GLOBAL FACTORS OF TECHNOLOGICAL DISPARITY IN THE WORLD ECONOMY

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ABSTRACT

The article analyzes the factors of economic growth and shows their influence on the technological development of the world economy. The evolution of views on factors of countries in the world space is studied. Based on the analysis of models of economic growth with endogenous technical progress and conceptual approaches of the Schumpeterian direction, the role of human capital in ensuring high indicators of technological development is demonstrated. It is emphasized that as factors of overcoming technological disparity and the potential opportunity for less developed countries to benefit from the knowledge that has been generated by others, without incurring significant investment costs, is stimulation of trade flows, import of equipment, foreign investments and more open access to international markets of skilled labor.

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The beginning of the 21st century was marked by radical changes in the positions of countries in the world economic space. The previous hundred years of the development of the world economy was marked by a clearly expressed tendency towards the integration of countries. The creation of the European Union, the strengthening of relations between the developed countries of the American continent, the dynamism of the development of the Association of Southeast Asian Nations (ASEAN) became the result of the processes of regional and interregional integration. The study of these trends in the 90s of the 20th century gave reasons for scientists to see the main reason for such attraction of countries to each other, which existed alongside the preservation of competition between them, socio-economic contradictions and interstate conflicts, in an effort to meet new trends of scientific and technological progress.

Indeed, it was during this period that the accelerated development of integration processes took place within the world economy and, above all, in the field of science and technology. Objective prerequisites for this were discoveries in atomic physics, genetics, space technology, computer science, telecommunications and information technologies. On this basis, the formation of the electronic industry, computer and optical fiber technology, software, telecommunications, robotics, automated systems for the extraction and processing of natural gas and oil, and the development of information services took place. The strengthening of the interdisciplinary nature of scientific research, the growing complexity of scientific and technical tasks and the need to form a comprehensive approach to their solution required significant capital investments and current costs, which could be provided only under the condition of combining national scientific and technical resources and thanks to the use of international division of labor.

However, already ten years later, the trends of world development have become different. Having secured significant autonomy from the sources of raw materials and foreign markets, the post-industrial world localized trade flows among its main actors, reducing the share of trade exchange with developing countries. In parallel with this, there was a closing of investment flows, which were increasingly localized within the borders of the USA and Western Europe. All these factors indicated that the concept of globalization, which became so popular during the 90s of the 20th century, does not adequately reflect real processes. The modern world does not look like a coherent entity in which the processes of integration between all its constituent elements are intensifying; it is a fragmented civilization with a single center of power represented by the community of post-industrial countries. Moreover, the post-industrial world, becoming the center of the international intellectual elite, only increases its technological advantage every year [1].

All this testified to the growth of global imbalances, which were manifested in the violation of the balance between the components of the global economy, namely between countries of different levels of development. The loss of balance was marked, first of all, by the deep disparity of socio-economic development in the world with the further consequences of its existence.

The question arises, why is there such inequality in the world and what causes it? As you can imagine, the answer should be obtained on the basis of a study of the factors on which technical and technological development depends. In our opinion, in order to solve this problem, the attention of researchers should be focused on a deeper study of the essential characteristics of models with endogenous technical progress, given the prerequisites that were introduced to them to demonstrate the role of human capital components in ensuring the rate of economic growth. If we turn to the origins of these conceptual approaches, it becomes obvious that in models with endogenous technical progress, human capital was not always associated with school education, which, in fact, was emphasized by underdeveloped countries when solving the problem of increasing the rate of economic growth.

Thus, in the works of K. Arrow and H. Uzawa, which served as prerequisites for the emergence of models with human capital, economic growth was associated with unabated technical progress, which was a consequence of people's learning in the process of their activities. In other words, the researchers demonstrated the impact of the human factor on increasing production output. In this regard, K. Arrow noted: «Technological engineers noticed that if the same product is produced, the production costs have a steady tendency to decrease along with the increase in output. Obviously, this happened because, as a result of the accumulation of production experience, many technological improvements were introduced into the production processes. I hypothesized that this model can be applied at the macroeconomic level» [2].

A new macroeconomic model created by the scientist showed that along with the acquisition of production experience, labor productivity increases and working time is saved (production function). In addition, the more products are produced, the greater the production experience, which allows finding new ways and techniques to maximize production. Therefore, there is an inverse effect of production activity on knowledge - the more people produce, the more they learn about production and directions for its improvement, and this new knowledge allows them to accelerate technical progress and achieve an even greater volume of output in the same working time. A little later, H. Uzawa came to similar conclusions [3]. Thus, it becomes obvious that in the models of K. Arrow and H. Uzawa, it was not about education as such, but more about production experience and the dependence of the acceleration of technical progress on the volume of products produced: the more goods are created, the more technical progress improvements occur and, accordingly, there is an opportunity to produce even more. Since developing countries cannot provide a large volume of production of goods, which means that they do not see a sufficient number of directions for the introduction of technical improvements and the increase in the qualifications of employees, they objectively lose in the pace of economic growth.

With all the importance of models of economic growth with endogenous technical progress, which were based on taking into account human capital, attention should be paid to the fact that they missed a very important factor related to the motivational component of the owners of human capital to produce new knowledge and implement it in new samples of technology and technological processes. This gap was eliminated in new models of economic growth, the authors of which tried to link technical progress with innovative activity based on the formalization of J. Schumpeter's idea about the process of «creative destruction».

The model proposed by H. Grossman and E. Helpman shows that investments in knowledge aimed at obtaining profit play a decisive role in the long-term process of economic growth [4]. The authors argue that innovation-based economic growth will occur if the innovator is able to reap the rewards of monopoly rents from innovations through their patent protection. If this occurs under an efficient patent system, then the market leader earns a stream of monopoly rents that serve as a reward for its prior investment in research. This flow continues until the appearance of a competitor - a firm that offers an even better version of the same product.

H. Grossman and E. Helpman also drew attention to the fact that when innovators produce successive generations of similar products, each of them begins where its predecessors left off. That is, the process of creating new models of equipment and technology does not always involve their invention «from scratch». For example, a typical representative of the personal computer industry who seeks to improve the relevant technique does not have to personally go from the invention of the analog computer to the digital version of the personal computer. Instead, it can use the latest generation of products already available on the market and get a greater return on the cumulative investment in knowledge. It follows that the increase in knowledge is not the property of those who invested in their production and directly created it [4]. These external effects contribute to «knowledge spillovers» (spillovers-effect) as a reflection of the opportunity for firms to receive information created by others for free, provided that innovators or current owners do not have an effective mechanism to counteract this process [5].

The discovery of spillover effects changed the scientific ideas about convergence, which served the emergence of conceptual approaches to understanding the nature of the influence of technical and technological factors of socio-economic development and, in particular, economic growth to a new level [6]. The fact that, together with the growth of the openness of the economy, information about technological innovations could cross national borders with a much greater speed and hinder the retention of innovative rent within the boundaries of the inventor country, intensified research in which the openness of the economy began to be considered as a new chance for underdeveloped countries to overcome technical technological backwardness.

So, for example, F. Aguillon and P. Howit not only point to the complementarity of new knowledge to the existing one, which serves as a source of reducing the costs of conducting research, but emphasize the growing possibilities of imitation of innovations, despite their patent protection. The scientists used the concept of distance to the technological frontier [7] as the basis of the research, on the basis of which they demonstrated that the Schumpeterian innovation process largely depends on the country's position relative to this frontier, i.e. the global technological level. F. Aguillon and P. Howit emphasize that a country that is on the technological frontier is forced to generate such ideas that are truly innovative on a global scale. At the same time, countries far from the technological frontier can simply learn to produce products that have long been produced in the leading country. In this way, developing countries can significantly increase the productivity of their production processes and save financial resources that should be directed to research goals. «In order to catch up with the technological frontier,» F. Aguillon and P. Howit point out, «the country needs to attract know-how or technological spillovers from border firms from more developed countries... For a country located near the border, the introduction of advanced technologies is less important for growth, and therefore savings should also be less important [7, p.311].

Based on the ideas of F. Aguillon and P. Howitt, R. Baro and H. Sala-i-Martin created a model of technology diffusion, in which they attempted to link endogenous technological changes with international trade and openness and thus show the possibility of convergence of countries with different levels of development. In the model of R. Barro and H. Sala-i-Martin, the existence of technology spillover between countries is assumed, which are divided into technological leader countries and follower countries. The former develop new technologies, the latter adopt the technological experience of the leaders and try to reproduce these technologies in their economy. The researchers introduce

Table 1

Convergent-divergent processes in models of economic growth

Models	Author	Content
Convergence of countries is ensured by access to the same technologies		
Exogenous models	R. Solow (1956)	Technological progress multiplies the labor force and increases its capabilities. On the basis of technical progress, the convergence of countries is taking place.
Divergence is associated with an insufficient amount of human capital		
Endogenous models	E. Denison (1962, 1969)	Economic growth is determined not so much by the number of factors of production, but by increasing their quality, primarily by technical progress and education.
	A. Maddison (1987)	Economic growth is determined to a greater extent by the level of education of the workforce.
	P. Romer (1987, 1990)	Economic growth is determined by the productivity of human capital in the research sector.
	R. Lucas (1992)	Economic growth is determined by the productivity of human capital in the research sector, as well as overall investment in education.
The divergence is associated with insufficient investment in R&D and an ineffective patenting system		
Schumpeterian models	H. Grossman, E. Helpman (1991, 1994)	Economic growth is determined by the quality of human capital, investments in research and development and the possibility of receiving innovation rents due to "typical improvement of products" (innovations).
	R. Aguillon, P. Howitt (1992)	Economic growth is determined by the quality of human capital, investments in the improvement of intermediate products and the possibility of obtaining innovative rents through patenting.

a new parameter into their model - the coefficient of approximation of the economic growth rates of regions and with its help show that there is an unconditional convergence between individual US states, provinces in France, and prefectures in Japan, similar to that which exists, for example, in the OECD countries. As for underdeveloped countries, their approach to developed countries turned out to be dependent on the internal rate of savings and the degree of openness [8].

R. Barro and H. Sala-i-Martin came to the conclusion that in the absence of foreign economic ties, there is no automatic leveling of economic growth between countries - each economy produces its pace, which is ensured by internal levels of capital accumulation and technology development. When the economy becomes more open, even poor countries can adopt the technical experience of developed economies, imitating the technologies borrowed from the leaders. The imitator country creates its own R&D sector, which also includes the possibility of obtaining and selling patents, and therefore allows for the establishment of internal monopoly power. Under such conditions, according to the authors, conditional convergence will take place, when in a state of equilibrium, the growth rates of the main macroeconomic indicators of imitator countries can be equal to the growth rates of the leaders (catch-up development) [9].

Thus, the third wave of economic growth models established the understanding that through trade flows, technology imports, foreign investment, and more open access to international skilled labor markets, countries have the potential to take advantage of the knowledge that has been produced by others without significant investment costs.

Table 1 summarizes the evolution of views on the factors of divergence / convergence of countries in the world space.

It followed that all economies that had access to the same technologies should be characterized by the convergence of long-term economic growth rates, which means that, using technological progress, they would gradually overcome their backwardness.

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