

About the Modern Stage of Technological Development of Branches of the Russian Economy

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Abstract—The paper presents theories on economic cycles and changing the economy's technological paradigm. We herein analyze the dynamics of the current technological development of the national economy. We describe the sector-by-sector discrepancy regarding how efficiently businesses use their resources. We also describe the logistic state-of-the-art of Russia's economy. The paper concludes that the state's innovation and investment policies must be adjusted to fit the current economic situation. We have developed a model that predicts the efficiency of the national economy's technological development.

What makes this paper relevant in terms of both theory and practice is that the research results can be used for substantiating the prospective directions of the Russian economy's innovative development, as well as for choosing appropriate state-of-the-art methods and tools which the state can use to support the technological development of different economic sectors.

Keywords—*modernization, innovations, efficiency, advanced technology, technological development, import substitution.*

I. INTRODUCTION

The economic modernization efforts announced by the President and the Government of the Russian Federation imply structural changes in all sectors of economy. Renewal of production and its methods is made imperative by the modern society's transforming demands, by the transformation of the wealth distribution system.

A transition to a new economic paradigm is impending as the national economy is becoming more efficient

[20]. The peculiar feature of state-of-the-art technology is that, rather than just improving the labor productivity, it also enables taking the global economy to a whole new level [4].

What distinguishes the state-of-the-art market is the ever fiercer competition of economic actors. In their strife for greater competitive advantages in the market, businesses tend to rely upon advanced production and sales technologies. Innovation enables businesses to increase the output of competitive products by using knowledge-intensive, resource-saving, and environmentally friendly technologies, as well as to maximize their profits by reducing costs. An active public innovation policy targeted at promoting innovation and technological upgrade of production, creating an environment where labor quality bar can be raised rapidly, does facilitate an accelerated technological development of the national economy [12].

II. RELEVANCE AND NOVELTY

For the current Russian economy functioning in the new economic conditions resulting from sectoral sanctions on the part of other countries, it is important to implement new technologies and to innovate. Development of high-tech production and active innovations on the part of national manufacturers provide better opportunities for achieving technological leadership in some key areas, for the country's knowledge-intensive products to enter the global markets, for the country to get a strategic foothold in high-tech products and smart-service markets [9], while also improving the population-wide quality of life, resulting in better wages and lower unemployment rates [2].

The novelty hereof consists in proposing an analysis algorithm, in selecting indicators to describe the sector-specific technological development, and in developing a model to improve such development.

III. STATEMENT OF GOALS AND PROBLEM

This research is to produce theories and guidelines on how to improve the sector-specific technological development of the Russian economy.

Problems to be solved include:

- clarification of concepts and categories used in the analysis of technological development specific to the national economy;
- substantiation and application of an indicator system to describe the dynamics and level of sector-specific technological development;
- proposing a model that predicts the efficiency of the national economy's technological development.

IV. ANALYSIS OF THEORIES

In the market economy, the periodic ups and downs of the national production is an objective fact related to various factors. The cyclicity of a market economy is recognized by most economists. As for the causes behind such cyclical economic activity, there are different theories. Those constitute a set of knowledge, ideas, and opinions aiming to explain the nature of economic cycles. There are three economic cycle theories: the Neoclassical theory, the Keynesian theory, and the Monetarist theory [6].

According to the Neoclassical theory, the economic cycle results from changes in aggregate supply caused by such factors as technology, resource availability, and productivity. According to the Keynesians and Monetarists, the economic cycle is resultant from changes in the aggregate demand. However, the Keynesians tend to believe the source of cyclical volatility lies in the total spending, while the Monetarists attribute it to the money supply.

Of all researchers behind the traditional models, the greatest contribution to the cycle theory was made by the Russian economist N.D. Kondratyev, who generalized the actual data on the national economies of the United States, England, and

France for 100 to 150 years, and identified three great economic cycles [7]. Kondratyev’s cycles laid the foundation for the modern view of long-wave periodization, which stipulates that the sixth upward wave is beginning in 2015-2025.

At present, Kondratyev’s theory is being supported and developed by S.Yu. Glazyev, who describes the economic development as a sequential change of technological paradigms [2]. According to this concept, we are currently observing a nascent new paradigm based on bio- and nanotechnologies as well as on the aerospace industry, see Table 1.

TABLE I. PARADIGM DESCRIPTION [19]

Paradigm #	Period of dominance	Leading countries	Paradigm core	Key factor
1	1780-1840	England, France, Belgium	Textile industry, metallurgy	Water engine
2	1840-1890	England, France, Belgium, Germany, United States	Mechanical engineering, rail and water transport, manufacture of machines, coal mining	Steam engine
3	1890-1940	England, Germany, France, Belgium, Switzerland, United States	Electrical equipment, heavy machinery, steel production, power line construction, inorganic chemistry	Electric motor
4	1940-1990	EU member states, Australia, Canada, Japan	Car production, synthetic materials, petrochemistry, organic chemistry, electronics	Internal combustion engine
5	1990-2020	Germany, Taiwan, South Korea, EU member states	Computer technology, aerospace industry, information and communications industry, robotics	Gas technologies
6	1995	United States, EU member states, Japan	Biotechnology; nanotechnology; optoelectronics; aerospace industry	Non-conventional energy sources

One important point of the technological paradigm theory is that the state must control the economic dynamics. Thus, S.Yu. Glazyev notes, “The development of a new technological paradigm relies on the productive capacity built during the preceding phase of techno-economic development. Not only does it make use of the energy, construction materials, raw materials... but also aligns the technological combination of the latter with its own needs, and once converted, integrates them into its own reproduction path.” [3]

In this regard, the emergence and development of a new technological paradigm must be supported by the state by promoting the development and implementation of basic innovations before the upward phase begins.

The global context proves large-scale competition for global leadership in science and technology, which will produce higher income when innovation is diffused. Russia’s today economy features the adoption and implementation of individual innovative development programs, like *Innovative Russia 2020*, the *Concept of the Russian Federation’s Long-*

Term Economic Development for Until 2020, the *Innovative Development Strategy of the Russia Federation for Until 2020*, and the *Advance Development Strategy of the Russian Federation in a Global Crisis* [8, 14, 15, 16]. The principles and priorities stated therein help focus on implementing a cluster of basic innovations fundamental to the sixth technological paradigm.

V. EXPERIMENTATION

Switching the economy to the path of innovation-driven development affects the GDP share of high-tech and knowledge-intensive products. For Russia, this trend can be described as stable and sustainable growth. In the light of the 2014 economic crisis, the import substitution program helped increase the output of innovative products in the country, resulting in its greater GDP share, see Figure 1. The current phase of economic development only proves the economy being restructured towards innovative development while also indicating its efficiency. For example, in 2017 high-tech and

knowledge-intensive industries accounted for 23.7% of the GDP, which is an increase against the last years under analysis.

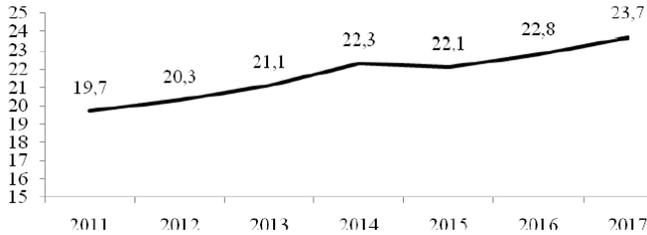


Fig. 1. High-tech and knowledge-intensive products GDP share dynamics, % [18]

The technological development of the national economy does affect the efficiency of using material, human, and other resources [17]. The changes in the Russian economy's assets indicate a greater use of efficient and highly-productive fixed assets. Thus, over the period under analysis the country's businesses have been gradually improving the availability of the necessary means of labor to their employees, as seen in the annual 3- to 5-% increase in this indicator. The use of new technologies in the national production has benefited the efficiency of using human resources by Russian companies. Thus, the labor productivity index has been increasing by 1% to 2% per annum over the past five years. The observed recent downward trends in the return on assets imply a less efficient use of fixed assets in the production of goods. However, when taking into account the increase in labor productivity, these trends suggest the efficiency of investments and innovations implemented by Russian businesses.

Resource efficiency analysis by industry indicates a considerable discrepancy: the worst use of fixed assets is observed in the construction industry, fishing, fuel and energy complex, agriculture, and transport. This trend is partly due to the decline in the financial capacity of such companies in the light of economic difficulties and in the commissioning of expensive highly-productive fixed assets amid a general decline in the investment demand [11].

Enhancement of the labor means availability in manufacturing (8.1%) and fuel industry (7.1%) is traditionally higher than that in the sector of real estate (1.8%) and in the hospitality industry (2.7%). For forestry and agriculture workers, this indicator has been relatively stable at 3.5%. In some sectors of the national economy, the crisis has resulted in a reduction in assets available; this applies to transport and communications, wholesale and retail, electricity.

Upward trends in the labor productivity are observed in manufacturing (4.3%), in the fuel and energy complex (1.4%), as well as in gas/water/electricity production and distribution. However, some sectors of the Russian economy tend to decrease their HR efficiency, e.g. the construction industry, the hospitality industry, wholesale and retail.

The problem of degrading logistics is acute even in high-tech industries. Over the period under analysis, the wear and tear of fixed assets has demonstrated an unfavorable upward trend. Given the economic difficult on top of the falling investment demand, 50% of the equipment used in the national

economy is obsolete, see Figure 2. State-promoted innovations cause a lower wear and tear of fixed assets in high-tech industries, cf. 45% in 2017 and 47% in 2014.

Thus, we may assume a favorable trend in the renewal and upgrade of the companies' logistics. However, such renewal and upgrades being slow hamper the sectoral technological development.

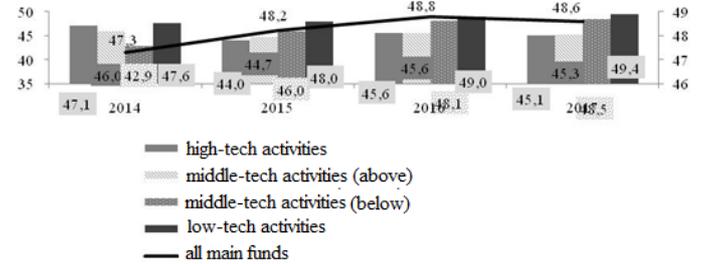


Fig. 2. Wear and tear of fixed assets by high-, medium-, and low-tech industries, % [18]

Worsening of the financial capacities of national enterprises in the current situation, coupled with the high cost of borrowed funds limits the investment opportunities available to manufacturers [10]; however, targeted and context-adequate state support of such manufacturers enables an investment intensification for economic actors. In 2017, the share of retrofitting- and upgrade-related investments in the total value of capital investments peaked at 17.8%, which exceeded the previous high of 2014 attributable to the import substitution program, see Figure 3. Besides, the structure of fixed-asset investments demonstrates an increase in investments in the assets that directly impact the production and the return on assets.

In such a situation, it is imperative to adjust the state's investment and innovation policy to create a favorable environment and to support the business of domestic companies.

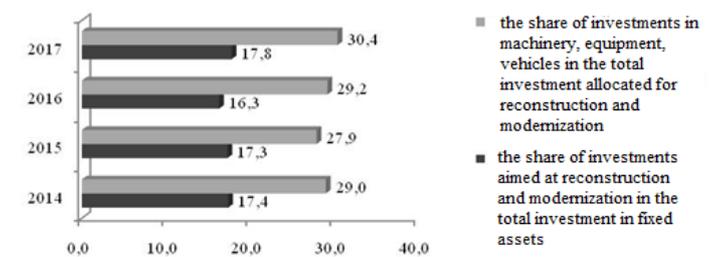


Fig. 3. Share of retrofitting and upgrade investments in the total value of fixed-capital investments, % [18].

As of today, the dynamics of international high-tech products trade proves both federal and regional anti-crisis measures efficient. Since Q1 2015, the exports of high-tech products has been on the rise, now accounting for about 13% of the country's total exports, see Figure 4. Such dynamics implies a greater global demand for, and the improved competitiveness of, Russian-made innovative products. However, in the light of ruble devaluation and tougher sanctions on the part of western countries, Russian products

become less competitive in the international markets, and exports begin to decline.

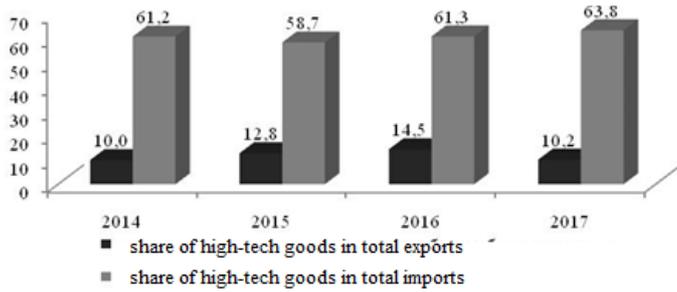
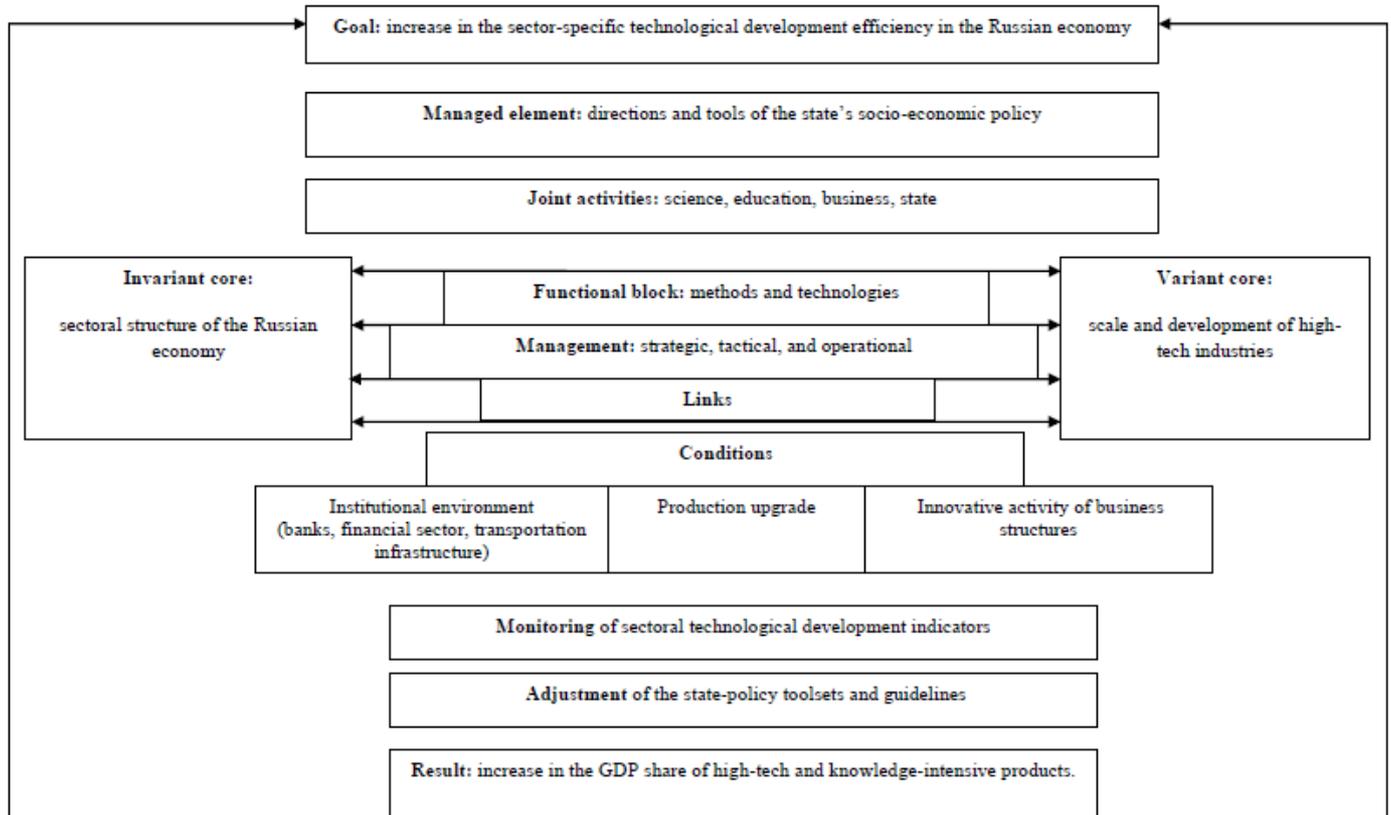


Fig. 4. Dynamics of foreign trade in high-tech products, % [18]

VI. CONCLUSIONS

We may therefore conclude that the current stage of Russia's economic development features its restructuring towards innovative development and more efficient business. Positive outcomes of the technological development of the national economy are proven by the upward trends in the efficiency of using material, human, and sundry resources, albeit sectoral discrepancy persists. This situation makes it imperative to implement a well-drafted and adequate state policy targeted at creating a favorable environment for, and promoting innovations and investments on the part of domestic enterprises. The author hereof proposes using the sector-specific technological efficiency model as a solution to the innovative economic development problem, see Fig 5.



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