

Modeling the Sustainable Innovative Economic Development Parameters

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Abstract: The country's economy sustainable development is accompanied by the formation of favorable conditions for enhancing the economic structures innovative activity. The presence of variable factors that determine their qualitative and effective transformation into an innovative path of development determines the need to identify key parameters that have the maximum impact on the effectiveness of solving the problems of economic modernization and increasing the country's rating at the world level. Modeling, analysis and forecasting of the dynamics of these parameters will make it possible to objectively substantiate the basic factors signs that affect the achievement of strategic goals and ensure the economic system stability.

1 INTRODUCTION

Achievement of a high level of country competitiveness at the global level, first of all, is due to the ability of economic systems to quickly adapt to constantly changing economic conditions (Gerasimov, Vasyaycheva and Gerasimov, 2018). The key aspect in solving this issue is to ensure high sustainability of economic development through the selection of adequate methods and tools for conducting economic policy. It should be noted that significant results can be obtained not only from creating a favorable climate for the implementation of state modernization programs, but also by strengthening the positions of advanced industries, increasing their added value, investment attractiveness and export potential.

In this case, the economic policy and the policy of managing production structures should be implemented systematically with a clear indication of strategic guidelines and measures to eliminate problems and restrictions that restrain the country's economic growth. Blind copying of the best world practices may not lead to the desired results and contribute to a failure in achieving the intended goals and consequently the economy degradation as a whole.

Today, the formation of a new mechanism for innovative economic development requires a detailed study of the factors affecting key financial indicators and giving a powerful impetus for structural renewal and increased business activity of high-tech industries (Berdnikov and Resnyanskiy, 2020; Malysheva, Shinkevich, etc., 2016). The identification of the most significant factors is a fundamental point in the aspect of identifying the directions of impact on the effectiveness of the innovative transformation of economic entities in the new economy and substantiating the innovative vector of change. The importance of this approach is emphasized in the works of Russian scientists (Chirkunova, Anisimova and Tukavkin, 2021; Kiselev, Korobkov, etc., 2018), who identify trends and patterns of sustainable evolution of Russian economic structures (stimulating and hindering the economy development) and argue the importance of developing the methods for determining conditions for advanced development and growth of the country's competitiveness in the world ranking.

The well-founded construction of this mechanism and the prediction of the results of its operation allows us to identify real opportunities for implementing structural changes in the management system at the macro-, meso - and micro-levels. In this paper presents the results of economic and mathematical

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modeling of the Russian economy innovative development which form the basis for the economic policy effective implementation, adequate use of borrowed management methods and tools for technological renewal of production structures (Bogatyrev, Bulavko, etc., 2018), economic justification of the need to introduce international standards into the domestic management practice and the formation of "cross-cutting" competencies from the leaders of the strategic and tactical management levels (Forrester, Ustinova, etc., 2016).

2 METHODOLOGY

The methodological basis of this study is based on general scientific approaches to the analysis of the innovative economic development effectiveness – system analysis, description, dialectical method, formalization method, correlation and regression analysis, principal component analysis, statistical methods of information collection and processing. In addition the paper uses special methods of cognition: econometric modeling, forecasting methods, component, and factor analysis.

The information base of the research includes statistical data of the Federal State Statistics Service of the Russian Federation, reports of the Ministry of Economic Development of the Russian Federation, scientific articles, monographs, abstracts and dissertations, and other scientific works of modern scientists and economists.

3 RESULTS

Modeling the parameters of innovative economic development was based on indicators of economic activity presented on the official website of the Russian Federation Federal State Statistics Service:

- i_1 - the number of personnel engaged in research and development (people);
- i_2 - the gross value added by sectors of the economy (million rubles);
- i_3 - the volume of innovative goods, works, services by the constituent entities of the Russian Federation (million rubles);
- i_4 - innovative goods, works, services, newly introduced or subjected to significant technological changes during the last three years in the Russian Federation (million rubles);

- i_5 - internal expenditures on research and development in the constituent entities of the Russian Federation (million rubles);
- i_6 - the share of innovative goods, works, services in the total volume of goods shipped, works performed, services (percentage);
- i_7 - funding of science from the federal budget (million rubles);
- i_8 - the cost of enterprises innovative activities (million rubles);
- i_9 - costs of production and sale of goods (works, services) of enterprises (legal entities) in the Russian Federation (million rubles);
- i_{10} - annual turnover of enterprises (excluding small businesses, etc.) (million rubles);
- i_{11} - gross domestic product (million rubles).

These indicators formed the basis for calculating the parameters of the country's economic development, determining the basic components of its effectiveness and visualizing the priority aspects that are of dominant importance in the formation of the constitutive mechanism for the development of the Russian economy.

To eliminate the multicollinearity of the listed indicators, integral indicators were calculated, reflecting the impact on the resulting indicator Y (indicator of the effectiveness of innovative development of the economy):

- innovative (indicator of the research and development effectiveness - X_1),
- personnel (indicator of personnel innovative activity - X_2),
- financial (indicator of the costs for production and innovative activities ratio - X_3),
- production and technological (indicator of production efficiency - X_4).

At the initial stage of constructing an economy innovative development dynamic model the influence of each of the factors on the resulting indicator was studied using the correlation-regression analysis method. As a result, we obtained models (Table 1) that can be used to predict the effectiveness of the economy innovative development for each of the four factors. Indicators R^2 and p prove models' reliability and indicate the significance of the results obtained from them.

Based on the application of the principal components method it was found that the factors X_2 and X_4 have the greatest impact on Y . The conclusions significance was confirmed by checking the adequacy of the constructed models using the Kaiser-Meyer-Olkin method and the Barlett test.

Table 1: Dynamic models of innovative economic development sub-vector efficiency.

Models	R^2	p
$Y = 6,87 + 1,06X_1$	0,99	0,000001
$Y = 61,12 + 0,80X_2$	0,94	0,00009
$Y = 262,88 - 78,82X_3$	0,88	0,0006
$Y = 79,23 + 5,48X_4$	0,71	0,008

A graphical model of the country's economy innovative development factors as a percentage of the contribution to the resulting indicator is shown in Figure 1.

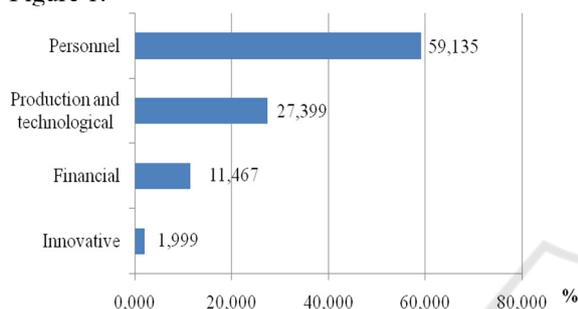


Figure 1: Resources that ensure the economy innovative development efficiency.

An increase in the share of contributions from the financial and innovation component to the total variance will ensure the multiplier effect of the Russian economy development. This conclusion can be laid in the basis for the economic policy development, strengthening the innovative potential and stimulating the domestic industrial structures innovative activity growth (Weolefnize0545<).

Modeling the dependence of Y on factors X_1 and X_3 will allow assessing not only the final results that can be obtained taking into account the current strength of their impact but also identifying their marginal and average values at which it will be possible to ensure high competitiveness of the domestic economy.

The results of the correlation and regression analysis are presented in Table 2.

Summarizing the study, we conclude that the cumulative effect of innovation and financial factors on the efficiency of innovative development of the economy can be estimated by the model:

$$Y = 12,61 + 1,04X_1 - 0,06X_3 \quad (1)$$

High values of the coefficient of determination ($R = 0.99$) and Fisher's test ($F(2.5) = 22.95$) and value of significance level ($p\text{-value} < 0,000001$) indicate the adequacy of the calculations and the significance of

the results obtained. The same conclusions are also confirmed by the graph of the initial values of the resulting indicator and obtained by the model (Fig. 2).

Table 2: Regression Analysis Results.

	Y	X_1	X_3
b^*	---	0,98	-0,04
Std.Error of b^*	---	0,02	0,02
b	12,61	1,04	-0,06
Std.Error of b	2,74	0,02	0,02
$t(5)$	4,59	59,28	-2,70
$p\text{-value}$	0,006	0,0000001	0,04
$R = 0,99, R^2=0,99, F(2,5)=22,95, p<0,000001$			

This model makes it possible to assess the degree and nature of the impact of each of the factors on Y . Thus, the value of the coefficient at X_1 (1.04) indicates a strong influence of the effectiveness of research and development on the effectiveness of economy innovative development. The value of the coefficient at X_3 (-0.06) indicates the inverse dependence of Y on this indicator and shows that the degree of its influence is 17.3 times lower than the influence of X_1 . This fact indicates the irrational funds distribution and the low efficiency of their investment in the production structures development.

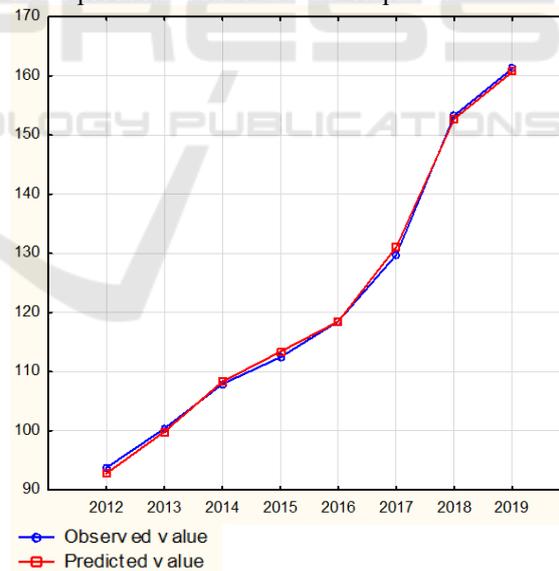


Figure 2: Dynamics of the economy innovative development efficiency indicator.

The current situation requires prompt state intervention and the implementation of corrective measures by optimizing management methods and tools that can increase the responsibility of the enterprises management for the negative results of

their activities. A retrospective analysis of this problem allows us to identify the following areas for overcoming existing pathologies:

- the organizational and economic systems managerial structure improvement;
- increasing the high-tech industries top management responsibility in the aspect of innovative development strategic tasks effective solution;
- production infrastructure reforming in the direction of creating adequate conditions for sustainable economic growth;
- promotion of co-competitive development of basic production industries that provide cross-industry interaction and synergistic effect;
- reduce costs by increasing the level of personnel competence at all levels of the production hierarchy and the formation of "cross-cutting" KPI.

The development of high-tech industries on the one hand is a platform for attracting investment and creating a favorable investment climate, and on the other hand, a motivating factor for creating an innovative economy with a high level of competitiveness.

4 DISCUSSION

Thus, the results of modeling the economy innovative development parameters indicate the dominant influence of the personnel and production-technological component of the economic development of the country and the insufficient influence of the factors of the innovation and financial group on its stability. Therefore, the priority aspect in the formation of the constitutive mechanism of innovative development of the economy should be the dispersion approach to the construction of a conceptual framework for economic management and the improvement of forms of state support for economic systems.

The issues of ensuring the sustainability of economic development are covered in the works of modern researchers and economists at a fairly high level. However, the impact of the innovation component is revealed on the basis of subjective judgments and its significance is not objectively justified. Moreover, innovative factors of economic growth at any level are fundamental, which determine the advanced nature of the development of the national economy (Chirkunova, Khmeleva, etc., 2020). Therefore, an assessment and reasoned forecast of changes in the dynamics of the resulting indicators is necessary to monitor the achievement of

strategic goals, proactively analyze the constantly evolving system and develop an adequate economic policy. This is the only way to ensure the country's high competitiveness on a global scale.

The analysis results prove the importance of increasing the innovative potential and the investment attractiveness of domestic production structures. Innovative development is impossible without the support of the state. Within the framework of a comprehensive policy, effective conditions are created to support and stimulate innovation and investment that lead to the formation of a competitive economy. As priorities in this aspect, it is necessary to strengthen the effectiveness of already established state programs and the infrastructure transformations currently being implemented in the direction of digitalization of management impact support (Bezudnaya, Gundorova, etc., 2020).

It is worth noting that over the past few years, the share of economic entities engaged in technological and managerial innovations has decreased, which negatively affected the overall state of the economy and its growth rates. Digital transformation and the introduction of innovations in the field of information and communication technologies will directly affect most of the Russian industrial sectors, as the share of large companies in Russia is 80% against 40% on average in comparable countries. From this point of view, Russia has all the opportunities for economic growth. However, in many economic indicators, it lags behind the leaders of the world economy. This is mainly due to the underdevelopment of the economic system in the field of innovation implementation and management (Vasyaycheva, Sakhbieva, etc., 2020).

First of all the effectiveness of domestic economy innovative development depends on the adequacy of legislative and organizational and managerial reforms that stimulate the activities of production structures in this direction. Increasing their innovation activity and increasing their investment attractiveness is a complex, multi-component and strategically important task, especially relevant in modern economic conditions. The effectiveness of its solution determines the state and prospects of economic growth, the status of the state on the world stage and the stability of the economic situation as a whole.

Thus there is a need of an integrated approach to economic policy and development strategy of the domestic industry with a clear argument key goals and objectives, methods, technologies and tools for their implementation taking into account the need to strengthen financial and innovative components of economic growth and support personnel and

production-technological components in a changing environment.

5 CONCLUSIONS

The study showed that the sustainable development of the economy should be a priority in the formation of the innovation policy of economic entities. At the same time, a clear argumentation of strategic guidelines is required, based on an objective justification of the directions of management actions rationalization.

The economy innovativeness is mainly determined by the activity of economic structures, the degree of their motivation to participate in the reform processes. The results obtained indicate the innovation activities low efficiency and the insufficient level of domestic industries innovation potential in ensuring the country's competitiveness in the world market. The implementation of revolutionary changes set in economic policy will increase the investment attractiveness of economic systems, revive their innovative activity, increasing its intensity and providing a multiplier effect.

The paper identifies the priority areas of economic, scientific and technological development of the country in modern conditions, ensuring the expansion of the domestic production structures share in emerging markets, increasing the competitiveness of high-tech industries in the world rankings. The main task of the management system for the innovative development of the economy is the rational choice of parameters that allow identifying "bottlenecks" and hidden reserves for accelerating the economic growth of domestic production industries.

REFERENCES

- Berdnikov, V.A., Resnyanskiy, M.M. (2020). Model for innovative transformation of the economic system in the context of western sanctions practices. In *Vestnik of the Volga University. V.N. Tatishcheva*, 2(1):13-21.
- Bezudnaya, A.G., Gundorova, M.A., Gerashchenkova, T.M., Gerasimov, K.B., Fraimovich, D.Y. (2020). Analyzing the use of the production potential in the Russian Federation's territories during the transition to the digital economy. lecture notes in networks and systems. In *Digital Economy: Complexity and Variety vs. Rationality*, pp. 185-192.
- Bogatyrev, V.D., Bulavko, O.A., Grodskiy, V.S. etc. (2018). *Regional aspects of the development of the industrial complex in the digital economy*. The publishing of Samara State Economic University.
- Chirkunova, E., Anisimova, V.Y., Tukavkin, N.M. (2021). Innovative Digital Economy of Regions: Convergence of Knowledge and Information. In *Lecture Notes in Networks and Systems*.
- Chirkunova, E.K., Khmeleva, G.A., Koroleva, E.N., Kurnikova, M.V. (2020). Regional digital maturity: design and strategies. In *Lecture Notes in Networks and Systems*, 84:205-213.
- Forrester, S.V., Ustinova, G.H., Kosyakova, I.V., Ronzhina, N.V., Suraeva, M.O. (2016). Human capital in the innovative conditions. In *International Electronic Journal of Mathematics Education*, 11(8):3048-3065.
- Gerasimov, Boris N., Vasyaycheva, Vera A., Gerasimov, Kirill B. (2018). Identification of the factors of competitiveness of industrial company based on the module approach. In *Entrepreneurship and Sustainability Issues*.
- Kiselev, S.V., Korobkov, S.N., Karpukhin, D.V., Pugachev, I.N., Kazinets, V.A., Ilyin, A.Y., Pavlushin, A.A. (2018). Modeling of industrial infrastructure services influence on economic growth of regional industrial complex. In *Modern Journal of Language Teaching Methods*, 8:3:296.
- Malysheva, T.V., Shinkevich, A.I., Kudryavtseva, S.S., Kharisova, G.M., Nuretdinova, Y.V., Khasyanov, O.R., Nuretdinov, I.G., Zaitseva, N.A. (2016). The sustainable development of competitive enterprises through the implementation of innovative development strategy. In *International Journal of Economics and Financial Issues*, 6(1):185-191.
- Sakhabieva, G.A. (2018). Innovative activity of the Russian Federation enterprises. In *Management Accounting*, 6:99-104.
- Vasyaycheva, V.A., Sakhabieva, G.A., Novoselova, O.V., Solodova, E.P. (2020). Innovation potential as a guarantee of effective industrial enterprises development in the digital economy. In *E3S Web of Conferences*.