JOURNAL
OF EUROPEAN ECONOMY
Vol. 23. № 3 (90). July–September 2024
Publication of West Ukrainian National University

Tertiary Sector Economics

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INNOVATIVE DEVELOPMENT OF UKRAINE'S ECONOMY IN THE CONDITIONS OF DIGITALIZATION: INSTITUTIONAL AND INFRASTRUCTURE PROVISION, HUMAN AND TECHNOLOGICAL POTENTIAL

Abstract

In the conditions of digital transformation, the key factor in the development of the country's innovative economy is its ability to dynamically change and adapt to the current state of the market, in particular through institutional transformations, the introduction of digital technologies and the adoption of innovative decisions. Innovative approaches to the harmonization and improvement of the efficiency of economic processes in the era of digitalization require a systematic and in-depth analysis of current trends in the development of digital technologies, the innovative economy, and the virtual market. The general level of innovativeness of the economy is currently determined taking into account the following aspects: institutional support, human capital and scientific research, market infrastructure and market development, business development, creative work results, knowledge and technical inventions. Ukraine ranks 55th in the Global Innovation Index 2023 innovation rating, which is due to the conditions of martial law, and eco-

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nomic difficulties. Changing the status quo in Ukraine is possible through even deeper implementation of modern digital technologies in the economic life of the country, complex institutional changes, creation of an innovative ecosystem for business, active formation of digital platforms for economic development, formation of Industry X.0. The development and implementation of innovative economic growth strategies lay the foundations for increasing the country's competitiveness in the era of digital transformations, and ensure long-term prosperity.

Key Words:

innovative economy, digital transformation, institutions, institutional transformations, digital technologies, business mobility, market infrastructure, human capital, scientific and technical development, business sophistication, knowledge, creative activity.

JEL: E11, H54, O14, O15, O30, O33, M10.

9 figures, 12 sources of literature.

Formulation of the problem

The state of the economy of many countries of the world today is characterized by an extremely high level of innovation, digitalization, environmentalization, socialization, intellectualization of activities and the actualization of fundamental transformational transformations, which significantly changes their strategic orientations. It also leads to the emergence of new challenges and risks that require additional attention and the formation of a completely different type of thinking in society, active accumulation of knowledge, but, at the same time, it creates new opportunities and expands the range for success in advanced and progressive spheres and industries. Under such conditions, the timeliness of responding to the demands of society and the market, as well as the complexity and systematic actions of the state, business, science, and the public, are precisely what can strengthen the human, production, technological and innovative potential of the

country, modernize its state-building components and, ultimately finally, to ensure a synergistic effect from their interaction in the conditions of digitalization.

Innovative development, digitization of the economy and production, automation of business processes, in the 21st century have already managed to become the main foundations of competitiveness, innovation and economic success of countries on the world map. And we are not only talking about the «technological explosion», the emergence of breakthrough technologies and innovations, the beginning of a new industrial revolution and the formation of Industry X.0. The digital transformation of the economy takes place in parallel with the emergence and implementation of technological innovations and institutional innovations, therefore, when talking about the formation of a new type of economy, we must also remember the need to develop new ways of managing existing institutes and institutions, and «cultivate» new ones – more progressive, efficient and effective. In order to clearly understand the vector of the future movement towards innovativeness of Ukraine's economy, we must understand the current state of affairs, outline the strengths and weaknesses of institutional, technological, market and human support, as well as assess the possibility of Ukraine occupying its competitive niche on the world economic map.

Literature review

Today's urgent questions regarding the trajectory of innovative development of the economy of the countries of the world in the conditions of global transformations and digital transformations are in the field of view of many researchers from different parts of the world. The opinion of scientists from those countries whose economies are leaders in innovativeness and the introduction of digital innovations is extremely valuable, but the opinion of Ukrainian scientists has its own practical significance, because it contains both a retrospective review of the internal potential in the country and valuable practical cases of successful experience in the implementation of innovative solutions and the use of digital tools in various economic processes.

Digital technologies contribute to the creation of innovations and stimulate the innovative development of the economy, at the same time, enterprises should be interested in trends of the development of the digital economy and embrace digital transformation, because «the correct use of digital technologies can help they must sustain their technological innovation and exploit the synergy between digital technologies and cutting-edge innovations such as 5G, big data, cloud computing and AI...» (Qinqin, 2023).

The integration of the digital and real economies has a direct impact on promotion of environmental, in particular green, innovations «through softening

the company's financial constraints, stimulating its digital transformation and promoting corporate social responsibility» (Sun, 2024).

Italian researcher P. Magliocca focuses on digital transformations of modern business and Industry 4.0 under the influence of advanced technologies and innovative solutions (Magliocca, 2021), and the Spaniards A. Botti, R. Parente, R. Vesci evaluate the available experience in the world on the practical application of digital technologies in production and business (Botti et al., 2021).

Worthy of attention, in our opinion, are the conclusions made regarding the digital transformations of the innovative development of the economy by scientists L. Hakam, E. Ahman, D. Disman, H. Mulyadi, and D. Hakam, who conducted a scient metric analysis to identify innovation trends in the digital economy (Hakam et al., 2023). In addition, under the condition of development of the digital economy, it is necessary to strengthen the integration of the digital economy and traditional industries in order to further optimize the industrial structure, promote the process of urbanization (Xu, & Li, 2022).

In Ukraine, digital changes in the business processes of modern enterprises are considered one of the most expedient ways of becoming Industry 5.0 (Manzhura, 2023). Namely, the formation of an innovative economy in the conditions of digitization and globalization requires systemic and deep institutional changes, which in the long run can provide the country with a strong competitive position on the world market and make Ukraine a «strong player» with a powerful economy (Крауc, 2015).

We agree with the opinion of researchers who admit that today there is an urgent need for innovators to be aware of the dynamics of digital platforms and ecosystems for the development of the digital economy (Mishra, 2023). When considering the role of the digital economy, it is worth remembering that it «has a driving effect on the creation of urban innovations; ...and can contribute to science and the emergence of urban innovations through the effect of industrial modernization» (Zhang, 2024). The digital economy has a stimulating effect on the quality of innovation and supports a favorable momentum in supporting high-tech innovation, and therefore, from the point of view of regional heterogeneity, strengthening the positive role of the digital economy will reduce regional development imbalances.

In view of the above, we see that the issue of innovativeness of the country's economy is currently extremely relevant, because it lays the foundations of its economic strength and competitiveness on the world market. We consider it necessary to continue our research in the context of studying and analyzing the existing institutional and infrastructural support of the economy in conditions of digitalization, as well as identifying human and technological potential to accelerate the country's innovative development.

The purpose of the article is to study the key factors that determine the innovativeness of the country's economy and influence it in the conditions of digital changes; consideration of the potential strengths of innovativeness of Ukraine's economy in order to strengthen them and participate in achieving long-term success, and identify weak points for their transformation and make them a source of strength in the future.

Research methodology

In the course of the scientific research, various scientific methods were used, in particular: the analysis method – when processing available foreign and domestic scientific literature on the practical use of digital tools to increase the innovativeness of the country's economy, as well as when identifying the current state of innovativeness of the economies of advanced countries of the world and Ukraine; methods of synthesis and generalization – when reviewing the scientific opinions of researchers regarding the factors of economic innovation and the prospects of using digital technologies, as well as formulating a conclusion regarding the main aspects of the innovative development of Ukraine's economy in the conditions of digitalization; the method of comparison – in the case of a retrospective review of the trends of changes in economic innovation factors in Ukraine and the world; statistical method – when analyzing the ranking positions of Ukraine and other countries of the world according to the innovativeness of the economy according to the version of the Global Innovation Index (GII); graphic method – with a visual presentation of the state and dynamics of innovativeness of the economy as a whole and by category.

Research results

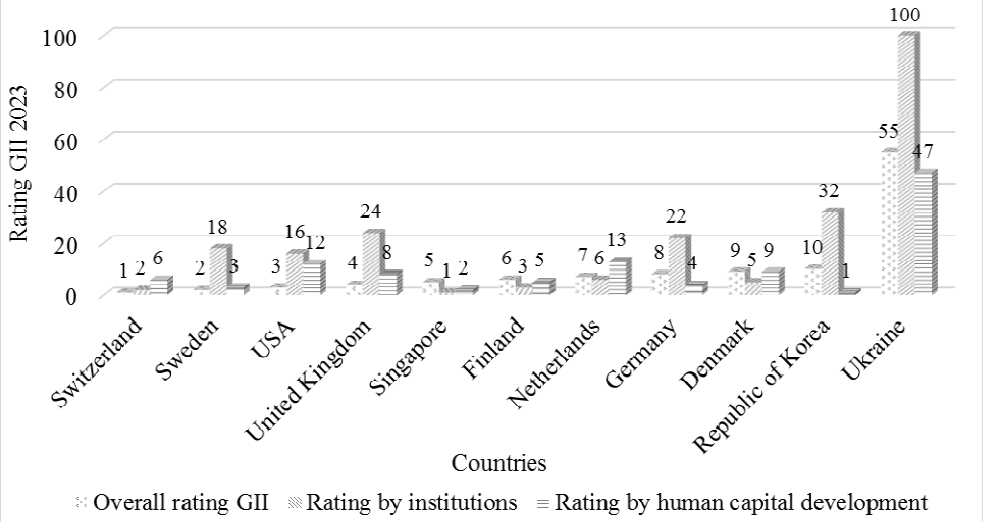
The current state of the economy and the prospects for its sustainable growth both in Ukraine and in many other countries of the world are determined by a number of important aspects, including: promoting innovative development, conducting fundamental scientific research, forming regional scientific and technological centers and industrial clusters, creating conditions for the development of virtual business, the formation of an innovative business ecosystem, the improvement of the quality and transparency of the provision of administrative services, the promotion of the mobility and adaptability of economic agents in an unstable external world, the strengthening of environmental friendliness and social responsibility of business entities, the construction of a new and high-quality architecture of the institutional environment, the systematic digital transformation of economic processes.

The innovative development of many economies of the world is currently in a state of turbulence. And the reason for this was that, without having time to overcome the negative economic consequences of the Covid-19 pandemic, the world faced an armed geopolitical conflict. Contributing to the innovative development of the country's economy is of great importance, because it transforms all aspects of human existence and social life (Hakam, 2023).

Let's try to analyze the results achieved in 2023. According to the GII 2023, in the ranking of the innovativeness of the economies of the world, the leaders are mainly European countries – 1st place is Switzerland, 2nd – Sweden, 4th – Great Britain, 6th – Finland, 7th – the Netherlands, 8th – Germany, 9th – Denmark (Fig. 1). In addition to the countries of the European continent, other countries are leading in terms of innovation – the USA (3rd position in the rating), Singapore (5th position) and the Republic of Korea (10th position). Notably, the top ten countries in the GII ranking in 2023 and 2022 were the same, except that some countries switched places. It is interesting to note that since 2011, when the GII rating was compiled, and until 2023 inclusive (13 years), Switzerland leads the rating of countries in terms of economic innovation, and its rating in 2023 was 63.82 points out of a possible 100.

Figure 1

Rating of innovative economies of some countries of the world as a whole, by institutions and by human capital development in 2023 according to the GII*



Source: Built on source (Global Innovation Index 2023, WIPO, 2023).
*The lower the country's rank, the higher its position in the GII ranking.

Undoubtedly, it is possible to improve the innovativeness of the economy, but it requires significant efforts: «prioritize the creation of strategic investments in the field of artificial intelligence, big data, cloud computing, blockchain and other basic technologies; expand and strengthen industry to support the innovative development of the digital economy; to introduce a new way of state management, enterprise participation, social crowdfunding and cooperation between state financial funds and social capital; build a multi-level, high-quality digital economy investment system; attract talents to create innovations...; explore the creation of a new mechanism for multilateral cooperation in the education of talents, integrate all kinds of educational resources and strengthen the education of professions related to the digital economy...; strengthen the creation of talent support services to retain them; create a multi-level exchange and cooperation mechanism...; protect the intellectual property rights of the digital economy; provide funding channels for digital economy enterprises and actively promote the development of digital infrastructure» (Zhang, 2024).

It is quite likely that following the mentioned recommendations, it is possible to achieve significant results in strengthening the innovativeness of the country's economy. Since 2011, Ukraine has significantly improved its position in the GII innovation rating: in 2011 it was on 60th place, in 2020 on 45th place, and in 2023 – on 55th place. The deterioration of the situation in the country in 2022–2023 is caused by conditions martial law, the difficult military-political situation on the global world map, and the country's economic difficulties.

We must take into account that the general level of innovativeness of the economy is influenced by a number of factors, in particular, the GII takes into account such factors as: institutional support, human capital and scientific research, market infrastructure and market development, business development, creative work results, knowledge and technical inventions. Each of these factors has its share of influence on the overall level of innovativeness of the economy, but the fundamental ones are institutional and human. This is explained by the fact that a highly developed institutional environment (transparent legislation, social protection and guarantees for both citizens and business entities, political will and the absence of corruption, the effectiveness of legal norms, the presence of incentives and clear rules of economic activity) and highly intellectual human capital (which includes the set of productive abilities, skills, personal traits and motivations of individuals formed, acquired and developed as a result of constant investment, which are actively used by them, modified and changed during the implementation of economic activity for the growth of both personal income and the welfare of the nation) form prerequisites for creating innovation by people who are able to take risks and feel the trends of today, but, at the same time, be sure that public institutions will help, support and protect in case of need.

In figure 1 we can see that the institutional component is systemically and qualitatively developed in Singapore (1st position in the ranking by institutions),

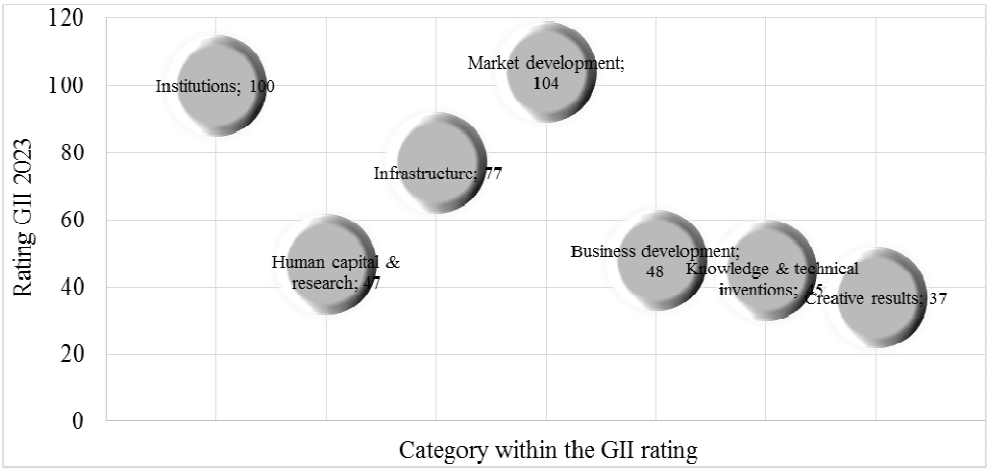
Switzerland (2nd position), Finland (3rd position), Denmark (5th position), and the Netherlands (6th position), while Ukraine, unfortunately, ranks only 100th.

Of course, any innovative ideas, solutions and developments can be produced and put into practice only by a person who is intelligent, spiritually and intellectually developed, who seeks knowledge and constantly learns, and therefore the level of development of human capital in the country is important nowadays, because the language it is about the development of the knowledge economy. Figure 1 showed that the best countries in terms of human capital development in 2023 were the Republic of Korea (1st place), Singapore (2nd place), Sweden (3rd place), Germany (4th place) and Finland (5th place).

In the ranking of human capital development in 2023, Ukraine was on 47th position, which indicates, although not significant, an improvement compared to 2022 (+2 positions). Speaking about other components of the innovativeness of our country's economy, we should mention the level of infrastructure development (Fig. 2), which in 2023 was in 77th place, and this indicates an improvement of 5 positions compared to 2022 (82nd place in the rating), and also about the development of the market, which, unfortunately, showed negative dynamics in 2022–2023 – from 102nd place in 2022, Ukraine fell to 104th place in 2023.

Figure 2

Rating of innovativeness of Ukraine's economy by category in 2023 according to the GII*



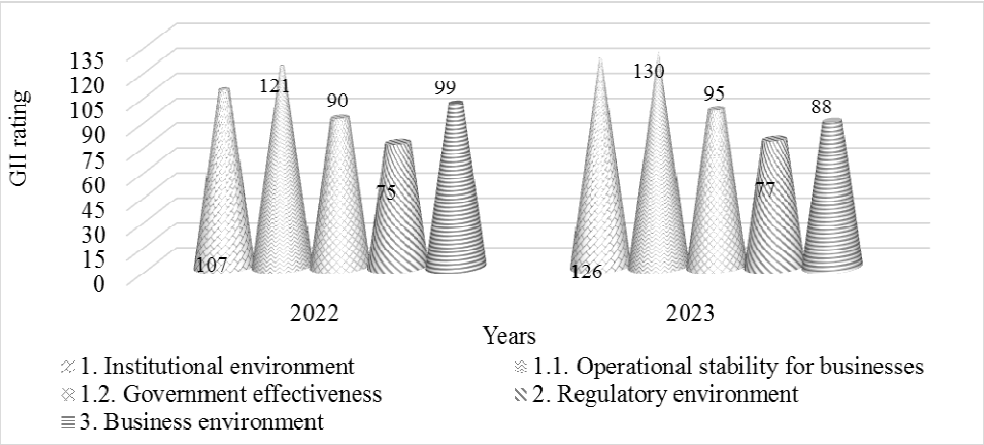
Source: Built on source (Global Innovation Index 2023, WIPO, 2023).
*The lower the country's rank, the higher its position in the GII ranking.

In 2022–2023, Ukraine also showed a decrease in ratings in terms of knowledge and technical inventions – from 36th position to 45th. There are factors of innovativeness of the country's economy, which have recently remained unchanged – e.g., in the rating of Ukraine's business development in 2022–2023, it remained in 48th place among other countries of the world, and with positive dynamics – in the rating by creative results in 2022–2023, the country rose from 63rd position to 37th.

In today's conditions, all business representatives have an urgent need to innovate in their activities due to the accelerated transition from traditional to digital business environment (Mishra, 2023). And for this, the innovative development of the country's economy must be closely correlated with the maturity and high quality of its institutional environment (Fig. 3).

Figure 3

Dynamics of the rating of the institutional support of the economy of Ukraine by distribution mediums in 2022–2023 according to the GII*



Source: Built on sources (Global Innovation Index 2022, WIPO, 2022; Global Innovation Index 2023, WIPO, 2023).
*The lower the country's rank, the higher its position in the GII ranking.

We already mentioned above that in 2023, Ukraine ranked 100th in the institutional development rating, which is, of course, its weak point and needs significant improvement. Such a difficult situation is connected, first of all, with the low level of development of the institutional environment in the country and the deepening of negative trends – in 2011, Ukraine had a rating of 36.2 according to the GII and a rating of 103, and in 2023 – a rating of 17.2 out of 100 possible points and a rating of 126. Unfortunately, the reason for this was the low stability of work for business (Ukraine's rating in 2023 is 130 and the score is 9 points) and the low efficiency of the government – 95th place among other countries in the world.

Consideration of current economic issues takes place through the prism of finding the keys to success from the implementation of innovations specifically in e-government and digitization of various spheres and branches of the economy (Botti, 2021).

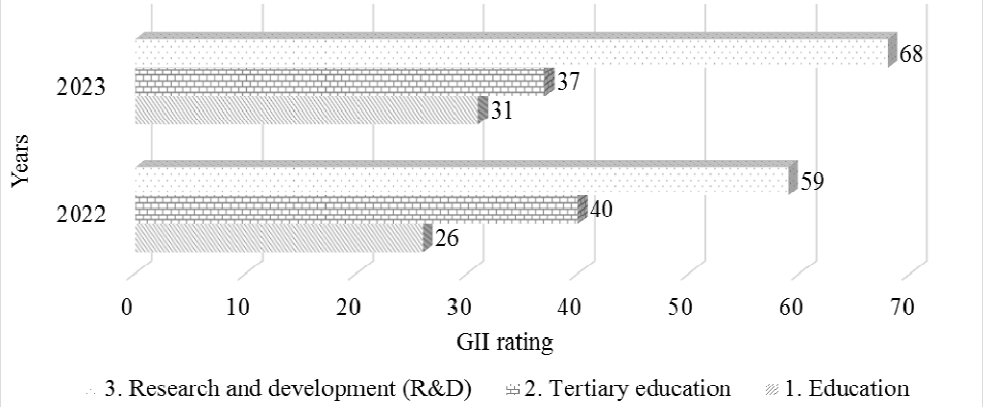
An important place in the country's institutional security belongs to the regulatory environment, which is from 2011 shows positive dynamics of changes from 2011 (Ukraine's 104th place) to now (in 2023, Ukraine took 77th place). This is due to the improvement of regulatory quality (in the 2023 GII rating, Ukraine received 34.9 points and 87th place), minor positive developments in matters of the rule of law (Ukraine took 107th place in 2023, although it was 114th in 2015) and the cost of layoffs due to downsizing (in 2023, Ukraine was on 41st place, while in 2011 – on 73rd place). The business environment makes its contribution to the development of institutional support – in 2022–2023, despite economic and political difficulties and the conditions of martial law, Ukraine managed to advance from 99th place to 88th place in 2023.

As already mentioned above, the key to the innovative development of the country's economy is a person with his ability to create ideas and innovations, carry out scientific research and create advanced technologies. Figure 4 shows us that in 2022–2023, Ukraine has a positive trend towards change – it rose in the ranking from 49th place to 47th.

In the development of human potential, an important place belongs to education, which in 2023 in Ukraine was in a fairly good position in the GII rating – 31st place among the countries of the world, while in terms of spending on education as a percentage of GDP, Ukraine is on the 24th place in the rating. Our country has always been distinguished by a high level of the share of people with higher education in the structure of the entire population, in 2023 Ukraine was ranked 37th in the ranking of obtaining higher education, and in terms of the gross percentage of enrollment in higher education, it had an even better position – 21st.

Figure 4

Dynamics of the ranking of the human and scientific support of the economy of Ukraine by category in 2022–2023 according to the GII*



Source: Built on sources (Global Innovation Index 2022, WIPO, 2022; Global Innovation Index 2023, WIPO, 2023).
*The lower the country's rank, the higher its position in the GII ranking.

Scientific research and development, their number and support from government institutions also determine the rating of the human and scientific endowment of the country's economy. According to this indicator, unfortunately, Ukraine worsens its result every year, and if in 2015 it was in 45th place in the GII rating, in 2022 – 59th place, then in 2023 – 68th place. The reduction in the number of researchers and the reduction of expenses for research and development work is justified by the conditions of martial law and the fact that even researchers and scientists are forced to join the defense of the country, the deficit of the state budget and the priority of the state to fulfill its defense function, however, we clearly have to realize that the creation of added value in the country, the production of goods (for both consumer and defense-industrial purposes), optimization and modernization of production and business processes, reduction of import dependence and increase of competitiveness on the international market is possible only in case of stimulation and maintenance of innovative activities of enterprises, educational institutions, scientific institutions, promoting the innovative development of the country's economy.

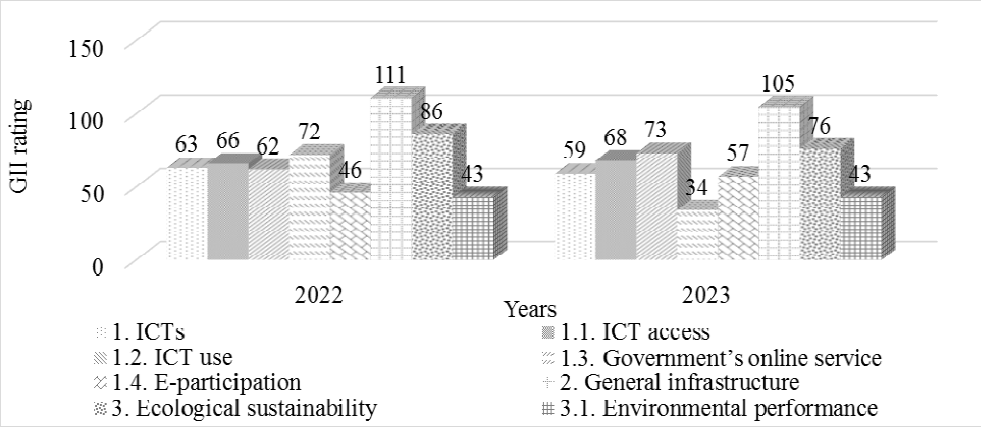
Developed and diverse infrastructural support is also a guarantee of stable innovative development of the country's economy. Market infrastructure must be digital today, because it will enable business representatives to effectively use

digital technologies to achieve market success (Magliocca (Ed.), 2021). Digital changes in business processes will help lay the foundations for the formation of Industry 5.0 (Manzhura (Ed.), 2023), as well as strengthen Ukraine's competitive position on the world market (Крауc, 2015).

The overall rating of infrastructure provision of Ukraine in 2023 was 77 with an estimate of 36.9 points (Fig. 5). Positive dynamics are observed in our country with the development and implementation of ICT – in 2015, the 89th position in the GII rating against 59th position in 2023, which was achieved by increasing accessibility to ICT, increasing the use of ICT in work, education, business, governance, etc., improving the government online service and deepening the electronic format of participation in economic processes.

Figure 5

Dynamics of the rating of infrastructural provision of the economy of Ukraine by category in 2022–2023 according to the GII*



Source: Built on sources (Global Innovation Index 2022, WIPO, 2022; Global Innovation Index 2023, WIPO, 2023).
*The lower the country's rank, the higher its position in the GII ranking.

Facilitating increased investment in the infrastructure of the economy and strengthening support for industry, create favorable conditions for the innovative economy and stimulate the development of digital innovation (Xu, & Li (Ed.), 2022).

Compared to 2022, Ukraine slightly improved the overall state of its infrastructure – it rose from 111th place to 105th. Innovativeness and high technology of economic development have no weight without environmental sustainability, which is not considered a strong point in Ukraine due to outdated and energy-intensive material-technical base of many enterprises, in particular industrial ones.

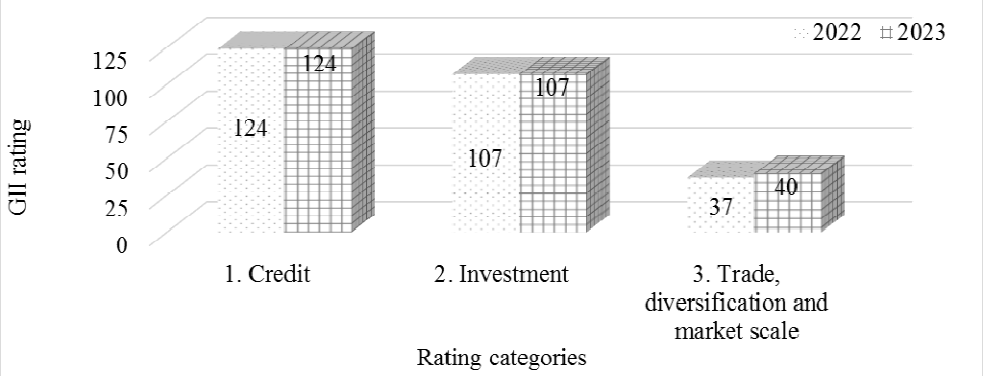
The combination of the digital and real economies opens up a multifaceted increase in environmental innovation. This enhances the synergies generated by this integration and increases the efficiency of innovation itself as digital technology tools that encompass big data and cloud computing open up opportunities for enterprises (Sun, 2024).

The «sophistication of the market» (credit, investment, trade) in the innovativeness of the world's economies is also of great importance today. As for investments in science and innovation, the data showed a mixed performance in 2022 in the context of new challenges and a decline in innovation funding, as global investments for 2020–2021 increased by 5.2% (average for 2011–2021 by only 4.8%), and corporate investment in R&D increased by 7.4% in 2021–2022. However, if we take into account the significant level of inflation, the real numbers are not so positive. The results of venture capital investment in the world in 2021–2022 are also disappointing, as they decreased by 37.8%, this is despite the fact that the number of venture capital participants increased by 17.6%, which indicates a deterioration of the climate for risk financing. But, if we consider these indicators for the period of the last 10 years (2012–2022), the picture looks more encouraging – the value of venture capital investment on a global scale increased by an average of 20.6%, and the number of participants – by 9.9%.

In Ukraine, the category «market sophistication» in the context of the innovative development of the country's economy, unfortunately, has negative trends (Fig. 6): in 2011, Ukraine was ranked 64th, in 2015 – 89th, and in 2023 – 104th. Such changes are caused, in particular, by a decrease in the availability and profitability of crediting – Ukraine's rating in crediting in 2023 was at the level of 124th place, although in 2011 it was at the level of 57th place (internal lending in the private sector had a negative trend, and loans from microfinance organizations remained at 2022).

Figure 6

Dynamics of the rating of sophistication of the market of the Ukrainian economy by category in 2022–2023 according to the GII*



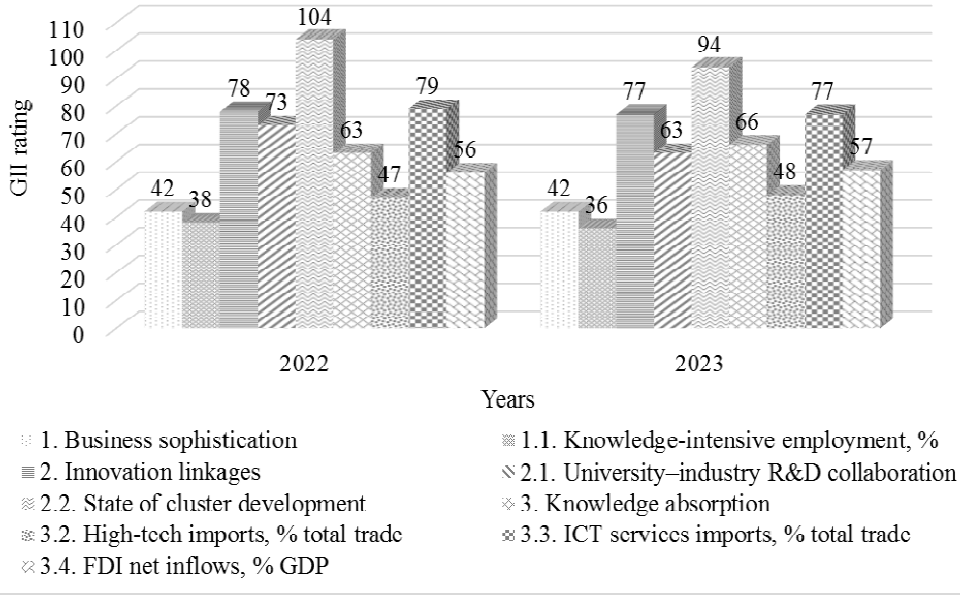
Source: Built on sources (Global Innovation Index 2022, WIPO, 2022; Global Innovation Index 2023, WIPO, 2023).
*The lower the country's rank, the higher its position in the GII ranking.

As for the investment policy, in 2022–2023 it remained unchanged in the country and this ensured Ukraine the 107th position in the rating (the market capitalization as a percentage of GDP is low, and the number of venture capital investors has decreased, which is fully justified by the unfavorable political and economic situation in connection with martial law conditions). Trade and market size, considered in the context of the «market sophistication» category for the period 2022–2023, also underwent negative changes – Ukraine fell 3 positions (from 37th to 40th place), but if compared with 2015, when the country was at 66 places, the situation is still better. We would like to remind you that diversification and the scale of the market are affected by the applicable tariff rate (Ukraine ranked 52nd in the GII 2023) and the scale of the domestic market (where our country ranks 43rd in the world).

Analyzing the rating of the innovativeness of the economy, we cannot ignore the business sophistication of the country's economy (Fig. 7), because it makes it possible to fully assess the human and technological potential, scientific opportunities and results of intellectual work.

Figure 7

Dynamics of the business sophistication rating of the Ukrainian economy by category in 2022–2023 according to the GII*



Source: Built on sources (Global Innovation Index 2022, WIPO, 2022; Global Innovation Index 2023, WIPO, 2023).
*The lower the country's rank, the higher its position in the GII ranking.

The rating of the business sophistication of Ukraine's economy remained unchanged during 2022–2023 and was at the level of 48th place, this was due to the stability of the number of knowledge workers (in the rating, Ukraine took 42nd place in 2022–2023), a high percentage of employed women with a high educational degree (Ukraine is in 2nd place in this ranking) and positive changes in the knowledge intensity of employment (Ukraine rose by 2 positions to 36th place in 2023).

The business sophistication of the country's economy is strengthened by existing innovative connections, although Ukraine is not among the leaders of the rating, the dynamics are positive – in 2015, it took 105th place in the rating, and in 2023 – 77th place (Fig. 7). In this context, it is worth mentioning the strengthening of cooperation between higher education institutions and industry in the field of science and technology (Ukraine rose by 10 positions to 63rd place in 2022–

2023), the development of cluster activities (+10 positions to 94th place in 2022–2023) and conclusion of agreements on joint business activities (+13 positions in 2022–2023).

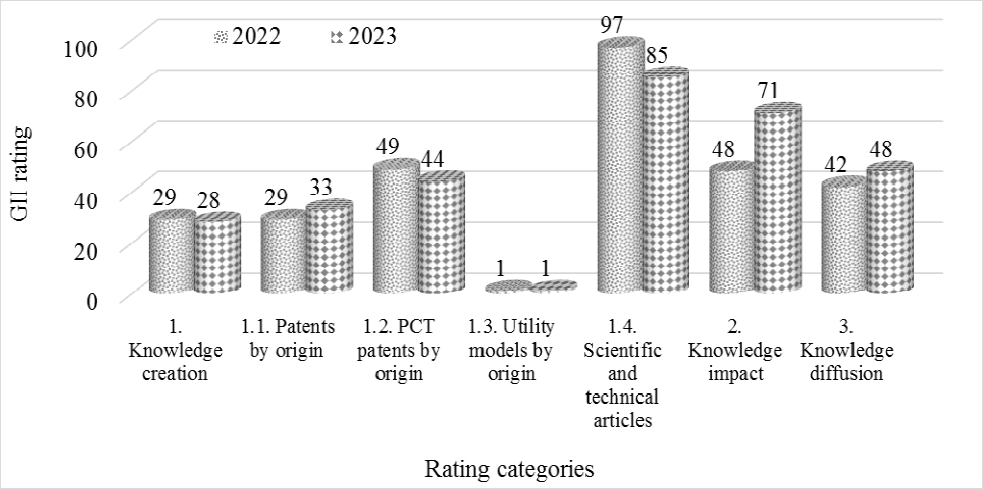
Another category considered in the business sophistication of the economy is trends in the assimilation of knowledge. Here in Ukraine, as in many other countries of the world, there is a deterioration of results, which dates back to 2020 – the global pandemic of Covid-19 and, as a result, remote (distance) learning and the implementation of scientific research, which reduced their quality. According to the knowledge assimilation rating, Ukraine was in 66th place in 2023 (Fig. 7), as opposed to 63 positions in 2022 (the country fell by 1 position (to 48th place) in terms of high technological import and by 1 position (to 57th place) volumes of net inflow of foreign direct investments), although the country rose to 45th place in the rating by the share of payments for intellectual property, and to 77th place by the share of ICT service imports (+2 positions in each rating).

The results of knowledge and technologies, their practical use and commercialization are the important aspects without which it is impossible to guarantee the growth of innovativeness of the country's economy. We note the fact of the increase in the publication activity of researchers in the world in the long-term period (for 2012–2022), their number increased by 4.9%, although the growth for 2021–2022 is not so indicative – only by 1.5%. Positive dynamics, albeit slow, can be observed in international patent applications filed. In 2021–2022, they were submitted by 0.3% compared to the previous period, and on average, in 2012–2022, their number increased by 3.6%. Global technological progress in a variety of progressive fields continues to open new horizons and make new achievements for global development, despite the significant reduction in spending on these fields (in 2020–2021, spending on solar energy decreased by 12.8%, wind energy – by 13.2%, genome sequencing – by 23.3%, etc.) (Global Innovation Index 2023, WIPO, 2023).

Adopting digital technologies and modern business models can help businesses to innovate, discover and innovate, develop new utility models, and innovate in design to outperform their competitors in the digital age; data analytics, will provide the definition of market trends and customer demand for inventions and design innovations, and digital tools – to develop and test the design of new products faster and be convenient for users. Effective use of digital technologies will enable enterprises to control their costs and increase efficiency, while automation and artificial intelligence will optimize business processes. A digital enterprise ecosystem that spans manufacturing, operation, and management can reduce manufacturing and operating costs, increase R&D efficiency, and improve product quality (Qinqin (Ed.), 2023).

Figure 8

Dynamics of the rating of the results of knowledge and technologies of the Ukrainian economy by category in 2022–2023 according to the GII*



Source: Built on sources (Global Innovation Index 2022, WIPO, 2022; Global Innovation Index 2023, WIPO, 2023).
*The lower the country's rank, the higher its position in the GII ranking.

In the category «Results of knowledge and technologies» in 2023, Ukraine fell by 9 positions (to 45th place in the GII) compared to 2022 (Fig. 8). Although, if we take into account the «Knowledge Creation» sub-index, here Ukraine took 28th place in the rating (+1 position relative to 2022), which is caused by the increase in the number of scientific and technical articles (+12 positions and Ukraine's 85th place in 2023), a consistently high number of useful models by origin (1st place in Ukraine in the last few years), unchanged citation of documents (in 2022–2023, Ukraine ranked 51st), an increase in the number of issued PCT patents by origin (+5 positions in 2023 and 44th place in Ukraine) in the rating).

The decrease in labor productivity and the reduction of high-tech production in Ukraine led to the fact that according to the sub-index «Impact of knowledge» the country fell in the rating to 71st place in 2023 (Fig. 8) compared to 48th place in 2022. Equally important for the creation of innovative products and solutions is the speed and quality of knowledge dissemination, where Ukraine, unfortunately, lost several positions in 2022–2023 (minus 6 positions and 48th place in 2023). This was the result of a reduction in revenues from intellectual

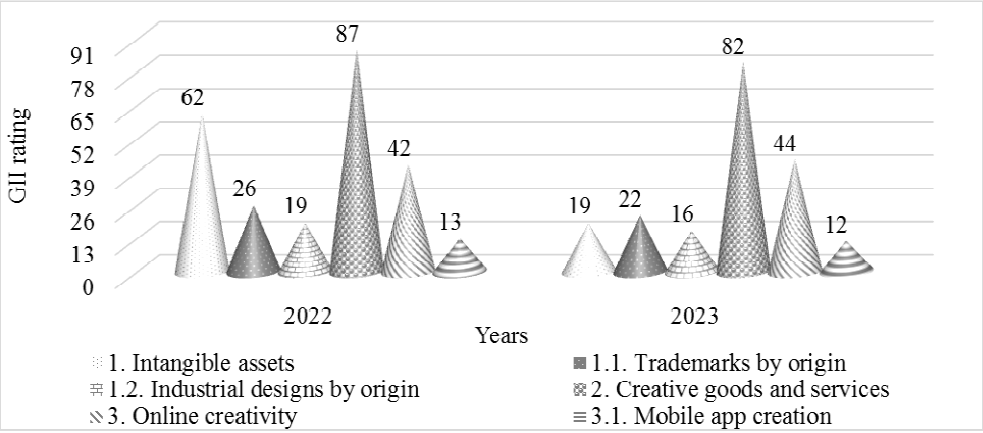
property, a decrease in the volume of high-tech exports, and a decrease in the specific weight of ICT services exports in the total trade.

The introduction of advanced technologies in the world is gradually opening access to safe sanitation (in 2021–2022 alone, there is an increase of 1.4%, and in 2012–2022 – by as much as 2.4%, while the penetration is observed in 2022 year in 57 out of 100 participants against 45 participants in 2012) and the spread of communication (in 2021–2022 fixed broadband increased by 4.8% (for 2012–2022 – growth by 6.7%), and mobile – by 6% (for 2012–2022 – growth by 14.8%)). The tendency to achieve carbon neutrality in many developed countries of the world stimulates the spread of electric cars, their number in use increased by 59.9% in 2021–2022 alone (by 63.5% in 2012–2022). Humanity is increasingly resorting to the use of robots – their number increased by 14.6% for 2021–2022, and the average indicator for 2012–2022 was 11.7%, which indicates an increase in the general level of penetration of technology into people's lives, but the level of their occurrence is still average or low (Global Innovation Index 2023, WIPO, 2023).

We positively assess the change in the ranking of Ukraine in the Global Innovation Index 2023 by creative results as extremely positive (growth on 26 positions for the year and 37th place in 2023) (Fig. 9).

Figure 9

Dynamics of the rating of the results of creative economic activity of Ukraine by category in 2022–2023 according to the GII*



Source: Built on sources (Global Innovation Index 2022, WIPO, 2022; Global Innovation Index 2023, WIPO, 2023).
*The lower the country's rank, the higher its position in the GII ranking.

This is due, in particular, to the improvement of Ukraine's position in terms of intangible assets – trademarks and industrial designs (+43 positions in 2022–2023 and 19th place in the 2023 ranking), produced creative goods and services (growth on 5 positions in 2023 and 82nd place compared to 2022) and Internet creativity, in particular created mobile applications (+1 position in 2023 and 12th place).

The analysis of the innovativeness of the economy and the factors that determine it gives us the opportunity to conclude that the institutional environment of the economy of Ukraine is, in comparison with other countries of the world, not as highly developed and high-quality. And this requires even greater attention from state authorities at various levels, in order to strengthen the positive effects of the achievements of innovative development and digital changes in economic processes.

Taking into account the current military, political and economic situation in the country (martial law conditions, the difficult financial situation of the state and the impossibility of fully fulfilling its defense, economic and social functions independently, increased emigration of the population (primarily, women of working age and children) from of Ukraine, a catastrophic decline in the birth rate in the country and an increase in mortality (in particular, among young men), the aging and impoverishment of the nation, a decrease in the well-being and purchasing power of citizens, a shortage of labor in the labor market in general and, in particular, in critical infrastructure, the destruction of jobs (factories, enterprises), loss of access to elementary goods (housing, drinking water, access to medical and educational services, electricity, etc.), pollution of atmospheric air, water resources and land by munitions and their combustion residues) is extremely important at present talk about the priority of developing institutional components of innovative economic development and digital transformations. However, these are precisely those aspects of state and social life that lay the foundations of a new type of social thinking; lead to deep and long-term, not superficial and short-term, changes in the state, industry and business; is a driving force for the creation of innovations and their implementation by all economic agents; supporting the digital transformation of the economy.

Conclusions

The need to increase the transparency, accessibility and effectiveness of institutional support for the implementation of economic processes in the country is due, first of all, to systemic and qualitative transformations in technological processes in the conditions of widespread and deep digitalization. Optimizing, harmonizing, and balancing various aspects of economic life in the country requires all participants in economic processes to change their economic behavior,

style of economic thinking, and perception of the current situation and events around, limits and angles of digital transformations, modern trajectories and future perspectives, building new science-based approaches to the institutional environment of the innovative economy in conditions of digitalization.

In the course of the study, it was found that the transparency of institutional support, highly intellectual human capital, in-depth scientific research, extensive market infrastructure, market development, business mobility and adaptability, new creative work results, expansion of knowledge and creation of technical inventions contribute to increasing the level of development of the innovative economy of the country.

It was found that the potential strengths of the innovativeness of the economy of Ukraine, which are capable of increasing economic benefits in the long term, are: the quality of education at all levels (general secondary, professional and technical, higher) and a consistently significant number of those who obtain it; high level of electronic participation (decryption of services) of citizens and business representatives in solving various issues; providing the opportunity to carry out trade operations, diversification and scaling in the market; a significant number of workers in the field of knowledge and the growth of knowledge-intensive employment in the country; stimulating conditions for production and dissemination of knowledge, creation of patents, utility models, trademarks, industrial designs, various mobile applications and other results of creative economic activity.

At the same time, there are a number of aspects of Ukraine's economy that need to be changed in order to become sources of innovation in the future. Among them: the transformation of the country's institutional environment, in particular in terms of creating conditions for stable business operations and increasing government efficiency; improvement of the regulatory and business environment; increasing funding for scientific research and development; strengthening the infrastructural support of the economy of Ukraine in the context of creating ICT, expanding access to them and their active use in practice, strengthening environmental sustainability and efficiency; search for new credit opportunities and improvement of the country's investment attractiveness; development of innovative connections, first of all, between higher education institutions and industry, and through the creation of innovative scientific-technological and industrial clusters; increasing the volume of high-tech imports in the general structure of trade and stimulating the inflow of foreign direct investments; creation of conditions for increasing the quality of scientific and technological articles, which will increase their popularity and citation among foreign scientists and create prerequisites for future joint work and scientific research; support for the creation of creative goods and services.

The development of practical tools and effective measures to improve the institutional, regulatory and business environment of Ukraine's economy, in order to strengthen its innovativeness in the conditions of digital transformations and post-war reconstruction, are especially relevant for the country in our time, and therefore will become directions of future scientific research.

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Received: June 19, 2024.
Reviewed: June 28, 2024.
Accepted: August 27, 2024.