

MODELING OF EXPECTATIONS OF ECONOMIC AGENTS AS INSTRUMENT OF DIAGNOSTICS OF ECONOMIC CYCLES (ON THE EXAMPLE OF THE RUSSIAN ECONOMY)

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Abstract. The emerging trends in the development of socio-economic systems characterized by a high level of the dynamics of institutional transformations and their corresponding macroeconomic generations, based on progressive forms of creating value added, require improved approaches to the analysis methods of their development. If previously the processes of economy industrialization, implementation of large-scale decisions, high localization of economic processes have been the priority development directions, now the following strategic development guidelines come to the fore: the formation and large-scale replication of local low concentrated growth points; diversification of business activity; development and dissemination of technological, institutional, product changes; development of social parameters of economic growth, based, inter alia, on the principles of environmental friendliness of economic and operational activities, etc. The complexity and multidimensionality of the socio-economic development processes creates a basis for improving the traditional approaches to the theory of modeling and forecasting the economic growth and, consequently, cyclical development of the economy. Strengthening the economy globalization processes and simultaneously regionalization, formation of complex and dynamic structures that form crisis phenomena actualizes the issue of modern regulation of the cyclical development of the economy, whose solution becomes difficult within the framework of classical methods of the theory of cyclism. The traditional approaches to modeling the cyclical development of the economy can lead to a decrease in the quality of predictive models built on the basis of extrapolation methods with the use of scenario forecasts for the development of market and institutional factors - drivers of cycle phase changes. The foregoing means that the current developments of the forecasting models under consideration carry a whole range of risks associated with the accuracy of prediction and anticipation of cyclical fluctuations. In this regard, there is a need to develop, scientifically substantiate (verify) and approbate the models of cyclical fluctuations based on such factors that would have a high sensitivity level to changes in the external and internal environment of the economic system and had a high level of predictability of the cyclical trends. In the course the research, we scientifically substantiated and tested the model of cyclical fluctuations of the economy constructed on the basis of an integral cross-correlation indicator that characterizes the expectations of economic agents in a concentrated form.

Keywords: short-term cycles, forecasting, phase shifts, leading indicators, advanced development cycles, taxonomic modeling method, development institutions, structural shifts, expectations, cross-correlation analysis.

1. INTRODUCTION

Traditional approaches to the interpretation of economic cycles are based on the modeling of system-forming macroeconomic factors that form the expectations of economic agents. The fundamental difference between the Keynesian and neoclassical approaches is the interpretation modeling of these expectations, which on the one hand, are not rational in accordance with the Keynesian theory, and on the other hand, are extremely rational based on the views of neoclassicists.

Despite the polarity of views between the representatives of Keynesianism and neoclassicism, expressed primarily in the interpretation of the expectations of economic agents that determine the paradigm of modeling the cyclical development of the economy, their system of identified factors generating the macroeconomic generations of these cycles unites them. They include fluctuations in the interest rates, money supply, employment, external conjuncture factors, etc.

In essence, we can state that the traditional approaches to modeling the economic growth operate with the economic factors, which, to our mind, narrows the research field in the context of determining the expectations of economic agents whose fluctuations form the economic cycles to a significant extent. In a modern economy characterized by a high level of globalization and integration into the system of world value added chains, social responsibility of the state, development of regulatory institutions and macroeconomic generations based, for example, on the principles of "green" economy, etc., the interpretation of the economic entities behavior, based on expectations, cannot be limited to a set of exclusively economic factors. There is a need to develop the multifactorial models that take into account not only the economic parameters undoubtedly having a significant impact on the expectations of economic agents, but also institutional, social and other factors that set the tone for the cyclical development of socioeconomic systems in many ways.

A prediction of macroeconomic generations on the basis of nature and logic knowledge of phase shifts within the generated economic cycles is of great interest within the framework of studying the theory of cyclism. At the same time, the overwhelming majority of works are focused on the fact that the

character and dynamics of cyclical development in the past will determine the nature and dynamics of cyclical development in the future. However, in our opinion, this approach causes a lot of discussion issues.

2. METHODS

Thus, the in-depth study of the processes of economic development of the territories and the generated economic cycles corresponding to them requires a fundamental analysis of a wide range of factors that determine their sensitivity to them, as well as predetermine the formation of channels for the spread of cyclical fluctuations of other economic systems that are mutually integrated into a particular economic system (Samuelson, 1939) (Petrosyan, (2002) (Viktorov, 2003). Cognition and scientific substantiation of this process will allow optimizing the solution of a number of issues (in the field of regulation and "manual management" of the phases of economic cycles) in the case of occasional need to impart additional impulses to the dynamics of economic development of a system that is in a certain cyclic phase at a certain historical period (Lucar, 1980) (Kaldor, 1940).

At the same time, the use of more factors and explanatory variables in the model for determining and identifying the economic cycles may lead to a number of known issues that reduce the quality of statistical estimates (Safiullin, Elshin & Prygunova, 2015). 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 phase change in the cyclical development of the economy - 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 characterizing the institutional and conjunctural parameters of the socio-economic environment development.

In the course of study, we developed and justified a structural and logical model for diagnosing the advanced development cycles, which allows determining, on the basis of the advanced

development indicators, the cyclical nature of the emerging trends in economic systems characterized by different types of structural disequilibrium.

The most important condition for the development of the model of cycles for the advanced development is the use of factors that are extremely advanced in relation to the trends in the economic dynamics of the national (regional) system that have developed over time. First of all, this is due to the fact that the theory of rational expectations lies at the basis of the methodology developed. In this regard, 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. The use of factors that would have a parallel trend with the general economic dynamics will not allow solving the task posed. Not to mention the extent to which it would not be true and counterproductive to use the factors that are lagging behind.

Cross-correlation analysis serves as an effective factor filtering tool by the criterion of their advanced development (Finn & Prescott, 1982) (Prescott, 1986).

In accordance with the above-mentioned research concept, we developed a set of indicators grouped into sub-indices, reflecting the expectations of economic agents and determining the composite advanced development index (Table 1).

Table 1: The list of sub-indices involved in modeling the expectations of economic agents

No.	Sub-index name
1	Urban development index (I1)
2	Human capital index (I2)
3	Production-resource sub-index (I3)
4	Sub-index of the quality of institutional and cultural development of a system (I4)
5	Sub-index of economic activity of the economic entities (I5)
6	Research capacity sub-index (I6)
7	Capital change sub-index (I7)

All the factors selected for constructing the composite sub-indices were presented in the form of chain growth rates at comparable prices.

3. RESULTS

The results of cross-correlation analysis of the statistical series under consideration, which include the effective factor (the reference series), on the one hand, and the time series of the analyzed factors under study, on the other hand, are presented in Table 2.

Table 2: Composition of factors characterized by advanced dynamics of the relative reference series (GDP) in the context of enlarged leading indices

No.	Factor name	Lag value, number of years		
		Short-term cycle	Medium-term cycle	Long-term cycle
I. Urban development change index				
1.	Number of rural population	1, 2	3, 4	
II. Human capital index				
2.	Number of graduates from secondary schools		3	12
3.	Number of graduates from higher educational institutions	2		
III. Production index				
4.	Commodity stocks	1		
5.	Freight turnover of motor transport	1		
6.	Mining process	1, 2	3	
7.	Freights transported by rail	1, 2		
IV. Social well-being index				
8.	Number of hospitals			11
9.	Number of theatres	2		
10.	Number of cultural and leisure type institutions	1, 2	3, 4	
V. Economic activity index				
11.	Investments in the fixed assets			8, 9
12.	Consumer price index	1, 2	3	
13.	Monetary incomes of the population	2		
VI. Research capacity index				
14.	Number of scientists	1, 2	4	
15.	Number of research institutes	1, 2		
16.	Number of proposals received in the field of R&D			9
17.	Internal costs for the research and development	3		12
VII. Capital change index				
18.	Oil price			9
19.	Interest rate level	1	3	

According to the results of cross-correlation analysis, the final composition of factors included 19 units. At the same time, the factors that have a short-term impact on the behavior model of economic agents include those that are completely consistent with the existing theoretical and methodological approaches to modeling the so-called short-term Kitchin cycles (Charles, 1982) (fluctuations in business and investment activity, introduction of innovations with a short-term payback period, inflationary pressure, amount of stocks, fluctuations in employment, etc.). It should be noted that one of the main results was that the factors characterizing the institutional and cultural potential of the system possessed the signs of advanced development. The observed phenomenon

indicates that the institutional and cultural factors influence both exclusively monetary factors and macroeconomic factors (this is permissible, and this is often found in the econometric models (Modigliani & Brumberg, 1954) (Lucas, 1976).

Determination of the set of factors involved in the development of the model of cycles of advanced development made it possible to move on to the subsequent stages of calculations aimed at assessing the aggregate values of grouped indicators – sub-indices, which determine the integral indicator of economic activity of the economic entities.

To calculate the integral index, it is necessary to isolate the enlarged components, which are sub-indices in their essence, from the total number of components. According to the generally accepted methodology for calculating the generalized or integral indices, if the calculated indicator includes more than one factor, it consists of the sum of intermediate indicators multiplied by the weight:

$$I_{ki} = \sum_{j=1}^m R_{ij} K_{ij}, \quad (1)$$

where I_{ki} – value of the k-th component in the i-th year,

R_{ij} – value of the j-th indicator in the i-th year,

K_{ij} – weight ratio of the j-th value.

The main condition that should be necessarily fulfilled is the equality of the sum of weight ratios to one.

The taxonomic method forms the basis of the calculation of sub-index weight ratios determining the value of the composite advanced development index (Mkhitarian, Arkhipova & Sirotin, 2008). It is based on determining the distances between the multidimensional space points, the dimension of which is determined by the number of factors involved in the model. The distances between the factors are determined by the Equation 2:

$$a_{rs} = \frac{1}{m} \sum_{i=1}^m |b_{ir} - b_{is}|, \quad r, s = \overline{1, n} \quad (2)$$

where a_{rs} - the distances between the factors r and s.

The final form of the distance matrix between the factors will have the following form:

$$\begin{bmatrix} 0 & a_{12} & \dots & a_{1n} \\ a_{21} & 0 & & a_{2n} \\ \dots & & 0 & \dots \\ a_{n1} & \dots & & 0 \end{bmatrix}. \quad (3)$$

After determining the values of the distance matrix, it shall be calculated the so-called critical distance, characterizing the maximum distance between two factors:

$$a_{\text{kpum}} = \max_r \min_s a_{rs} \quad (4)$$

Further, the sum of all distances not exceeding the critical distance is found for each factor:

$$p_j = \sum_{s=1}^m a_{js}, \quad \text{для } a_{js} \leq a_{\text{kpum}} \quad (5)$$

Then the weight ratios are calculated by the Equation 6:

$$w_j = \frac{p_j}{\sum_j p_j} \quad (6)$$

In the form of a formula, (Equation 7) the calculation of the composite advanced development index is as follows:

$$I_i = W_k * I_{ki} + W_\phi * I_{\phi i} + W_p * I_{pi} + W_n * I_{ni}, \quad (7)$$

where I_i - value of SOP;

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

I1(i) – urban development index in the i-th year;

I2(i) – human capital index in the i-th year;

I3(i) – production and resource development index in the i-th year;

I4(i) – institutional and cultural development index in the i-th year;

I5(i) – economic activity development sub-index in the i-th year;

I6(i) – research capacity sub-index in the i-th year;

I7(i) - capital change sub-index in the i-th year.

W1, W2, W3, W4, W5, W6, W7 – weight ratios of the corresponding indices.

The calculation results for short-term cycles of advanced development applied to the Russian economy in the period of 1996-2015 are shown in Figure 2.

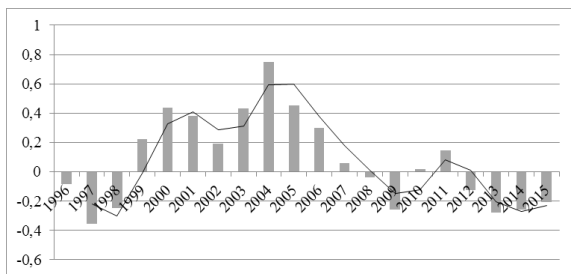


Figure 2. The advanced development cycles of the Russian economy in the period from 1996 to 2015 (Advanced development index)

4. CONCLUSIONS

Based on the calculations of the advanced development indices for the Russian economy, the dynamics of short-term cycles of Russia's advanced development, consisting of two phases, is presented in Table 3.

Table 3: The advanced development short-term cycles of the Russian economy in the period from 1994 to 2015.

Advanced development cycle	Downward phase	Upward phase
1994 – 1997	1994 - 1995	1996 - 1997
1998 – 2002	1998 - 2000	2000 – 2002
2002 – 2009	2002-2004	2004-2009
2009 – 2013	2009 - 2011	2011 – 2013
2013-2018, 2019*	2013-2017*	2017-2019*

* Evaluation

It shall also be borne in mind that the Russian economy, as it has been previously noted, synchronously combines the principles of market and planned economy, which of course cannot but affect the arrhythmicity and duration of the

observed cyclical fluctuations. As the share in the mechanisms of economic regulation of instruments attributed to the administrative and command system decreases, the observed arrhythmia will decrease, and the classical mechanisms of cyclical development will become more widespread.

5. SUMMARY

The analysis results demonstrate that the short-term cycles of the Russian economy differ slightly from the classic short-term cycles of Kitchin, whose periodicity is from 2 to 4 years. The revealed duration of the economy cycles of the Russian Federation fluctuates in a rather wide range, depending on the corrective measures taken by the public authorities, as well as on the volatility of conjuncture parameters. Moreover, it shall also be borne in mind that the Russian economy, as it has been previously noted, synchronously combines the principles of market and planned economy, which of course cannot but affect the arrhythmicity and duration of the observed cyclical fluctuations.

Given that the short-term cycles of advanced development are presented in Figure 2, the real cyclical fluctuations in the Russian economy have corresponding values of the years ahead of the dates of the phases of advanced development cycles for 1-2 years. Thus, it is possible to predict, in accordance with the data on the adjustments of advanced development index, that the Russian economy will enter a revival phase in 2016 (due to the fact that over the past two years (2014-2015) there has been a positive trend in the dynamics of advanced development cycle). Following the logic of data extrapolation, as well as trends in the sinusoidal development of the trajectory of advanced development cycles in the Russian economy, it is highly probable that the revival phase will enter the growth phase in 2016-2017. Given the advanced nature of development of the series obtained, real growth in the Russian economy can be observed not earlier than in 2018-2019.

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