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THE ROLE OF TECHNOLOGIES IN STIMULATING THE INNOVATIVE DEVELOPMENT OF THE ECONOMY

Abstract. *The article analyzes the role of technology in stimulating innovative economic development. It is identified that two key trends can be distinguished today: the automation of economic processes and the use of artificial intelligence in the economy. The automation of economic processes may involve the use of industrial robots in factories, the automation of warehouse processes, as well as the roboticization of certain types of services, such as chatbots and automated information processing systems in the banking sector. It is noted that concurrently with the automation of the economy, a second wave of relocation of production from countries with cheaper labor is observed in many countries. The cost reduction in robot production, especially against the backdrop of increasing labor costs, stimulates the automation of the economy, often leading to the reshoring of production. However, the regularity of increasing the level of economic automation with the reduction of production costs and the introduction of robots, and the increase in labor costs, is not absolute in open economic systems with a developed system of the international division of labor. This is because a part of production, mainly low-tech and with low value-added, is outsourced to countries with high labor costs. The described trends in the development of artificial intelligence in the economy include the increase in efficiency of production processes and the creation of new products and services. In the industry, artificial intelligence systems are used to solve various production tasks, improving the accuracy and speed of individual processes, rationalizing resource utilization, operational decision-making quality, and management efficiency. Today, the implementation of artificial intelligence is particularly effective in the following economic sectors: demand forecasting, financial markets, production optimization, risk management, and quality control. It is emphasized that one of the important issues is the regulation of artificial intelligence in the economy. Thus, the state should have legislative norms and mechanisms to regulate the use of artificial intelligence in business.*

Keywords: *digital economy, digital transformation, robotics, economic processes artificial intelligence.*

Introduction. The transformation of technological innovations in the economic sector is an extremely relevant topic today due to its significant impact on the global economy and society. Modern transformational processes are turning traditional economic sectors from production models into ecosystems where innovations and high-tech solutions play a key role. Technological innovations refer to the process of developing new or improved products, services, or processes using scientific and technical knowledge. On the other hand, such technologies are cutting-edge technologies that may include high-tech manufacturing, artificial intelligence, robotic systems, and other innovative solutions. These technologies not only modernize the way of production but also affect various sectors of the economy, including trade, finance, healthcare, education, and others. Modern trends in the development of the global economy are largely shaped and will continue to depend on the future evolution of the global electronic network, information intelligence, and digital technologies [1, p. 165–166].

In today's technological stimulation of innovative economic development, two key trends can be identified: the robotization of economic processes and the use of artificial intelligence in the economy.

Robotization of economic processes is the implementation of robots and automated systems in production and service sectors. This may include the use of industrial robots in factories, automation

of warehouse processes, as well as the robotization of certain service types, such as chatbots and automated information processing systems in the banking sector.

Robotics is a promising scientific field that is dynamically evolving and is the basis for modernizing contemporary production. Scientific and technological progress in the fields of microelectronics, new materials, information, and computer technologies in recent decades has influenced the development of robotics, expanding its possibilities for use in all areas of human activity, and as a result, attracting the interest of scientists, investors, governments, and other stakeholders to this field.

Outdated robotic systems mainly consisted of mechanical systems. Due to gradual progress in computing, interfaces, and sensors, it became possible to create robotic systems that were previously impossible to construct. The synergy of technology and science has revolutionized the use and implementation of robotics in all aspects of daily life [2, c. 308].

Thus, the development of science, technology, and robotics-related fields can be considered factors of economic robotization in modern conditions. Robots are beginning to perform increasingly complex and diverse tasks thanks to progress in object recognition, learning mechanisms, technical improvement of multifunctionality, robot autonomy, their ability to work with ever smaller objects and in increasingly challenging conditions, expanding possibilities for reprogramming, etc.

In addition to technological capabilities, the expanded use of robots in all spheres of human activity is impossible without a significant accompanying reduction in the cost of these processes. The development of technology and robotics leads to a gradual decrease in the price of robots, which, along with increasing wages for workers potentially replaced by robots, often associated with a shortage of labor resources, stimulates their implementation in the economy.

Based on the analysis of empirical data conducted by Chinese researchers regarding the relationship between increasing labor costs and the implementation of industrial robots, interesting patterns have been identified. It was noted that with a 10% increase in the minimum wage from 2008 to 2012, the probability of companies adopting robots increased by 0.11%. This is compared to the average probability of robot adoption, which was 0.19% over the same period. These results indicate that raising the minimum wage may stimulate companies to adopt industrial robots [3]. This study confirms the thesis that factors such as productivity levels and industry specifics can influence companies' strategies in using automated technologies in the face of rising labor costs.

It is worth noting that previously, the number of cases where the use of robots was economically advantageous could not compete with human labor in terms of cost-effectiveness. However, according to research by the Boston Consulting Group, manufacturers are now considering the possibility of transitioning to automation when the difference between the cost of labor and the cost of purchasing and servicing robots is at least 15% in favor of robots [4]. This indicates that with technological advancements and rising labor costs, automation becomes not only technologically feasible but also an economically justified strategy for businesses. The implementation of robots can lead to increased efficiency and reduced production costs, which is particularly relevant in today's competitive economic environment.

While it is worth noting that such a percentage should be seen more as a general trend of labor-capital substitution (by robots) as labor becomes more expensive and robots become cheaper, it should be understood that there can be no universal methodology for assessing the cost of implementing and operating robots: we are talking about some average indicators based on calculations in a specific country over a certain period.

One cannot unequivocally agree with this expert assessment of the economic efficiency of robotization due to the presence of numerous factors that "affect the indicators of the economic efficiency of robot use. <...> The decision to implement them in a particular industrial enterprise should be based on thorough research, which allows evaluating the net discounted value, payback period, internal rate of return of the robotization process" [5, c. 165]. Additionally, the level of uniqueness of the competencies of scarce labor resources is not always reflected in the price of labor, which, along with social factors, does not allow making decisions about the feasibility of robotization based solely on the price of labor and robots.

The conclusions of the Boston Consulting Group may seem quite justified if we abstract from a large number of other (non-purely economic) factors that drive or restrain the robotization of the economy, such as: government incentives for robotization, trade union activities, scarcity of labor

resources in the economy, etc. For example, Chinese researchers have demonstrated that “expenditures on robotization are significantly correlated with the membership status of the company’s CEO in the Communist Party” [6, p. 36].

In other countries, their unique historical-civilizational, cultural, institutional, and other conditions will also influence the robotization of the economy. All these factors will, to some extent, imbalance the established expert ratio, sometimes significantly distorting it.

Moreover, one cannot overlook the fact that today the economies of most countries in the world (especially leaders in robotization) belong to an open type. The openness of the economy, which involves intensive exchange with the outside world in all types of resources, allows leveraging the competitive advantages of other countries in the production of goods and services, including advantages in cost and/or qualification of labor resources.

As a result, in practice, alongside the robotization of the economy, many countries are currently witnessing a second wave of production relocation to countries with cheaper labor. This applies to countries that, over many years, have increased their industrial potential by relocating production from other countries, thanks to low labor costs and a large internal labor market, and are usually perceived as “world factories.”

Some scholars point out that “in China, for example, over the past 5 years, against the backdrop of slowing economic growth, there has been a trend towards exporting elements of its own production to Vietnam, Laos, the Philippines, and other countries in the Asia-Pacific region” [7, p. 190]. These trends are observed against the backdrop of China being the world’s largest consumer of industrial robots today.

Thus, it can be concluded that the cheapening of robot production, especially against the backdrop of rising labor costs, stimulates the robotization of the economy, often leading to the reshoring of production. However, the correlation between the increase in the level of robotization of the economy with the cheapening of production and the introduction of robots, and the increase in labor costs is not absolute in open economic systems within the framework of a developed system of international division of labor, as some production (mainly low-tech and low value-added) is relocated from countries with high labor costs to countries with cheap labor.

The intensification and diversification of international political and economic problems, as well as disruptions in supply chains due to military conflicts, to some extent, modify the manifestations of this regularity. For the development of the processes of economic robotization in the conditions of new technological and geo-economic realities, the mere cheapening of robot production, even accompanied by an increase in labor costs, is insufficient for a complete understanding of the situation. It is important to consider the impact of factors such as globalization, international division of labor, and geopolitical aspects on the trends of economic robotization.

In the context of our study, let us further analyze the second trend of technological stimulation of innovative development of the economy — the use of artificial intelligence (AI) in economics. Artificial intelligence is a technology that uses computer systems to simulate human intelligence and behavior. Artificial intelligence is widely used in various fields, including medicine, science, engineering, education, and business.

One of the main trends in the development of artificial intelligence (AI) in the economy is the increased efficiency of production processes. The use of AI allows automation of many production processes, reducing production time, minimizing errors, and improving product quality. “Under the condition of correct usage, AI technologies can enhance both economic and ecological efficiency of production” [8, c. 58].

For example, companies can use artificial intelligence for inventory management, production optimization, quality control enhancement, and cost reduction in manufacturing. This enables companies to lower their production costs and increase profits.

Another important trend in the development of artificial intelligence in the economy is the creation of new products and services. The use of artificial intelligence allows companies to develop innovative products and services that were previously unavailable. For instance, in retail, artificial intelligence is used to create personalized offers and recommendations for customers based on their purchase history and preferences [9, c. 37].

According to many researchers [2; 6; 10], priority areas for the implementation of artificial intelligence should be industries such as manufacturing, medicine, finance, and transportation, where

qualitative improvements can ensure high economic growth. For instance, in the healthcare system, the use of artificial intelligence technologies allows for a more accurate assessment of a person's health condition and forms the basis of personalized medicine. Artificial intelligence can also be used to create individualized treatment plans based on patient's genetic data.

In the industry, artificial intelligence systems are used to address a range of production tasks, increasing the accuracy and speed of individual processes, rationalizing resource utilization, and improving the promptness and quality of managerial decision-making.

The use of artificial intelligence can also help companies enhance their business management. It can be employed to analyze large volumes of data and identify trends, aiding company leadership in making more informed decisions. For example, artificial intelligence can be utilized to analyze sales and customer data, helping companies understand which products and services are most popular and adjust their marketing and sales strategies accordingly [10, c.112].

Currently, the implementation of artificial intelligence is particularly effective in the following sectors of the economy [2;6;10]:

1. Demand forecasting: Artificial intelligence enables companies to predict demand for goods and services, helping them improve marketing efficiency, optimize production activities, and inventory management.

2. Financial markets: Artificial intelligence analyzes data from financial markets and forecasts price changes for financial instruments, aiding investors in making more informed investment decisions.

3. Production optimization: Automation and robotics in manufacturing processes increase productivity and reduce production costs.

4. Risk management: Artificial intelligence allows for data analysis, identification of non-standard patterns, and prediction of risks associated with business operations. This can be used by companies to identify potential risks and develop strategies to mitigate them.

5. Quality control: Artificial intelligence automates product quality control, enabling manufacturers to quickly detect defects and prevent their spread.

However, despite high expectations, the economic impact of applying artificial intelligence technologies is difficult to assess [11, c. 290].

The expected value of artificial intelligence technologies often does not correspond to objective business productivity metrics, and their practical implementation is often accompanied by production inefficiency. This effect is associated with the imperfection of existing statistical tools, which cannot fully assess the impact of technologies due to uneven innovation dissemination, lack of practical implementation methods, and depth of understanding of the technologies crucial for their dissemination in the economy.

However, one should not forget about the potential threats that widespread use of artificial intelligence may pose. For instance, workers employed in sectors where it is applied may find themselves unemployed. Moreover, with the emergence of AI-controlled machines, there may be a threat to human safety. Measures need to be developed to prevent such threats even in the distant future.

At the same time, workers capable of using artificial intelligence will be a valuable resource, considering the breadth of possibilities of automated decision-making systems and data analysis. Additionally, by using artificial intelligence, companies will be able to reduce their costs and increase operational efficiency, giving them an advantage over competitors. Furthermore, the cost reduction from the smart use of artificial intelligence may be so high for such enterprises that those not using machine intelligence simply cannot compete with them.

Robotization and automation have both direct and reverse relationships with unemployment. At first glance, automation and robotization may lead to job cuts, especially those that can be done more efficiently and accurately using artificial intelligence technologies. This can result in increased unemployment among workers whose professions are more prone to automation. However, automation can also create jobs in new fields related to design, programming, and technical maintenance, and increase productivity in the economy as a whole, which can lead to increased business activity and employment growth.

In our opinion, professions most vulnerable to automation include tasks such as cleaning, packaging, and assembly, as well as roles in sales, finance, healthcare, and transportation. These professions are often associated with repetitive routine work that can be performed more easily and

accurately with the help of artificial intelligence, robotization, and automation. However, the cost of widespread and simultaneous automation of these professions will be too high to cause a sharp increase in unemployment in these sectors.

Meanwhile, professions requiring highly skilled work, such as programmers, engineers, and scientists, are likely to have new opportunities with the advancement of artificial intelligence technologies, as they can use them to improve the efficiency of their work. Thus, artificial intelligence will not replace the workforce in the near future. Humans will remain a more versatile and economically accessible workforce at this stage.

The development of artificial intelligence may face stagnation due to the limitations of the socioeconomic system and its inability to create something new without predefined conditions. However, the rapid pace of scientific and technological progress resulting from the use of artificial intelligence may lead to such prospects being timeless — ultimately, the main and final constraint on the development of artificial intelligence will be human capabilities. Nevertheless, artificial intelligence will still play an important role in everyday life because it can perform many routine tasks.

One of the important issues is the regulation of artificial intelligence in the economy. For example, the government should have legislative norms and mechanisms to regulate the use of artificial intelligence in business. For instance, obtaining consent from consumers for the use of personal data should be a mandatory requirement, as well as mandatory disclosure of how this data will be used. Additionally, the government should establish standards for the security of artificial intelligence to guarantee the protection of confidential information and prevent violations of people's rights.

It is important for governmental organizations and entrepreneurs to collaborate in developing effective policies for regulating artificial intelligence. The government should take responsibility for safeguarding human rights and ensuring that artificial intelligence is used in consideration of these rights. Entrepreneurs, in turn, should be prepared to cooperate with the government, ensuring standards of security and ethics in the use of artificial intelligence.

Currently, in the domestic legal field, there are general regulatory acts that govern the digitization of the economy and the use of advanced technologies, such as the Law of Ukraine No. 1667-IX dated June 15, 2021 [13], "On Stimulating the Development of Ukraine's Digital Economy," and the Law of Ukraine No. 2075-IX dated February 17, 2022, "On Cloud Services" [14]. However, they have a generalized nature, and this is currently insufficient.

After examining the existing regulatory framework, we have concluded that soon the government will need to introduce a series of laws regulating the use of artificial intelligence, and these laws, in one form or another, should exist not only at the national but also at the international level. These laws will likely define relations between the state and enterprises using artificial intelligence, the state and private individuals using artificial intelligence, as well as the state and companies that have created artificial intelligence. Possible general formulations of some of these laws could be as follows:

1. Law on Regulating the Use of Artificial Intelligence in Business and Economy: This law should define categories of companies and uses of artificial intelligence that may be prohibited or restricted. It should also contain descriptions of relevant protocols for monitoring and controlling the use of artificial intelligence.

2. Law on Liability for the Use of Artificial Intelligence: This law should establish the rights and obligations of companies using artificial intelligence. It should also develop procedures for investigating complaints and compensating damages in case of violations related to the use of artificial intelligence.

3. Law on Data Confidentiality Protection: This law should regulate the use of artificial intelligence related to the collection, storage, and use of personal data. It should guarantee that the collection, storage, and use of personal data occur with the consent of the subject and based on appropriate protocols.

4. Law on Transparency in the Use of Artificial Intelligence: This law should regulate the use of artificial intelligence in business and the economy to achieve transparency in this process and ensure civilian control. The law should provide interested parties with free access to information on how artificial intelligence is used and require mandatory reports on its effectiveness and performance.

5. Law on Protection Against Discrimination in the Use of Artificial Intelligence: This law should ensure that artificial intelligence is not used to discriminate against population groups based on characteristics such as age, gender, race, nationality, etc. The law should provide appropriate measures to control the use of artificial intelligence.

6. Law on Protection Against Accidental or Hazardous Use of Artificial Intelligence: This law should guarantee that the use of artificial intelligence does not pose a threat to human life and health, the environment, or religious and cultural values.

To transform economic entities in the realm of artificial intelligence usage, it is necessary to:

- Initiate training for employees on the basics of using artificial intelligence to improve their professional skills and ability to work with new technologies.
- Establish rules for the use of artificial intelligence in business with consideration of ethical standards to prevent unintended or accidental harm to humans in the process of using artificial intelligence.
- Develop assistance programs for small and medium-sized enterprises to reduce costs for the implementation and use of artificial intelligence through subsidies or other forms of government support.
- Facilitate the acceleration of the development of laws and regulations governing the use of artificial intelligence in business, maintaining ongoing dialogue with the government to ensure the safety and protection of consumer rights, employees, and society as a whole.
- Create platforms for exchanging experiences and knowledge about the use of artificial intelligence in business, allowing entrepreneurs to communicate and learn from each other, interact with program developers, and improve their business processes.

Therefore, artificial intelligence can become a powerful tool for business development, but only if it is used effectively and in accordance with consumer rights and legislative standards. The success of artificial intelligence implementation will largely depend on how open governmental bodies and entrepreneurs are in using it to achieve their goals.

In summary, the opportunities and advantages of robotics and artificial intelligence usage in various economic sectors are evident and already noticeable in practice. However, this impact can be ambiguous: on one hand, artificial intelligence can reduce production and management costs, enhance competitiveness, and increase the income of companies and the economy as a whole, while on the other hand, it can lead to increased unemployment due to automation and the risk of job loss, exacerbating poverty and inequality. One solution to this conflict may be to allocate part of the companies' profits to social programs — improving education, retraining, and rehabilitating those who lost their jobs due to automation.

The state should not only support and develop artificial intelligence but also create appropriate laws and take measures to protect the rights and interests of workers, mitigate the social consequences of automation, and ensure the viability of the economy in the transitional period. Additionally, successful implementation of plans in this area requires long-term and close cooperation between businesses and governmental bodies in the national economy.

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