# DEVELOPMENT OF THE MEDIUM-TERM PROGNOSIS OF THE VOLGA FEDERAL DISTRICT DEVELOPMENT USING COMPATIBLE PATTERNS OF ECONOMIC GROWTH

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Abstract: The development of predictive economic growth models, their improvement and adaptation, and the transforming conditions of institutional factors require constant refinement of the methodological tools. Upon that, the most important task is the search for a system of factors that would explain the trends in economic dynamics on the one hand and, on the other hand, would be unified for the whole set of regional systems, what creates the possibility of a comparative analysis for economic growth drivers. This paper is devoted to the investigation of this problem. The object of the study is unified factors of economic growth in the regions of the Volga Federal District. The subject of the study is a system for modeling the parameters of economic dynamics based on the identification of exogenous factors which are uniform for all regional systems. As a result of the implemented estimates based on econometric modeling tools, economic growth models for the regions of the Volga Federal District were determined based on the principles presented above. This allowed using the methods of scenario modeling to develop a system of prognostic assessments of their economic development for the period up to 2020, as well as to justify the system of measures for state regulation of regional development in the conditions of cyclical development of the national economic system.

Keywords: modeling of economic dynamics, regional system, scenario prediction, unified factors of economic growth, factor analysis

## 1 Introduction

The questions of constructing prognostic models on the economic growth of regional systems with regular frequency arise and damp within the scientific and expert research discussion space. The theory of prediction and modeling of economic dynamics, despite its seemingly extensive elaboration within the framework of various kinds of traditional and non-traditional approaches, is still far from complete state and requires further improvement and refinement of the concepts of structural and logical analysis, and the paradigm and patterns of comparative analysis.

To date, the scientific community has developed a very large number of methodological approaches that form the basis for the development of economic growth models. At the same time, three main directions of research are distinguished: traditional, evolutionary and institutional, and synergetic (Ivanter et al, 2007; Villalobos Antúnez & Bozo, 2010).

Each of them operates with its own set of tools and factors that reveal the characteristics of macroeconomic generation. At the same time, the entire set of key factors affecting economic growth can be presented in concentrated form as follows:

- Price changes;
- Adjustment of interest rates;
- Investment activity;
- Savings;
- Adjustment of the money supply
- Growth / decrease in the level of employment;
- Innovative activity, shaping the change in labor productivity;
- Income of the population;

In fact, Their conjunction and combination between themselves, determines the differentiation of scientific views and approaches to building models of economic growth. Thus, it can be stated that the diversity of views and scientific approaches to the study of economic dynamics is rather multidimensional, complex and often contradictory (Safiullin et al, 2017; Elshin & Abdukaeva, 2017; Aksyanova, 2010; Folarin & Folarin, 2018).

## 2 Methodology

In this paper, the authors attempt to apply the identified set of factors affecting the parameters of economic growth within the framework of building unified economic growth models for the regions under study of the Volga Federal District. At the same time, an important methodological element was the definition of such factors, which on the one hand were standardized from the point of view of their unification to the models being developed, and on the other hand, characterized the macroeconomic dynamics applied to the group of regions of the Russian Federation under study.

In the course of solving the task, the following unified factors were identified and scientifically substantiated from the set in question, which have statistical significance for the constructed regression models that estimate the level of their influence on the dynamics of the gross regional product of the Volga Federal District: consumer price index, the number of unemployed and the dollar rate, indirectly characterizing the investment activity of economic entities. In all fairness, it should be noted that, undoubtedly, during the implementation of the statistical and correlation analysis for the set of regions studied, other factors were also significant (with reference to a specific region), but adhering to the concept of implementing factor analysis based on a unified system of indicators, these factors were not taken into account in the study (Yule, 1897; Fisher, 1922; Mingazova, 2002). In our opinion, the implemented approach which is based on a comparative evaluation of a unified system of factors, allows not only to compare the degree of reaction of regions to a changing group of homogeneous indicators, but also broadens the research range in the development of measures of state regulation in the field of regional development.

Further, on the example of the Republic of Tatarstan, we demonstrate the process of modeling the dynamics of economic growth using a selected set of factors. As a result of the economic modeling procedures, the following regression model was obtained, reflecting the impact of the analyzed set of indicators on the region's gross regional product:

$$GRP_{RT} = 11045316.5 - 92229.7\ CPI + 28847.2R\$ - 8315.3NE$$

Where:

$GRP_{RT}$ - gross regional product of the Republic of Tatarstan, million rubles;

CPI - consumer price index, in% to the previous year;

R $ is the average annual value of the dollar exchange rate;

NE - number of unemployed, thousand people.

The results of the statistical significance parameters of the obtained model are presented in Tables 1, 2.

Table 1. Parameters of model regression statistics

| *Regression statistics* | |
|---|---|
| Multiple R | 0.907896478 |
| R-square | 0.824276014 |
| Adjusted R-square | 0.771558819 |
| Standard Error | 252186.2694 |
| Observations | 14 |

Table 2. Estimated parameters of regression model coefficients and their statistical significance

| | *Coefficients* | Standard Error | *t-statistic* | *P-value* |
|---|---|---|---|---|
| Intercept | 11045316.574 | 2534112.157 | 4.359 | 0,001 |
| CPI | -92229.666 | 23143.125 | -3.985 | 0.003 |
| Dollar exchange rate | 28847.158 | 8320.773 | 3.467 | 0.006 |
| Number of unemployed | -8315.301 | 2905.427 | -2.862 | 0.017 |

The data presented indicate that the calculated regression substantially approximates the initial series to a significant degree. The corresponding coefficient of determination $R^2$ is 0.91. Consequently, the equation obtained within the framework of multi-iterative calculations and actions adequately describes the initial data (Freedman, 2005). Therefore, it seems reasonable and justified to use the constructed model in the process of developing scenarios for modeling and prediction the region's economic growth.

Similarly, using the methods of multi-iterative calculations and the selection of statistically significant unified factors, the assessments of the effect of the considered set of parameters on the dynamics of the gross regional product for other regions of the Volga Federal District have been implemented (Table 3.4). The obtained estimates of the regression equations also very closely approximate the predicted values of the statistical series.

Table 3. Parameters of the regression equation and their significance

| Regions | CPI | Number of unemployed | Dollar exchange rate | R-square | Adjusted R-square |
|---|---|---|---|---|---|
| Republic of Bashkortostan | -79016.24 | -6095.13 | 20858.17 | 0.8 | 0.74 |
| Nizhny Novgorod Region | -47483.22 | -5314.04 | 12845.99 | 0.77 | 0.71 |
| Mari El Republic | -2714.38 | -2945.09 | 1972.94 | 0.84 | 0.79 |
| The Republic of Mordovia | -3825.89 | -3527.67 | 3458.56 | 0.76 | 0.69 |
| Udmurt republic | -20029.87 | -2636.79 | 7162.15 | 0.83 | 0.69 |
| Chuvash Republic | -8382.06 | -3159.17 | 1699.96 | 0.86 | 0.74 |
| Perm Region | -37047.46 | -5364.17 | 13594.18 | 0.81 | 0.66 |
| Kirov region | -14582.99 | -2380.78 | 3254.36 | 0.86 | 0.74 |
| Orenburg region | -19597.42 | -7070.88 | 6521.543 | 0.92 | 0.90 |
| Penza region | -8556.65 | -4855.52 | 4768,356 | 0.8 | 0.74 |
| Saratov region | -12063.96 | -4943.65 | 4696.11 | 0.86 | 0.81 |
| Ulyanovsk region | -13470.36 | -2653.00 | 5,064.43 | 0.88 | 0.78 |
| Republic of Tatarstan | -92229.66 | -8315.30 | 28847.15 | 0.82 | 0.77 |
| Samara Region | -46435.70 | -7654.70 | 19184.48 | 0.79 | 0.73 |

**3 Results and Discussion**

The regression models developed for the regions of the Volga Federal District form stable prerequisites for constructing predictive estimates, based on those models, and also on scenario modeling of homogeneous exogenous factors for the resulting equations.

Scenario modeling of the factors generating the dynamics of the economic development of the Volga Federal District regions was mainly based on the data of the predictive analysis published by the Ministry of Economic Development of the Russian Federation for the period up to 2020[1]. The prediction is formed for the medium-term period based on the parameters of strategic planning established by the above-mentioned regulators (Table 4). In order to standardize the results of the predictive estimates for the studied set of regions, the scenario values of exogenous factors were formed on the basis of the trends proposed in the Prediction, in accordance with the average Russian values. Thus, using equal conditions (in terms of the scenarios on the predicted dynamics of development of the macroindicators under study in

[1] Ministry of Economic Development of the Russian Federation / Prediction for the long-term social and economic development of the Russian Federation for the period until 2020: M. March, 2013

accordance with the average Russian parameters), a prediction for their development was obtained for all regions of the Volga Federal District on the basis of a unified system of explanatory factors. At the same time, it should be noted that the developed toolkit for constructing models on the economic growth of regional systems can use other scenario parameters for the development of exogenous factors, of course, taking into account regional specifics. However, in this study, the attempt to work out a modeling process and a medium-term prediction of the gross regional product development dynamics for the regions of the Volga Federal District is realized intentionally on the basis of "standardized" parameters of scenario prediction of the factors studied. This, in our opinion, it will allow us to look more universally at the parameters of the future development trends of regional systems in unified scenario conditions of transformation of institutional and conjuncture parameters.

Table 4. Scenario parameters of the CPI dynamics for the regions of the Volga Federal District

| Region | **Scenario Title** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Base** | | | **Objective** | | | **Conservative** | | |
| | **CPI** | | | | | | | | |
| | 2018 | 2019 | 2020 | 2018 | 2019 | 2020 | 2018 | 2019 | 2020 |
| Republic of Bashkortostan | 101.6 | 101.9 | 101.9 | 101.6 | 101.9 | 101.9 | 101.9 | 101.9 | 101.9 |
| Mari El Republic | 102.5 | 102.8 | 102.8 | 102.5 | 102.8 | 102.8 | 102.8 | 102.8 | 102.8 |
| The Republic of Mordovia | 101.1 | 101.4 | 101.4 | 101.1 | 101.4 | 101.4 | 101.4 | 101.4 | 101.4 |
| Republic of Tatarstan | 102.2 | 102.5 | 102.5 | 102.2 | 102.5 | 102.5 | 102.5 | 102.5 | 102.5 |
| Udmurt republic | 101.4 | 101.7 | 101.7 | 101.4 | 101.7 | 101.7 | 101.7 | 101.7 | 101.7 |
| Chuvash Republic | 101.4 | 101.6 | 101.6 | 101.4 | 101.6 | 101.6 | 101.6 | 101.6 | 101.6 |
| Perm Region | 101.4 | 101.7 | 101.7 | 101.4 | 101.7 | 101.7 | 101.7 | 101.7 | 101.7 |
| Kirov region | 102.0 | 102.3 | 102.3 | 102.0 | 102.3 | 102.3 | 102.3 | 102.3 | 102.3 |
| Nizhny Novgorod Region | 103.1 | 103.4 | 103.4 | 103.1 | 103.4 | 103.4 | 103.4 | 103.4 | 103.4 |
| Orenburg region | 101.9 | 102.2 | 102.2 | 101.9 | 102.2 | 102.2 | 102.2 | 102.2 | 102.2 |
| Penza region | 101.6 | 101.8 | 101.8 | 101.6 | 101.8 | 101.8 | 101.8 | 101.8 | 101.8 |
| Samara Region | 101.5 | 101.8 | 101.8 | 101.5 | 101.8 | 101.8 | 101.8 | 101.8 | 101.8 |
| Saratov region | 101.2 | 101.5 | 101.5 | 101.2 | 101.5 | 101.5 | 101.5 | 101.5 | 101.5 |
| Ulyanovsk region | 102.5 | 102.8 | 102.8 | 102.5 | 102.8 | 102.8 | 102.8 | 102.8 | 102.8 |

* The dynamics of the consumer price index in the context of the regions of the Volga Federal District was determined in accordance with the growth parameters estimated in the Prediction (the actual level of the consumer price index for the region was adjusted by the average Russian consumer price index growth rate)

Table 5. Scenario parameters for the dynamics of the number of unemployed for the regions of the Volga Federal District

| Region | **Scenario Title** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Base** | | | **Objective** | | | **Conservative** | | |
| | **Number of unemployed** | | | | | | | | |
| | 2018 | 2019 | 2020 | 2018 | 2019 | 2020 | 2018 | 2019 | 2020 |
| Republic of Bashkortostan | 107.4 | 104.5 | 101.7 | 107.4 | 101.7 | 96.1 | 113.0 | 110.2 | 107.4 |
| Mari El Republic | 22.4 | 21.8 | 21.2 | 22.4 | 21.2 | 20.0 | 23.5 | 22.9 | 22.4 |
| The Republic of Mordovia | 17.6 | 17.1 | 16.6 | 17.6 | 16.6 | 15.7 | 18.5 | 18.0 | 17.6 |
| Republic of Tatarstan | 66.7 | 64.9 | 63.2 | 66.7 | 63.2 | 59.7 | 70.2 | 68.4 | 66.7 |
| Udmurt republic | 41.2 | 40.1 | 39.0 | 41.2 | 39.0 | 36.9 | 43.4 | 42.3 | 41.2 |
| Chuvash Republic | 31.3 | 30.5 | 29.7 | 31.3 | 29.7 | 28.0 | 33.0 | 32.2 | 31.3 |
| Perm Region | 78.5 | 76.4 | 74.3 | 78.5 | 74.3 | 70.2 | 82.6 | 80.5 | 78.5 |
| Kirov region | 34.7 | 33.8 | 32.9 | 34.7 | 32.9 | 31.1 | 36.6 | 35.7 | 34.7 |
| Nizhny Novgorod Region | 72.7 | 70.8 | 68.9 | 72.7 | 68.9 | 65.1 | 76.5 | 74.6 | 72.7 |
| Orenburg region | 46.0 | 44.8 | 43.6 | 46.0 | 43.6 | 41.1 | 48.4 | 47.2 | 46.0 |
| Penza region | 29.6 | 28.8 | 28.0 | 29.6 | 28.0 | 26.5 | 31.1 | 30.4 | 29.6 |
| Samara Region | 67.4 | 65.7 | 63.9 | 67.4 | 63.9 | 60.3 | 71.0 | 69.2 | 67.4 |
| Saratov region | 57.1 | 55.6 | 54.1 | 57.1 | 54.1 | 51.1 | 60.1 | 58.6 | 57.1 |
| Ulyanovsk region | 24.8 | 24.1 | 23.5 | 24.8 | 23.5 | 22.2 | 26.1 | 25.4 | 24.8 |

** Scenario parameters for the indicator dynamics are formed, based on parameters of dynamics of the indicator "Total number of unemployed citizens" taken from the Medium-Term Prediction of the Social and Economic Development of the Russian Federation to 2020

Table 6. Scenario parameters for the dynamics of the US dollar exchange rate

| Region | **Scenario Title** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Base** | | | **Objective** | | | **Conservative** | | |
| | 2018 | 2019 | 2020 | 2018 | 2019 | 2020 | 2018 | 2019 | 2020 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Dollar exchange rate, RUR / USD** | 64.7 | 66.9 | 68 | 64.2 | 66 | 67.4 | 70.3 | 70.8 | 73.2 |

The obtained scenarios for changing the values of exogenous factors made it possible to develop on the basis of the previously formed regression models for the analyzed set of factors the predictive parameters for the values of the gross regional product for the period up to 2020 (Fig 1).

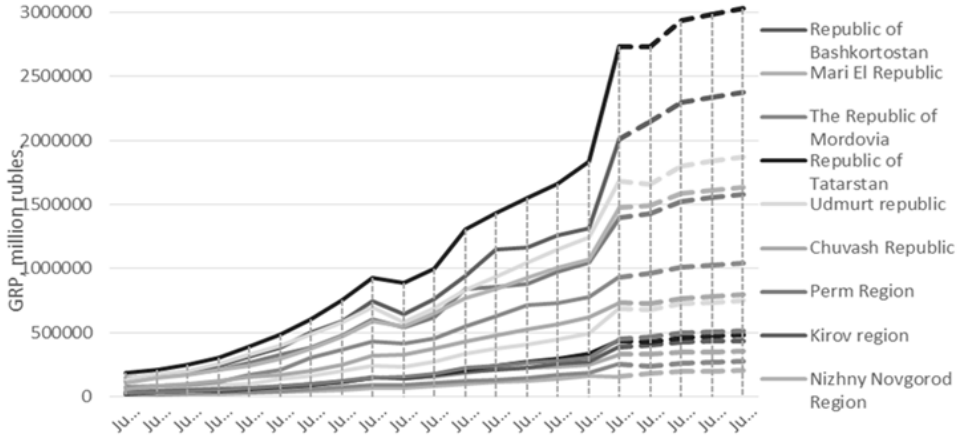


Fig 1. Medium-term prediction of the gross regional product parameters for the the regions of the Volga Federal District (baseline scenario)

**4 Summary**

In accordance with the predictions obtained for the medium-term development of the regions studied, it was revealed that the following regions will have the greatest growth dynamics: the Republic of Bashkortostan, the Republic of Tatarstan and the Samara Region. Average annual rates of their growth will be about 105 % per year. In many respects, this is due to the fact that these regional systems are more sensitive to positive adjustments of the investigated factors (Fotheringham & Wong, 1991).

Taking into account that in the prediction of the Ministry of Economic Development there are considered the scenarios with very favorable dynamics of the factors studied in the present work, their positive adjustments will have a positive impact on economy of the regions that are more sensitive to them.

In general, it should be noted that the growth rates of economic dynamics in the regions of the Volga Federal District are estimated at the level about 101.1-105.5%, taking in account a deflated predictive values of the gross regional product indicators. Despite the positive dynamics, the projected growth rates are clearly insufficient for the majority of the regional economic systems to enter the growth trajectory ahead of the world economy. This, in turn, determines the potential for reducing their global competitiveness and, as a result, a strategic lag in the transition to a long-term development path in accordance with the principles of the "fourth industrial revolution". In this connection, undoubtedly there is a very urgent problem of developing special measures of state regulation in the field of growth intensification. One of such tools can be the proposed algorithms for economic growth modeling. The developed toolkit allows, in addition to implementing the prognostic modeling of regional economic growth, to identify the factors of its dynamics (from the set of a single system of macroindicators) and to develop mechanisms of state regulation of regional development on this basis.

**5 Conclusions**

Thus, it can be stated that the algorithm laid in the basis of the research toolkit for determining the sensitivity of regional economic systems to a unified system of factors forms stable bases for the development of measures of an adapted state policy. Its adaptability is expressed, first of all, in understanding the degree of regional response to the transforming parameters of fundamental factors and in the possibility of development on this basis of specific targeted measures aimed at "smoothing out" the negative effects that arise as a result of the crisis phases of economic dynamics. The estimates which determine the reaction of regional economic systems to the "standardized" set of exogenous factors indicate the need to implement a differentiated state policy in the sphere of regional development. It seems absolutely expedient to apply to the regions of the corresponding system of state incentive measures which are the most "sensitive" to the adjustments of the investigated factors, while it seems obvious that for regions that are less sensitive to the assessed parameters, a somewhat different model of state impact in different phases their economic development should be applied. For example, based on the study, it is quite obvious that regions which in their essence belong to the category of "donors" need more "tough" measures of state regulation in the context of manifestations of crisis processes in the national economy. This is due to their more acute "sensitivity" to changes occurring in the market and institutional environment. At the same time, this "rigidity" should be expressed, first of all, in the increased level of state support measures in the crisis phases of their cyclical development with the aim of smoothing the negative effects. On the contrary, under conditions of economic revival and growth, attention should be shifted to the regions of the second cluster, characterized by intensification of economic growth due to inadequate response to positive impulses generated in the external and internal environment (Waegeman et al, 2008).

In conclusion, it should be noted that the findings are largely supported by the conceptual approaches proposed in the study, based on the use of the so-called "standardized" set of factors in the process of building the regional economic growth models. As the study showed, this allows more accurate looking at the degree of response of the analyzed subjects to the macroeconomic indicators that are transformed in time and are represented in a single system of coordinates.

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**Literature:**

1. Ivanter V.V., Budanov I.A., Sutyagin V.S. (2007). Applied predicting for the national economy: Textbook. Institute for Economic Prediction of the Russian Academy of Sciences, Moscow School of Economics, Lomonosov Moscow State University. - Moscow: Publishing house, p. 896.
2. Safiullin M.R., Elshin L.A., Abdukaeva A.A. (2017). Identification of aggregate demand factors and their influence on the parameters of industrial development of a region (by the example of the Republic of Tatarstan). Economic Bulletin of the Republic of Tatarstan, No.4, pp. 5-12.
3. Elshin L.A., Abdukaeva A.A. (2017). Analysis of Demand Factors for Industrial Development of the Region's Economy. Mechanisms of Economic System Management: Methods, Models, Technologies, pp. 223-226.
4. Aksyanova A.V. (2010). Modeling and analysis of structural dynamics of regional economic systems. Monograph, p.216.
5. Yule, G. (1897). On the Theory of Correlation. Journal of the Royal Statistical Society, 60 (4). pp. 812–54.
6. Folarin O.M., Folarin S.F. (2018). A strategic and prescriptive approach to nation-building and national development in Nigeria, Astra Salvensis, Supplement No. 1, p. 525-531.
7. Fisher R.A. (1922). The goodness of fit of regression formulae, and the distribution of regression coefficients. Journal of the Royal Statistical Society. 85 (4), pp597–612.
8. Mingazova Yu.G. (2002). Main trends in the change in the gross regional product of the Republic of Tatarstan. Economic Bulletin of the Republic of Tatarstan, No.3, pp. 26-36.
9. Freedman D.A. (2005). Statistical Models: Theory and Practice, Cambridge University Press.
10. Fotheringham A.S., Wong D.W.S. (1991). The modifiable areal unit problem in multivariate statistical analysis. Environment and Planning A, 23 (7), pp.1025-1044.
11. Villalobos Antúnez J.V., Bozo F. (2010). El discurso jurídico y la tesis de indeterminación del derecho de Jürgen Habermas, Frónesis, 17(3), pp. 379-397.
12. Waegeman W., Bernard D.B., Boullart L. (2008). ROC analysis in ordinal regression learning. Pattern Recognition Letters, No.29, PP. 1-9.