +                         | +                                | +                             | +                        | +                             |
| Corporate and retail deposits |                          |                        |                           |                                  |                               | +                        | +                             |

4. Practical relevance
In this research, we proved that there are interregional differences in regions’ financial stability indicator sets.

Using the statistic, calculation, constructive, economic and mathematical methods of data analysis, we identified key economic indicators for each region of Russia in order to assess and forecast their financial stability.

The suggested approaches to indicator selection can be used for developing additional key indicators characterizing the public and business sectors in a region.

5. Conclusions
In this research, we formulated and presented key indicators for the analysis of the financial situation in the regions of Russia. The indicators in Tables 1, 3, and 4 shall be used for the comprehensive assessment of a region’s financial situation, while Table 5 data can be only used for predicting recession using binary choice model.

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