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The development of the intellectual economy of the future: trends, challenges of the future

Iryna Bushman

Ph.D. philosophy of education SKILLS VMBO College, Netherlands,

ORCID: 0000-0003-1036-9066,

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Abstract: The modern development of scientific and production technologies leads to profound transformations in global economic life. The intellectualization of the economy has become a challenge, which in recent decades needs additional scientific actualization. The article aims to analyze the possible trends and challenges of the intellectual economy of the future. The article is based on general scientific methods of research: analysis, synthesis, induction, and deduction. Special economic research methods are also used (methods of collecting and processing information, analytical work, forecasting). The results of the article emphasize the general trends of global investment in education and science, which are typical for modern EU countries, the USA, Asian states (primarily, China). It is also established that within the framework of a large-scale transition of world economies to the phenomenon of intellectual production it is necessary to take into account the intensification of scientific and technical work and the increasing number of scientific resources, the global impact of information and communication technologies, the growth of international trade in intellectual services, the increase in the international movement of investment capital, etc. Important challenges have become new requirements for workers whose knowledge and skills in times of intellectualization of the economy. It is noted that the intellectual economy can lead to many problems, in particular the growing gap in the development of countries. The conclusion summarized the general trends, found that further research requires an assessment of the indexes of the intellectual economy, the analysis of industries related to the sphere of knowledge.

Keywords: economics, intellectualization, learning-by-doing, technology, asymmetry.

Introduction

Under the influence of scientific and technological progress (STP) and information and communication technologies (ICT), significant changes in the economic organizations of modern society have emerged. At the same time, the intellectual potential is increasingly seen as a basic factor for growth and development. In the context of globalization and increasing competition in markets, the production of goods with significant added value is an extraordinary advantage. Minimizing resources and increasing efficiency is also possible through the use of formerly knowledge-intensive industries, which use a

considerable layer of modern developments in their production processes that are impossible without intellectual property. Current examples show that in the United States more than 40 million people use only intelligence and a computer or laptop to make products. Approximately similar trends are also tangible in the member states of the European Union, where up to 60% of jobs belong to those sectors of the intellectual economy, which combine the development of scientific knowledge, commercialization of science, research, and development of the latest technologies, and the IT-industry.

The Netherlands has a special place in the free family of European nations because the small country is the heart of the high-tech and scientific product of the European Union. European and American experiences of implementing technological innovations and maximizing the use of the latest developments demonstrate the promising potential of this industry for the whole world, including Central and Eastern Europe (Chekina et al., 2020).

The methodological basis of the article is based on the developments of American and European scientists. Marquez-Ramos & Mourelle (2019) in their empirical work looked at education as a factor in improving not only human capital but also economic growth. Their results showed a correlation between higher education and economic growth. However, the authors hypothesize the existence of a special threshold of education, after which the features of economic growth are transformed. Goczek et al (2021) tried to study. How the quality of education affects the process of economic growth. Their results were based on data from developed countries and an analysis of GDP over the past 50 years. Their results confirmed the relevance of education quality as an important factor in economic growth. A study by Chekina et al. (2020) demonstrated the impact of higher education funding on GDP growth in several European countries. The authors concluded that there is a tendency for higher spending on education to be proportional to higher GDP. Hayes (2021) explained the term knowledge economy, described its basic criteria, principles, and gave practical examples of the use of an intelligent economy. Messacar & Frenette (2019) identified the impact of education on reforming the economy. Nordin et al. (2019) characterized the transformations in the economy of foreign countries in recent decades. However, the possible consequences of the intellectualization of economic life, the direct results of the transition to a new level of production, have been little explored.

Research Problem

It is obvious that the trends of development of the intellectual economy have developed into an established pattern. Intellectualization has moved from the state_ of formation to the stage of further improvement. The reduction of remuneration for physical labor led to a simultaneous increase in payment for intellectual work. Various economic structures, as components of the economic system (labor, capital, property, rent, innovation potential, organizational features) during the subsequent development become a substitute for each other, acquire intellectual saturation, and generally determine the elements of intellectualization of the economy. Prospects for the formation of this model on the example of economic development indices, taking into account the criterion of intellectual potential of individual European countries is an important scientific problem, because, on the one hand, local economic life is inherent in all these trends, but at the same time the features of economic life development are worth additional attention. In particular, investment in science and education and other science-intensive industries, which in the future will determine the production and economic capacities of countries, need to be analyzed separately.

Research Focus

The main focus of the study turns to the introduction of a new system of building a world economy based on intelligence and related products. It is formed based on mega-trends inherent in the modern world. This study draws attention to the dependence of indicators of investment in education and science and the overall indices of economic development. However, given the development of the intellectual economy, the possible negative consequences of its development, as well as the possible difficulties of functioning in society as a whole, also remain extremely important problems. We are talking about the emergence of such a phenomenon as the asymmetry of economic capacities in developed and developing states.

Research Aim and Research Questions

The purpose of the article is to analyze the possible trends and challenges of the intellectual economy of the future.

Consideration of the main purpose involves the study of the following issues: statistical and investment indicators and their impact on the intellectualization of the economy, consideration of the debatable problem of the formation of a new economic order, analysis of possible future trends and risks of forming a global intellectual economy.

Research Methodology

General Background

The methodological approaches used in this study are based on the practice of analytical-corporate research and the corresponding characterization of the most appropriate and effective solutions that have significant potential for the implementation of the intellectual economy, taking into account regional characteristics.

The article was formed based on general scientific methods of research: analysis, synthesis, induction, deduction. Of particular importance was the use of special methods of economic knowledge (methods of collecting and processing information; methods of analytical work; forecasting).

Instrument and Procedures

Based on the analysis the main subject of research (intellectual economy) is divided into the following key discussion issues: the characteristics of the innovation economy, its main elements, outlined trends and prospects for its implementation, analyzed the key negative trends in the case of its global spread. As a result of using the synthesis, the mentioned elements are combined and the own conclusions and judgments concerning the future development of the intellectual economy are formed. The work also used a systemic, based on which the intellectual, considered as a special system, which develops and consists of many elements. The use of the historical and structural method on the basis of which the emergence of the term "knowledge economy" was marked and characterized on the basis of its components was of separate importance. Based on abstraction the transition from general (accepted in economic science statements) to the discussion of debatable points in the studied problem was carried out.

The study was implemented in several stages. On the first - the relevance of the subject of research was defined, on the second - the key foundations of the intellectual economy were characterized, the problem of the concept of a new world order based on the intellectualization of the economic sphere was characterized, the main current, in case of large-scale implementation - positive and negative trends were investigated. In the last stage of the study, the result of the obtained results was carried out.

Data analysis

In the methodology of this study, the use of the method of collecting the necessary information by surveying the process under study through the prism of statistical observation is noteworthy. Through the statistical analysis, primary information is gathered about the main opportunities for the development of the intellectual economy in the future. The use of materials based on rankings has helped to illuminate the potential of certain countries for the wide implementation of the knowledge economy.

The study also used indicators of such world indices as the Index of Globalization, the sub-index of education, and the sub-index of information and communication technologies development. These indicators showed the countries that have the greatest potential for large-scale implementation of the intellectual economy.

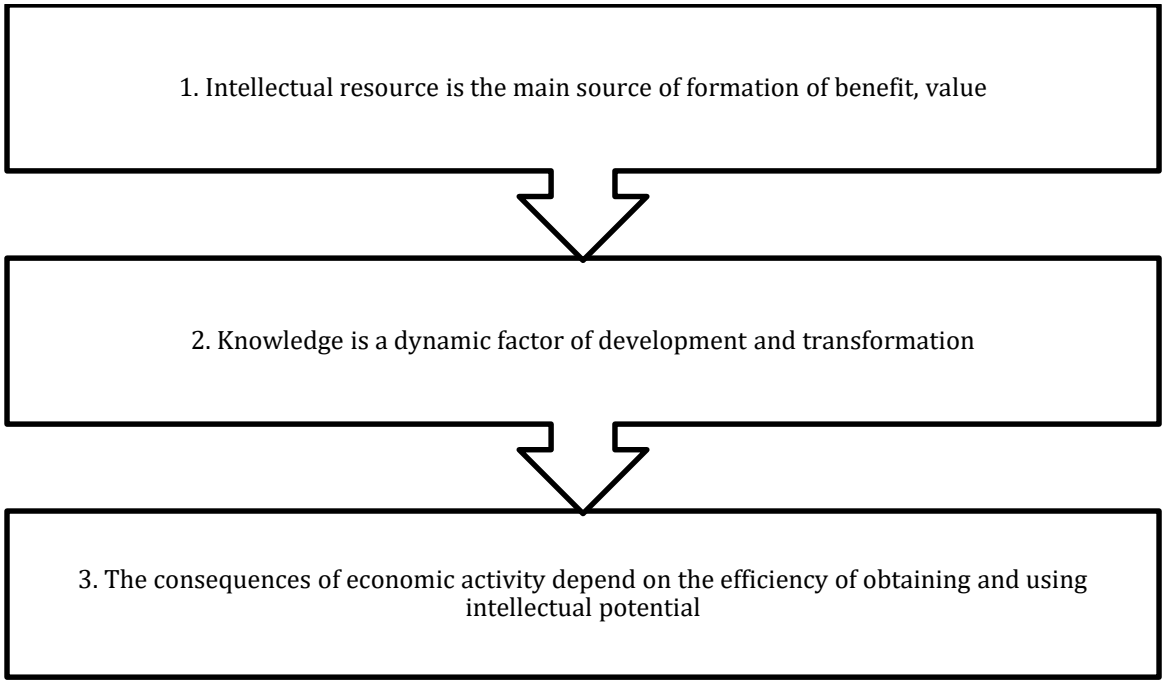
Research Results

Most modern researchers believe that the intellectual economy represents a new development period of modern society (Chekina et al., 2020). The main feature of this type of economy is the transformation and development of intellectual capital and its combination with other key factors of production, fundamentally distinguishing this economy from all previous ones.

The concept of intellectual economy is based on some key principles (See Figure 1).

Figure 1

Key Fundamentals of the Intellectual Economy



Author development

The term "smart economy" was first used by F. Machlup in 1962 (Machlup, 2012). In his book, "Knowledge Production and Dissemination in the United States" F. Machlup depicted the future economy as a separate sector including: educational factor, communication, and information. Note that he explored this area in terms of changes in humanity's intellectual potentials (Machlup, 2012). F. Machlup's explanation of the intellectual economy initially had a synthetic character because his concept united the idea of "four disciplines or directed research". The author included here: philosophy (epistemology), mathematics (cybernetics), economics (informatics), and statistical analysis. Later the American scientist Drucker (2016) expanded the interpretation of this term.

Note that the phenomenon of the intellectual economy can be studied in a broad and narrow sense. Under the broad meaning, it is interpreted as a separate type of economic organization of mankind, in which the main source of resource is intellectual potential (knowledge). In turn, this affects the transformation of the entire economic system, the nature, and technology of production, the entire system of economic relations, etc. At the same time, in a narrow sense, the economy of intellectual potential is understood as such a branch of economic activity, which contributes to the production and dissemination of knowledge.

The Intelligent Economy and the Concept of a New World Order

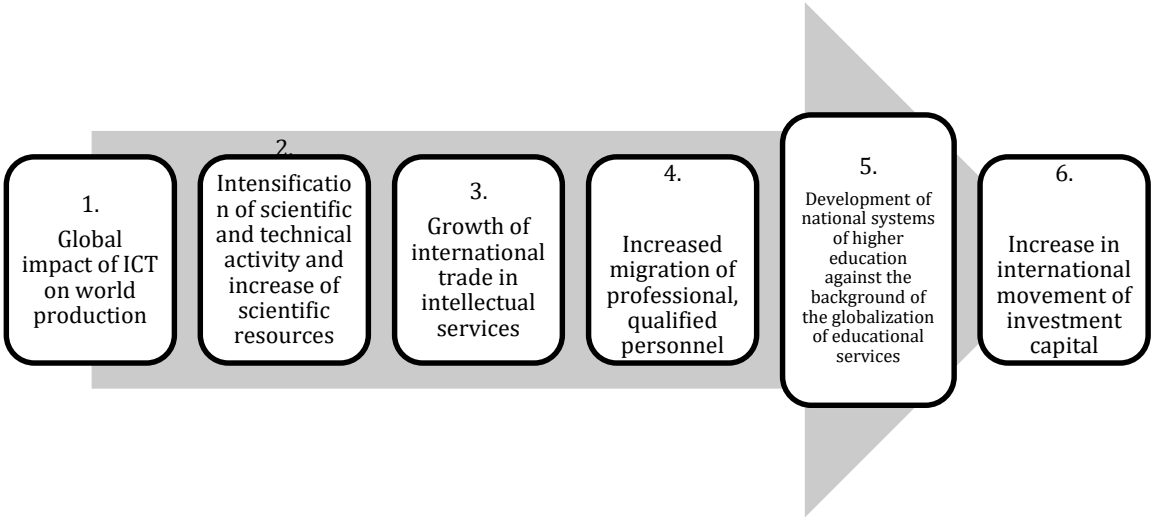
The emergence of the intellectual economy is a key vector of global economic development and is characterized by certain features associated with the period of development of the new world economic order (Dennison, 2018b). Note that the world economic order that existed before the XXI century was characterized by a number of negative trends: instability, chaotic development of economic and production processes, fluctuations, weakening of global institutions, instability, weighty dominance of developed countries. This, in turn, manifested itself noticeably in the efficiency of national economic models and did not help to overcome the gaps between different countries (Goczek, 2021). This order was characterized by an intensification of forceful confrontation and geopolitical fragmentation. These negative features generally contradict the further development of the world economy and require the formation and creation of a new order conducive to the transition to an intellectual economy.

We believe that the concept of a new world order corresponds to the determinants of economic knowledge because in this case the key accents in ensuring socio-economic transformation and relations of exchange and cooperation in the field of science and technology are supported (Picchio & Santolini, 2020). The above factors also influence the emergence of the economy of the future, in which the main role will play knowledge and technology. Current research predicts that the elimination of all possible barriers to the free dissemination of knowledge, the movement of highly skilled professionals, technology, and the provision of intensive information exchange will contribute to the formation of a new type of world economy (Marquez-Ramos & Mourelle, 2019).

However, a number of global trends in economic development should be taken into account in the large-scale transition of world economies to the phenomenon of intellectual production. First of all, we are talking about the intensification of scientific and technological work and the increase in the number of scientific resources, the global influence of information and communication technologies, the growth of international trade in intellectual services, the increase in the international movement of investment capital, focused on the sphere of intellectual innovation, etc. (See Figure 2).

Figure 2.

Global economic development trends



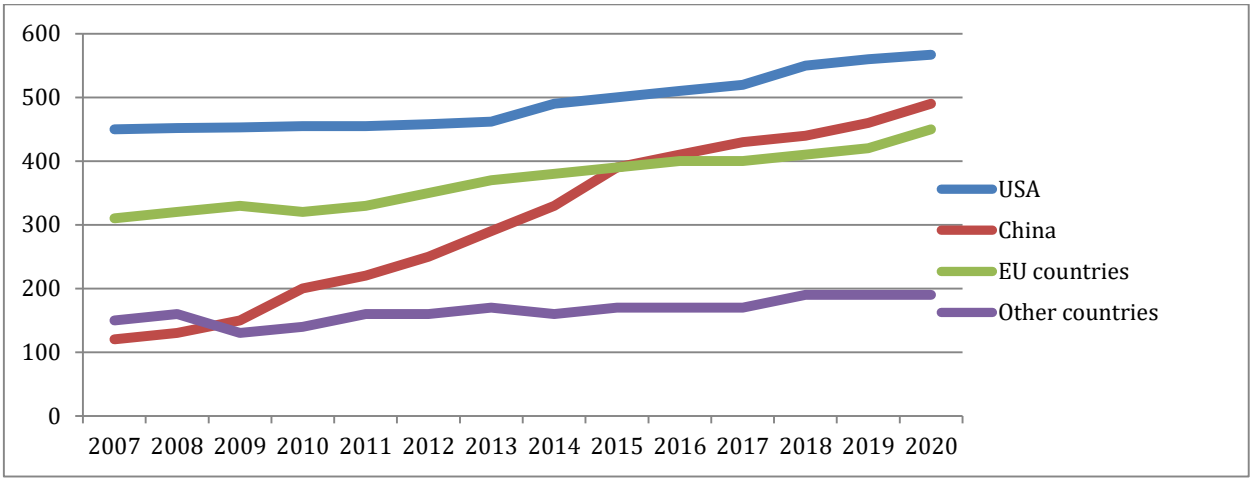
Author development

Each of the above-mentioned trends is influenced by the key New Year trends and vectors of science and technology development, however, the results of robotics, artificial intelligence, alternative energy, medicine, nano- and biotechnology, ecology, new materials, chemistry, aerospace, etc. should be taken.

An important condition for the development of the intellectual economy is the wide use of intellectual potential. Recent trends have demonstrated the dependence on the growth of investment in science and education to increase the level of knowledge-intensive production capacity in the economy (See Figure 3).

Figure 3

Trends in spending on the science industry



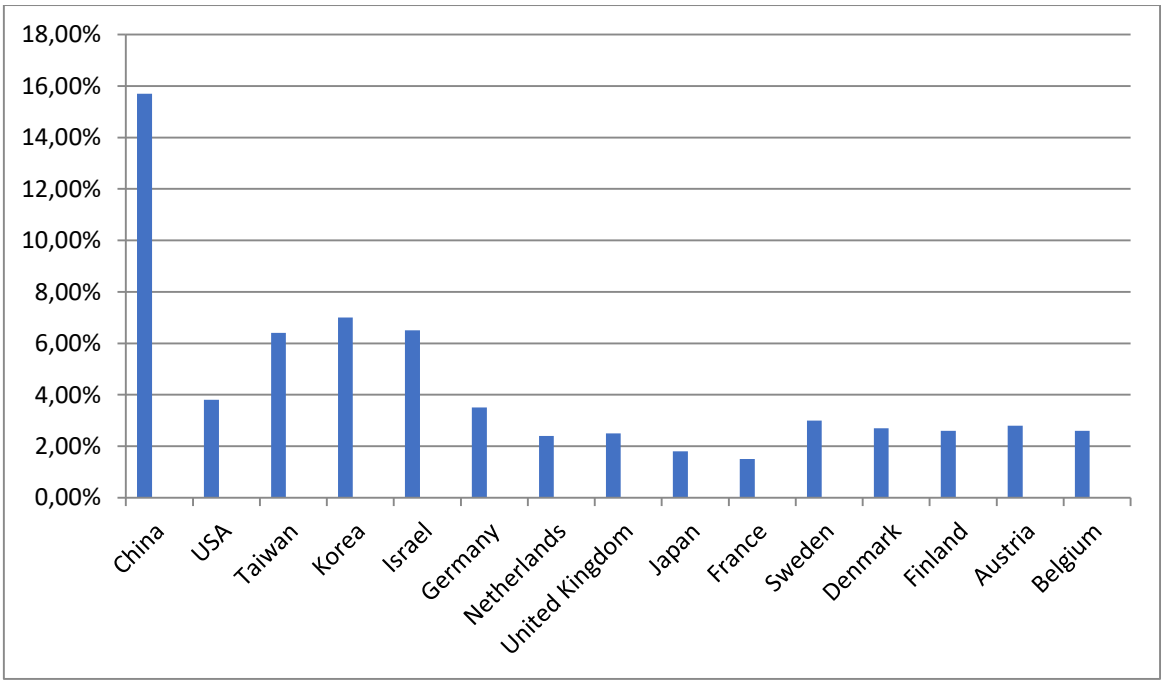
Note. Adapted from *China is closing the gap with the United States on research spending by G. Viglione, 2020. (https://doi.org/10.1038/d41586-020-00084-7)*

Figure 3 shows that the trend of spending on the science industry in the developed world is noticeable. Consequently, these countries will be the first to be able to adapt quickly to the new intellectual economy. Despite the effects of the 2008-2009 crisis, these nations continued to actively develop the S&T industry. China has increased its spending on science by 15% annually since 1995, and subsequently even more (Viglione, 2020).

An important indicator of the further development of an intellectualized economy is the possibility of spending on science and education, which depends on the overall indicators of GDP (See Figure 4).

Figure 4

Structure of expenditures on science in the system of general indicators of GDP



Note. Adapted from R&B Global funding forecast, 2019. (https://www.rdworldonline.com/2019-rd-global-funding-forecast/)

Figure 4 shows that China's spending in 2020 was 15.8% of GDP, up 0.04% from 2019. The EU as a whole spent 2.22% of GDP on scientific research in 2020. The highest intensity of scientific research in 2019 was noted in Germany, Sweden, and Austria, where the figure exceeded 3% of GDP. At the same time, in Denmark, Finland, Belgium the level of spending on Research and Development (R&D) is about 3% of GDP.

The level of globalization of the country is an important condition for the development of the intellectual economy of knowledge. It is calculated by the Index of Globalization, developed by the Swiss Economic Institute, taking into account the indicators of social, economic, and political globalization. In this ranking for 2019, Poland ranked 25th, Germany 16th, and the Netherlands 1st.

The 2018 Education Subindex covered 189 countries. Germany led the study, followed by Australia, Denmark, Ireland, New Zealand, etc. (Education index by country, 2018). The Netherlands is in 9th position. Regarding the innovation subindex, it was calculated for 129 countries. Switzerland is in the first place, Sweden second, the United States third, followed by the Netherlands and the United Kingdom (See Table 1).

Table 1

Indicators of educational development (according to the education index).

Country	Level	Indicator
Germany	1	0.940
Australia	2	0.929
Denmark	3	0.920
Ireland	4	0.918
New Zealand	5	0.917
Norway	6	0.915
England	7	0.914
Iceland	8	0.912
Netherlands	9	0.906
Finland	10	0.905
Sweden	11	0.904
USA	12	0.903
Canada	13	0.899
Switzerland	14	0.897
Belgium	15	0.893

Note. Adapted from Education index by country, 2018. (https://rankedex.com/society-rankings/education-index)

The information and communication technology sub-index was determined for 175 countries. As a result, the first position was taken by Iceland, second - South Korea, third - Switzerland, then - Denmark, Britain, Hong Kong, and the Netherlands. At the same time, Ukraine was ranked 79th.

The Global Knowledge Index (GKI), which has been updated annually since 2017, also holds an important place. Its results for the last year are important for understanding the role of industry leaders (See Table 2).

Table 2

Key indicators of global intelligence capabilities

№	Country	Technical education	Higher education	Research development and innovation	Information and communication technology	Global knowledge index
1	Switzerland	77,5	68,6	65,7	82,7	73,6
2	USA	63,2	57,8	64,3	86,5	71,1
3	Finland	78,5	56,1	57	81,9	70,8
4	Sweden	76,4	57,9	65,5	84,6	70,6
5	Netherlands	71,2	56,2	58,4	85,3	69,7

Note. Adapted from Global knowledge index, 2020. https://www.undp.org/publications/global-knowledge-index-2020

The Global Knowledge Index is a composite indicator for tracking countries' knowledge at the level of seven domains. These are pre-university education, technical, vocational, higher education, research, development and innovation, information and communication technologies, economy, and enabling environment (Global knowledge index, 2020). Given the variations in its application and meaning, the GKI seeks to introduce a more systematic awareness of knowledge, dividing the core concept into its components, recognizing the multidimensional nature of knowledge systems in all contexts and applications related to economic structures (Dennison, 2018). . This will allow us to explore more meaningfully and in detail the context of the implementation of the intellectual economy, identifying the top 5 countries that are leaders in many educational categories: Switzerland, USA, Finland, Sweden, and the Netherlands. We believe that it is these countries that have ample opportunities for the total introduction of the type of intellectual economy and the spread of this practice to other countries.

Discussion

We should agree with researchers Oliinyk et al. (2021) that the intellectualization of economic processes is not only related to the digitalization of economic activity. The spread of informative processes and the increase in the rate of intensive information flows than significantly accelerates the intellectualization of economic development (Nordin et al., 2019). At the same time, the economy throughout its development acquired informativeness, with informatization proper being a function of the intellectualization of economic processes, and not vice versa. A fundamental approach for making generalizations about the beginnings of the intellectualization of the economy can be considered the recognition of innovative ideas as derived from the products of the productive sphere (Marquez-Ramos & Mourelle, 2019).

Production becomes more efficient through increased output. Profits from this increase, especially this phenomenon becomes tangible when workers gain some positive experience under their direct duties (Groll et al., 2021). The mechanism of improvement of production processes functions using the principle of “learning-by-doing”, that is, obtaining the necessary skills, abilities, and knowledge directly in the performance of practical work.

The innovation of such a system was that both private firms, businesses and companies, and national economies worked on a large scale and benefited directly from it, growing accordingly. Such a pattern persisted according to the Ricardian theory of downward productivity, and primarily for those industries dominated primarily by elements of simple labor (Giesenow et al., 2020). On the contrary, in production processes where there was a greater percentage of applied knowledge and abilities of workers, profitability rose steadily. Therefore, the growth of economic power was solely due to the introduction of new knowledge and scientific approach. According to Goczek et al. (2021), knowledge and new capabilities were spread through the general development of educational processes. However, the aspect of global economic development trends directed along the production-worker axis remains understudied in contemporary scientific publications.

In particular, the rate of technological progress and economic growth has been extremely high over the past few centuries. It is fair to assume that this has been possible due to the use of the products of human

mental activity, but also due to the increase in population density and the growth of interpersonal relations, which have formed a suitable environment to facilitate the improvement and replication of technology, the use of ideas (partly alien) and general development. human. This environment, through its advantages and comprehensive globalization, has realized an effective diffusion of knowledge and technology for the entire world economy. The spatial and forced integration of professionals from many countries ensured the creation of synergies between science and the productive sector, efficiencies that increased the productivity of both industries. Thanks to these processes, the effect of increasing returns to scale has become relevant.

Under such conditions, we can argue that the general institutional environment has in practice acted as the next intangible mode of production after the human mind. At the present stage of scientific development, from a subjective and functional point of view, knowledge can be divided into socially new, that is, not known to society, and subjectively new, which act as innovation for individual societies, countries, national economies, etc.

Currently, socially new knowledge is formed by scientific institutions around the world, institutions of higher education, giant corporations and leaders of the digital industry, as well as knowledge-intensive industries of economically developed countries. Therefore, the gradual abandonment of the "learning-by-doing" principle in many countries of the world can be considered a characteristic feature of modern production. One consequence of this process may bring certain negative trends.

In particular, the transition to the intellectual economy of the future will be characterized by asymmetry, has different manifestations (different types of economy, different levels of development, potential, uneven transformative changes, uneven use of intellectual resources, etc.). In addition, the new world economy is also heterogeneous: it finds countries at different stages of production, industrial, agrarian, industrial, digital development. In order for the intellectualization of the economy to become a lever for economic development, it is necessary to change the relations between the participants in this process, to expand their potential.

For this reason, in the realities of the intensification of the innovation and information race, the economic asymmetry between states will increase. We should also take into account the fact that a new dimension may emerge - the global unevenness in knowledge. It may become super-high and diverse as a result of the expansion of the components. Economically developed countries are leaders and show positive dynamics in all elements of economic knowledge. However, some other countries are also dismantling science and technology capacity building and innovation capabilities. The key problem is that the concept of intellectualization of the economy is complex. The U.S., the EU, Japan, and China have partly overcome the contradiction of the intellectualization of the economy as an innovative progress, which allowed these countries to be leaders in the science and technology industry.

Conclusions and Implications

Therefore, modern processes of development of the world intellectual economy are in permanent motion - for this reason, its research refers to the current scientific challenges. It can be assumed that the current intellectual economy can be considered a system in which knowledge is both the basis and the result of the activity. At the same time, information flows in modern society are growing at a high rate, so the obvious task should be its separation and isolation of important elements, which will become a relevant resource of the intellectual economy in the near future. Current investment in science and education demonstrates China's advantage in this area, but the figures of recent years should not be deceiving. European countries and the United States have been investing in this field for a long time, so the current figures point more to the constancy of the process than to regression.

At the same time, the challenge of further introducing the smart economy is also relevant to the workforce. The "learning-by-doing" principle that was hastily applied in many countries of the world is gradually losing its relevance, as refined scientific novelties are becoming the basis of technological production even now. It is therefore important for the structure of the world's modern intellectual economy that workers acquire knowledge and information. For this reason, it is important to develop scientific and educational potentials in conditions of further development of intellectual economy, to promote the realization of the acquired knowledge and skills in practice. It should be noted that not all countries of the world can afford to maintain the pace of development properly. It is predicted that in

the future the difference in the economic development of countries with high rates of innovation and intellectualization of the labor force and the rest of the world will significantly worsen.

The next increased attention will require the problems of characterizing the participants of the economic structure, the assessment of intellectual economy indices through the prism of the development of individual trends, the analysis of industries related to the sphere of knowledge and coming from the cooperation of participants of intellectual production. All the indicated problem moments are the basis for the prospective search of vulnerabilities in the national economies of developing countries. The world experience of the EU member states, the USA, and Asian countries will allow to update the idea of the key principles of formation and functioning of the intellectual economy, identification of the weak points in its use.

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