Modelling of expectations of economic agents and their influence on dynamics of Industrial Growth

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ANNOTATION

The article presents a step-by-step assessment algorithm for the expectations of economic agents in a concentrated form that is an expression of business activity determining the dynamics of social and economic growth. We justified that the process of identifying the expectations should be based on a comprehensive assessment of factors characterized by the advanced dynamics relative to general economic trends and representing an expression of institutional and opportunistic transformations. Relying on this approach, we made an attempt in this work to develop a step-by-step modeling algorithm for the expectations of economic agents, the approbation of which was reflected in their quantitative assessment, applied to the Russian economy for the period of 1996-2015. The implementation of this stage of the study made it possible to assess, using the economic and mathematical analysis methods, the level of influence of the business activity index on the industrial development parameters of the Russian economic system. This, in turn, determined the procedure for developing scenarios for the development of the industrial sector of the national economy for the medium term (until 2020), taking into account the programming of structural components determining the expectations of economic agents.

It is established that high rates of industrial development contributing to overcoming the structural problems in the economy are able to be formed mainly in the case of implementation of the institutional reforms forming a stable basis for the generation of positive, stable expectations regarding the transformation of the current order forming the mechanisms of macroeconomic shifts.

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Key words: expectations of economic agents; business activity; industrial development; scenario modeling; forecasting.

1. INTRODUCTION

The multiplicity of factors forming the "points and quality of growth" of socio-economic systems greatly complicate the objective modeling processes, which predetermines the need to improve the methodological approaches to the analysis and identification of the macroeconomic generation mechanisms. Today, a reliance, which predominantly occurs in neoclassical and neo-Keynesian concepts, on mono- and micro-parametric (including a very limited set of exogenous parameters) models of economic growth, means a decrease in the objectivity of the estimates obtained and their conclusions (Abalkin et al ,2002; Hicks.1988, Perez1983; Keynes, 2002).

It is believed that the transformation processes taking place in the Russian Federation, including the processes of phase shifts in economic cycles, are inherently structural in their nature. Perhaps there is no economic study, where there has been no attempt to explain the economy state by the structural changes taking place in it.

Of course, the economic development parameters are closely linked with the directions and logic of the restructuring of economic and political processes in different periods of economic development, mainly caused by the system of emerging expectations of economic agents about future transformations in the system of institutional and opportunistic factors. In this regard, there are a number of issues, the solution of which would enable us to clarify and formalize the totality of concepts, methods and tools of knowledge of such an important section of economic theory as modeling and forecasting of the social and economic development.

It is impossible to deeply understand the essence of the current shifts in the economy without defining their internal contradictions and the logic of their development in specific historical conditions and not taking into account the factors and the extent in which these changes are induced by such factors. The study of the socio-economic development processes, generating their institutional and conjunctural factors, is important for the disclosure of development features and patterns of the economic systems at both national and regional levels. It is important to understand what driving forces and factors determine the generation of economic growth processes in certain

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market systems with different types of economic disequilibrium and what inconsistencies they generate.

A prediction of macroeconomic generations on the basis of nature and logic knowledge triggering their mechanisms is of great interest, within the framework of studying the theory of economic growth. At the same time, the overwhelming majority of works are focused on the fact that the character and dynamics of economic development in the past will determine the nature and dynamics of economic development in the future. However, in our opinion, this approach causes a lot of discussion issues.

2. METHODS

Taking into account that the economic systems, for a variety of reasons, adapt differently and react to any changes (of institutional, economic, social and other order) occurring, including within the national or global socio-economic environment, the nature and trajectories of their development will have personalized features, including cyclical fluctuations of these systems (Hicks,1988). Thus, the in-depth study of economic development requires a fundamental analysis of a wide range of factors that determine their sensitivity to them.

At the same time, the use of more factors and explanatory variables in the model for determining and identifying the economic development may lead to a number of known issues that reduce the quality of statistical estimates (Fischer, 1977; Friedman ,1957). Thus, there arises the need to select a very limited set of such exogenous factors that would completely correspond to the solution of the issue posed. In our opinion, the optimal solution to the issue posed is to use an integral indicator in the model, which is an expression of the whole set of parameters in a concentrated form that characterize the mechanisms of macroeconomic, social, institutional and other types of generations. A quantitative assessment of the expectations of economic agents - the main drivers of macroeconomic generation may act as such integrated indicator. In this case, the expectations of economic agents need to be modeled as an integral function of weighted components characterized by advanced dynamics relative to the trends in economic dynamics and expressing the institutional and conjunctural parameters of the socio-economic environment. First of all, this is due to the fact that the theory of rational expectations lies at the basis of the methodical approach being developed. In this regard,

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it is advisable to develop a model that would reflect the current expectations of economic agents, which, in turn, would reflect the most probable parameters of the system functioning in the future.

Cross-correlation analysis serves as an effective factor filtering tool by the criterion of their advanced development (Mkhitaryan et al,2008). To do this, it should be modeled the cross-correlation functions of the effective factor (reference series), depending on the predefined variables (leading economic components).

As a result of numerous iterations and implemented measures of quantitative analysis, processing of public statistics, we determined a system of institutional and opportunistic factors that satisfied the fundamental criterion for their selection, as well as the lag values of these factors. By grouping them according to the homogeneity criterion (Table 1), we obtained a system of sub-indices forming the basis for modeling the business activity index of the economic system, calculated as the sum of average weighted sub-index values characterizing its institutional and market potential (I1, ..., I6).

Table 1 - System of grouped factors satisfying the condition of their advanced nature with respect to general economic dynamics

Factor name	**Lag value**
Urban development change index (I1)	
Number of rural population	1, 2, 3, 4
Human capital index (I2)	
Number of graduates from secondary schools	3
Number of graduates from higher educational institutions	2
Production index (I3)	
Commodity stocks	1
Freight turnover of motor transport	1
Mining process index	1
Freights transported by rail	1
Social well-being index (I4)	
Number of theatres	2

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Number of clubs	3
Economic activity index (I5)	
Consumer price index	2
Monetary incomes	2
Research capacity index (I6)	
Scientists	1
Research institutes	2
Internal costs for the R&D	3

Having identified the initial database of factors used to determine the integral values of the business activity index, assessing the expectations of economic agents in a concentrated form, we implemented a sequence of actions aimed at quantifying the sub-index values (I1, ..., I6). The calculation algorithm consists in calculating the weighted values of the normalized (standardized) factors used to estimate the corresponding sub-index. A more detailed description of this algorithm, including the process of determining the weight ratios, is specified in the earlier works of the authors (Safiullin,2015; Safiullin et al,2012). As a result, we obtained the data presented in Table 6.

Table 6 – Sub-index integral values of the business activity index

	I1	I2	I3	I4	I5	I6
1996	2.090	-1.300	-0.880	0.421	0.782	-0.259
1997	1.173	-0.566	-0.851	-0.486	-0.337	-0.453
1998	0.406	-0.712	-0.169	0.606	-0.147	-1.036
1999	-0.017	0.566	-0.552	0.470	-0.040	0.160
2000	-0.150	1.130	0.828	0.476	-0.381	0.626
2001	-0.038	0.610	0.730	0.308	-0.375	-0.402
2002	-0.134	1.005	0.529	-0.014	-0.257	0.662
2003	-0.364	0.751	0.539	0.464	0.332	0.701
2004	-0.443	1.362	0.837	0.979	0.169	0.781
2005	-0.798	1.584	0.734	-0.399	0.289	0.353
2006	-0.243	0.731	0.563	0.360	-0.169	0.241
2007	0.084	0.260	0.442	0.173	-0.060	-0.705
2008	-0.074	0.118	0.636	-0.732	0.052	-0.034
2009	0.078	-0.390	-0.208	-0.925	0.052	0.135

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2010	-0.475	0.647	-0.770	-0.275	-0.252	0.361
2011	-0.442	-0.212	1.115	0.168	0.166	-0.105
2012	-0.190	-0.582	0.668	-0.417	-0.221	0.632
2013	-0.188	-1.085	0.598	0.277	-0.507	-0.252
2014	-0.197	-1.141	0.185	0.210	-0.150	-0.093
2015	-0.078	-1.064	0.141	-0.133	-0.040	0.464

3. RESULTS AND DISCUSSION

The implementation of procedures aimed at identifying the sub-index integral values enables us to proceed to the final stage of modeling the business activity index, based on the previously stated algorithm. Formally, the process of assessing the values of business activity index is presented in formula (4)

$$I_i = W1 \cdot I_1 + W2 \cdot I2 + W3 \cdot I_3 + W4 \cdot I4 + W5 \cdot I5 + W6 \cdot I6, \quad (4)$$

where I_i - the BAI value;

i – value of a period (of the month in our case);

I_{1i} – urban development index in the i-th year;

I_{2i} – human capital index in the i-th year;

I_{3i} – production and resource development index in the i-th year;

I_{4i} – institutional and cultural development index in the i-th year;

I_{5i} – index of economic activity develpment in the i-th year;

I_{6i} – research capacity index in the i-th year;

$W_1, W_2, W_3, W_4, W_5, W_6$ – weight ratios of the corresponding indices.

Based on data for the period from 1996 to 2015, the calculated dynamics of the business activity index in the Russian Federation, based on the expectations of economic agents about the changes in institutional and conjuncture factors, is shown in Figure 1.

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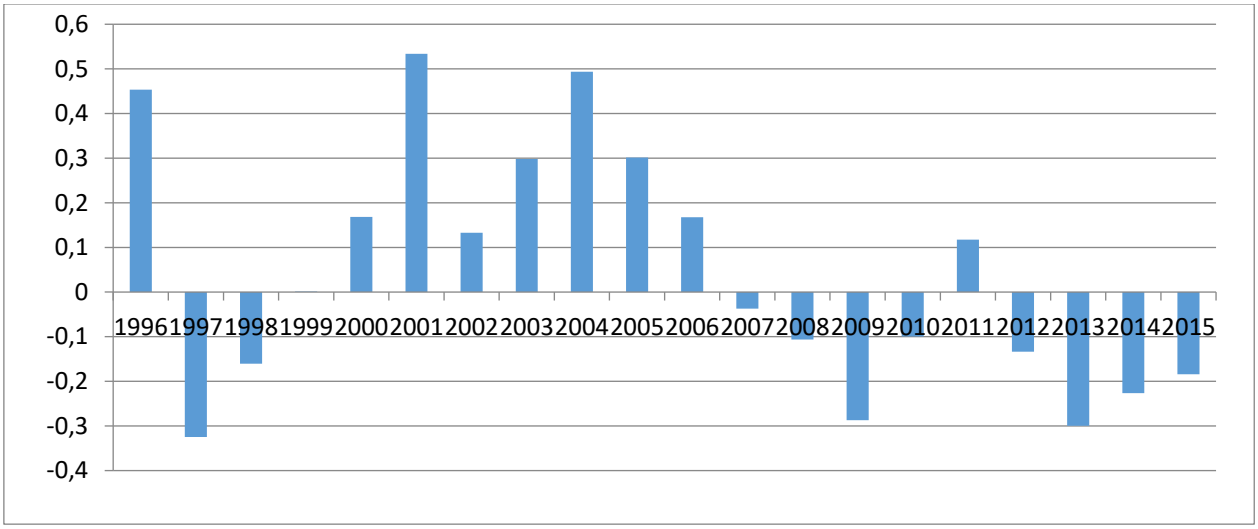

Figure 1 - The business activity index assessing the expectations of economic agents in a concentrated form

The results of business activity assessment, obtained during the approbation of presented methodological approaches, which are based on the change not only of opportunistic, but also institutional parameters of the social and economic environment, enable us to pass to the development of prognostic models. At that, it is important that these models will have a significant potential in terms of their predicting the explanatory variables as a result of their high "sensitivity" to transforming multilevel parameters that characterize the expectations of economic agents.

According to the implemented economic and mathematical analysis of the BAI influence on the IPI dynamics with the use of probit -, logit - models and multiple choice models (Bonabeau,2002; Diaz ,2010), the following equation was obtained:

$$IPI = 0{,}053 + 2{,}462 \cdot I + 1{,}62 \cdot f_1 + 1{,}03 \cdot f_2 . \qquad (5)$$

where

IPI - industrial production index;

I – business activity index;

f1, f2 – fictitious variables.

The dynamics of calculated and observed IPI values is shown in Fig. 2.

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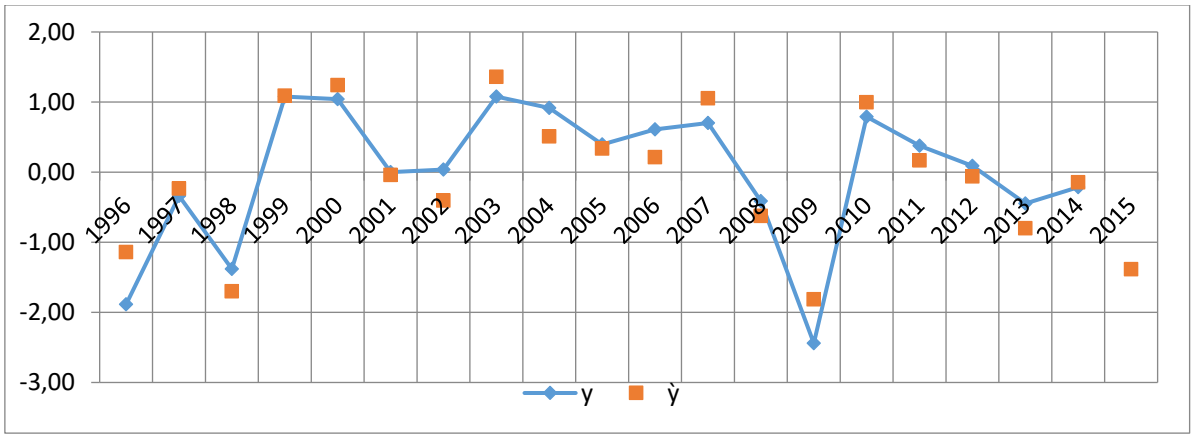

Figure 2 - Ratio results predicted by the model of normalized IPI values and their actual level

Thus, we obtained the model that verifies the convergence of two dynamic standardized series, which enables us to relate the real IPI dynamics to the dynamics of the calculated composite index acting as a business activity assessment tool expressing the expectations of economic agents in a concentrated form with a high degree of reliability. The results of econometric modeling made it possible to obtain fairly predictable results within the framework of the above hypotheses and assumptions. If the advanced development index increases by one point, the normalized value of the industrial production index increases by 2.462 units. Thus, this confirms the high level of elasticity between two indicators considered. That is, minor changes in the expectations of economic agents form a noticeable reaction in the generation of economic processes, expressed in the corresponding volatility of industrial production.

4. CONCLUSIONS

The implemented approach forms a significant potential for the implementation of activities aimed at developing the scenario-prognostic development models of the socio-economic systems. Approbation of the above algorithms is presented in the form of developed scenario models for the Russian economy development for the period up to 2020. At that, we determined three possible scenarios for the medium-term development:

- the pessimistic development scenario (the scenario of hard resource constraints) is focused primarily on overcoming the most acute phases of economic and social development.

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- the basic development scenario (the scenario of moderate resource constraints) is based on the fact that the necessary measures aimed at stimulating the new forms of organizing the macroeconomic processes will be implemented;
- the optimistic development scenario (the scenario of soft resource constraints). This scenario characterizes the maximum possible rates of socio-economic development based on achieving high competitiveness and ensuring high-quality social and economic growth.

The difference in scenarios arises from the possible transformation of factors involved in the BAI model. The scenario parameters for the factor change are presented in Table 8.

Based on the results of regression model preliminary design explaining the dynamics of change in the standardized IPI values depending on the business activity index (IDA) change, we carried out the projected estimates of the IPI change by 2020 as a result of transformation of the system of institutional and conjuncture factors.

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Table 8 - Scenario parameters of key factor development dynamics of the business activity model for the period up to 2020, in % by 2015

Factors	Scenario 1	Scenario 2	Scenario 3
Number of rural population	100	99	98
Number of graduates from secondary schools	98	99	102
Number of graduates from higher	98	99	102
Commodity stocks	95	100	110
Freight turnover of motor transport	95	100	110
Mining process index	95	100	105
Freights transported by rail	95	100	105
Number of theatres	100	101	102
Number of clubs	100	101	102
Consumer price index	110	105	103
Monetary incomes	100	110	120
Scientists	100	101	102
Research institutes	100	102	105
Internal costs for the R&D	100	105	110

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The scenario modeling results of the business activity index for the period up to 2020, as well as the calculated parameters of the statistical series characterizing the real values of the industrial production index (IPI) and the business activity index (BAI), are shown in Figure 3.

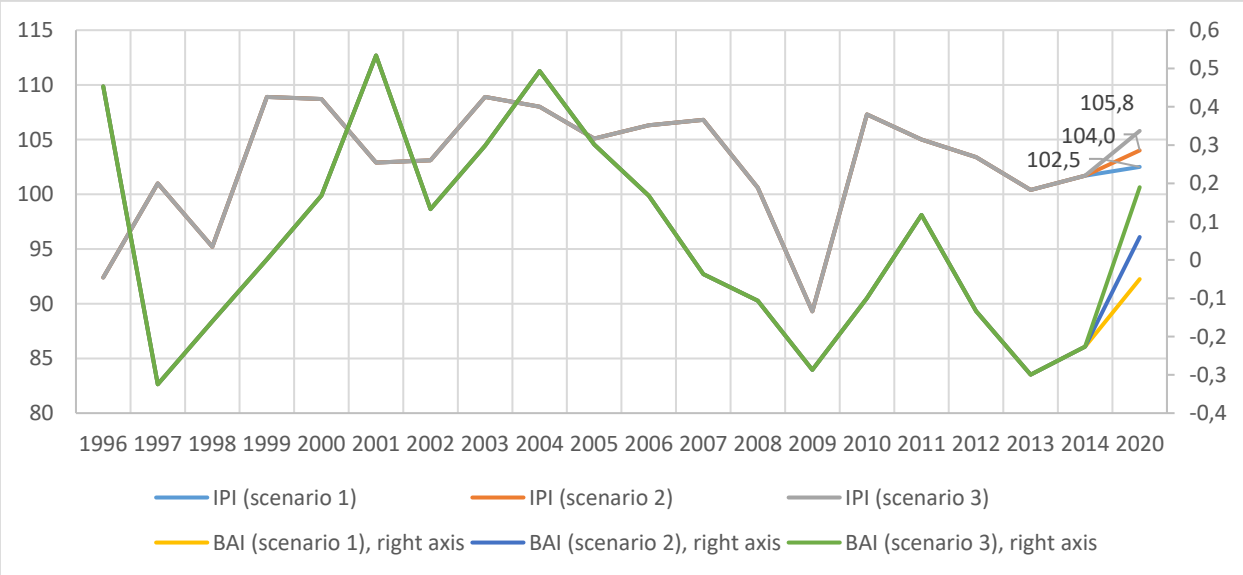

Figure 3 - Forecast dynamics of the industrial production index of the Russian Federation for the period up to 2020, in growth rates

5. SUMMARY

The set of tools for programming the expectations of economic agents and assessing their impact on the industrial production index presented in this paper enables us to implement the scenario-prognostic assessments of the development of key economic parameters. According to the research results, we established that in case of preservation of the institutional and market trends formed in 2014-2015 for the period up to 2020, it is expected very moderate growth rates in industrial production, comparable to the dynamics of 2012-2013 - the period of aggravation of structural problems in the Russian economy. This scenario will not contribute to their overcoming, which will significantly complicate the transition of national economy to the transformation of macroeconomic generations based on the labor productivity growth and the restructuring of inefficient development tools that have developed in recent years, based on the prevailing development of rental mechanisms (13).

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On the contrary, the third scenario considered in this paper and based on activation of the institutional and conjuncture order processes presupposes a significant growth in business activity and a transition of Russian economy to high growth rates in industrial production (about 106% per year by 2020).

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