Innovations in Industry as a Factor of Structural Changes in the Economy: Russian Experience

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Abstract. Sustainable development the industrial complex is impossible without the creation and maintenance of an innovative climate. The article presents a study of the patterns and trends of structural changes in the Russian economy. The authors describe the model of structural-dynamic processes, justify the thesis that the dynamics of economic indicators and structural technological changes are in a certain correspondence. In conclusion, the authors identify a number of reasons for Russia's lagging behind developed countries.

1 Introduction

The result of technological innovations in industry is a dynamic change in the structure of the economy. In this regard, the problems of monitoring structural technological changes that lead to the improvement of the industry structure of GDP are of great importance. One of the main problems of the analysis of the technological structure is to find out the quantitative conditions of its innovative development, the use of these conditions for the analysis of the added value of the national economy.

Balanced and sustainable development of industries is impossible without technological innovations, which are based on digital technologies. Digital solutions penetrate all areas of the real economy and have an impact on production efficiency. Today, innovative technologies (artificial intelligence, additive manufacturing, and the transition to platform-based business organizations) completely change the entire technological process, existing business models and government policies.

Purpose and data. The purpose of this study is to identify the key factors of industrial development in the field of production and innovation. The data of the study is the industrial dynamics of Russia. Data provided by the Federal State Statistics Service of Russia.

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2 Previous research

The most interesting theoretical and applied research for the period 2017-2020, concerning structural shifts and the role of innovation in this process, can be seen in academic publications of Nakamura Y. [1], Lima Almeida L.M. and Freitas Balanco P.A. [2], Lee J.-D., Baek C., Maliphol S. and Yeon J.-I. [3], Leonidova E.G. and Sidorov M.A. [4], Yun, J.J., Won, D. and Park, K. [5], Gruber, H. [6], Geldes C., Felzensztein C. and Palacios-Fenech J. [7].

The issues of innovation potential are considered from the perspective of competitiveness: Babkin A.V., Zdolnikova S.V., Kozlov A.V., Babkin I.A. [8], Zastupov A. V. [9], Müller J.M., Buliga O., Voigt K.-I. [10], Polyakova A.G., Akhmetshin E.M., Goloshchapova L.V., Rakhmeeva I.I., Noeva E.E., Rakovskiy V.I. [11] et al.

3 Methods and models

Structural-dynamic processes have reasonable types. In total, there are four types of these processes: structural cycle; innovation "corridor" of economic dynamics; structural stagnation and structural-dynamic instability. Of the listed types of structural and dynamic processes, the first two types are the main ones, and the other two are related.

The dynamics of growth indicators and structural technological changes are in a certain correspondence. Over time, the shares in the structure of any economic aggregate indicator change. Some share characteristics increase, others decrease, and others do not change. At the same time, the economic aggregate indicator (most often GDP) is exposed to either growth or decline. Part of the index of growth or decline of an economic aggregate is associated with a decrease or non-increase in its constituent shares. This part is called the structural lag (S_1). The other part of the growth or decline index is responsible for the growth of increasing shares. It is called structural advance (S_2). The sum of the structural lag and the structural advance is exactly equal to the rate of change of the considered aggregate (S).

We introduce the structural elasticity coefficient of GDP (E_s), which shows how many percent of the growth or decline associated with structural lag is accounted for by one percent of the growth associated with structural advance.

$$E_s = S_1/S_2 \quad (1)$$

The structural elasticity index has threshold values that separate the different modes of structural dynamics. There are five such modes:

- a) zero mode (structural changes are insignificant);
- b) the first mode (the economic growth of the aggregate is accompanied by a situation where some shares displace others);
- c) the second mode (growth in some shares covers the decline in others);
- d) the third mode (growth in increasing shares is not able to cover the decline in decreasing shares);
- e) the fourth mode (collapse of the economy).

The optimal structural dynamics are those that combine intensive structural changes with substantial economic growth. The situation when significant structural fluctuations are combined with significant economic growth sets an innovative "corridor" of structural dynamics. For any economy, it is desirable to move within this "corridor". The condition of the innovation "corridor" is following:

$$-1 \leq E_s \leq 1 \quad (2)$$

4 Results and discussion

The study of the technological level of development of the world economy shows that technological diversity in industry is often becoming one of the main problems of development today. At the same time, it should be noted that technological diversity itself is a normal phenomenon, provided that the outdated technologies communicate with the new ones and are gradually replaced by themselves. In developing countries, however, along with the latest industries, there continue to be production of outdated technological structures that have long been displaced from the market of developed countries and are no longer carriers of economic growth. As a rule, they are unprofitable and artificially supported by the local government, their continued reproduction reduces the efficiency of the economy and hinders further development.

Industry occupies one of the key roles in the structure of the Russia's GDP. According to the index of industrial production and the share of industrial production in GDP in Russia, we can conclude that, despite the positive dynamics of the industrial production index, the share of industry in GDP has been declining for several years. On the services, sector accounts for an increasing proportion (Fig. 1).

Fig. 1. The relationship of the index of industrial production and the share of industrial production GDP in Russia for the period 2007-2020, percentage

In our study we have identified the following patterns of changing technological paradigms:

- 1) the changes in technological patterns begin in the structure of R&D costs, and only after the changes in innovation the structure of output and GDP changes accordingly;
- 2) the potential and prospects of the technological patterns are most reflected in the structure of the output of innovative products;
- 3) the economic efficiency of the technological patterns can be evaluated through cooperative network connections.

Firstly, we argue that it is possible to quantify the change of patterns by estimating the share of patterns in the structure of innovation costs and the output of final products. It is obvious that the lower the technological level, the smaller its share in R&D costs and the

higher its share in the production. The high share in production is due to the significant funds invested in fixed assets, personnel and organizational solutions. We analyze the main indicators of innovation organizations in industry (Fig. 2).

Secondly, the analysis of the indicator of innovation activity in Russia and foreign countries in 2019 shows that Germany has a high indicator – 52.6%, Great Britain and France have significant indicators – 40.9%, Brazil-38.9 %, the Republic of Korea – 34.6% (Table 1). In Russia, this indicator is much lower, which is largely due to the technological complexity – the simultaneous development of both outdated technologies and the new ones.

Fig. 2. The structure of costs for technological innovation (by type of activity industrial production) in 2019, million rubles

Table 1. Share of organizations implementing technological innovations in the total number of organizations by country in 2019, percentage

Country	2010	2015	2019
Russia	7,9	8,3	7,5
Brazil	41,2	38,2	38,9
United Kingdom	32,7	40,9	40,9
Germany	64,2	52,6	52,6
India	n/a	35,4	n/a
Italy	40,4	37	37
Canada	58,1	32,2	32,2
China	28,8	35,4	26,9
Republic of Korea	37.2	16,9	34,6
USA	23,3	14,3	12,8
France	34,3	40,9	40,9
Japan	n/a	27,5	28,3

Fig. 3. Cooperation relations of organizations that carried out technological innovations in 2019, percentage

Thirdly, the use of innovative technologies in network projects increases the competitiveness of market participants, determines the prospects for the development of enterprises, industries and national economies (Fig. 3). The use of such technologies makes it possible to increase the availability and competitiveness of the industry, as well as to modernize existing business models.

5 Conclusion

The analysis of changing technological patterns is of great interest for understanding the problems of Russia's economic development, creating competitive advantages, and studying trends in the development of high-tech industries. The analysis of the technological structure showed a significant lag between the Russian economy and the world economy. Focusing on the current profit, Russian enterprises, as a rule, are guided by the economic situation, missing out on long-term alternatives to technical development. Often, they start implementing radical innovations only under the pressure of a sharp drop in the efficiency of capital investments in aging industries, when significant excess capacity has already accumulated and it is impossible to avoid a depression.

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