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The impact of geopolitical trends on the technological renewal of industrial enterprises as a basis for the convergence of investment processes in the Ukrainian economy

Abstract. The global economy is influenced by geopolitical trends that create new challenges and opportunities for the development of national economies. The studied geopolitical factors indicate that it is important for Ukraine to integrate its economy into global financial processes, introduce the latest technologies and develop international cooperation. The purpose of this study was to identify the impact of geopolitical trends on the technological upgrading of industrial enterprises in Ukraine and to substantiate their role as a key factor in the convergence of investment processes, taking into account the specifics of the Ukrainian economy's integration into global markets. The study was conducted using

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the methods of theoretical generalisation, statistical data analysis, comparison and logical and structural modelling. The study summarised and structured geopolitical trends and identified their impact on the nature of investment flows into industry. The factors that facilitate or impede the attraction of foreign investment in the technological renewal of Ukraine's industry in the context of geopolitical instability were substantiated. The relationship between the technological renewal of industry and the convergence of investment processes in Ukraine was substantiated, and the synergy between technological renewal and investment was investigated. A model of adaptation of industrial enterprises of Ukraine to changing geopolitical conditions through technological renewal was proposed, which is aimed at increasing their investment attractiveness. Recommendations for the state policy to stimulate technological renewal of industry in the context of geopolitical instability have been developed. The practical value of this study lies in the identification of key factors that affect the investment attractiveness of enterprises in the context of geopolitical uncertainty. This allows for creating a mechanism for managing and adjusting the impact of geopolitical risks, which will help to increase competitiveness in the domestic and foreign markets

Keywords: geopolitical factors; investment volumes; direct investment; adaptation model; public policy

INTRODUCTION

The world economy is influenced by geopolitical processes that create new challenges and opportunities for the development of national economies. For Ukraine, which is at the epicentre of geopolitical changes, these processes are of particular importance. On the one hand, political and economic instability create barriers to attracting investment, while on the other hand, they open up opportunities for integration into global markets through the modernisation and technological upgrading of the industrial sector. Geopolitical factors such as sanctions, trade wars, and changes in global supply chains have a significant impact on investment flows. Studies by K.E. Meyer *et al*. (2023) and J. Benchimol & L. Palumbo (2024) emphasised the role of sanctions regimes in transforming international financial relations. G. De Souza *et al*. (2024) and L. Zou *et al*. (2024) focused on the growing importance of trade conflicts for the redistribution of economic resources. These processes necessitate the adaptation of strategies of transnational corporations and national economies to new conditions.

As identified by J. Aizenman *et al*. (2024), geopolitical news affects the stability of financial markets, including stocks, currencies, and bonds. At the same time, M.E. Hoque *et al*. (2024) findings showed that certain markets, such as oil, gas, and gold, have shown relative resilience to geopolitical risks, particularly during the Ukraine-Russia conflict. This indicates their importance as tools for risk management and investment stability. The Ukrainian crisis, according to B. Gao & Z. Xu (2024), affects multinationals at three levels: through supply chain adjustments, national policy making, and the response of international organisations such as the WTO. This highlights the need for coordination between governments, businesses and global institutions to minimise risks and adapt to challenges.

As noted by X. Yu *et al*. (2024), the convergence of investment processes ensures the integration of national capital markets and creates new opportunities for economic growth. For Ukraine, this opens up prospects for attracting foreign capital but at the same time requires stabilisation of domestic conditions for investment, including risk reduction and development of the technological base. According to A. Kostruba (2024), the development of foreign business and investment are critical to Ukraine's economic recovery. In this context, technological upgrades, the introduction of Industry 4.0 principles, automation, and the transition to renewable energy sources are key factors in increasing competitiveness. This also contributes to Ukraine's integration into global investment processes, forming a new economic environment. The study by Y. Yakymenko & V. Yurchyshyn (2024) emphasised the importance of international support in creating favourable conditions for attracting investors. Effective cooperation with international organisations will allow Ukraine not only to restore its economy but also to create the preconditions for long-term sustainable development.

These aspects show that for Ukraine, given the global challenges, it is necessary to integrate the economy into global financial processes, introduce advanced technologies and strengthen international cooperation. Geopolitical stability and strategic initiatives become the basis for attracting investments and adapting to dynamic changes in the world market. The purpose of this study was to identify the impact of geopolitical trends on the technological renewal of industrial enterprises in Ukraine and to substantiate their role as a key factor in the convergence of investment processes, taking into account the specifics of the integration of the Ukrainian economy into global markets.

MATERIALS AND METHODS

The study used a comprehensive approach to analysing the impact of geopolitical trends on the technological renewal of Ukrainian industrial enterprises. The main methods used in the study are the methods of theoretical generalisation, analysis of statistical data, comparison and logical and structural modelling. The method of theoretical generalisation was used to systematise scientific approaches to determining the relationship between geopolitical processes and economic development. The article analysed scientific publications covering the impact of geopolitical instability on investment processes, as well as economic aspects of the integration of national economies into world markets. The use of this method made it possible to formulate the conceptual framework of the study and identify the key factors that influence the process of technological renewal of enterprises in the global economy.

The method of statistical data analysis was used to assess the dynamics of investment flows into the Ukrainian industry and the degree of integration of the country's economy into global financial processes. The main sources of statistical information were the data of the State Statistics Service of Ukraine, the World Bank, the International

Monetary Fund (IMF), the European Bank for Reconstruction and Development (EBRD), as well as analytical reports of international economic institutions for 2012-2024. The analysis of these data allowed to identify patterns and trends in the development of Ukraine's industrial sector in the context of geopolitical instability. The method of comparison was used to compare the experience of other countries (Poland, the Czech Republic, Germany, France) that have faced similar challenges in attracting investment in industry in the face of geopolitical instability. This made it possible to assess the effectiveness of different approaches to stimulating investment in technological upgrades.

Several scientific methods were used to develop a model of adaptation of industrial enterprises to changing geopolitical conditions through technological renewal, which depends on such factors as the level of technological renewal (*TOR*), financial sustainability (*FS*), environmental friendliness of processes (*EPP*) and geopolitical risks (*GR*). The method of theoretical synthesis was used to analyse and summarise the theoretical foundations and models describing the relationship between technological renewal, financial sustainability, environmental performance and geopolitical risks. In particular, the research papers and concepts on the impact of geopolitical factors on the economy and investment processes were studied. The method allowed formulating the theoretical basis of the model and identifying the key factors that affect the investment attractiveness of an enterprise in a changing geopolitical environment.

The theoretical generalisation helped to identify existing approaches to understanding the investment attractiveness of enterprises and determine which of them are most relevant for Ukraine in the context of geopolitical instability. Logic-structural modelling was used to develop the authors' adaptation model. This method helped to build a mathematical model that takes into account the relationship between all the main factors: technological innovation, financial sustainability, environmental friendliness of processes and geopolitical risks. Logic-structural modelling made it possible to clearly define how changes in each of the factors affect the investment attractiveness of an enterprise and what interrelationships exist between them. The sequence of the study included an analysis of scientific literature and regulatory documents on the impact of geopolitical factors on economic processes; collection and processing of statistical data on investment in Ukrainian industry and the level of its technological upgrading; comparative analysis of international experience in attracting investment in technological upgrading in the context of geopolitical instability; development of a logical and structural model of adaptation of industrial enterprises to geopolitical changes; formulation of recommendations for public policy.

RESULTS

International economic cooperation is developing under the influence of several key trends that reflect global changes in the economic and political spheres. The trend towards fragmentation of globalisation, i.e., global investment flows are increasingly oriented along geopolitical lines. This means that countries are starting to invest more in their regions or allies rather than in global projects. An example is the United States and China, which are creating separate economic blocs, which is reflected in the inflows of foreign direct investment (FDI) to different regions (The 2024 geopolitical reading list, 2023; World investment report 2024, 2024). The trend of supply chain redistribution is caused by geopolitical tensions, trade conflicts between the US and China, the war in Ukraine and sanctions against Russia. This stimulates states and businesses to diversify suppliers and strengthen regional economic ties. In turn, this leads to the growth of reshoring (return of production) (Unterberger & Müller, 2021) and friendshoring (transfer of production to friendly countries) (Klarin & Sosnovskikh, 2024). Trends in energy investments – sanctions against Russia have stimulated the development of new energy chains and the search for alternative energy sources. This was an impetus for increased investment activity in renewable energy, although some countries temporarily returned to using coal to ensure energy security (Esonye *et al*., 2023; Larysh, 2024; Rubbaniy *et al*., 2024). The trend of financial vulnerability of infrastructure projects, which is associated with the fact that in 2023 global FDI flows decreased by 2%, in particular due to a reduction in international financing for these projects. The price had a greater impact on the least developed countries that depend on international financing for the development of critical sectors (World investment report 2024, 2024).

To summarise the above, it is concluded that investments are becoming more regional, i.e., industrial sectors, especially those integrated into global production chains, are trying to locate production closer to key markets. And regional development strategies are aimed at providing access to the resources needed for the transition to a green economy, which helps strengthen partnerships between developed economies and mineral-rich countries (Top geopolitical risks of 2024, 2024). Thus, current geopolitical changes are contributing to a rethinking of approaches to investment, with an emphasis on security, sustainability, and regional cooperation. The system of geopolitical factors (Fig. 1) allows structuring the impact on the technological modernisation of enterprises and determining which aspects of politics, economy, society, environment and science have the greatest impact on investment processes in a changing geopolitical situation.

As discussed above, geopolitical trends have a significant impact on the technological upgrading of industrial enterprises, as they shape the context for technology development, change access to resources, and prioritise investment processes (Prokhorova *et al*., 2019). In the case of Ukraine, these trends are particularly relevant due to its geographical location and economic ties with the European Union, the United States, and Asian countries. The key factors that facilitate or impede the attraction of foreign investment in the technological modernisation of Ukraine's industry in the context of geopolitical instability are: changes in the structure of trade and investment flows; support from international organisations and funds; development of the military-industrial complex; changes in environmental and energy standards. Their impact should be considered in more detail. Changes in the structure of trade and investment flows. After the beginning of the Russo-Ukrainian War, there was a significant reduction in trade with Russia. In Figure 2 and Figure 3 the dynamics of exports and imports to Ukraine's trading partners are shown.

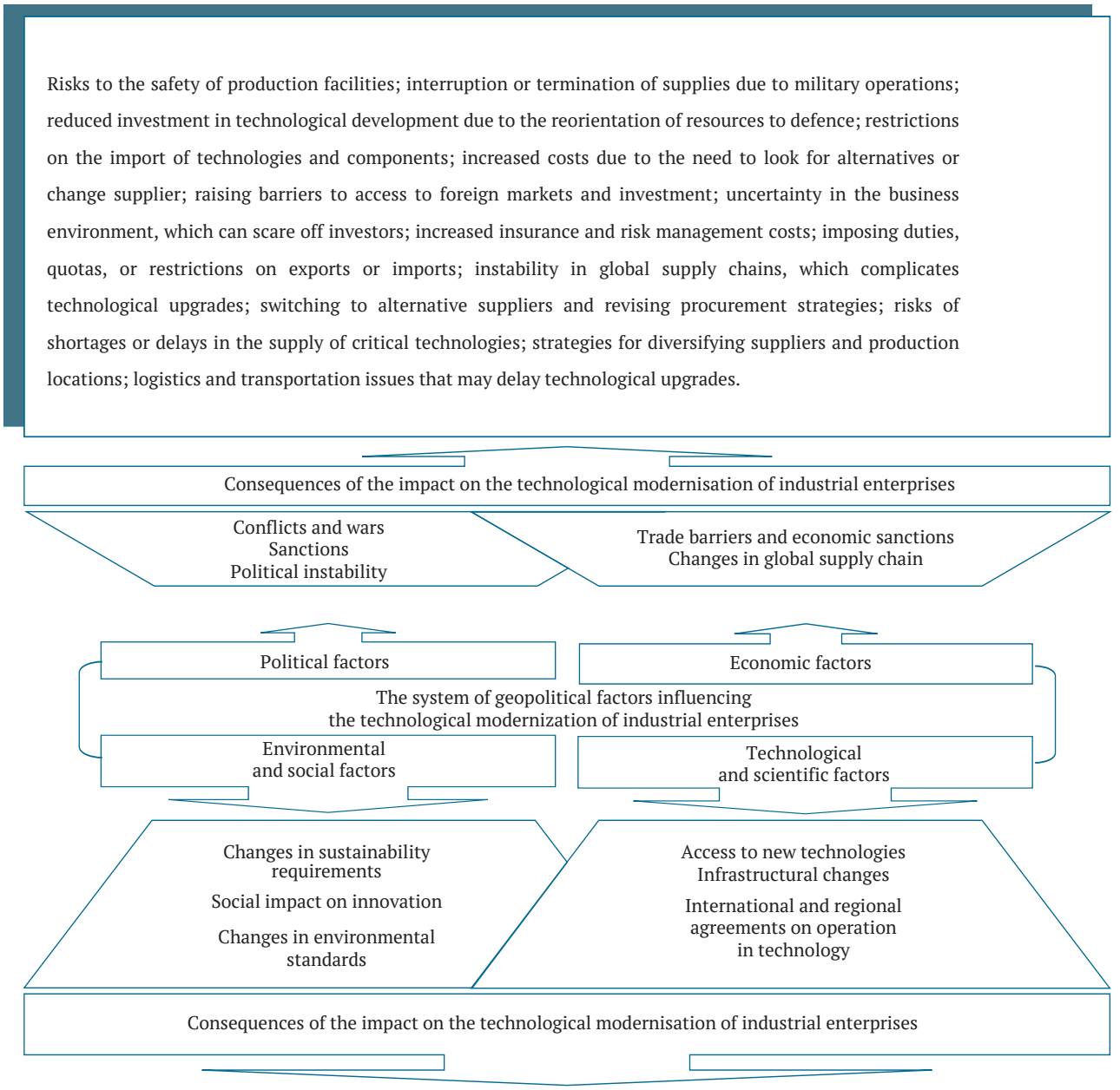
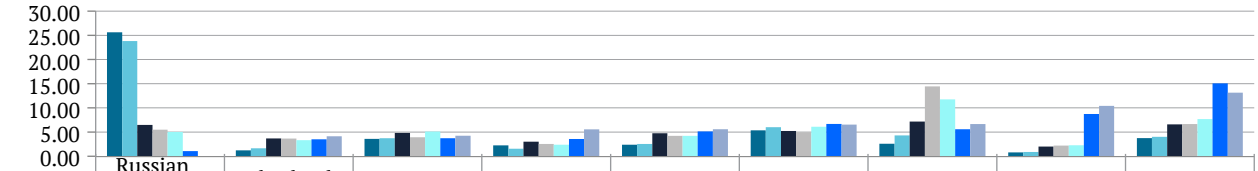


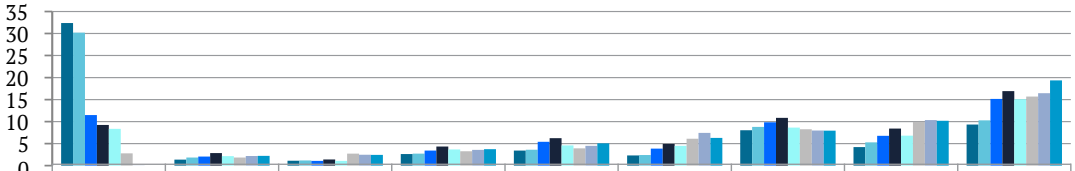
Figure 1. The system of geopolitical factors influencing the technological modernisation of industrial enterprises
Source: developed by the author



	Russian Federation	Netherlands	Italy	Spain	Germany	Turkey	China	Romania	Poland
2012	25.62	1.21	3.60	2.24	2.39	5.36	2.58	0.80	3.74
2013	23.80	1.64	3.72	1.56	2.53	6.01	4.31	0.88	4.02
2019	6.48	3.69	4.83	3.00	4.76	5.23	7.18	2.01	6.58
2020	5.50	3.66	3.92	2.54	4.21	4.95	14.43	2.20	6.65
2021	5.02	3.32	5.10	2.38	4.21	6.09	11.76	2.27	7.68
2022	1.07	3.49	3.73	3.56	5.13	6.67	5.59	8.74	15.07
2023	0.00	4.12	4.25	5.55	5.58	6.55	6.65	10.41	13.14

Figure 2. Structure of Ukraine's exports

Source: calculated by the authors based on Economic statistics / Foreign economic activity (n.d.)



	Russian Federation	Hungary	Romania	Italy	USA	Turkey	Germany	Poland	China
2012	32.39	1.37	1.1	2.64	3.43	2.31	8.04	4.21	9.33
2013	30.19	1.82	1.17	2.71	3.59	2.41	8.8	5.29	10.27
2019	11.49	2.06	1.06	3.41	5.4	3.87	9.85	6.76	15.14
2020	9.23	2.85	1.39	4.33	6.24	4.92	10.85	8.42	16.91
2021	8.35	2.16	1.09	3.67	4.58	4.48	8.63	6.81	15.08
2022	2.79	1.85	2.72	3.26	3.93	6.1	8.25	9.93	15.68
2023	0.01	2.18	2.46	3.58	4.5	7.43	7.96	10.35	16.43
I half 2024	0	2.21	2.45	3.73	5.07	6.3	7.93	10.18	19.35

Figure 3. Structure of Ukraine's imports

Source: calculated by the authors based on Economic statistics / Foreign economic activity (n.d.)

According to the State Statistics Service of Ukraine, in 2012, the share of exports to Russia was about 25.62% of total Ukrainian exports. But by 2019, this figure had dropped to 6.48%, and the downward trend continued for the next 5 years. Between 2012 and 2019, the volume of exports to Russia fell by 74.7%. Imports have also declined significantly. While in 2012 it accounted for 32.39% of Ukraine's total imports, in 2019 it dropped to 11.49%, in 2020 to 9.23%, with a further downward trend in recent years. Between 2012 and 2019, the volume of imports from Russia decreased by 64.53%.

Such a significant reduction in trade with Russia has encouraged businesses to look for new markets and sources of investment, particularly in Europe and Asia. The growth in the shares of exports (to) and imports (from) Europe and Asia at the end of 2023, with this trend continuing in the first half of 2024 (Fig. 2-3), indicates that this process is continuing and Ukraine is significantly expanding its trade with the leading countries of Europe and Asia. According to the NBU's annual statistics on foreign direct investment (FDI), 75% of foreign capital in Ukraine's economy was reinvestment of income earned by a foreign investor in Ukraine (In 2023, $4.25 billion..., 2023; Prokhorova *et al.*, 2024). As of the end of 2023, the accumulated volume of FDI amounted to $54,261 million. The main investor countries in 2019-2023 were as follows (Table 1).

Figure 4 clearly shows the dynamics of the shares of the main investor countries in the structure of foreign direct investment volumes in Ukraine. Cyprus and the Netherlands have remained stable investment partners of Ukraine over the past 5 years. The share of investments from Russia in the total volume of foreign direct investment in Ukraine was insignificant compared to other countries, amounting to only 2.19% in 2019, and has been on a steady downward trend over the past 5 years.

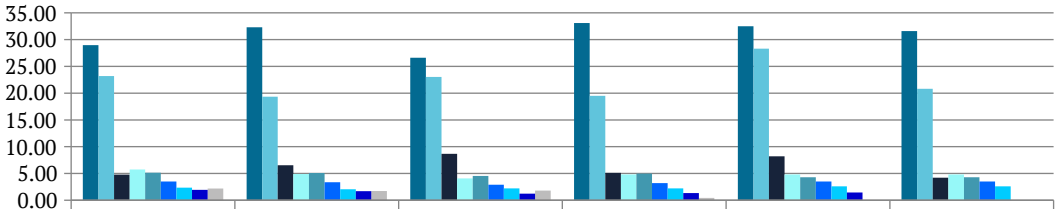
Table 1. Volumes of investments in Ukraine and key investor countries

Investor country	2019	2020	2021	2022	2023
Cyprus	28.96	32.29	26.62	33.10	32.50
Netherlands	23.18	19.33	23.02	19.50	28.30
Switzerland	4.79	6.53	8.66	5.10	8.20
Great Britain	5.75	4.90	4.08	4.80	4.80
Germany	5.15	5.09	4.55	4.97	4.30

Table 1. Continued

Investor country	2019	2020	2021	2022	2023
Austria	3.49	3.35	2.89	3.20	3.50
France	2.36	2.06	2.21	2.20	2.60
Poland	1.94	1.70	1.24	1.34	1.44
Russian Federation	2.19	1.73	1.81	0.43	0.00
Volume of foreign direct investment in Ukraine, mln. USA	5,860	–868	6,687	1,152	4,247
Total accumulated volume of foreign direct investment, mln.	54,210	52,091	65,746	50,987	54,261

Source: calculated by the authors based on S. Mushnykova *et al*. (2024), Investment activity in Ukraine (2024)



	2019	2020	2021	2022	2023	I quarter 2024
Cyprus	28.96	32.29	26.62	33.10	32.50	31.6
Netherlands	23.18	19.33	23.02	19.50	28.30	20.8
Switzerland	4.79	6.53	8.66	5.10	8.20	4.2
Great Britain	5.75	4.90	4.08	4.80	4.80	4.8
Germany	5.15	5.09	4.55	4.97	4.30	4.3
Austria	3.49	3.35	2.89	3.20	3.50	3.5
France	2.36	2.06	2.21	2.20	2.60	2.6
Poland	1.94	1.70	1.24	1.34	1.44	0
Russian Federation	2.19	1.73	1.81	0.43	0.00	0

Figure 4. Dynamics of shares of major investor countries in the structure of foreign direct investment volumes in Ukraine

Source: calculated and systematised by the authors based on S. Mushnykova *et al*. (2024), Investment activity in Ukraine (2024)

Support from international organisations and funds. Attracting investments from international donors and financial institutions plays an important role in supporting economic growth and modernisation of industrial enterprises in Ukraine. In 2024, international donors and financial institutions will continue to actively invest in Ukraine. The European Union, the EBRD, the International Finance Corporation (IFC), and individual governments are allocating significant amounts of money to support reconstruction, infrastructure modernisation, and business development. The EU provides Ukraine with grants, guarantees, and technical assistance to help restore and develop various sectors of the economy. For example, through 2024, the EU has invested around €1.4 billion through programmes such as renewable energy support and infrastructure projects to help attract private investment and strengthen the economy. In total, the EU plans to provide up to €50 billion in support to the country through the Ukraine Facility until 2027. The EU4Business (n.d.) programme provides additional support for small and medium-sized enterprises, in particular in war-affected regions (EUsigns €1.4 billion to UNeighbours East, 2024). The EBRD also plays a key role in supporting Ukraine. In 2023, the Bank invested a record €2.1 billion and is providing €1.5 billion in 2024. Financing is channelled to support the private sector, including through lending to partner financial institutions and trade finance programmes. In addition, the EBRD receives significant support from the EU and other donors, including the governments of Canada, Norway and Spain (EBRD planning..., 2024). These efforts are aimed at stimulating economic growth, developing sustainable infrastructure, and ensuring Ukraine's energy independence in the face of war and further integration with the EU.

The geopolitical support of Ukraine by the EU, the US, and other countries facilitates access to international financing programmes, which allows for the modernisation of technologies at enterprises. The most significant international programmes for financing technological upgrading and development of Ukrainian industrial enterprises are summarised in Table 2. The international programmes presented in Table 2 emphasise the active participation of international partners in the restoration and modernisation of Ukrainian industry, focusing on sustainable development and innovation; they also provide opportunities for Ukrainian enterprises to attract financing, modernise production facilities and introduce advanced technologies, which contributes to the growth of their competitiveness and investment attractiveness in international markets.

Table 2. International programmes for financing technological upgrading and development of industrial enterprises in Ukraine

International programme/ organisation	Brief description of the programme or areas of technological renewal and development of enterprises
European Union (EU)	EU funds: The EU funds various programmes to support infrastructure development, energy efficiency, green economy and SMEs in Ukraine. The main programmes include the Eastern Partnership Programme, Horizon Europe's Enterprise and Innovation Support Programme and other projects under the European Neighbourhood Instrument (ENI). EU4Business Initiative: This programme supports entrepreneurs in Ukraine by helping to attract investment for the development of small and medium-sized businesses.
World Bank	The World Bank provides loans and grants to support infrastructure projects, agricultural development, healthcare, education and the energy sector. The main programmes are the Health System Modernisation, Water Supply and Sanitation Efficiency Improvement, and Energy Saving Project. The IFC, a member of the World Bank, specialises in supporting the private sector, including investments in Ukrainian enterprises that innovate and promote sustainable development.
EBRD	The EBRD is actively investing in energy efficiency, renewable energy, small and medium-sized businesses and infrastructure projects. The bank also provides loans and financial instruments to support businesses, develop the digital economy and modernise transport infrastructure. The main areas of investment in Ukraine include the Green Economy Programme, the Small Business Support Initiative and the Innovative Development Programme.
United States Agency for International Development (USAID)	USAID funds projects in the areas of energy, agriculture, health, democracy and governance. The programmes aim to improve economic resilience, support transparent governance, and strengthen democracy. USAID programmes, such as the Energy Security Project and AgroInvest, support technological development, productivity and economic stability. During Russia's war against Ukraine, USAID has delivered life-saving humanitarian assistance, helped ensure that Ukrainians have heat and electricity despite Russia's attacks on their energy systems, supported Ukrainian agricultural producers and food exporters so they can continue to supply grain to countries around the world, and helped Ukrainian partners advance critical anti-corruption and European integration reforms. USAID's key programmes in Ukraine: Democracy, Human Rights, and Governance; Economic Development; Critical Infrastructure; Health; Transition; and Humanitarian Assistance. Since the beginning of the war on 24 February 2022, USAID has provided $2.8 billion in humanitarian assistance, $3.4 billion in development assistance, and $26.8 billion in direct budget support.
UNIDO	In order to fulfil its mandate in Ukraine under the unique circumstances, UNIDO has developed a special programme for the green recovery of industry, covering three key areas: creating new opportunities for people, supporting businesses and attracting investment, and promoting the development of a green economy. Over the past year, UNIDO has conducted a comprehensive diagnostic study of Ukraine's industry, which provided important baseline data and in-depth analysis at various levels – micro, meso and macro. With the support of development and funding partners, UNIDO has initiated new projects in the following areas.
IMF	The IMF provides loans to Ukraine to support macroeconomic stability and to implement reforms aimed at stabilising the financial system. IMF programmes include Extended Fund Facility to support macroeconomic stability, including support for reducing the budget deficit and strengthening the banking system. IMF financing is usually accompanied by conditions for economic, legal and governance reforms.
United Nations Development Programme (UNDP)	UNDP supports Ukraine in implementing sustainable development projects, fighting poverty, strengthening democratic institutions and improving the environment. UNDP programmes also include support to small and medium-sized enterprises in the transition to sustainable production. One of UNDP's key projects is the SME Development Programme, which supports environmentally responsible businesses and sustainable development projects.
Innovate Ukraine (Great Britain)	The UK government is investing £16 million in the restoration and sustainable development of Ukraine's energy sector, including the replacement of fossil fuels. The programme, implemented by the UK Innovation Agency, will attract an additional £5 million from the private sector and involves the cooperation of more than 50 UK and Ukrainian organisations. The key projects include new heating technologies, renewable energy battery solutions, and geothermal energy. The projects will last for two years and will be supported by accelerators to further attract investment.
Fund for International Cooperation and Development (TaiwanICDF)	TaiwanICDF provides support to Ukraine in the areas of agriculture, healthcare, infrastructure development and competitiveness. Projects often include technological upgrades and support for export-oriented enterprises.
German Society for International Cooperation (GIZ)	GIZ supports projects in the areas of sustainable development, energy efficiency, environment, education and training. GIZ programmes, such as the Energy Efficiency Support in Ukraine, aim to increase energy savings, develop renewable energy sources and improve economic efficiency.
Nordic Environment Finance Corporation (NEFCO)	NEFCO finances environmental modernisation and energy efficiency projects, supporting the development of clean energy, carbon emission reduction and environmental protection. In particular, NEFCO supports renewable energy programmes and projects to reduce the environmental impact of industry. Currently, financial support is being used for environmentally sound repairs and reconstruction of municipal infrastructure, accommodation of internally displaced persons (IDPs) and capacity building for the development of local green recovery plans. The programme promotes the development of a green economy and energy transition during the recovery process, and supports further integration with Europe. The programme was launched in July 2022, and project implementation is ongoing with the first projects already completed. About 50 projects are currently being implemented: Repair of critical infrastructure (district heating and water supply and sewerage) in 12 communities in Kyiv Oblast; Modernisation of water supply systems in six communities; Energy efficiency in five small towns (Andrushivka, Radomyshl, Khmelnytskyi); Housing for IDPs, 20 projects in different cities (Chernivtsi, Dubno, Kovel, Lviv, Makariv, Zhytomyr, Ivano-Frankivsk, Khmelnytskyi, Nemishaievo, Novovolynsk, Ternopil, Chortkiv, Kivertsi, Zolochiv, Rivne, Novohrad-Volynskyi).

Source: summarised by the authors based on EU4 Business (2024), EU signs €1.4 billion of new guarantee and grant agreements to support Ukraine's recovery and attract private sector investments (2024), EBRD planning 1.5-bln-euro investment in Ukraine in 2024, versus 2.1 billion euros in 2023 (2024), Ukraine and UNIDO signed the Green Industrial Recovery Program in Ukraine for 2024-2028 (2024)

The international programmes for financing technological upgrades and development of Ukrainian industrial enterprises listed in Table 2 illustrate the current global investment processes that are technology-oriented and in line with global trends in sustainable development, digitalisation, automation, and the transition to renewable energy. Green energy and renewable energy sources: key areas include solar and wind energy, with a focus on expanding the use of solar panels and wind turbines and developing more efficient and affordable technologies for energy generation. Hydrogen energy is seen as a promising environmentally friendly resource to reduce dependence on fossil fuels. Also important are technologies for the development of batteries and energy storage systems that ensure a stable supply of energy from renewable sources (Sotnyk *et al.*, 2023).

Energy efficiency and sustainable development: this includes smart grids, which allow for more efficient management of electricity distribution and reduce losses, as well as technologies for building green buildings that consume less energy and water, reduce CO_2 emissions, and use environmentally friendly materials. In addition, the transition to a circular economy, where products and materials are recycled and reused to reduce waste, is an important part of global trends (Iarmosh *et al.*, 2021; Li *et al.*, 2024). Digitalisation and automation: this area includes the Internet of Things (IoT), which allows devices and equipment to be connected to the network for real-time monitoring and control. The use of artificial intelligence (AI) and machine learning to analyse data, optimise production processes, forecast demand, and automate tasks is also important. Robotics is actively used to automate production, increase productivity and reduce labour costs (Aljohani, 2024).

Digital security and blockchain: the growing importance of cybersecurity in protecting data and networks due to digitalisation requires investment in the latest technologies to protect businesses from cyberattacks. Blockchain technologies are used to ensure transparency, reliability and security in transactions, supply chains, financial transactions, data management and smart contract management. Smart cities: infrastructure management technologies, such as traffic, energy, water and waste management systems, are becoming important for smart cities. Unmanned vehicles such as autonomous cars and delivery drones are being introduced to reduce logistics costs. Environmental and quality of life monitoring systems that track air, water, and noise pollution are becoming an important part of the infrastructure.

Biotechnology and medicine: the use of personalised medicine based on a patient's genetic profile allows for the development of individualised treatments. In addition, artificial intelligence helps to speed up the development of new drugs, improve diagnostics and the choice of treatment. Agribiotechnology is also used to increase agricultural productivity and develop new crop varieties. Financial technologies (FinTech): mobile payment systems, digital currencies, and mobile banking applications are developing rapidly. Investment and asset management tools use AI to create customised investment strategies, while decentralised financial services (DeFi) ensure transparency and security of financial transactions using blockchain technologies (Zhang *et al.*, 2022). Additive manufacturing (3D printing): 3D printing is actively used to create prototypes, spare parts, and even finished products, which significantly reduces production costs. In medicine and bioprinting, medical implants, prostheses, and organs are created from biocompatible materials. In the construction industry, 3D printing technologies are used to create modular building components that reduce construction costs (Jewell & Stones, 2024).

The above-mentioned technologies expand the capabilities of enterprises, contribute to solving global challenges such as climate change, energy security, food supply and the creation of new jobs in high-tech industries. Investors are actively investing in companies that take geopolitical trends into account when upgrading and modernising their production, which contributes to their sustainable development and global competitiveness.

Development of the military-industrial complex: the conflict with Russia has led to the need to strengthen Ukraine's defence capabilities, which stimulates the development of military technologies and raises the requirements for technological standards that are being introduced into civilian industries. Strengthening Ukraine's defence capabilities and developing military technologies cover several key areas aimed at modernising the army, increasing technical equipment and improving infrastructure. This requires additional attraction of various types of funding, including investments. Foreign investors are interested in investing in Ukraine's industry even in the current unstable economic environment: as of 01.10.2024, the volume of foreign direct investment amounted to USD 2,960 million. The volume of foreign direct investment in Ukraine is 2,960 million US dollars. Table 3 systematises the directions of development of military technologies in Ukraine.

Table 3. Areas of development of military technologies in Ukraine

Development direction	Brief description
Unmanned aerial vehicles (UAVs)	Ukraine is actively developing and deploying UAVs for reconnaissance, surveillance and even combat missions. For example, in cooperation with Turkey, it is developing strike drones, such as the Bayraktar TB2, which are used to detect and destroy targets on the front line. Ukraine's own developments are also gaining popularity. For example, the PD-1 and Leleka-100 UAVs, which are used to gather intelligence, monitor and adjust fire.
Cybersecurity and cyber defence	In response to cyber threats, Ukraine is developing cyber defence systems, in particular to protect critical infrastructure, military networks and government agencies. Initiatives in the areas of cyber intelligence, data protection and cyber threat detection are also important. Cooperation with NATO and other partners allows Ukraine to introduce advanced technologies to detect and prevent cyber-attacks, as well as to train personnel to respond effectively to cyber threats.

Table 3. Continued

Development direction	Brief description
Missile and artillery systems	Ukraine is developing missile weapons systems such as the Vilkha and Neptun systems. The Vilkha missile systems are capable of delivering precision strikes over long distances, which enhances defence capabilities. Artillery systems modernisation programmes are aimed at increasing accuracy and range, improving mobility and integrating with digital fire control systems.
Armoured vehicles and modernisation of combat vehicles	The production and modernisation of armoured vehicles, including armoured personnel carriers (BTR-3, BTR-4) and tanks (T-64, T-72), are a priority. The latest models are equipped with modern defence systems, including dynamic defence and active defence systems. The use of digital control systems that increase the accuracy and efficiency of combat operations, as well as integration with modern communications and surveillance systems.
Electronic warfare systems (EW)	Ukraine is actively developing electronic warfare technologies to counter drones, intercept and jam signals, and protect its own communications. Systems such as Mandat and Bukovel can be used to create radio interference and protect military units from enemy control systems.
Maritime defence technologies	Given the threat from the sea, Ukraine is developing its own anti-ship missiles (in particular, Neptune) and modernising its fleet. The anti-ship missiles are designed to protect against attacks by naval forces, particularly from the Black Sea. Other areas include the development of high-speed boats and a maritime surveillance system.
Integration of digital control systems	Digitalisation of command-and-control structures allows Ukraine to manage military units and resources more effectively. Automated systems for managing troops and combat operations are being introduced to ensure coherence and increase efficiency. Systems such as Kropyva allow for real-time monitoring of military operations, improving accuracy and coordination between different units.
Personal protective equipment and equipment	Modernisation of military equipment, including the latest models of body armour, helmets and tactical equipment that meet modern standards of protection and mobility. Use of digital devices, such as GPS navigators, thermal imagers and night vision devices, to enhance situational awareness.

Source: compiled by the authors based on M. Lopatin (2024)

The development of these areas increases Ukraine's defence capability. This requires technological and technical upgrading of the defence industry enterprises, providing them with modern technologies and standards. The analysis of international programmes for financing technological upgrades and development of industrial enterprises (Table 2) made it possible to summarise trends in global investment processes, which are focused, among other things, on the transition to renewable energy. Changes in environmental and energy standards. Ukraine's integration into the European market involves adaptation to the EU standards, in particular in the area of environmental protection and ecological requirements. This requires industrial enterprises to invest in environmentally friendly technologies, primarily in renewable energy and energy efficiency (Table 4).

Table 4. Environmental and energy standards of the EU, to which Ukrainian industrial enterprises need to be adapted for further integration into the European market

EU standards	Characteristic
Industrial Emissions Directive (IED, 2010/75/EU)	The IED Directive sets out rules for reducing industrial emissions into the air, water and soil. It requires the use of Best Available Techniques (BAT) to minimise pollution. Enterprises must implement modern technologies to reduce harmful emissions and control them within permitted limits. Each company must obtain an operating permit that includes specific environmental requirements that meet the terms of the IED.
The European Emissions Trading System (EU ETS)	The EU ETS sets quotas for greenhouse gas emissions and allows businesses to trade emissions. Ukrainian companies integrating into the European market must meet these requirements and work to reduce CO_2 emissions. It also encourages investment in technologies that reduce greenhouse gas emissions. Joining the ETS involves the gradual introduction of emissions accounting systems and upgrades to meet quotas and participate in emissions trading.
Waste Management Directive (2008/98/EC)	This directive regulates waste management and requires businesses to minimise waste generation, promote reuse, recycling and safe disposal. It also provides for the creation of national waste management plans and the development of waste reduction programmes. Businesses are required to implement separate waste collection strategies, reduce hazardous waste, and seek ways to reuse materials.

Table 4. Continued

EU standards	Characteristic
Drinking Water Directive (98/83/EC) and Waste Water Treatment Directive (91/271/EC)	Ukrainian companies that discharge wastewater must meet water treatment and quality requirements to avoid pollution of water bodies. The Directive defines water quality standards and treatment methods that must meet strict norms. Wastewater treatment facilities must provide high-quality wastewater treatment to prevent pollution of surface and groundwater.
REACH Regulation (1907/2006)	REACH regulates the registration, evaluation, authorisation and restriction of chemicals. Businesses that manufacture or import chemicals must go through the process of registering and assessing the safety of these substances, as well as provide appropriate labelling and information about their potential risks to health and the environment. Compliance with REACH means that companies are required to carry out risk assessments of chemicals, provide data on chemicals and comply with all restrictions on their use.
Energy Efficiency Directive (2012/27/EU)	The directive encourages businesses to improve energy efficiency and reduce energy consumption. The requirements include energy audits for large enterprises, the introduction of energy-saving technologies, and the use of energy management techniques. The directive provides for a reduction in energy consumption through modernisation of equipment, reduction of heat losses and use of renewable energy sources.
Air Protection Directive (2008/50/EC)	This directive regulates air quality, including concentrations of harmful substances such as SO_2, NO_x, PM_{10} and others. Ukrainian enterprises must comply with the standards that provide for the reduction of emissions of harmful substances into the atmosphere and control of air quality. To achieve compliance, companies must install emission control systems, reduce energy consumption from fossil sources and switch to cleaner fuels.
The EU Renewable Energy Directive (2018/2001/EC)	actively promotes the transition to renewable energy sources, and this directive sets targets for increasing the share of renewable energy in total energy consumption. Ukrainian enterprises are required to gradually switch to renewable energy sources such as solar, wind, and biomass. This will encourage companies to invest in energy solutions that use renewable resources, reducing their dependence on fossil fuels.

Source: summarised by the authors based on Council Directive No. 91/271/EEC (1991), Regulation (EC) of the European Parliament and of the Council No. 1907/2006 (2006), Directive of the European Parliament and of the Council No. 2008/50/EC (2008), Directive of the European Parliament and of the Council No. 2008/98/EC (2008), Directive of the European Parliament and of the Council No. 2010/75/EU (2010), Directive of the European Parliament and of the Council No. 2012/27/EU (2012), Directive (EU) of the European Parliament and of the Council No. 2018/2001 (2018), Understanding the European Union's emissions trading systems (EU ETS) (2024)

Compliance with these standards is mandatory for companies seeking to enter the European market or cooperate with EU partners. The functioning of the investment process ensures the investment flow, as it is the material basis for the realisation of investment goals. Without the organisation of efficient flows, the implementation of the investment process is impossible. Technological upgrades of industrial enterprises stimulate the integration of various investment flows, which allows for the pooling of resources from different sources for more efficient project financing. The main investment flows that are integrated through technological upgrading include foreign direct investment and domestic investment. Investors can be individuals, corporations (national or multinational), financial institutions (banks, investment funds, insurance companies, and others), states or governments, and international organisations. Figure 5 schematically shows the integration of investment flows that ensure the technological renewal of industrial enterprises.

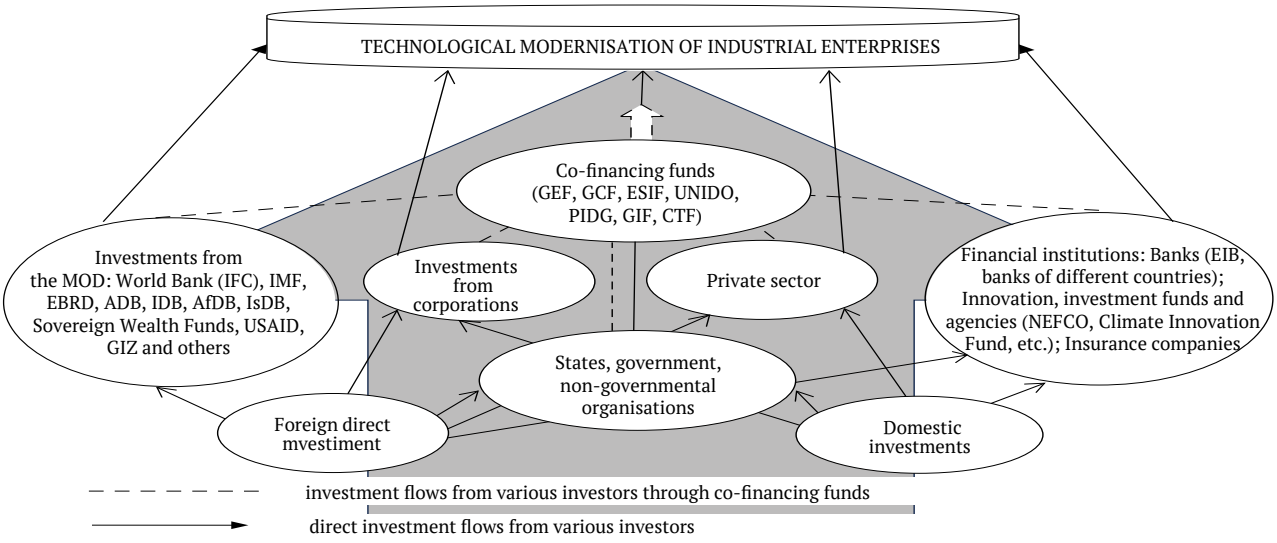


Figure 5. Schematic integration of investment flows to ensure technological modernisation of industrial enterprises
Source: developed by the authors

Convergence implies the convergence of investment approaches, structures, and strategies in different countries due to the globalisation of capital markets. Convergence promotes technological renewal through: access to capital, knowledge exchange (integration of international companies creates opportunities for technology transfer and dissemination of best practices), and increased competition. The convergence of global investment processes and technological upgrades mutually reinforce each other, creating the preconditions for sustainable economic growth. The combination of investment flows from different investors facilitates large-scale modernisation projects, allowing Ukrainian enterprises to adapt to new technological requirements faster, strengthen their competitiveness and meet European standards. Technological upgrades and the convergence of investment processes form a two-way relationship that ensures Ukraine's integration into the global economy. This allows attracting capital, increasing competitiveness, and strengthening the country's economic stability in the face of global instability. The relationship between the technological renewal of industry and the convergence of investment processes in Ukraine is shown in Figure 6.

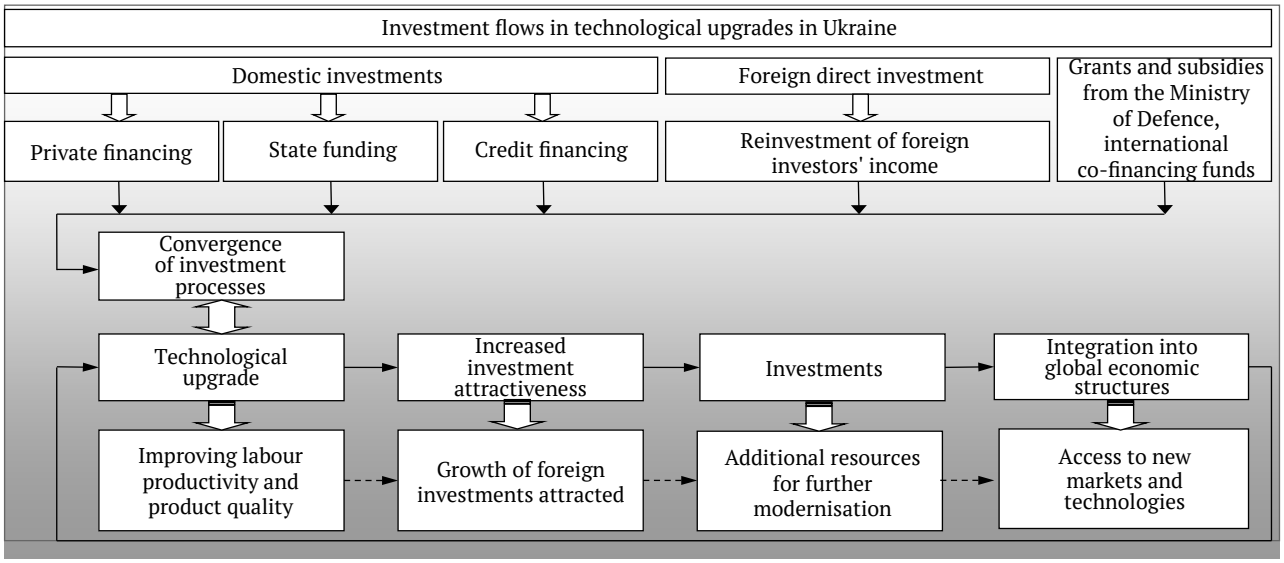


Figure 6. Justification of the relationship between technological modernisation of industry and convergence of investment processes in Ukraine

Source: developed by the authors

Technological upgrading of industrial enterprises is a key factor for increasing their productivity, product quality, and ability to meet international standards. This creates a basis for attracting investment, as investors are interested in high-tech enterprises that can ensure high profitability and rapid growth, as well as enterprises with modern technologies that can integrate into global supply chains faster and more efficiently. The convergence of investment processes implies the harmonisation of national investment practices with global standards. Technological upgrading contributes to this process by attracting foreign investors who seek to invest in industries with a high level of technology, transparency and efficiency of financial flows through the introduction of digital technologies. Technological upgrading creates the preconditions for Ukraine's active participation in international economic processes by increasing foreign trade through the production of competitive products, cooperation with international organisations and participation in economic development programmes, and investment attractiveness, as technologically advanced enterprises become part of global value chains, making them more interesting for international capital.

Investments are the only component of GDP that is not consumed but lays the foundation for future economic growth. To ensure sustainable economic development, a level of investment of 20% of GDP or more is required. If this figure is lower, the country gradually loses its economic prospects. Since 2008, Ukraine has never reached this threshold. In the five years before the war, the share of investment in GDP averaged only 15% (Who are the largest..., 2024). In 2023, thanks to business activity and significant (about 4%) public investment, especially in the defence sector, the investment rate rose to 17% (Davydenko, 2024). The five largest state-owned companies invested UAH 135 billion ($3.9 billion) in two years, which is equal to the investments of the ten largest private companies (The country's largest..., 2024). In total, the top twenty investors increased their capital expenditures (CAPEX) by 33%, investing UAH 173 billion ($5 billion), although a significant portion of these funds was directed to restore damaged infrastructure. For example, DTEK and Ukrenergo spend more than half of their investment budgets on reconstruction, which does not create new capacity for the economy (Metinvest is among..., 2024).

Despite the war, businesses are mostly financing their capital expenditures from their resources, as access to external financing remains limited. Capital investments are not only about the development of companies but also about the sustainability and growth of the economy as a whole. DTEK, Metinvest, and Epicenter are among the leaders in investment. In 2023, domestic investment in Ukraine's economy exceeded UAH 390 billion. The majority,

72%, was financed by entrepreneurs themselves, 15% came from state and local budgets, and bank loans accounted for only 3%. The main sectors for investment are agriculture, food, real estate, and defence. Each of these sectors received 10-12% of total investment (There is work…, 2024). Despite this, the main problem remains the lack of new large foreign investors. In 2023, foreign direct investment (FDI) inflows amounted to $4.25 billion, which is several times higher than in 2022 but significantly lower than pre-war levels. More than 90% of these funds were directed to Ukrainian companies, with $3.2 billion being reinvested profits, indicating restrictions on capital outflows (In 2023, Ukraine received…, 2024).

As of the beginning of 2024, the total volume of accumulated FDI amounted to $55.2 billion, which is less than the pre-war level and significantly lower than in neighbouring countries. For comparison, in Poland, this figure reaches $270 billion (Are foreign investors…, 2024). The Ukrainian economy remains less attractive to foreign capital due to the high risks associated with the war. At the same time, reinvestment by existing companies demonstrates that businesses continue to operate and support the economy. In terms of annual investment inflows, Ukraine lags far behind many other countries. According to World Bank data for 2022, Poland attracted $35 billion in FDI, the Czech Republic – $10.5 billion, Germany – $47.3 billion, and France – $105.4 billion. The structure of accumulated investments in 2023 shows that $37.1 billion (68.4%) were equity investments, while $17.1 billion (31.6%) were debt instruments (Are foreign investors…, 2024). This indicates a lack of interest from foreign investors in Ukraine. The main reason for this is the high level of military risks, which significantly complicates doing business and makes the prospects for return on investment unpredictable. At the same time, Ukrainian entrepreneurs do not leave their companies to fend for themselves. The volume of reinvested profits indicates that business activity remains at an acceptable level despite the difficult conditions. In turn, the adaptation of Ukraine's industrial enterprises to changing geopolitical conditions through technological upgrades requires a holistic approach that combines strategic planning, investment attraction, and innovation. The key aspects that need to be taken into account are shown in Table 5.

Table 5. Key aspects of adaptation of Ukrainian industrial enterprises to changing geopolitical conditions through technological upgrading

Aspects	Brief description
Analysis of the geopolitical environment and risks	Assessment of external factors affecting the company's operations (political instability, sanctions, trade barriers, etc.). It can be carried out using SWOT analysis, PESTEL analysis, risk management. As a result of the assessment, a certain set of risks and opportunities for the company should be formed.
Assessment of the current state of them enterprise	Analysis of the technological level (outdated processes, automation, digitalisation). As a result of the analysis, key performance indicators (KPIs) that need to be improved should be identified. Also at this stage, it is necessary to assess the current level of financial stability and investment attractiveness of the enterprise for further comparison after technological modernisation.
Developing a strategy for technological modernisation	Selection of priority technologies (Industry 4.0, energy-saving technologies, robotisation, use of IoT). Integration of sustainable development concepts (ESG). Search for strategic partners to implement new technologies.
Implementation of technological upgrade projects	Creating a roadmap for technological changes with clear stages. Involvement of international standards (ISO 9001, ISO 14001). Conducting staff training for the effective integration of new technologies.
Evaluation of results and flexible adjustments	Continuous monitoring of the modernisation efficiency using KPIs. Amendments to the strategy depending on changes in the geopolitical environment.

Source: developed by the authors

The mathematical description of the model of adaptation of industrial enterprises to changing geopolitical conditions through technological upgrading can be presented as a multifactor optimisation problem. It takes into account the key parameters that determine the efficiency of the processes of updating and increasing investment attractiveness. The purpose of the model is to maximise the investment attractiveness of enterprise *I*. The objective function formula is:

$$I = f(TO; FS; EPP; GR) \rightarrow max; \quad (1)$$

$$I = w_1 TO + w_2 FS + w_3 EPP + w_4 GR, \quad (2)$$

where w_1, w_2, w_3, w_4 are weighting coefficients that reflect the importance of each parameter. Technological update:

$$TO = \alpha_1 PAP + \alpha_2 DL + \alpha_3 R\&D, \quad (3)$$

where *PAP* is the level of automation (percentage of automated processes (share of automated processes, $0 \leqslant A \leqslant 1$); *DL* is the level of digitalisation (use of digital technologies such as IoT, bigdata; (share of implemented digital technologies, $0 \leqslant D \leqslant 1$); R&D – research and development expenses (as a percentage of the total budget of the enterprise); α_1, α_2, α_3 – weighting coefficients. Financial stability:

$$FS = \frac{P}{C} - R_f, \; R_f \leq ALR, \quad (4)$$

where *P* is the company's profit; *C* – total costs of the enterprise; R_f is the risk of financial losses due to external factors (estimated in shares from 0 to 1); *ALR* is the acceptable level of risk. Environmental friendliness EPP:

$$EPP = \frac{C_{EPP}}{C}, \; EPP \geq EPPmin, \quad (5)$$

where C_{EPP} is the cost of environmental measures; *EPPmin* is the minimum regulatory level of environmental friendliness. Consideration of geopolitical risks:

$$GR = \beta_1 DMD + \beta_2 LDIR, \quad (6)$$

where *DMD* is the degree of diversification of sales markets (the share of the export market that is independent of risky regions); *LDIR* is the level of dependence on imported resources (share of imports in total raw material costs); β_1, β_2 – weighting coefficients.

The weighting coefficients of the respective factors that determine the priority are set by experts. The model takes into account both internal factors (technological innovation, financial stability) and external factors (geopolitical risks, environmental friendliness). Depending on the specifics of the enterprise, the weighting coefficients can be adapted to focus on certain aspects. This model provides a comprehensive view of the investment attractiveness of an industrial enterprise by integrating several factors that affect sustainable development. The formula will balance the following aspects: technological innovations, financial stability (taking into account risks), environmental friendliness (a requirement of Western investors), and management (consideration) of geopolitical risks. Each factor has its own weight, and the formula can be used for decision-making, scenario analysis, or optimisation of the company's development strategy. Taking into account the above, the authors offer some recommendations that, in the authors' opinion, are considered appropriate to include in the state policy to stimulate technological renewal of industry in the context of geopolitical instability. To create a favourable investment climate, it is necessary to:

1) simplify the regulatory environment, namely, to reduce bureaucratic procedures for foreign investors and introduce a "single window" for registration of investment projects; to provide guarantees of investment protection by establishing clear mechanisms for protecting investors' rights and ratifying and complying with international treaties on investment protection;

2) create financial incentives, i.e., provide tax breaks (e.g., income tax cuts for companies investing in technological upgrades; tax holidays for new production facilities using innovative technologies); create a Fund for Supporting Technological Development by establishing a public or public-private fund to finance innovative projects and provide grants and subsidies for technological upgrades;

3) improve infrastructure (development of industrial parks and special economic zones (SEZs) and investment in digital infrastructure);

4) stimulate public-private partnerships (PPP) through joint investment projects: cooperation between the state and the private sector in strategically important industries (machine building, energy, agriculture), providing state co-financing of innovative projects and public-private support mechanisms (providing state guarantees to attract foreign investment);

5) develop human capital through the implementation of state training programmes for new technological industries, support for cooperation between universities and enterprises (Pylypenko *et al.*, 2021);

6) expand the international cooperation;

7) create a system for monitoring technological upgrades: regular analysis of the impact of state support on industrial modernisation and flexible response to changing geopolitical conditions.

A comprehensive strategy, including financial incentives, infrastructure development, attracting foreign investment, and improving human capital, will facilitate the technological modernisation of Ukrainian industrial enterprises.

DISCUSSION

A review of contemporary scientific studies focused on the impact of geopolitical risks on economic processes and technological modernisation of industrial enterprises demonstrates a wide variety of approaches to addressing this issue. Researchers emphasise various aspects of this topic, including international trade, investments, energy security, and the adaptation of economies to new challenges. The study by M.S. Hossain *et al*. (2024) thoroughly proved that geopolitical risk poses significant challenges to international economic, social and political systems. In particular, it has a significant impact on attracting foreign direct investment. The study, conducted in five Southeast Asian countries – Indonesia, South Korea, Malaysia, the Philippines, and Thailand – showed how geopolitical risk, as measured by the GPRI index, affected the investment attractiveness of these countries during 1996-2019. The results of the analysis, which uses stationarity and cointegration testing methods, showed the existence of a long-run cointegration between such variables as FDI, GPRI, GDP, inflation, interest rates and trade openness (TOP). According to the results of regression analysis (OLS, fixed effects, Arellano-Bonda and GMM panel data), GPRI and TOP have a negative impact on FDI in these countries, while GDP, inflation and interest rates have a positive effect on foreign investment. This confirms that geopolitical risk is a significant deterrent to investment, as investors tend to avoid countries with high political or economic instability. At the same time, economic stability and TOP contribute to investment growth.

A study by B. Gao & Z. Xu (2024) highlighted that crisis situations, such as the Ukrainian crisis, undermine investment attractiveness due to increased geopolitical risks, which in turn affects global supply chains and international trade. They noted that not only economic factors are important for transnational corporations (TNCs), but also political stability, which determines the direction of investment. This correlates with the studies of the above researchers and is consistent with the concept that Ukraine should work through international organisations such as the WTO to stabilise the legal framework and reduce risks, which will help create a more favourable environment for investors.

At the same time, as M. Li *et al*. (2024) noted, Ukraine should focus on developing decentralised energy systems to increase energy security and reduce dependence on external energy suppliers. Such initiatives, in particular in the context of rebuilding energy infrastructure, create favourable conditions for attracting investment in the energy sector, which is in line with current global trends. This allowed Ukraine not only to reduce geopolitical risks but also to create a basis for sustainable economic development. Thus, in order to attract foreign investment, countries need not only to reduce geopolitical risks but also to create favourable conditions, in particular through a stable economic environment, risk mitigation and active integration into global trade. Taking these factors into account will allow governments to formulate strategies aimed at attracting investment, which is important for economic development and strengthening macroeconomic stability.

M. Li *et al*. (2024) and M. Laryš (2024) raised the issue of energy security in the context of geopolitical instability, in particular, the decline of Russia's dominant role in the EU energy market. M. Laryš (2024) noted that Russia has lost the ability to use gas as a "weapon", which opens up opportunities for diversification of energy suppliers, including through renewable sources. This highlights the importance of investing in green energy and the development of energy networks, such as solar panels, wind turbines, energy storage batteries and hydrogen technologies. This focus is an important element in ensuring energy independence and resilience to geopolitical crises.

J. Cifuentes-Faura (2023) emphasised the need for a comprehensive approach to Ukraine's recovery, focusing on the principles of sustainability, energy efficiency and environmental friendliness. At the same time, the researcher emphasised the importance of developing infrastructure to create smart cities that use green technologies and promote sustainable development. Such approaches, the author noted, can reduce CO_2 emissions, improve energy efficiency and reduce the consumption of natural resources.

Innovative technologies, such as additive manufacturing (3D printing), are actively supported in the face of global change. C.M. Jewell & J.A. Stones (2024) noted that 3D printing not only helps to reduce production costs but also ensures more efficient use of resources through the ability to create prototypes and spare parts without the need for large material costs. At the same time, these technologies support the principles of the circular economy and green technologies, as they allow recycling materials and reducing waste. This, in turn, is an important part of the recovery of the Ukrainian economy, which requires technological upgrades and innovations to improve competitiveness in international markets.

D. Gřešica *et al*. (2024) also considered 3D printing as one of the promising technologies for the development of sustainable business models, particularly in construction and manufacturing. They noted that 3D printing can reduce the cost of materials and energy, which is an important aspect for achieving sustainable development in industry. J. Cifuentes-Faura (2023) also placed a significant emphasis on reconstruction, proposing a comprehensive approach to the reconstruction of Ukraine based on the principles of sustainability, energy efficiency and environmental friendliness. According to J. Cifuentes-Faura (2023), green technologies and energy efficiency are key to rebuilding Ukraine, creating smart cities and increasing competitiveness in global markets.

Thus, these studies revealed the multidimensional impact of the Ukrainian crisis and geopolitical risks on global processes and demonstrate the prospects for adapting to new realities through energy, economic and innovative approaches. Technological upgrading and investment attraction are fundamental aspects for ensuring Ukraine's sustainable development. The transition to innovative technologies, energy efficiency, digitalisation, and green transformation will help modernise the economy and increase its competitiveness. Creating a favourable environment for investors, including through transparency, stability and strategic initiatives, will help attract the resources needed for Ukraine's recovery and long-term prosperity.

Continuing the study of the issues raised in the above-mentioned scientific works, the authors systematised the impact of geopolitical factors on the technological upgrading of industrial enterprises, in particular in the context of conflicts, sanctions and changes in global supply chains. The authors substantiated the relationship between the technological renewal of industry and the convergence of investment processes, which ensures Ukraine's integration into global economic structures. Recommendations for state policy to stimulate technological upgrading of industry in the context of geopolitical instability, including optimisation of mechanisms for attracting foreign investment, are proposed. These recommendations are somewhat theoretical in nature, as some points require additional research and mathematical justification.

CONCLUSIONS

Given geopolitical changes, in particular the war in Ukraine, changes in trade and investment flows, as well as the fragmentation of globalisation, the country's economy is under significant pressure. Factors such as military conflict, sanctions against Russia, trade wars between major economies (in particular between the USA and China) create obstacles to stable economic development, in particular due to a decrease in foreign investment. On the other hand, they open up new opportunities for the modernisation of the industrial sector and integration into new economic blocs, in particular the European Union, which stimulates domestic investment and the transition to new technologies. One of the important trends is the change in the orientation of investments towards regional economic blocs. The risks associated with the war in Ukraine and global political conflicts force companies to apply strategies of reshoring (returning production) and friendshoring (transferring production to friendly countries). This, in particular, has a positive effect on the development of the domestic economy, as it requires the renewal of production capacities and the introduction of new technologies. At the same time, Ukraine manages to receive significant support from international financial institutions, in particular the European Union and the EBRD. These investments are aimed at restoring infrastructure and developing the energy and environmental sectors, which is an important step towards increasing the country's competitiveness in the international market.

Despite the difficulties, domestic investments, in particular in the agro-industrial complex and the defence sector, contribute to economic recovery. However, due to the high level of geopolitical risks, Ukraine still has limited access to large foreign investments compared to other countries, such as Poland or the Czech Republic. This emphasises the need to improve the investment climate in the country, in particular by improving the transparency of business processes, protecting investor rights and the stability of legislation. For the sustainable development of industrial enterprises in an unstable geopolitical situation, it is important to implement technological renewal and adapt strategies to new realities. This not only increases the investment attractiveness of enterprises but also allows them to integrate into global economic processes. To this end, a model of enterprise adaptation has been developed that takes into account investment risks and opportunities and also includes recommendations on state policy that

will promote technological innovation, increased competitiveness, and sustainable development of industry in conditions of geopolitical instability. Given the complexity of geopolitical challenges, future research should focus on developing adaptive models for industrial enterprises that integrate technological renewal, investment risk management, and strategic alignment with emerging regional economic blocs to enhance competitiveness and resilience.

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Вплив геополітичних тенденцій на технологічне оновлення промислових підприємств як основа конвергенції інвестиційних процесів в економіці України

Анотація. Світова економіка перебуває під впливом геополітичних тенденцій, які створюють нові виклики та можливості для розвитку національних економік. Досліджені геополітичні чинники свідчать про важливість інтеграції економіки України у світові фінансові процеси, впровадження новітніх технологій та розвитку міжнародного співробітництва. Метою даного дослідження було виявити вплив геополітичних тенденцій на технологічне оновлення промислових підприємств України та обґрунтувати їх роль як ключового чинника конвергенції інвестиційних процесів з урахуванням специфіки інтеграції української економіки у світові ринки. Дослідження проведено з використанням методів теоретичного узагальнення, статистичного аналізу даних, порівняння та логіко-структурного моделювання. У дослідженні узагальнено та структуровано геополітичні тенденції та визначено їх вплив на характер інвестиційних потоків у промисловість. Обґрунтовано фактори, що сприяють або перешкоджають залученню іноземних інвестицій у технологічне оновлення промисловості України в умовах геополітичної нестабільності. Обґрунтовано взаємозв'язок між технологічним оновленням промисловості та конвергенцією інвестиційних процесів в Україні, досліджено синергію між технологічним відновленням та інвестиціями. Запропоновано модель адаптації промислових підприємств України до мінливих геополітичних умов, яка спрямована на підвищення їх інвестиційної привабливості через технологічне відновлення. Розроблено рекомендації щодо державної політики стимулювання технологічного відновлення промисловості в умовах геополітичної нестабільності. Практична цінність дослідження полягає у визначенні ключових факторів, що впливають на інвестиційну привабливість підприємств в контексті геополітичної невизначеності. Це дозволить створити механізм регулювання та коригування впливу геополітичних ризиків, що сприятиме підвищенню конкурентоспроможності на внутрішньому та зовнішньому ринках

Ключові слова: геополітичні чинники; обсяги інвестицій; прямі інвестиції; модель адаптації; державна політика