

DIAGNOSTICS AND FORECASTING OF MEDIUM-TERM BUSINESS CYCLES: METHODOLOGY OF THE ANALYSIS AND ITS APPROBATION BY THE EXAMPLE OF PLANNED ECONOMY IN THE USSR

^aMARAT R. SAFIULLIN, ^bLEONID A. ELSHIN, ^cALIYA A. ABDUKAEVA

^a*Kazan Federal University, 18 Kremlyovskaya street, Kazan 420008, Russian Federation*

^{b,c}*State Budgetary Institution Center of Perspective Economic Researches of the Academy of Sciences of the Republic of Tatarstan, Bauman St, 20, Kazan, Respublika Tatarstan, Russia, 420013*
email:^aeditor@ores.su, ^bLeonid.Elshin@tatar.ru, ^cglobal@ores.su

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Abstract: The development of socio-economic systems is characterized by the cyclical dynamics of the changes taking place there. These changes affect various aspects and levels of economic system and its structure, forming a number of regularities. Among them, of considerable interest are the regularities of economic cycle's development. No less interesting is the fact which factors influence the structure of the reproduction processes of the national economy, as well as the processes by which the main economic agents make decisions. The latter, in turn, largely determine the nature and dynamics of phase shifts within the economic cycles. The object of our study is the evolution of national economy for the period from 1947 to 1990 in the context of modeling medium-term economic cycles. Authors use the mechanisms of modeling medium-term expectations of economic agents to identify the trajectories of cyclical development phase shifts formed as a result of the transformation of behavioral models. This allowed not only to identify the parameters of medium-term economic cycles within the analyzed period within the time horizon under consideration, but also to scientifically substantiate them using the multivariate analysis methods and the main drivers of phase shifts in the identified cycles. The methodology of the research is based on the tools of economic and mathematical modeling of the studied set of factors, the mechanisms of cross-correlation analysis of time series, generalization and grouping methods, and the descriptive analysis. Based on the developed methodology for constructing cycles of rapid development and its approbation to a system of statistical data characterizing the growth dynamics of the planned economy in the USSR, the effectiveness of the developed toolkit for identifying the cyclical development of the economy has been proved, what is confirmed by comparing the obtained economic cycles with the data of other Russian researchers.

Key words: medium-term economic cycles, prediction, national economy, phase shifts, rapid development cycles, economic growth modeling, factor analysis.

1 Introduction

Analysis and diagnosis of the cyclical development of the administrative-command economy has a number of specific features. They were expressed in the fact that traditional, classical tools and mechanisms for regulating macroeconomic generation do not have a stable institutional basis (Maximo & Perez, 2002). At the same time, in order to understand and define the paradigm of transformational processes in the economy, it is necessary to determine precisely the leading mechanisms that trigger the transformation processes which formed the basis for phase shifts within the cycles. In the economic system which belongs to the administrative-command type, these mechanisms have a qualitatively different structure (in contrast to the market economy) what in turn determines the unique features of the generated cyclic shifts (Chaffin & Talley, 1989).

In other words, the study of the USSR planned economy cycles, as well as of any other cycles characteristic to the administrative-command system, should take into account the above-mentioned features. Taking into account also the fact that state intervention in the economy is aimed in large part at adjusting the institutional and conjuncture parameters of a dynamically changing social environment, the need to use factors that take into account this fact in the model becomes the most important task in the theory of cyclical development of a planned economy (Berge & Jordà, 2011; Villalobos Antúnez & Bozo, 2010).

2 Methodology

Earlier, within the framework of publishing a number of author's works devoted to the topic of modeling economic cycles on the basis of constructing and evaluating the expectations of economic agents, we presented in some detail the methodological apparatus that reveals the features of identification of cyclical fluctuations in the economy of short-, medium- and long-term nature, based on the construction and evaluation of the expectations of economic agents. In a concentrated form, this concept can be presented in the form of an assumption that cyclic development cannot be characterized as a regular phenomenon occurring in time, on the contrary, the irregularity of changes in the phases of economic cycles is quite a natural process. Thus, the determination of an occurrence probability of these phases and their duration is represented by a complex function with a set of undefined variables. In this connection, there is a need to develop, scientifically substantiate (verify) and approbate models of cyclic fluctuations based on such factors that would have a high level of sensitivity to changes in the external and internal environment of the economic system. Such factors, as already noted and justified above, are, first of all, the expectations of economic agents. Their identification and quantification greatly contribute to an understanding of fluctuations of economic activity in the future, and, as a consequence, the prediction of phase shifts in economic cycles (Chauvet & Hamilton, 2006; Kolesnikova & Kamasheva, 2017).

The methodology used in this study is based on the use of a multi-factor approach, that is, the identification of a set of factors that affect the expectations of economic agents, and, consequently, the economic activity of the system as a whole. In this approach, the analyzed factors are first combined into subindexes, which are the sum of a set of weighted average estimates for the components being analyzed. Based on this system of indicators that characterize certain types of activity and behavior models, and on the index method, an integral (composite) or consolidated index is calculated - the "Rapid development cycles index". In this case, this work refers the rapid development cycles to periodic stable fluctuations in the expectations of economic agents with special types of regularities that are subject to a change in short-, medium- and long-term conjuncture and institutional factors and form the conditions for phase shifts in economic dynamics on the basis of transforming current and mental assessments of the upcoming transformations in the future, which allows on the basis of known postulates of the expectations theory to improve the quality of the regional prediction, timely predict the turning points of the phase shifts of the economic cycle, depending on the programmable (identifiable) parameters of the expectations of economic agents.

Since the expectations theory is the basis for the study of cyclic development, simulated cycles will have significant predictive properties and predict the turning points of any cycle depending on the composition of the factors used and the magnitude of their lag values (Marat et al, 2016)

The prediction horizon is determined by the lag values of the factors that fit into the paradigm of logic and scale of the cycle under study (Table 1). The lag size in a model is determined by the average length of the cycle phase.

Table 1. Prognostic horizons of simulated cycles of rapid development depending on their length and scale

No.	Length of the analyzed cycle, years	The value of the applied lag, years	Prognostic period, years	
			min	max
1	40 - 60	8-10	8	10
2	7 - 12	5	5	-
3	2 - 4	1-2	1	2

Thus, the methodology for working out rapid development cycles that is implemented in the paper allows us to evaluate and predict the phase shifts of the economic cycle, depending on the definition of the scale of lag values (Elshin, 2017).

In a generalized form, the structural-logical scheme for simulating cycles of rapid development is presented in Fig 1. (Elshin, 2017).

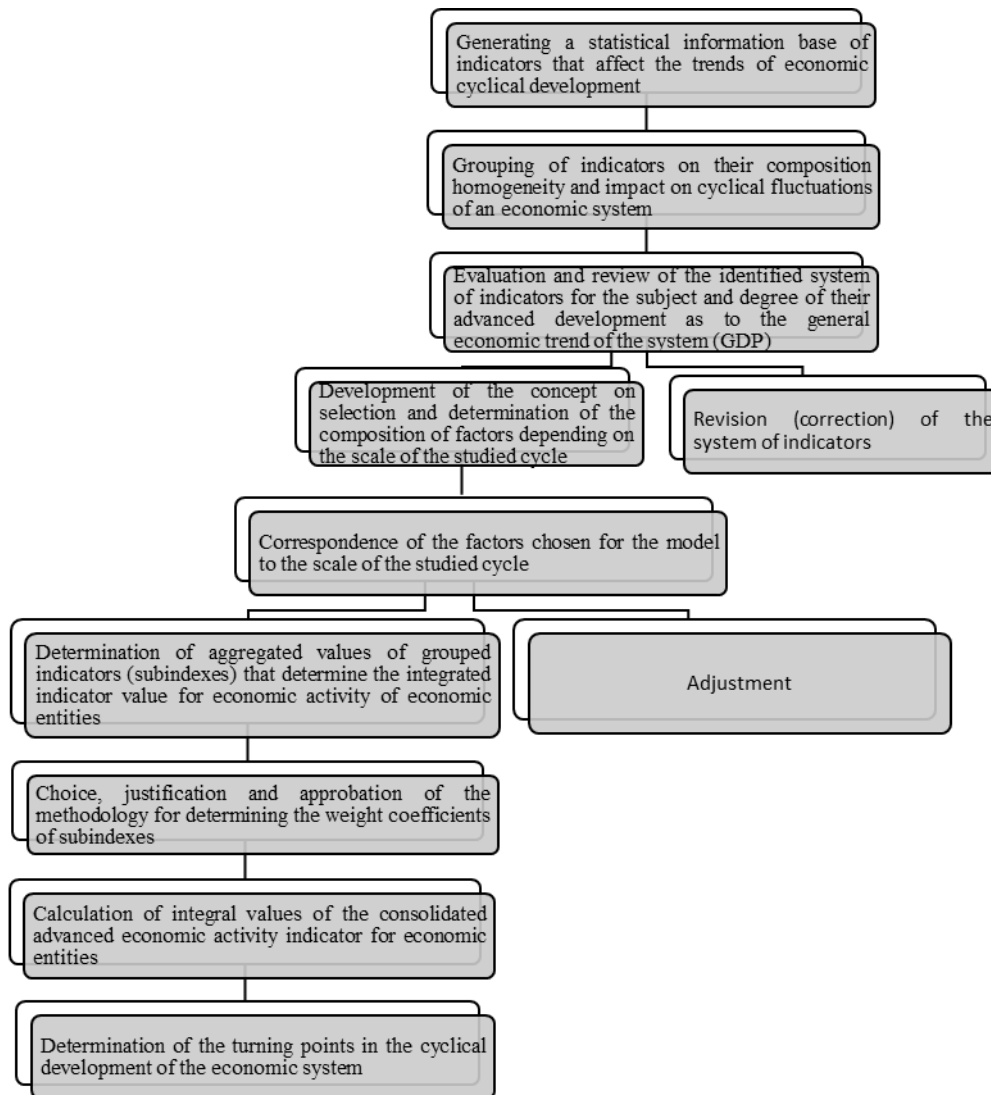


Fig 1. Structural and logic scheme for modeling the rapid development cycles

The search for solutions aimed at identifying the system of factors for the subject and the degree of their rapid development relative to the general economic trend of the system (industrial production index) was realized through the use of cross-correlation analysis tools (Gumerov et al, 2008).

3 Results and Discussion

Based on the results of cross-correlation analysis, the final composition of the factors included 19 units of the originally defined list of 52 units.

The index method of analysis provides for the decision of a question on a choice, and a substantiation of a methodology of definition of weighting coefficients of subindexes. In our study,

the method of taxonomic analysis was used as the most methodologically "rapid" method for determining weight coefficients. It is based on the determination of distances between points in a multidimensional space, the dimension of which is determined by the number of factors participating in the model.

The implementation of the above methodological procedures allows us to proceed to the final stage - construction of the so-called composite index of rapid development (IOD). The value of this indicator which estimates the expectations of economic agents consists of calculated series of indicators, or subindexes.

In the form of a formula, the calculation of IOD is as follows:

$$II = W_1 * I_{1i} + W_2 * I_{2i} + W_3 * I_{3i} + W_4 * I_{4i} + W_5 * I_{5i} + W_6 * I_{6i} + W_7 * I_{7i}$$

Where I_i is the value of the leading development index (IOD);

I - the period value (year in our case);

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

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

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

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

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

I_{6i} - index of scientific research potential in the i -th year;

I_{7i} - capital change index;

$W_1, W_2, W_3, W_4, W_5, W_6, W_7$ are the weight coefficients of the corresponding indices.

The implementation of this stage allows us to obtain a quantitative and graphical interpretation of the rapid development cycles.

The use of the rapid development cycles laid in the basis of the methodological model and their development diagnostics mechanisms makes it possible to identify the contribution of each factor to the trajectory of the rapid development composite index (Table 3, Figure 2). The values of the indices are defined as the weighted sum of the standardized values of the analyzed series, generalized by the group attribute, constructed on the basis of the factors revealed by the results of the cross-correlation analysis.

Based on the results of the analysis, six subindexes of seven were included in the composition of the factors determining the medium-term cycle dynamics of the rapid development of the USSR's planned economy. We did not include the capital changes subindex, because the factors determining its quantitative assessment are extremely short-term and cannot influence the expectations of economic agents with a long planning horizon.

The lagged parameters under study as well as the weighting factors of the subindexes are defined within the framework of the developed methodological approaches and the studied medium- and long-term developmental cycles (Table 2 and Fig 2).

Table 2. The weight coefficients values for subindexes of the composite index for the USSR's rapid economy development in the period from 1947 to 1990 (medium-term cycles)

No.	Subindex name	Weighting factor value
1	Index of change in urban development (I_1)	0.178
2	Human Capital Index (I_2)	0.161
3	Production index (I_3)	0.154
4	Index of social well-being (I_4)	0.162
5	Index of economic activity (I_5)	0.180
6th	Index of research capacity (I_6)	0.165

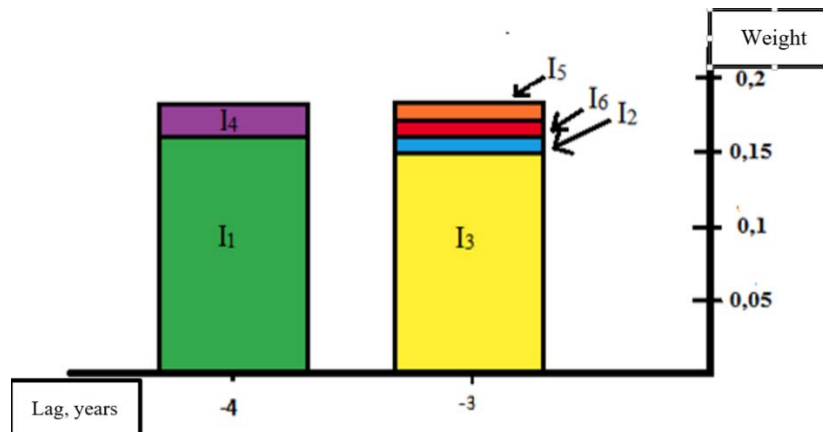


Fig 2. Influence of the aggregative rapid development indicators (subindexes) on the nature and dynamics of the medium-term cyclical development of the USSR economy in the period from 1947 to 1990.

Comparison of the results presented in Fig. 2 for assessing the lag values of the priority development subindexes and their weight coefficients allows us to determine the degree of their individual influence on the macroeconomic generation processes and the cyclical development of the administrative-command economy of the USSR. The implementation of this stage of work is aimed at conducting a comparative analysis of institutions regulating the priority development cycles in the medium-term development prospects.

From the point of view of estimating the weighting coefficient, and the subindexes (in the decrease order of weight values), such as the index of economic activity (I_5), the index of changes in urban development (I_1) and the index of the research potential (I_6), have the greatest impact on medium-term macroeconomic trends). The weight coefficient values for the group of subindexes in the definition of the rapid development composite index are within the range from 0.165 to 0.180.

The lag values for the priority subindexes are characterized by a very significant spread in the presented set. The lowest level of

the lag variable (5-6 years) refers to the subindex reflecting the ongoing adjustments in the production sector (production index - I_3). The research potential index has the maximum value. It is noteworthy that the economic activity index (I_5) describing changes in economic agents' expectations, due to a result of the transformation processes in the "consumption - savings - investment" model, also has a very high value of the lag variable (11 years).

4 Summary

So, the results of the experimental evaluations demonstrate that the dynamics and speed of phase transformations in the medium-term rapid development cycles of the administrative-command economy in the USSR were most affected by the subindex which estimates the expectations of economic agents regarding the changing production conditions in the economy. Thus, one can observe the synchronism of classical and administrative-

command mechanisms for the generation of medium-term economic cycles based, primarily, on the basis of overproduction crises.

In addition, subindexes related to the institutional group and forming representations of economic entities on the prospects for the development of human and urban potentials have a significant influence on the medium-term cyclical fluctuations in the planned economy.

There were obtained results based on the evaluations and calculations according to the methodological approaches outlined above, the results determine the nature and trends of the medium-term cyclical development of the USSR economy (Fig 3).

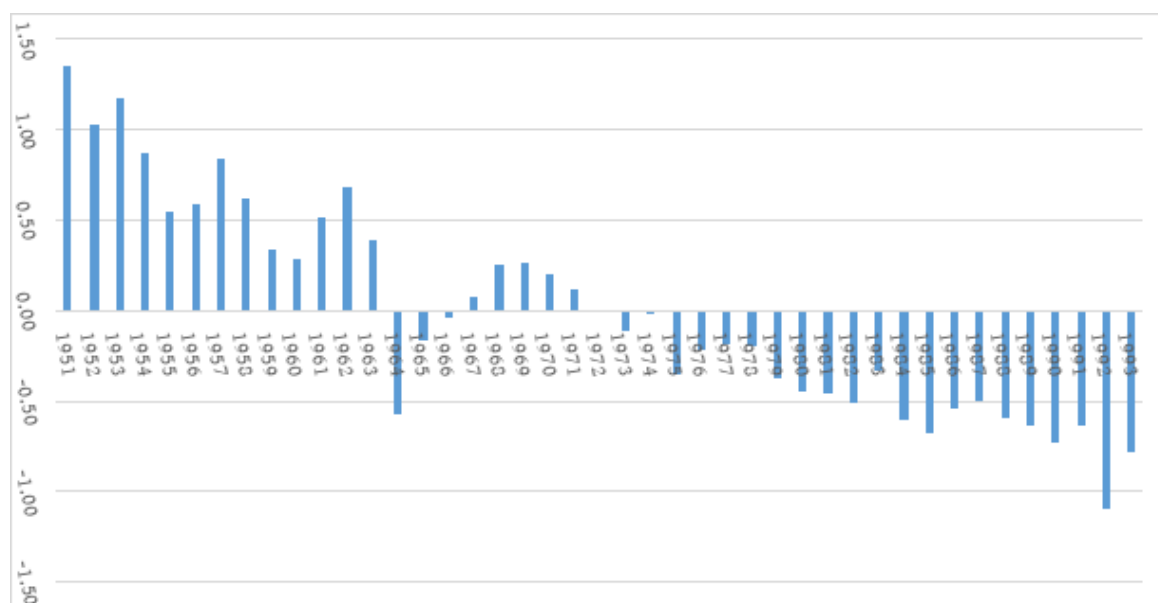


Fig 3. Medium-term cycles of rapid development of the economy in the USSR in the period from 1951 to 1990.

During the period from 1951 to 1990, 4 medium-term cycles of rapid development have been identified (Table 3).

Table 3. Medium-term cycles of rapid development in the economy of the USSR in the period 1951-1990.

Medium-term cycle of rapid development	Short-term cycle of rapid development	Downward phase	Upward phase
1955-1964	1955 - 1960	1955 - 1957	1957 - 1960
	1960 - 1964	1960 - 1962	1962 - 1964
1964-1975	1964 - 1975	1964 - 1969	1969 - 1975
1975 - 1985	1975 - 1980	1975 - 1978	1978 - 1985
	1980 - 1985	1980-1983	1983-1985
1985 - 1993, . . .	1985 - 1990	1985-1987	1987-1990
	1990 - . . .	1990 - 1987	1987 - 1993

According to the developed methodological approaches, the cycles of rapid development form a system of expectations of economic agents whose change predetermines real changes in the economy with a certain lag in the model. Since in this case

we are analyzing the medium-term developmental cycles which subindexes have lag values on average about 5-6 years, the real cycle trajectory should have a shift by the corresponding number of years (Fig 4).

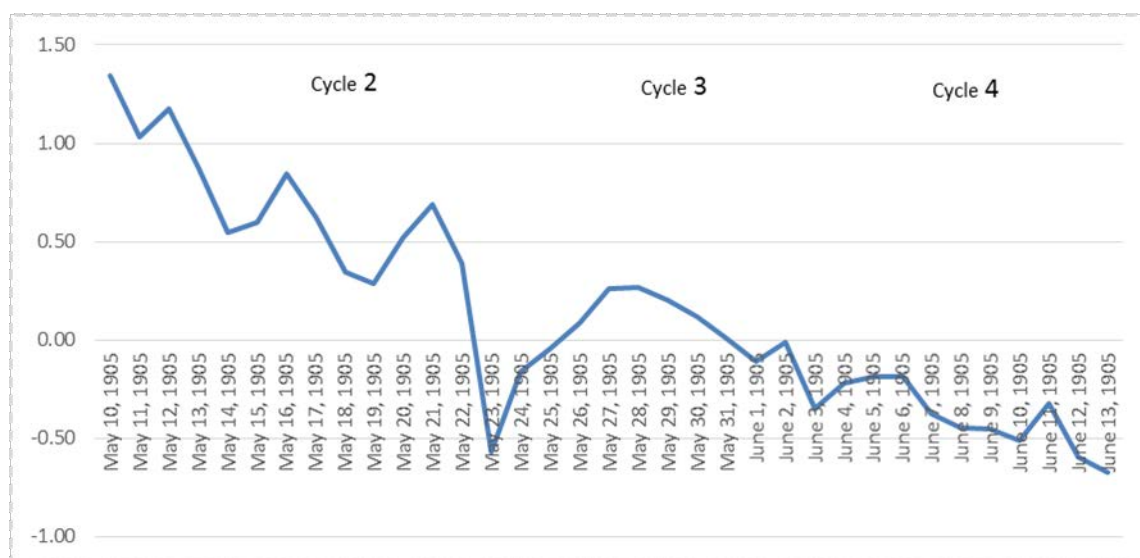


Fig 4. Predictive assessment of the medium-term cyclical development of the economy of the USSR

5 Conclusions

The developed structural and logical model for assessing the rapid development cycles based on the modeling of the leading indicators system characterizing the institutional and conjuncture transformations; it allows us to accurately identify future shifts in the economy with a lag of 5-6 years. This effect is achieved as a result of the conceptual framework laid down in the developed methodology, which is based on the principle of programming the expectations of economic agents regarding the prospects for the medium-term development of socio-economic processes. Thus, with a high degree of confidence and validity, it can be argued that the methodological apparatus used allows not only to identify cyclical fluctuations in the economy, but also to predict phase shifts within the cycles 5 to 6 years prior to their formation. In addition, the proposed conceptual model allows us to largely escape from traditional prediction models based on the extrapolation of cyclical economic data for future periods. The predictive functions of the model are provided as a result of the estimated adjustments to the expectations of economic entities that form the basis for current, medium and long-term trends in the socioeconomic development of the national economy. Thus, it can be stated that the model tools provides predictive diagnostics of the cyclical development of the economy, which largely ensures the accuracy and predictability of measures developed by public authorities aimed at the maximum possible smoothing of negative trends. In other words, the implemented approach promotes an expanded understanding of the prospects for phase shifts within the cycles and thereby "warm up" optimistic sentiments at the time of a decline in expectations and, on the contrary, "cool down" the excessive business activity of economic agents during periods of intense expectations about the long-term trend (Yakovets, 1997; Chauvet & Piger, 2008).

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