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ТЕХНОЛОГИЧЕСКИЙ ДИНАМИЗМ И ДОМИНИРУЮЩИЕ ФАКТОРЫ НЕОИНДУСТРИАЛЬНОЙ ЭКОНОМИКИ КАК ОСНОВА ОБЕСПЕЧЕНИЯ НЕПРЕРЫВНОГО БЛАГОПОЛУЧИЯ

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Аннотация.
В данной статье рассматриваются доминирующие факторы экономического роста и новые факторы промышленного производства в экономике. Авторами сделана попытка выделить общие имманентные источники роста и показать, как современная экономика может перейти от стагнации к росту и, наконец, к ситуации, когда технологический динамизм становится уникальным явлением, лежащим в основе непрерывного благополучия общества. Экономический рост включает в себя определенные ценности и приобретает четкую социальную направленность. Под влиянием современных цифровых и интеллектуальных технологий неоиндустриальное развитие экономики ускоряется. Это актуализирует теорию эндогенного экономического роста. Чтобы быстро достичь границы технологического динамизма экономики, требуется активное участие государства в инвестиционном процессе, планировании и программировании инноваций в экономике. Макроэкономические условия будут созданы для реинвестирования, мобилизации эндогенных ресурсов и распространения импульса роста, возникающего в инновационных отраслях. По мере модернизации экономики ее структура претерпевает кардинальные изменения, проходит через различные фазы обновления и достигает технического динамизма.

TECHNOLOGICAL DYNAMISM AND THE DOMINATING NEO-INDUSTRIAL ECONOMY CLUSTERS AS THE BASIS OF ENSURING CONTINUOUS WELFARE

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Abstract.
This article discusses the dominating factors of economic growth and the new factors of the industrial production in the economy. Here, an attempt is made to highlight general immanent sources of growth and to show how a modern economy can move from stagnation to growth and, finally, to a situation where technological dynamism becomes a unique phenomenon underlying the continuous well-being of society. Economic growth includes certain values and acquires a distinct social orientation. Under the influence of modern digital and intelligent technologies, the neo-industrial development of the economy is accelerating. This actualizes the theory of endogenous economic growth. To rapidly reach the frontier of technological dynamism of the economy, the active participation of the state in the investment process, planning and programming of innovations in the economy are required. The macroeconomic conditions will be created for reinvesting, mobilization of endogenous resources and diffusion of growth momentum, emerging in innovative industries. As the economy is been modernized, its structure is undergoing dramatic changes, passing through different update phases and achieves technical dynamism.

1 Introduction / Введение

The inertial economic structure determines inelasticity of supply of production factors in the short term. This causes certain difficulties with obtaining further investments which are necessary for economic growth. In these conditions, it is difficult to fully utilize the existing industrial capacity in the economy. To accelerate economic growth, it is necessary to increase the industrial capacity utilization, to change the technological structure and to modernize the industrial production on the basis of digital and intellectual technologies. The economy can extend beyond its production capacities in the context of technological dynamism. Implementation of this model is possible due to:

1) new combination of production factors;

2) use of the latest results of the information-technology revolution in order to increase the efficiency of the technological basis of economy.

Economic growth is a capacity to produce larger amount of goods and services which ensures the continuous well-being of society. Investments in the latest technologies serve as the strategic parameter of economic growth. Massive investments in the technological infrastructure and critical economic sectors are also important. Investments should stimulate the economic environment and create a basis for technological dynamism of the economy.

2 Materials and methods / Материалы и методы

In the latest decades, the digital and intellectual industrial technologies increasingly determine the economic growth path. Meanwhile, one can observe maximization of the amount of new information and minimization of the amount of traditional factors in production, distribution and consumption of goods and services in the society. Of principal importance is the fact that information is getting through to all the spheres of technological basis and creates a multiplier effect in the modern economy.

There is a need to answer following theoretical questions arising in critical macroeconomic situations in the country:

a) how the dominants of technological development and endogenic factors (that define the current state of industrial branches in the modern information-technology revolution) are determined;

b) why the technological dynamism and economic growth in a particular country are interconnected;

c) why the uneven development of industries and regions requires a modern national technological policy in the country;

d) what are the sources, conditions and factors of technological renewal of the modern economy and how to accelerate the economic growth.

The objective of this research is to form a holistic concept of interaction between technological advances and economic growth, to determine new mechanisms of technological transformation that would be appropriate to business environment in a modern market economy.

The theoretical and methodological background of the research is the scientific findings of Russian and foreign economists in the field of contemporary economic theory. The attainment of the objectives was based, first of all, on the concept of a new growth model. The methodology of research of technological advances in economy is important. In the research, the dialectical principles, allowing to determine the essence of economic processes and phenomena, as well as their development trends and contradictions, have been used. Such general scientific methods as analysis and synthesis, matching processes and comparisons, determining interconnections between the whole and its elements, as well as interaction between the economy and the technological sphere, were used in the study.

3 Results and discussion / Результаты и обсуждение

The calculations demonstrate that the gross domestic product (GDP) in developed countries is created mostly due to the new information whilst declining share of other economic resources. Here GDP is characterized not so much by its material substrate, but rather by its functional and informational content. The introduction of digital and intellectual technologies to the economy has made fundamental corrections and brought new principles to the engine of its growth. Meanwhile, the new combination of factors of economic growth is formed. This stems from the fact that the needs are met mostly due to the benefits generated on the basis of information resources. In the context of new growth, providing new information becomes a priority. New economic-growth model creates GDP mostly by the means of new information and grows out of a new emerging technological basis. This model retains some traditional imperatives and operating principles of the economy, whilst reviewing and correcting the other ones.

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Thus, the model serves as a logical reflection of new industrial structures of the economy and its dominating quality outline. It is this growth that can contribute to reducing poverty, ensuring sustainable neo-industrial development and improving the quality of life [1].

The new economic-growth model is characterized by the fact that, as a result of differentiated increase in the share of new information, the share of traditional economic resources is declining; meanwhile, the total expenditure of resources included in GDP is decreasing, while GDP grows.

The new principle of interaction between production factors, based on the positive feedback system which reduces the significance of time and space, is formed and implemented. The development of critical industries, science and education, and improvement of the labor force quality depend on how efficiently information as a strategic factor of economic growth is used. K. Arrow noted that "the knowledge is not only a useful and necessary benefit, but also a commodity" [2, p. 100]. In today's economy, as D. Bell writes, "it is the knowledge, not the labor, that serves as a source of value" [3, p. 330-342]. In the industrial economy, scientific achievements were only used in production, but today, the production itself is based on science and technologies. Production of technologies becomes knowledge-intensive, the industrial technology is being transformed into intellectual. Information is the new production factor, and gathering of information is the core of accumulation of dispersed knowledge [3].

Goods and services, produced in the modern economy, in many cases are unique and systemically important. Producers reap exclusive benefits from each stage of demand expansion not only within the product life-cycle, but also in the process of changing patterns of production and the functioning of the economy as a whole. Thus, the situation of dramatic replacement of older needs with the new ones turns out to be the most favorable for producers of new goods and services. This is the basis for increasing the well-being of the society [4].

Permanent changes in the structure and technological foundation of the market economy, based on digital technologies, determine the conditions for breaking former sustainability and make possible a transition into the new condition, accompanied by dynamical changes. Digital and industrial technological breakthroughs are closely interrelated and together form a common flow. This flow carries a tendency for digital growth. This means a continuous development of digital technologies and their constant shifting, which often results in quality renewal of the technological basis that transforms each economic sector, infrastructure and social sphere. Digital technological basis integrates economic processes, binds together production, management, supply and marketing. The expansion of digital development becomes multidimensional and forms the unity between technological, organizational and social elements of the national production. Meanwhile, there is an emerging outline of digital technological basis of the market economy. In the process of building and development of the given basis, patterns of economic and technological relations and, first of all, patterns of combining factors of the production process, are changing.

Technological basis of the market economy is a combination of technological paradigms, underlying this basis. At the present time, the existence of five technological patterns has been recognized. The technological basis of the modern market economy is formed by the fifth (informational) and sixth (which is still at a formative stage) technological paradigms. They are characterized by the integrated production platforms which are based on the flexible production systems, aggregated into a technologically integral complex of linked proceedings, based on the achievements in micro-electronics, information technologies and biotechnology, as well as new materials and latest renewable electricity resources. Meanwhile, various technologies are being integrated, converged and intellectualized; their efficiency and productiveness are growing. Under the influence of the information-technology revolution, the cycles of technological paradigm shifting become shorter. The fundamental science, which largely determined changes in technological paradigm since the second half of the 20th century, became a global production force. It is now possible to change of 2 or even 3 technological paradigms within a single generation.

For example, R. Foster cited many episodes of rather quick updating of technological paradigms in various industries and in many countries [5].

The idea of S-shaped life-cycles of technological patterns (that he put forward after G. Mensch) allows creating a clear picture of innovation shifts [6].

Today, the sixth technological paradigm is emerging. It is based on the accelerated renewal of the whole life-cycle of products and services and reflects the changes in the market situation. This paradigm

is still in its embryonic stage. In expanded form, it has not yet been implemented; at the moment, it exists in fragments. It is based on membrane and quantum technologies, photonics, micromechanics, bio- and nanotechnologies, bioinformatics (computer biology), biomedicine, molecular biology, nuclear medicine, genetic engineering, and laser technologies. The fact is that development and implementation of science and technology projects based on new information requires the "convergence of all necessary knowledge", including mathematics, physics, biology, chemistry, information technologies, etc. [7]. This creates the common ground for construction and operation of the various machine systems, which causes, in turn, a commonality in educational and special training of the employees, as well as in labor skills and methods of technology maintenance. Convergent technologies are not just another stage of the scientific revolution. Judging by the consequences, this is a revolution that had never happened before. The distinctive feature of this paradigm is combining fundamental research activities and solution of applied problems. To release the full potential of this paradigm, a wide range of basic innovations underlying future economic growth will be required [8]. At the same time, the principles of economic growth are changing [9]. One of the possible directions of basic innovations is quantum computer science which will be a synthesis of the above technologies. This scientific activity may lead to creating completely safe and inaccessible for hacking data transmission networks, submicron optical electronics, new systems for hypersensitive brain tomography, compact and accurate timers for navigation system. Utilizing the lows of quantum mechanics changes the nature of matter. This is achieved through advanced technologies that use the laws of quantum physics at a fundamentally new level. Laser physics allowed to control the light. This has led to a chain of the landmark discoveries in coherent linear optics. In the 21st century, the direction named "green innovation" is being developed. The innovations will be tolerant to the environment and will have a minimal impact on it. Lasers have found many applications in medicine. It is important that lasers became an interdisciplinary that field has combined the achievements of many scientific disciplines. Inter-disciplinarity is a key feature of modern science. Technology development, as well as development of all modern science, is difficult to imagine without high-performance computing and the exchange of a large amount of information. In fact, the grid and cloud technologies have been developed for these purposes; their symbiosis is a question of time [10]. In Russia, an industrial technology for information-analytical systems of new generation has been developed on the basis of grid technologies; this technology provides a unique approach to creating commercialized application systems for knowledge management, based on natural language processing.

Within the framework of the fifth technological paradigm, basic science, research and development, production and consumption of the product have been operating separately. The sixth paradigm, based on the CALS-technologies, provides a combination of these stages.

The concept of the CALS-technologies consists in applying the principles and technologies of information support at all stages of the product life-cycle, based on the integrated information environment (IIE) which provides unified methods of process management and interaction of all the participants of this cycle. These principles and technologies are implemented in accordance with the requirements of international standards, regulating the rules of management and interactions primarily through electronic data exchange [11]. Therefore, the sixth technological paradigm is rigidly connected to the program of digitalization and integration of the related processes.

The fifth and sixth technological paradigms are based on the unique innovation clusters. These are the local spatial concentrations of the newest related proceedings, related industries and dedicated institutions, specializing on creating and spreading innovation technologies and the relevant means of production in the economy. Interactions between the proceedings and industries, aggregated on the principle of technological commonality, come down to the problem of harmonizing inter-sectoral flows of goods and services and the structure of final consumption. The social division of labor defines inter-sectoral flows of goods and services, which have a strong impact on the formation of the technological structure of the economy.

Within the context of the digital economy, the inter-sectoral interrelationship between production and distribution of the goods and services intensifies. The end result is an integrating characteristic of many interrelated proceedings and industries that make up clusters. We shall notice, that only innovation clusters have the greatest impact on the development of other industries and sectors. From this point of view, the role of the innovation clusters as a macroeconomic efficiency generator is confirmed by practices in developed countries. The impact of this cluster and its results – basis innovations – can be seen

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in the market economy, where the production and advances in productivity assume new dynamism due to them.

In reality, the productivity grows unevenly; each time it reaches a new high level, this is a result of technological innovations. According to M. Porter, "the only sound concept of competitiveness at the national level is productivity". At the same time, "competitiveness of a particular field of science depends on the ability of its industry to innovate and modernize". He notes that: "… in relation to competitiveness, the roots of productivity lay in the national and regional environment" [12].

In establishing the newest technological paradigms, innovation clusters and regional concentration of the competitive potential, venture patterns of investment play a special role.

In general, the market economy is characterized by venture principle of financing innovation. This principle is implemented through the efficient mechanism for the selection of innovations embedded in the national production. If innovations undergo this selection at an early stage, it is better for the economy; only those directions are selected which correspond to the actual economic growth.

At the same time, the selection of innovations ensures maximizing the return on innovations per unit investment, increasing private investment in production, a higher demand in related industries, and developing related production. In this case, the economic impact is reached as the result of alliance between science and industry.

The efficiency of venture capital is determined primarily by the level of development of the national innovation system. This system represents an aggregate of mutually bound organizations which make their own direct contribution to the production and commercial disposal of scientific knowledge and technology, as well as a complex set of law, finance and social institutions, guaranteeing the functioning of these organizations. The research-and-production part of systems consists of large and small businesses, universities, government laboratories, technology parks and incubators [13].

The national innovation system serves as the main source and instrument of technological restructuring of the economy. As a result, there is a coordinated movement towards the new technological paradigms and clasters. However, in Russia, the national innovation system has still not been formed. The unevenness of regional development carries the danger that integration of Russian economy to the global economy will be fragmentary. In this case, the economy may lose its integrity. In order to prevent this risk, the levels of regional development need to be synchronized. The innovation clusters, aiming at implementing the fifth and sixth technological paradigms, may be a means of this synchronization.

The regional structures for supporting innovation activities should be built as a necessary element of the system. Their main function is to provide legal services, register intellectual property rights, draw up business plans, etc.

The state industrial policy must take into account the suggestions and developments of manufacturing companies, Federal Districts governments and investors. The new industrial Russian policy, based on the innovative development path, will be coordinated with all sectors of business community and created with the active participation of regions.

Best global practices show that Russia needs an innovative partnership, where federate entities and federal authorities would be able to cooperate in addressing barriers to innovative activity development in the regions.

This partnership is intended to focus industrial, scientific-technical and regional policy on establishing a modern innovative infrastructure in the regions and to promote the establishment of neo-industrial clusters. This is complicated by the factor of uneven development of the regions of Russia. In line with the increasing cumulative investment, the differentiation of regions by their investment attractiveness is deepening.

Comparing the regions of Russia, one can see that the figures significantly vary. The Central and North-Western Federal Districts are the largest industrial, financial and economic centers of the country; they have the highest potential among the regions.

It should be noted that differentiation of the developed regions is not an exclusively Russian phenomenon [14]. In the regions of the developed countries, scientific and technological resources are unevenly distributed. Science in the developed countries is based on several large multi-sectoral regions, complemented by medium and small centers. In the developed countries, the regions ranked first in scientific activities contain more than 50 % of scientific potential. Industrial R&D of the developed countries are unevenly distributed throughout the territory and concentrated in several zones. Placement of R&D is closely related to the industry and, in general, is concentrated in the largest regions.

Policies to support R&D should focus on technological development. The success of the national technology policy is determined by the combination of several factors:

1. Political will of the state, focusing on the long-term prospective;

2. Effective linkages between research institutions, large and small businesses;

3. Socio-cultural dimensions of society (organizational and scientific culture, mobility of researchers and entrepreneurs, etc.).

The new technology policy may aim at positioning industries, taking into account international factors, in order to attract investment and experts to the research centers, laboratories, multinational companies and innovative firms. The national technology policy may serve as a tool for neo-industrial development of the economy, if it helps to take the key positions in one or several scientific or technological clusters. On this basis, technological determinants of societal well-being in the 21st century must be created [15].

In conditions of the information-technology revolution, the methods involving the leading role of the state in determining critical industries with the highest growth potential become increasingly effective. These industries, in the long term, are the most dynamic, highly profitable and provide an opportunity to significantly increase the labor productivity. Accelerated development of these industries lays the groundwork for rapid growth of the underdeveloped industries to the level of the developed ones. This policy should lead to a continuous decline in the costs of production, to increased internal competition and, as a consequence, to rapidly falling prices and growing investment in the innovations [16,17]. This will become one of the main factors for development of the innovative economy.

4 Conclusion / Заключение

As a result of the new technological policy being implemented, natural selection of enterprises which are competitive not only nationwide, but on the global market as well, takes place; the opportunities for export of the unique goods and services are broadening.

With increasing technological competitiveness, inter-sectoral diffusions of technological innovations are speeding up, which in turn should accelerate economic growth.

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