NOTAS E CONÓMICAS 60

SPECIAL ISSUE ON "ECONOMIC RESILIENCE AND TRANSFORMATION IN TIMES OF GLOBAL UNCERTAINTY: INSIGHTS FROM EASTERN EUROPEAN SCHOLARSHIP"

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Special Issue on "Economic Resilience and Transformation in Times of Global Uncertainty: Insights from Eastern European Scholarship"

The global economy is navigating a period of profound turbulence. Geopolitical instability, technological disruption, and the imperative of sustainable development have converged to create unprecedented challenges for policymakers, businesses, and researchers. This special issue of *Notas Económicas*, prepared by the Eastern European Union of Scientists of Ukraine under the coordination of Prof. Mykola Biloshkurskyi (Pavlo Tychyna Uman State Pedagogical University, Ukraine), addresses these challenges through contributions that combine theoretical rigor with practical relevance.

The authors explore critical themes in economics and management, engaging with questions that resonate across academic and policy makers: how to strengthen economic resilience, safeguard socio-economic security, and harness digital transformation for sustainable growth. The nine contributions span diverse areas: from cognitive modelling in financial risk management and digital security frameworks for industry, to the integration of socio-cultural and technological factors in hospitality, and the evolution of accounting practices under ESG imperatives. Collectively, they provide a multidimensional view of contemporary economic challenges and propose pathways for navigating uncertainty with analytical rigor and strategic foresight.

It is important to note the context in which this research was conducted. Ukraine is currently experiencing the severe consequences of armed conflict, which has disrupted economic activity and created significant uncertainty. This issue acknowledges the resilience and dedication of scholars who continue to advance economic research under these extraordinary circumstances.

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Exploring Cognitive Patterns in Credit Default Risk Management

Explorando Padrões Cognitivos na Gestão do Risco de Incumprimento de Crédito

Vitalina Zubova

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ABSTRACT
The study aims to encapsulate methodologies for implementing cognitive models, focusing on tactics and strategies to predict financial risks. The methodology employs general scientific methods: analysis, synthesis, classification, and bibliographic review. The topic's significance arises from complex economic transactions, stricter banking supervision, and the need to enhance risk management. Traditional risk assessment methods are insufficient amid global financial uncertainty and the rapid flow of information. Thus, innovative frameworks that autonomously process large datasets, predict risks, and provide mitigation strategies are needed. Incorporating cognitive models marks a shift towards adaptive, predictive risk management, promising better decision-making but remaining underexplored. The research's applied value lies in mitigating risks in volatile markets.
Keywords: Cognitive modelling technology, Cognitive map, Switching process, Generation of alternatives, Impact consonance, Dissonance effects

JEL Classification: G21; G32; C63; D83

RESUMO
O estudo visa sintetizar metodologias para a implementação de modelos cognitivos, com foco em táticas e estratégias para prever riscos financeiros. A metodologia emprega métodos científicos gerais – análise, síntese, classificação e revisão bibliográfica. A relevância do tema decorre da complexidade das transações económicas, da supervisão bancária mais rigorosa e

da necessidade de reforçar a gestão de riscos. Os métodos tradicionais de avaliação de risco revelam-se insuficientes perante a incerteza financeira global e o rápido fluxo de informação. Assim, são necessários enquadramentos inovadores que processem autonomamente grandes volumes de dados, prevejam riscos e proponham estratégias de mitigação. A incorporação de modelos cognitivos representa uma mudança para uma gestão de riscos adaptativa e preditiva, prometendo uma melhor tomada de decisão, embora ainda pouco explorada. O valor aplicado da investigação reside na mitigação de riscos em mercados voláteis.

1. Introduction

The concept of global economic crises is evolving: crises are becoming more frequent, their scale is growing, and they are not disappearing, despite intensive study of them and counteraction to the factors that cause them. It is important to recognize that the banking system plays a dual role – it is both a catalyst for crises and a tool for overcoming them (Yevenko, 2017). The development and improvement of the competitiveness of banking institutions contributes to the social and economic progress of regions and the nation-state as a whole, although many tend to consider this factor as the starting point for numerous modern crises.

The relevance of the study of cognitive models in banking risk management is due to the growing complexity of financial systems and the need to make effective management decisions promptly. In today's environment, banks face high market volatility, changes in legislative regulation, technological transformations, and growing requirements for the security of financial transactions. Traditional risk assessment methods are often unable to adequately consider the complex interrelationships between various factors affecting the financial stability of banks (Makedon et al., 2024).

Cognitive models pave the way for more adaptive risk analysis strategies by combining the capabilities of artificial intelligence, machine learning, and expert systems. These models help to identify implicit relationships, anticipate potential crises, and improve decision-making. Cognitive maps only show the directions of influence, how one factor affects another and, accordingly, the study' object. Meanwhile, they do not disclose the details of the mechanism of influence, as well as changes in this influence depending on changes in external conditions, or temporal changes in individual factors.

The analysis of international banking activities using cognitive maps helps to understand the logic of events in the context of a large number of interrelated factors. The process of building a cognitive map traditionally consists of several main stages. The first stage involves prioritization of factors, which allows for identifying the most important factors for international banking – both endogenous factors arising within the system and exogenous factors outside it, separating them from less important ones. The next stage implies classifying the factors according to their origin into internal factors that can be controlled and external factors that a banking institution has no influence over. The third stage establishes the cause-and-effect relationships between the factors and the indicator under study, including both direct and indirect relationships (Morozova et al., 2019). Thus, although cognitive maps may not cover all possible factors and their interactions, they serve as a basis for developing more detailed models that describe in detail the impact of specific factors on international banking.

Similar examples can be given for many other tools used in banking (hedging, regulatory regulations, scoring, risk assessment, solvency assessment, business plan analysis, collateral assessment, etc.). However, just as it is impossible to give a one-sided assessment of these tools, procedures, and phenomena in general, it is not enough to state that they have or can have both positive and negative effects on the results of their use (Johri et al., 2022).

The article aims to study cognitive models in banking risk management, determine their effectiveness, and substantiate the possibilities of their application to enhance the stability of the banking system. The hypothesis of the study is that the use of cognitive models in

banking risk management allows for improved forecasting accuracy, decision-making efficiency, and reduces the likelihood of financial losses due to a deeper analysis of cause and effect relationships and adaptability to changes in the market environment.

2. Literature Review

The cognitive model enhances current management tactics and alleviates financial dangers associated with misleading responses that contribute to industry hazards Vinnichenko, Gudz (2020). According to Pymostka and Pymostka (2019), the implementation of risk-based strategies increases the ability of banks to identify and manage potential risks, thereby strengthening their fiscal strength.

Cognitive models play a crucial role in aiding decision-making, analysing market trends, predicting downside potential, and adjusting banking strategies to address different circumstances. According to researchers such as Arndorfer and Minto (2015) and Wiwanto (2020), while multifaceted risk assessment measures are useful, a tiered approach may limit cognitive integration within banking procedures. Wiwanto (2020) noted that four-tiered protection models provide a broader scope of risk management. Kovalenko (2017) emphasizes the need to advance the theoretical and methodological aspect of risk management in banking, emphasizing the crucial role of cognitive constructs in predicting and adjusting to financial market fluctuations (Leo et al., 2019).

Current research suggests that liquidity threat also presents itself as a crucial element that financial institutions should be vigilant about in the area of systematic risk factors (Dang and Nguyen, 2020). Another study (Samorodov et al., 2019a) considers credit risk management as the main method of ensuring the financial stability of banks. Despite the large number of papers on bank risk management, there are still significant gaps in the scientific literature regarding the use of cognitive models for risk reduction and forecasting. In particular, it is not well understood how cognitive processes influence decision-making in risk management and how cognitive approaches can be integrated into traditional risk assessment models.

3. Methodology

The research methodology employed in this study integrates a range of general scientific methods alongside specialized analytical techniques to comprehensively investigate cognitive patterns in credit default risk management. Central to the approach are fundamental methods such as analysis and synthesis, which enable the decomposition of complex phenomena into constituent elements and their subsequent integration into coherent conceptual frameworks. Classification methods facilitate the systematic categorization of diverse risk factors and cognitive models, providing structure to the multifaceted domain of banking risk management.

A thorough bibliographic analysis underpins the theoretical foundation of the research, involving a critical review and synthesis of contemporary and classical scholarly works across several intersecting disciplines. These include banking management, risk management theory, decision-making theory, situational management, and cognitive modelling. This literature

review serves not only to identify existing knowledge gaps but also to contextualize the current study within the broader scientific discourse.

Furthermore, the study draws upon mathematical modelling techniques specifically tailored to processes in weakly structured systems, which are characteristic of financial markets and banking environments. These models enable the simulation and prediction of risk dynamics in conditions of uncertainty and incomplete information, thereby reflecting the complex nature of credit default phenomena.

Cognitive modelling forms a methodological core, emphasizing the replication of human cognitive processes in automated systems to enhance decision-making in risk assessment. This includes the use of frameworks capable of processing large-scale datasets, identifying latent patterns, and generating adaptive strategies for risk mitigation. By combining theoretical constructs with computational approaches, the methodology supports the development of innovative, predictive models that address the limitations of conventional risk management practices.

4. Results and Discussion

The cognitive modelling of weakly structured systems implies the development of formal models and methods that allow taking into account the so-called cognitive abilities of the manager, in particular his or her perception, representation, knowledge in the subject area, understanding and explanation of intermediate tasks in solving management problems (Table 1) (Zhyhaylo, 2019).

Table 1 – Stages of building cognitive maps in international banking

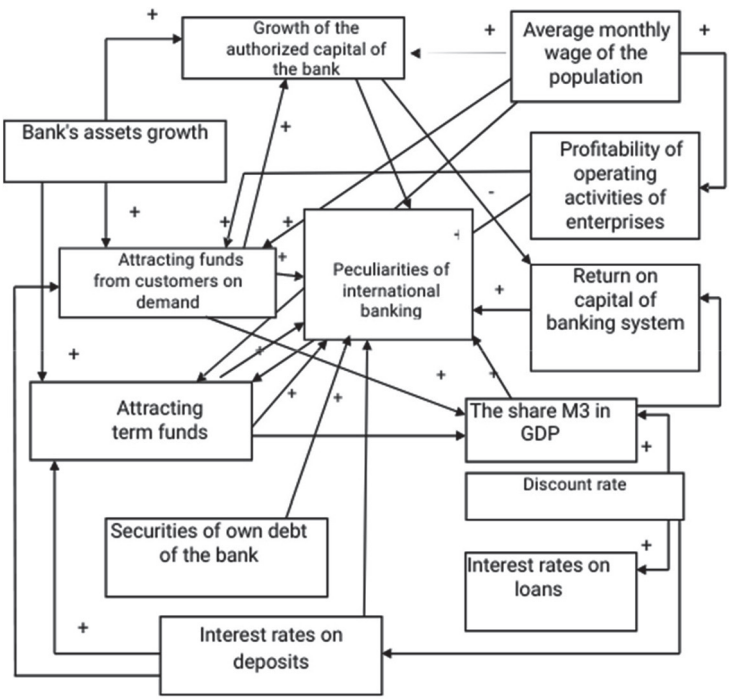
Stage	Meaning
Identification of key aspects that describe the p roblem situation	Selecting the fundamental factors that define the problem. Identification of the key target factors whose state it is desirable to transform.
Grouping factors into separate parts	Identify the factors that influence the goal. These factors will serve as potential levers of influence on circumstances (control parameters).
Identify the interactions between these factors	Grouping of factors into components that describe a particular area of the problem (in this case, macro- and microeconomic components).

Source: compiled from Bodnar et al. 2019; Fedevych et al. 2020; Morozova et al. 2019.

The main tool for such a study is a cognitive map (CM), which reflects individual and/or subjective perceptions of the problem or phenomenon under consideration. A CM contains basic factors (components) and cause-and-effect relationships between them. From the subject matter point of view, basic factors determine and limit the observed phenomena both within the system under consideration and in its environment. These factors are interpreted by the

management entity as essential, key parameters or as features of the observed exogenous and endogenous phenomena and processes (Ramlall, 2018). A cognitive map is created to analyse the aggregate positive impact of factors on international banking, based on a built graphical system that reflects the existing relationships between factors and the activities of international banks, as well as the relationships between the factors themselves (Figure 1) (Apostolik et al., 2012).

Figure 1 – Cognitive map of factors influencing the activities of international banks



Source: Developed based on Vinnichenko, Gudz (2020).

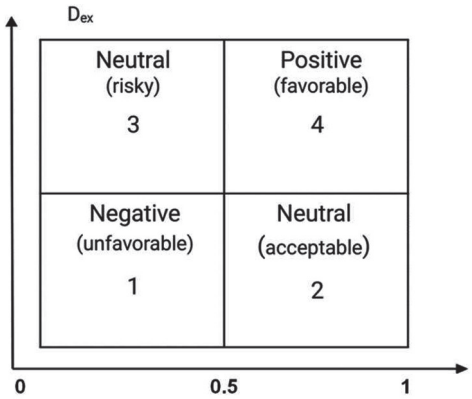
In essence, the CM is an oriented graph over a set of factors that reflects a tool for structuring the system and its possible states. The study of the interaction of factors within the framework of the CM allows us to assess the spread of their effects and thus describe the system' behaviour. Analysing the system's behaviour with the help of the CM involves finding the most significant factors of influence and assessing the impact of these factors on each other. This makes it possible to apply classical methods of system theory for modelling, dynamics analysis, and control.

To assess the impact of external and internal factors, it is proposed to develop a two-dimensional matrix that will reflect the results of integral calculations (Fig. 2). This can be represented by the equation:

$$P = \{Dex \mid Dend\} \quad (1)$$

where P is the overall level of influence of the macroenvironment and the microenvironment.

Figure 2 – Matrix of factors affecting international banking



Source: Concluded based on Samorodov et al. (2019b).

The matrix contains four quadrants, each of which allows to assess the impact of various factors on the international banking sector, determining their positive or negative effect. Each quadrant has its own economic interpretation: Quadrant 1 (Dex(0-0.5); Dend(0-0.5)) reflects the negative impact of external and internal factors on international banking, which creates threats to the bank's further development and reduces its competitiveness in the financial market. Quadrants 2 (Dex(0-0.5); Dend(0.5-1)) and 3 (Dex(0.5-1); Dend(0-0.5)) have similar characteristics and indicate a neutral impact of these factors on the bank's development and international activities. Quadrant 4 (DEX (0.5-1). The Comprehensive Deviation Endpoint (CDE) model emphasizes the key factors that lead to an extended positive impact on a bank's global operations. Good (4), fair (2), uncertain (3), not good (1) (Alwan Ali Naser, 2018).

Cognitive modelling analysis reveals the critical elements that shape system behaviour, including their interactions and impacts. This facilitates the deployment of the systems paradigm to test options in the banking industry and to create management tactics.

The proposed two-dimensional matrix for assessing the impact of the macro-environment and the micro-environment helps to establish the level of threat or favourable components that affect international banking. The distribution of factors into matrix quadrants can be used to assess their impact as positive, neutral or negative. The first one suggests harmful effects from internal/external problems that reduce the bank's competitiveness, while the

fourth one means excellent chances for global development. Quadrants 2 and 3 show a mixture of influences, where elements are not key, but can affect progress based on additional scenarios (Alazzabi, et al. 2023). Using this approach allows banks to make strategic decisions based on possible risks and prospects. The definition of four classes of situations – favourable, acceptable, risky, and unfavourable - provides a comprehensive approach to risk management, which is necessary for the stable functioning of the banking system in the context of international activities.

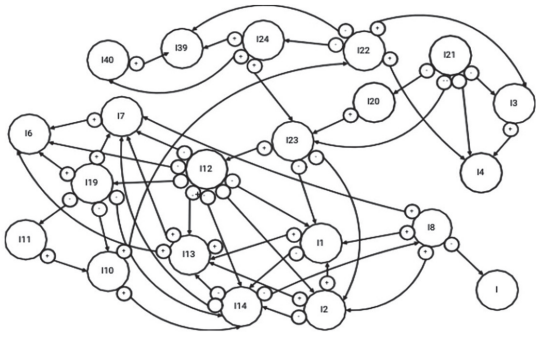
Analysis of the system's behaviour using cognitive modelling allows us to identify the most significant factors of influence and assess their interaction. This facilitates the application of systems theory methods to study the dynamics of changes in the banking sector and develop effective management strategies. The proposed two-dimensional matrix for assessing the impact of the macro-environment and the micro-environment helps to determine the level of threat or favourability of factors affecting international banking. The study showed that in 37% of cases the influence of factors is neutral, in 28% – negative, and in 35% – positive.

In this procedure, we identify and assign factors to the four quadrants of the matrix to determine whether they have a favourable, unfavourable or neutral impact. The study found that 19% of the components are in the primary sector, 31% in the secondary sector, 26% in the tertiary sector, and 24% in the quadrant, demonstrating the marked diversity in the banking sector's operational environment (Torban, 2020).

Using this method helps banks to make well-informed strategic choices, considering both potential risks and opportunities. The definition of four categories of risk – favourable (24%), tolerable (31%), hazardous (26%), and adverse (19%) – offers a method that captures the risk required for consistent performance of the banking system in global operations. Taking these aspects into account, the NBU is developing a concept and mechanisms for managing banking risks. This implies the need to consider the key characteristics of individual risks, which allows developing strategies to mitigate them (Makedon et al., 2025).

In order to structure various banking risks, considering their interdependence by sources of origin and impact, nature of influence, factors, and areas of localization, a logical detailing of banking risks is proposed using the cognitive map shown in Figure 3.

Figure 3 – Cognitive map



Source: Compiled by the author from Li et al. (2022).

To analyse the specifications of the cognitive model, the level of cognitive consistency of the model was determined. Consistency in cognitive modelling reflects the positive or negative impact of a particular concept on the entire system as a whole (Abdi and Williams, 2010). The matrix of causal interactions and directions of influence of concepts in the system of indicators used to assess the financial stability of the banking sector of Ukraine is presented in Table 2.

Banking risk monitoring is presented as a structure that is not fully connected and consists of factors and arcs that reflect the relationships between causes and effects. In this case, it is a sign graph, where the "+" sign indicates that an increase in the value of one of the factors leads to an increase in the dependent factor (Von Solms and Langerman, 2020).

Table 2 – Matrix of causality and directions of influence of concepts in the system of indicators used to determine the financial sustainability of the Ukrainian banking system

	I1	I2	I3	I4	I6	I7	I8	I9	I10	I11	I12	I13	I14	I18	I19	I20	I21	I22	I23	I24	I39	I40	I
I1		←+	0	0	0	0	←+	0	0	0	→-	←+	←-	0	0	0	0	0	←-	0	0	0	0
I2	→+		0	0	0	0	←+	0	0	0	→-	→+	←-	0	0	0	0	0	←-	0	0	0	0
I3	0	0		→+	0	0	0	0	0	0	0	0	0	0	0	0	←-	←+	0	0	0	0	0
I4	0	0	←+		0	0	0	0	0	0	0	0	0	0	0	0	←-	←+	0	0	0	0	0
I6	0	0	0	0		←+	0	0	0	0	←-	←+	0	0	←+	0	0	0	0	0	0	0	0
I7	0	0	0	0	→+		←+	0	0	0	←-	←+	←-	0	←+	0	0	0	0	0	0	0	0
I8	→+	→+	0	0	0	→+		0	0	0	0	←+	←-	0	0	0	0	0	0	0	0	0	→-
I9	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
I10	0	0	0	0	0	0	0	0		←+	0	0	→+	0	←-	0	0	→+	0	0	0	0	0
I11	0	0	0	0	0	0	0	0	→+		0	0	0	0	←-	0	0	0	0	0	0	0	0
I12	→-	→-	0	0	→-	→-	0	0	0	0		→-	→+	0	→-	0	0	0	←+	0	0	0	0
I13	←+	←+	0	0	→+	→+	→+	0	0	0	←-		←-	0	0	0	0	0	0	0	0	0	0
I14	←-	←-	0	0	0	→-	→-	0	←+	0	←+	→-		0	←-	0	0	0	0	0	0	0	0
I18	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0
I19	0	0	0	0	→+	→+	0	0	→-	→-	←-	0	→-	0		0	0	0	0	0	0	0	0
I20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		←-	0	1	0	0	0	0
I21	0	0	→-	→-	0	0	0	0	0	0	0	0	0	0	0	→-		→+	→-	0	0	0	0
I22	0	0	→+	→+	0	0	0	0	←+	0	0	0	0	0	0	0	0		0	→-	→-	0	0
I23	→-	→-	0	0	0	0	0	0	0	0	→+	0	0	0	0	←+	←-	0		←+	0	0	0
I24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	←-	→+		→+	→+	0
I39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	←-	0	←+		←+	0
I40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	←+	→+		0
I	0	0	0	0	0	0	←-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Source: Compiled from Statistics of financial sustainability indicators (n.d.).

The nodal factors of the FCM (fuzzy cognitive map: a method for modelling and analysing complex systems based on fuzzy logic) are interpreted as corresponding fuzzy sets, and each causal relationship can be established based on a limited set of fuzzy implicit rules that also determine the weight of the corresponding relationship between the factors.

If xk1 is Ak1 and xk2 is Ak2 and ... and xkn is Akn, then y is Bk", (1), where xkj (j=1n; k=1, 2, ...) is:

– are the input linguistic variables;
– y is the output linguistic variable;
– Akj – fuzzy sets describing the corresponding terms xkj;
– Bk – fuzzy sets describing the corresponding terms of y.

To assess the risks caused by the localization of banking operations, the terms of the input linguistic variables are described by fuzzy subsets of the universe U = 0, 0.25, 0.5, 0.75, 1:

– almost certainly (a risky situation is expected under any circumstances): ak1=0/0, 0/0.25, 0/0.5, 0.5/0.75, 1/1;
– very likely (a risky situation is almost always possible): ak2= 0/0, 0/0.25, 0.5/0.5, 1/0.75, 0.5/1;
– probable (risky situation occurs from time to time): ak3=0/0, 0.5/0.25, 1/0.5, 0.5/0.75, 0/1;
– unlikely (the risky situation may sometimes occur): ak4=0.5/0, 1/0.25, 0.5/0.5, 0/0.75, 0/1;
– occasionally (risky situation may occur under exceptional circumstances): ak5=1/0, 0.5/0.25, 0/0.5, 0/0.75, 0/1 (Abramova, 2022).

The need to create a well-built and independent risk management system in a banking institution, given the complexity of banking products and the current crisis in the financial sector, does not require additional justification. The issue of developing effective banking risk management systems is extremely relevant today, which makes it the subject of research by a significant number of scholars and practitioners (Torban, 2020).

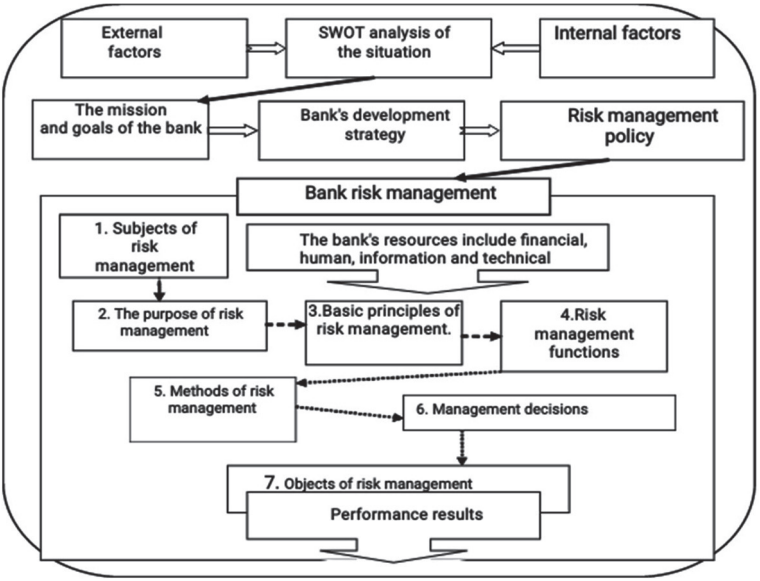
The specifics of banking activities are characterized by a significant level of risk, so any managerial inappropriateness can lead to a loss of liquidity, ability to pay, and ultimately to bankruptcy. Banking risk is the possibility of occurrence of events, foreseen or unforeseen, with a negative impact on the bank's capital and/or financial receipts. Effective risk management is crucial for every business entity, but it is especially critical for a bank. Improved risk management leads to increased financial stability and security of the bank (Mazayo et al., 2023).

Improving the bank's risk management involves the application of a set of methods, approaches, and actions aimed at timely forecasting risks, determining their potential size and consequences, in order to prevent or minimize the losses associated with them. At the state level (macro level), the improvement of risk management in the banking system is realized through the creation of an appropriate legislative and regulatory framework. At the

bank level (micro level), risk management improvements are aimed at increasing the bank's efficiency and preventing or reducing the risk of losses (Feyen et al., 2021).

A set of interrelated and interdependent components involved in risk management form the bank's risk management system. The key components of this system are: management entities, management objects, principles, functions, methods, and management decisions (Figure 4) (Blahun, 2021).

Figure 4 – Bank risk management



Source: Compiled by the author after Blahun (2021).

In fact, the risk management process does not stop; its phases (stages) consistently follow each other. The bank's protective mechanisms against risks include operational risk management and ways to reduce it (Arndorfer and Minto, 2015). Operational risk management means monitoring important indicators and making immediate decisions on banking operations. The regulator pays most attention to credit risk, as it is often the cause of bank failures.

Due to the large number of banking risks, there is a problem of choosing methods of managing them, which will allow making informed decisions on the expediency or inexpediency of entering into certain transactions or performing certain operations, and reducing their riskiness. For this purpose, there are certain methods of banking risk management (Table 3).

Table 3 – Banking risk management methods are divided into the following groups

Group of banking risk management methods	Description
Methods of avoiding banking risks	Provides for the rejection of risky activities that lead to a loss of potential profit. They are used only for the bank's internal risks.
Methods of accepting banking risks	They include three subgroups:
Methods of reducing banking risks	Improvement of organizational structure, staff training, technical improvement, diversification, limitation, monitoring and control.
Methods of independent counteraction to banking risks	They involve covering losses from own funds and creating reserve funds for self-insurance. They require a balance between the amount of reserves and possible financial losses.
Methods of transfer of banking risks	Provides for the distribution of risks among other market participants: banks, insurance, investment, leasing companies and other financial organizations.

Source: Compiled by the author based on Modernizing the three lines of defense model (2018).

There are methods of transferring banking risks such as insurance, hedging, asset sales and securitization, consortia and parallel loans, guarantee and surety contracts, factoring, and leasing (Chen et al., 2022).

Effective risk management protects investors' capital, enhances mutual trust, and becomes a cornerstone of long-term stability in a constantly changing environment. The field of risk management is in a state of continuous evolution, driven by market fluctuations, regulatory requirements, and continuous advances in methodologies and tools. This evolutionary process of risk management is inextricably linked to the features and advances of machine learning, in particular, based on cognitive models (Heß and Damásio, 2025).

In the market risk management system of Ukrainian banks, the most effective approach is to set limits that will limit banks' open positions in assets with the highest market risk (Alazzabi et al., 2023).

The studies demonstrated the prospects of using available data to analyse problem areas in order to make the most informed management decisions. However, certain aspects of the findings contrast with some approaches of other scholars, in particular, the use of cognitive models to enhance financial stability and minimize liquidity and credit insolvency risks. This can be justified by the diversity of methodological tools and analysis, as well as by differences in approaches to model building in different financial industries (Feyen et al. 2021). The results confirm the effectiveness of cognitive frameworks for interpreting and managing disordered systems, particularly in financial risk sectors.

The study found that financial risks exhibit a multifaceted pattern of interconnectedness that cannot be invariably formalized using standard mathematical approaches. The use of a fuzzy cognitive model explains the uncertainty and instability of financial activities, improving the accuracy of risk forecasting and management efficiency (Interest over time, 2023).

Cognitive modelling helps us spot dangers early and guess what might happen next. This method quickly identifies risks, considers what might happen next, and finds ways to

deal with them. This facilitates insightful management choices, thereby ensuring an effective response to risk and circumventing adverse consequences (Prymostka and Prymostka, 2019). The proposed mental assessment scheme adjusts the probability of danger with environmental shifts, contributing to the bank's financial security and reducing the chances of a crisis.

5. Conclusion

A cognitive framework for controlling monetary risk can significantly improve decision-making efficiency and reduce liabilities for the banking sector. Modelling these procedures is essential for assessing and predicting risks associated with human elements, a critical factor contributing to asset volatility in the trading domain. Such an approach enables a more structured and psychologically informed understanding of risk perception, tolerance, and behavioural biases that directly influence financial outcomes.

Therefore, the applied value of this study lies in the potential for using the developed methods to mitigate hazards, especially in changing and high-uncertainty market situations. The results may also serve as a basis for integrating cognitive models into algorithmic trading strategies, adaptive banking risk management systems, and regulatory compliance tools. At the same time, further research aimed at improving mental frameworks for enhanced monetary practices and the development of new systems to automate them in real-time execution is essential. Expanding this work to include cross-cultural decision-making patterns and stress-resilience testing could further strengthen its applicability and reliability in diverse financial contexts.

References

Abdi, H., & Williams, L. J. (2010). Principal component analysis. WIREs Computational Statistics, 2(4), 433-459.

Abramova, A. S. (2022) Transformational nature of operational risks of commercial banks. Problems of modern transformations. *Series: Economics and Management*, 3.

Alazzabi, W. Y. E., Mustafa, H.; Karage, A. I. (2023) Risk management, top management support, internal audit activities and fraud mitigation. *Journal of Financial Crime*, 30(2), 569-582.

Alwan Ali Naser, (2018) The role of accounting information in financial risk assessment (Practical Study). *Sci.Int. (Lahore)*, 30(3), 359-368.

Apostolik, R., Donohue, C.; Went, P. (Eds.). (2012). *Foundations of Banking Risk*. Wiley.

Arndorfer, I.; Minto, A. (2015) The "four lines of defence model" for financial institutions. Financial Stability Institute. Occasional Paper, 11.

Blahun, I. I. (2021) Sustainability of the banking system of Ukraine in the context of financial market turbulence. [PhD dissertation brief]. Sumy.

Bodnar, E.; Tishechkina, K.; Ivanenko, A.; Tarasenko, V. (2019). Control and Methods of Minimizing Credit Risk of the Bank. *Modern Economics*, 15(1), 21-26.

Chen, B.; Yang, X.; Ma, Z. (2022). Fintech and Financial Risks of Systemically Important Commercial Banks in China: An Inverted U-Shaped Relationship. *Sustainability*, 14(10), 5912.

Dang, T. L.; Nguyen, T. M. H. (2020) Liquidity risk and stock performance during the financial crisis. *Research of International Business and Finance*, 52, 101165.

Fedevych, L.; Luvdar, M.; Mezhyrytska, Y. (2020). Ukrainian Banking System: Current State and Prospects of Development. *Economy and Society* (21).

Feyen, E.; Frost, J.; Gambacorta L. Natarajan, H.; Saal M. (2021) Fintech and the digital transformation of financial services: implications for market structure and public policy. BIS Papers, Bank for International Settlements, 117.

Heß, V.; Damásio, B. (2025) Machine learning in banking risk management: Mapping a decade of evolution. *International Journal of Information Management Data Insights*, 5(1), 100324.

Interest over time (2023). GoogleTrends.

Johri, S.; Qureshi, N. I.; Mehta, K.; Othman, B.; Waghmare, S.; Pant, B. (2022) A critical significance of using machine learning in strengthening financial risk management in banking firms. In *2022 2nd International Conference on Advance Computing and Innovative Technologies in Engineering* (ICACITE), IEEE, pp. 1933-1937.

Klioba, L. G. (2016) Financial security and risks of bank investment activity. *Investments: practice and experience*, 12, 6-12.

Kovalenko, V. V. (ed.) (2017) The system of risk management in banks: theoretical and methodological aspects. Odesa: ONEU.

Leo, M.; Sharma, S.; Maddulety, K. (2019) Machine learning in banking risk management: A literature review. *Risks*, 7(1).

Li, G.; Elahi, E.; Zhao, L. (2022) Fintech, Bank Risk-Taking, and Risk-Warning for Commercial Banks in the Era of Digital Technology. *Front. Psychol.*, 13, 934053.

Makedon, V.; Trachova, D.; Myronchuk, V.; Opalchuk, R., & Davydenko, O. (2024). The development and characteristics of sustainable finance. In A. Hamdan (Ed.), Achieving sustainable business through AI, technology education and computer science (Studies in Big Data, Vol. 163, pp. 373--382). Springer.

Makedon, V.; Myachin, V.; Kuriacha, N.; Chaika, Yu.; Koptilyi, D. (2025). Development of strategic management of a corporation through the implementation of scenario analysis. Scientific Bulletin of Mukachevo State University. Series "Economics", 12(2), 135-146.

Mazayo, K.; Agustina; S.; Asri, R. (2023) Application of Digital Technology Risk Management Models in Banking Institutions Reflecting The Digital Transformation of Indonesian Banking BLUEPRINT. *International Journal of Cyber and IT Service Management*, 3(2), 130-143.

Morozova, N. L.; Pasechnik, I. V.; Malafeev, T. R.; Galushko, Y. P.; Goikhman, M. I. (2019) Assessment of the impact of capital concentration on the efficiency of the banking system. *Modern transformation. Financial and Credit Activity: Problems of Theory and Practice*, 2(29), 55-65.

Prymostka, L. O.; Prymostka, O. O. (2019) Risk-oriented management in the bank. *Financial and Credit Activity Problems of Theory and Practice*, 2(29), 66-72.

Ramlall, I. (2018) FinTech and the financial stability board. In: *Understanding Financial Stability (The Theory and Practice of Financial Stability*, Vol. 1), 71-81.

Samorodov, B. V.; Azarenkova, G. M.; Golovko, O. G.; Miroshnik, O. Y.; Babenko, M. V. (2019a) Credit Risk Management in the Bank's Financial Stability System. *Financial and Credit Activity Problems of Theory and Practice*, 4, 301-310.

Samorodov, B.; Azarenkova, G.; Golovko, O.; Oryekhova, K.; Babenko, M. (2019b) Banks Stability Management: The Strategic Cards. *Banks and Bank Systems*, 14(4), 10-21.

Torban, T. K. (2020) Assessment of credit risk management in micro finance institutions: A Case of Adama Town MFIs, Ethiopia. *Srusti Management Review*, 13(1), 42-53.

Vinnichenko, O. V.; Gudz, A. V. (2020) Financial condition of the bank and methods of its assessment in Ukraine. *Bulletin of Economics of Transport and Industry*, 69, 217-228.

Von Solms, J.; Langerman, J. (2020) Risks and Threats Arising from the Adoption of Digital Technology in Treasury. *Communications in Computer and Information Science*.

Wiwanto, F. (2020) Three common problems with the three lines of defense framework. *ForbesFinance Counci.*

Yevenko, T. I. (2017) The Ukrainian economy in 2018: the revival or stagnation. *Young Scientist*, 12(52), 617-619.

Zhyhaylo, G. G. (2019) Financial instruments: recognition and valuation. *Bulletin of the National Bank of Ukraine*, 1, 12-13.

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Socioeconomic Growth of EU Countries: Key Drivers, Regional Disparities and Lessons for Ukraine's Integration

Crescimento Socioeconómico dos Países da UE: Principais Motores, Disparidades Regionais e Lições para a Integração da Ucrânia

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ABSTRACT
The study of socio-economic development of European regions is increasingly relevant amid globalization and the need to harmonize economic and social standards. This is particularly important for Ukraine as it seeks European integration and improved living standards. The study analyzes key factors influencing regional development, including development models, economic indicators, and support tools, comparing European regions with Ukraine. Results show that successful development relies on sustainable policies, innovation, and human capital investment. Examples like Switzerland and Finland highlight the role of education, environmental, and technological strategies. Ukraine faces challenges such as regional disparities and institutional reforms. EU policies, including development funds and climate adaptation, offer lessons for improving Ukraine's economic policy, infrastructure, and human capital.
Keywords: Socio-economic development; Sustainable development; Economic integration; Development indicators; Regional disparities.

JEL classification: O18; R11; P25

RESUMO
O estudo do desenvolvimento socioeconómico das regiões europeias é cada vez mais relevante num contexto de globalização e da necessidade de harmonizar os padrões económicos e sociais. Isto é particularmente importante para a Ucrânia, que procura a integração europeia e a melhoria das condições de vida. O estudo analisa os principais fatores que influenciam o desenvolvimento regional, incluindo modelos de desenvolvimento, indicadores económicos e instrumentos de apoio, comparando regiões europeias com a Ucrânia. Os resultados mostram que o desenvolvimento bem-sucedido depende de políticas sustentáveis, inovação e investimento em capital humano. Exemplos como a Suíça e a Finlândia evidenciam o papel da educação, das estratégias ambientais e tecnológicas. A Ucrânia enfrenta desafios como disparidades regionais e reformas institucionais. As políticas da UE, incluindo fundos de desenvolvimento e adaptação climática, oferecem lições para melhorar a política económica, a infraestrutura e o capital humano da Ucrânia.

1. Introduction

Socio-economic development is an important factor determining the level of prosperity, stability and competitiveness of individual European regions (Chorii, 2023). Infrastructure development, access to education and healthcare services, and an effective social security system are all interconnected and form the basis for stable and balanced development at the regional level. For Europe, socio-economic development is important at all levels, from national to regional. The EU aims to reduce economic and social disparities between different regions by providing financial support through development funds, infrastructure investments, and innovation promotion (Yermachenko et al., 2023). For example, Poland and the Czech Republic have implemented significant institutional changes by transitioning to market economies and democratic political structures, which contributed to their rapid economic development (Yeriemieiev, 2024).

The current state of globalization, economic integration, and technological change poses new challenges for European countries to support sustainable development, reduce inequality, and ensure a high standard of living for their citizens (Kalina et al., 2022; Oliinyk et al., 2022; Bielousov et al., 2023; Byrkovych et al., 2023). Regional disparities, changing socio-economic conditions, political and institutional transformations – all these factors have an important impact on development processes, both at the level of individual states and at the level of the European Union as a whole (Shevchenko, 2021). A detailed characterization of this topic is especially important for Ukrainians, as the analysis of successful practices and policy initiatives of European countries can be the key to effective reforms in Ukraine, which critically needs them.

In the context of rapid changes in the economy, in particular due to the effects of global crises, war, and pandemics, the issue of effective socio-economic development of regions is becoming even more relevant. The European experience requires analysis both at the level of pan-European initiatives and at the level of specific states, which will allow the use of international experience to achieve the success of the Ukrainian state.

2. Literature Review

The problem of socio-economic development of European regions is actively studied in economic science. Numerous domestic and international scholars and practitioners have studied the problems of regional development and trends in regional policy in different countries of the world, including the European Union and Ukraine (Cherepiekhina, 2025). This topic is revealed in the studies of such authors as Dolishnyi (2003) conducted research on the socio-economic development of the regions of Ukraine, in particular, studying the impact of investment activity on the development of territorial communities, Kyzym (2006) analyzed and improved the mechanisms of the European Union's regional policy, in particular on sustainable development and the impact of European integration processes, Varnalii et al. (2023) focused on the problems of economic dynamics in the context of interaction between central and local authorities, Fedorenko et al. (2017) characterized the development of small and medium-sized enterprises at the regional level, in particular in the context of

globalization and integration processes, which were studied during 2017–2024, Romanuk and Romanuk (2023) analyzed the impact of institutional changes on the development of regional economies and studied the issues of economic efficiency in the context of modern transformation processes, Tkachuk (2023) focused on the management of regional economies in the context of the economic crisis and globalization.

Important are the studies in the field of economic growth theory, analysis of income convergence and reduction of inequalities between regions conducted by Barro and Sala-i-Martin (2004). Also, inequality in the development of EU regions, as well as political and economic factors influencing this process, were studied by Fiorenza and Laffont, 2001). The effectiveness of the cluster concept was evaluated by Martin and «Sunley, 2003. The researchers examined the benefits of these concepts for economic growth in European regions (Martin and Sunley, 2003). Richard Vickerman studied the economic aspects of EU integration (Vickerman, 2013). Victor Ginsburg and Michel Thiessen described the causes and consequences of economic imbalances in the EU. The researchers examined the economic and political factors that determine uneven development between regions (Ginsburgh and Thissen, 2014). John Bachtler and Carlos Mendez studied the EU cohesion policy and its impact on regional development. The object of their research was socio-economic inequality in European countries (Bachtler and Mendez, 2007). The importance of investment in education was studied by Ivo Izvorski (2024), who emphasized the problem of education quality. The author argued that improving the quality of higher education can accelerate economic growth and human capital development (Izvorski et al., 2024). Additionally, researchers such as Alice Bertoletti, Jasmina Berbegal-Mirabent and Tommaso Agassisti have paid considerable attention to the analysis of regional economic development in Europe (Bertoletti et al., 2022).

Comparative regional or sub-regional studies of the integration of European youth into the labor market were conducted by Rosario Scandurra and co-authors (Scandurra et al., 2021).

The topic of socio-economic development of European regions has been the subject of a large number of studies. However, no comprehensive analysis has yet been conducted that would consider the specifics of European countries and regional differences. A deeper study is needed of integration processes, the comparative characterization of which would provide practical implications for Ukraine. In particular, little research has been done on the interconnection of social factors (access to education and health services, economic growth and the level of regional disparities). Also important is the imperfect understanding of how integration processes affect Ukraine's socioeconomic development.

The purpose of this study is to examine the socio-economic development of European regions and assess the possibilities of applying their experience to the development of Ukraine.

The objectives of the study are: 1) Analysis of the socio-economic parameters of the development of European regions; 2) Assessment of factors that promote or hinder socio-economic development; 3) Study of instruments and policies to support regional development in the EU; 4) Analysis of regional disparities and their impact on socio-economic growth; 5) Assessment of Ukraine's development prospects based on European experience.

3. Research Methods

To achieve the results of this study, a comprehensive approach was used. It is based on comparative analysis, which allows to identify key factors of socio-economic development of European regions and compare them with the conditions and characteristics inherent in Ukraine. The analysis was conducted using secondary statistical data published by international organizations such as the World Bank, the European Union, the International Monetary Fund, and national statistical agencies (World Bank, 2022).

Official statistical reports published by government agencies and international organizations over the last 5 years were used to determine socio-economic indicators such as GDP, unemployment, access to education and healthcare (World Health Organization, 2021). In addition, to compare institutional approaches to development and the use of state support instruments, the study included an analysis of policies and programs implemented in the EU, as well as the study of successful cases from countries such as Germany, Sweden and Poland.

The qualitative analysis method was used to study the theoretical aspects of socio-economic development, such as institutional theories and models of economic growth. Scientific articles, monographs, and reports by leading economists covering regional development and sustainable growth were systematized and analyzed.

Additionally, the study used the case study method to investigate specific examples from European countries that have made significant achievements in the areas of economic stability and social policy. This allowed for a deeper understanding of the mechanisms that lead to successful development at the regional level, as well as an assessment of the possibility of their adaptation to the conditions of Ukraine.

The above methods were applied within the framework of a theoretical approach, focusing on interdisciplinary knowledge of economics, politics and social sciences, which allows for a comprehensive assessment of various aspects of socio-economic development and the development of appropriate recommendations.

4. Results

As a result of the study, the author obtained experimental and theoretical data that allow to assess the socio-economic development of European regions. In particular, the theories and approaches to socio-economic development are identified, among which the growth models of specific European countries, key structural changes, and institutional theories are clearly distinguished. Thus, the characterization of such a parameter as a growth model allows us to see how an economy can grow in the long term under certain economic processes, investments, and technological changes. This refers to the impact of factors such as investment, innovation, and human capital development (Kovalov et al., 2023). The Solow model, or neoclassical growth model, is considered to be one of the most important growth models (Mashkina, 2023). This trend interprets economic growth as dependent on three main factors: physical and human capital, and technological innovation. This model explains the steady growth of a country's economy by increasing investment in capital and technology. Germany is one of the best examples of implementing this model. The

country's government actively invests in educational programs, particularly in STEM (science, technology, engineering, and mathematics), maintains a large number of universities and research institutes, and supports the development of innovative startups (Ministry of Education and Science of Ukraine, 2024). Since 2008, Germany has developed a number of initiatives aimed at integrating STEM into the education system at all levels. These include the Dresden Resolution, the MINT for the Future program, and the Recommendation for Strengthening MINT Education. STEM programs in Germany are focused on combining theory with practice through extracurricular activities and practical courses in schools. This helps to attract students to technical and engineering disciplines. In addition, Germany is actively investing in the development of STEM education through new initiatives, such as the MINT Action Plan, which aims to improve the situation in the field (Yang, 2015). For example, the German government has allocated more than 5 billion euros for national programs to support research in science and engineering through the Excellence Strategy initiative (German Research Foundation, 2023). This program supports 11 universities and 57 research institutes working on advanced technologies, artificial intelligence and robotics.

Another important area is the Digital Hub Initiative program, which supports the development of startups in the field of digital technologies. As part of this initiative, the German government is investing in technology hubs in cities such as Berlin, Munich, and Hamburg. Thanks to such investments, Germany is creating conditions for the development of innovative companies, where young entrepreneurs can receive funding for their projects in the field of technology and engineering (Federal Statistical Office of Germany, 2023).

In terms of statistics, according to the Federal Statistical Office of Germany, in 2023, scientific and technological research in Germany accounted for about 3% of the country's GDP, which is one of the highest rates among developed countries. Programs to support startups have also shown significant growth: over the past 5 years, the number of technology startups in Germany has increased by 20%, and the level of investment in these companies has increased by 15% annually.

The next model is the endogenous growth model, which states that economic growth not only depends on external factors such as technology or capital, but can also be driven by internal processes in the economy. Important factors include innovation, entrepreneurship, government policies, and the creation of conditions for high labor productivity. Sweden is one of the most successful examples of endogenous development. The country invests in education, science, technology, and innovation, which contributes to sustainable economic growth (the Royal Institute of Technology (KTH) and Lund University, which are leading centers of innovation and research). It has significantly improved the standard of living of its citizens through strong infrastructure and high quality education, which are key components of endogenous development (National Defense University of Ukraine, 2020).

Investment and capital accumulation model. According to this model, economic growth is determined by the intensity of investment in physical capital (construction of factories, roads, bridges) and human capital (education, training). Accordingly, the more investment, the more resources are available for economic development and growth. For a more thorough analysis of economic growth models, it is useful to consider the following table (see Table 1).

Table 1 – Models of economic growth in EU countries

Growth model/ country	Model description	Key features and tools	The level of development before 2000	Achievements by 2020
Model Solow/ Germany	Economic growth depends on three main factors: physical capital, human capital, and technological innovation	Active investment in education (STEM), support for scientific research through national programs (Excellence Strategy) The German government allocates billions of euros to support technology and research In 2023, scientific and technological research accounted for 3% of the country's GDP	By 2000, Germany had gone through reunification and transformation after the fall of the Berlin Wall, maintaining strong industrial sectors, but overall its economy was relatively stable, with problems in the transition period	Germany's GDP in 2020 amounted to USD 3.8 trillion (according to the World Bank) Thanks to steady investment in science and technology, Germany has made significant economic progress, becoming one of the leading countries in Europe High level of GDP per capita (45,000 USD per capita) (Elk, 2023)
Endogenous growth model/ Sweden	Economic growth is driven not only by external factors, but also by internal processes: innovation, entrepreneurship, government policies, and conditions for high labor productivity	Investments in education, science and technology, infrastructure development and high quality education contribute to sustainable economic growth Strong innovation and education base	Until 2000, Sweden was a developed economy with a high level of social welfare, but with some economic difficulties due to globalization and competitive challenges	Sweden's GDP in 2020 amounted to USD 601 billion (according to the World Bank) Sweden has become one of the leaders in innovation indices, demonstrating stable economic growth, high quality of life, low unemployment, and influential entrepreneurial innovation (World Bank, nd) International recognition as a leader in technology and education
Investment and capital accumulation model/ Spain	Economic growth depends on the intensity of investment in physical capital (factories, infrastructure) and human capital (education)	After joining the European Union, Spain made massive investments in infrastructure and industry This included modernization of transportation networks, energy facilities, and construction of new factories In the 2000s, Spain began to actively implement innovative technologies, increasing the efficiency of the national economy	Until 2000, Spain was a relatively less developed country that was undergoing a transition to a modern industrial economy after the Franco dictatorship	Spain's GDP in 2020 amounted to USD 12 trillion (according to the World Bank) Spain has significantly modernized its infrastructure and industry and improved social conditions, which has contributed to a high level of economic development with a GDP per capita of USD 25,000 Investments in infrastructure and technology have become important drivers of economic growth (Eurostat, 2023)

Structural changes in agriculture, industry and services have become another key factor in the development of the European region. This refers to the transition of economies from agrarian to industrial and then to a post-industrial state, where services, information technology, and knowledge play a greater role (Moroz et al., 2024). Structural changes are known to be divided into types. The first type is the transition from an agrarian to an industrial economy. It is a reorientation of the economy to industrial production, which makes it possible to increase labor productivity and ensure the growth of national income (National Bank of Ukraine, 2022). In the European region, the United Kingdom went through a stage of industrialization in the nineteenth and twentieth centuries, which contributed to rapid economic growth, rising welfare, and increased employment (Yeriemieiev, 2024). The second is economic diversification, which means promoting the progress of industries such as high technology, pharmaceuticals, and financial services without weakening key industries (agriculture or natural resource extraction). An example of economic diversification in Europe can be seen in Norway. The country was initially focused on oil and gas production, but has now shifted its focus to the development of technology and innovation sectors, as well as investments in education, healthcare, and sustainable agriculture.

The Norwegian government pays special attention to the development of clean technologies and alternative energy, which allows the country to reduce its dependence on oil and gas while increasing economic stability (Zhao and Xu, 2022). Over the past few years, a number of important programs and projects have been implemented in this area. In particular, the Green Platform Program, launched in 2020, is one of the main tools to support the development of renewable energy sources and clean technologies in Norway. As part of the program, the government has allocated more than NOK 2 billion to invest in CO2 reduction technologies. Projects related to the development of wind and solar energy received funding (Larsen and Høyer, 2022). Another striking example is the Norwegian Climate Investment, a program launched in 2021 (UNESCO, 2021). The goal of the program is to develop and implement new technologies in the field of renewable energy. As part of this initiative, the Norwegian government has invested NOK 1.5 billion in reducing greenhouse gas emissions and increasing the efficiency of renewable energy sources (Pedersen and Holm, 2023).

The third type is technological change and the transition to the information economy. This process is characterized by the growing influence of information technology, telecommunications, and high value-added services. An example is Estonia, which has become one of the leaders in the IT sector. The state has introduced digital technologies at all levels of society (Järv, 2019). The country is actively developing e-government (online identification, e-voting, and digital services for citizens). For example, the e-Residency program, launched in 2014, allows entrepreneurs from all over the world to register a business in Estonia, access banking services and payment systems, and manage the company remotely. As of 2023, more than 80,000 people from different countries have become e-residents, and more than 17,000 companies have been registered through this program. Such an increase in interest in Estonia indicates a strong demand for digital services (Kallaste and Lehtsalu, 2022).

Another important aspect of the program's implementation is electronic voting. The i-Voting program, which was launched in 2005, allows Estonian citizens to participate in elections via the Internet. This makes the election process fast, accessible and convenient.

In 2019, about 44% of Estonians took part in the parliamentary elections via electronic voting. This is one of the highest rates in the world (Rossi and Tuomi, 2023).

Estonia is also a center for IT startups and outsourcing services, attracting international companies. The Startup Estonia program, established in 2016, promotes the development of the startup ecosystem by providing financial and advisory support to new technology companies. As of 2023, more than 1,500 startups were registered in Estonia, particularly in areas such as financial technology (FinTech), artificial intelligence, and blockchain. The program has created more than 30,000 IT and startup jobs and attracted more than €200 million in investment in 2022 (Kase and Tinn, 2022).

In addition, Estonia actively supports innovation in the technology sector through R&D investment programs. One such project is the Tehnopol Science and Business Park, which provides startups with access to laboratories, funding, and international partnerships. In 2023, the park supported more than 300 technology companies, particularly in software development and IT consulting (Järv, 2019).

Having described the main aspects of the socio-economic development of the European region, the role of institutions (political, legal, economic, and social) cannot be overlooked. Institutions provide a framework for the functioning of the economy, defining the rules and interaction between participants in economic processes (Shtan, 2023).

New institutional economic theory (Douglas North). According to this theory, the success of economic development depends on effective institutions, such as the legal system, property protection, and contractual relations, which reduce uncertainty and promote business and investment (Ushchapovskyi, 2023). Countries with an effective legal system, such as Germany or Sweden, have a high level of economic development because they have clearly defined rules that stimulate investment and economic activity (Savchyn and Perepeliukova, 2024).

Theory of institutional change (Kenneth Pomerantz). Focuses on the temporal changes in institutions and the impact they have on the development of economies. In particular, the transition from authoritarian to democratic political systems, from planned economies to market economies contributes to more efficient economic development. For example, after the collapse of the Soviet Union, European countries, such as Poland and the Czech Republic, made significant institutional changes, moving to market economies and democratic political structures, which contributed to their rapid economic development (Yeriemieiev, 2024). And although the European Union is taking steps to reduce economic inequalities between regions through the Cohesion Policy, there are still significant differences between developed and less developed regions, and even these may increase over time. Cohesion policy usually includes financial assistance for infrastructure, education, science and technical innovation in regions with lesser opportunities. However, this problem remains relevant, and regional disparities are becoming more pronounced (European Commission, 2020b). Certain regions, such as Eastern Europe, Greece, southern Italy, southern Spain, and Portugal, have significantly lower levels of economic well-being compared to other parts of the European Union. This emphasizes that there are significant economic gaps even within the union (Barbero and Rodríguez-Crespo, 2022). In addition, the northern regions are characterized by low levels of social exclusion, meaning that fewer people face problems of poverty and exclusion from basic social and economic benefits. On the other hand, the regions mentioned earlier (Eastern Europe, southern Italy, southern Spain) have a higher risk of poverty and

social exclusion, which indicates a greater vulnerability of their populations (European Commission, 2020a). Thus, institutional quality is a significant determinant of economic development, as inefficient institutions can impede the accumulation of human capital and technological innovation, which in turn slows down economic progress. The quality of the institutional environment has a direct impact on economic productivity, as institutions can both facilitate and constrain development processes (Aghion et al., 2022).

The theory of inclusive institutions (Daron Acemoglu, James Robinson) (Mokhniuk, 2022). The authors of this theory argue that inclusive institutions are the basis for long-term and sustainable development. Their absence can lead to economic and social inequalities, which in turn hinders development. Among European examples, Ireland can be singled out. The country has achieved significant improvements in its economic development, albeit with complex problems in the implementation process. One cannot overlook the Social Inclusion and Community Activation Program (SICAP) (2015), which was created to combat poverty and social exclusion. This program was aimed at supporting the most vulnerable groups (unemployed, youth, people with disabilities and other socially disadvantaged groups). It provided financial assistance to communities and supported social enterprises and organizations working to integrate these groups into society (Danylenko and Sokolska, 2017). Also, worth mentioning is The Action Plan for Jobs (2012), an Irish program to combat high unemployment and promote economic development through job creation. It focused on small and medium-sized enterprises, providing subsidies for innovative companies and supporting startups. The result was the creation of more than 170,000 new jobs by 2020.

The socio-economic development of a region is a multifaceted process that includes not only economic but also social aspects. In order to assess the level of this development in the European region, we will use additional parameters and indicators. Parameters include values that help to assess the overall level of development, such as gross domestic product (GDP), unemployment, income, access to basic social services, etc. Indicators, on the other hand, are specific measures used to assess the level of development and changes in the economy and social sphere. They allow us to track changes in economic processes and quality of life. These include GDP growth, unemployment, income, access to education and healthcare services.

GDP growth is the main macroeconomic indicator of economic development. Ireland is an example of a European country with a steady increase in gross domestic product (GDP) over the past five years (State Statistics Service of Ukraine, 2022; Central Statistics Office, 2025). The unemployment rate shows the efficiency of labor utilization in the economy. In the European Union, it varies depending on economic conditions, and in particular, in Greece, it remained high after the 2008 global financial crisis, reaching 27% in 2013. But by 2020, the unemployment rate had dropped to 17%, thanks to the 2012 Greek Labor Law Reform, which was part of a broader economic program under financial assistance from the EU, the International Monetary Fund (IMF) and the European Central Bank under three major bailout programs (2010, 2012, 2015) (European Commission, 2020a). Switzerland, for example, has one of the highest per capita incomes in the world, which is the result of stable economic policies, high levels of investment, and a developed financial infrastructure (OECD, 2021). Access to education and healthcare are critical indicators of quality of life and social development. The level of access to quality education and healthcare services determines not only the physical and intellectual development of the population, but also

affects overall social progress. The Scandinavian countries (Sweden, Norway, Denmark) have a high level of access to education and healthcare services, which contributes to the high standard of living and economic development of these countries (Olofsson et al., 2021).

The demonstrated examples of socio-economic development of European regions (through the prism of different growth models and additional parameters and indicators) form a specific list of countries in the region whose experience can be applied to countries that are trying to improve their own socio-economic development. This list includes Germany, Sweden, and Ireland. Germany is actively investing in education and innovation, while Sweden is investing in science and technology, which contributes to endogenous development. Ireland shows stable GDP growth due to attracting investments and developing the technology sector. The experience of Norway and Estonia is also noteworthy, where the focus is on structural changes in the economy, transition to a post-industrial society, and diversification of economies. Through a critical analysis of the policies of these countries, it is possible to form a group of important factors that should be considered when planning Ukraine's socio-economic development. They can be summarized in the form of a table (see Table 2).

Table 2 – Analysis of policies of representatives of the European region

Country/ Region	Economic development	Social cohesion	Infrastructure and technology	Investment and decentralization	Education and human capital	Resilience to change (climate, globalization)
Spain	After the 2008 crisis, Spain again stabilized its economy through reforms. The high unemployment rate remained until 2014, but it will decrease by 2020 due to labor reforms.	Social inequality has been reduced through government programs. Support for vulnerable groups through social programs has been introduced.	Active investment in infrastructure and development of smart cities. Increasing the digitalization of the economy.	Implementation of the decentralization policy. Investing in less developed regions (especially through European funds).	Improving vocational education and retraining programs.	Adaptation to climate change through investments in the green energy sector.
Greece	Slow recovery from the 2008 financial crisis. Development of tourism and agriculture contributed to economic growth after 2015.	Unemployment rate has increased due to structural reforms. Policies are in place to support the most vulnerable groups.	The need to modernize infrastructure due to the crisis, but gradual reconstruction of ports, roads and transport.	Co-financing with the EU to support local businesses. Focus on tourist regions and farming communities.	Programs for the development of small and medium-sized businesses and training for young people.	Implementation of environmental standards in industry and tourism.

Country/ Region	Economic development	Social cohesion	Infrastructure and technology	Investment and decentralization	Education and human capital	Resilience to change (climate, globalization)
Ireland	Rapid economic growth after the 2008 crises. Development of the technology sector and multinational companies.	Improved living standards due to economic growth, but still social inequalities in some regions.	Strong investments in digital infrastructure, particularly in technology and communications.	Decentralization and changes in local governance have increased the efficiency of using European funds.	Focus on higher education and creating opportunities for the development of technological specialties.	Adaptation to technological changes, environmental initiatives, particularly in the energy sector.
Poland	After 2008, Poland achieved stable economic growth due to favorable policies and investments.	Cohesion policies were aimed at reducing economic disparities between cities and villages.	Infrastructure projects through the EU have supported the development of modern transportation and digital networks.	The EU's investment policy for small and medium-sized enterprises was of great importance.	Education reform, improving the quality of school and higher education, and emphasizing vocational training.	Investing in green energy and climate change adaptation.

Source: Compiled by the authors based on European Commission (2017).

5. **Discussion**

European regions demonstrate different approaches to socio-economic development, particularly in the context of supporting weaker regions. Successful countries, such as Sweden, Germany, and Switzerland, have stable economic performance, which has enabled them to make significant progress in supporting innovation, infrastructure, and business development. One of the most effective approaches is to balance efficiency and equity in economic development policies. As the experience of Switzerland, Finland, and Sweden shows, investments in business and innovation in weaker regions, as well as tax incentives for businesses in these areas, can contribute to faster local economic growth. The European Union, as a driving force for the development of member states' economies, has demonstrated many positive processes, some of which can be summarized in the table below (see Table 3).

Table 3 – Efficiency and equality goals in regional policies

Performance targets: investing in business in all regions	**Mainly efficiency, but with more funding for weaker regions**	**Efficiency and equality – investing in business in weaker regions**	**Equality – job creation or quality of life in weaker regions**
Economic development strategies of regional governments in all regions: Austria, Switzerland, Germany, Spain, Italy, United Kingdom	Contracts between the state and regions for economic development in all regions: France	Economic development programs in all regions: Switzerland, Finland, Sweden	Strategies for businesses in any region: United Kingdom
Clusters: Finland, Netherlands, Norway, Sweden	European cohesion policy as a whole – additional national emphasis on weaker regions, e.g. Denmark, Germany, Finland	Economic development strategies in all regions, but with more funding for weaker regions: Denmark	Grants for business investment/innovation in weaker regions: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Finland, Greece, Ireland, Italy
Tax incentives for business investment/ innovation in weaker regions: Switzerland, Germany, France, Italy	Financing business context/ infrastructure in weaker regions: Germany, Spain, France, Italy, Portugal	Transportation assistance in weaker regions: Greece, Finland, Norway, Sweden, United Kingdom	Grants to create jobs in weaker regions: Germany, Italy, Sweden
Tax incentives for job creation in weaker regions: France, Italy, United Kingdom	Tax incentives for all businesses in weaker regions: France, Norway	Financing local services/ quality of life in weaker regions: Greece, Norway	Fiscal equalization mechanisms: all countries

Source: Eurosocial II (2025).

However, it is important to note that not all European countries have the same level of development. For example, many Eastern European countries are facing major economic challenges, not only due to the transition from a centrally planned economy to a market economy, but also to the negative effects of external and internal crises. For countries such as Poland, Romania, and Bulgaria, EU programs to support economic cohesion are important, helping not only to modernize infrastructure but also to create new jobs, attract investment, and provide access to quality healthcare and education services. Moldova demonstrates low GDP per capita, high unemployment and emigration. Albania has problems with infrastructure, social services, and high unemployment. Kosovo is also characterized by high unemployment, poor infrastructure development and economic stability. North Macedonia faces a low standard of living and high unemployment. Ukraine should not be overlooked. Ukraine, despite its significant potential in various sectors of the economy, faces serious socio-economic challenges. Developing innovation, increasing investment, and raising incomes remain critical issues for these countries. However, without proper reforms in education, healthcare and social security, as well as without adequate support for business and job creation, socio-economic development will remain limited.

The issue of effective use of international support programs and ensuring investments in the weaker regions of Europe is extremely relevant. Especially for Ukraine. It is important for the country not only to introduce tax incentives for businesses in remote regions, but also to intensify the use of fiscal equalization mechanisms. This will help reduce economic disparities between different regions of the country.

Security and stability issues remain important for development. Military conflicts have a direct impact on economic development, reduced investment, and capital outflows. In this regard, the role of defense policy and the development of cybersecurity is important. Modern threats can significantly affect the economic stability of a country. Countering cyberattacks and strengthening defense capabilities should be prioritized, as they provide the very possibility of socio-economic development.

This theoretical study can be of practical importance for Ukraine. After all, the mistakes and achievements of others are lessons for growth and warnings against mistakes. Ukraine should focus on the factors that contribute to development. These include investments in innovation and business (support for innovation, small and medium-sized businesses), reducing economic inequality between regions (support for weaker regions through public funding, tax breaks, and infrastructure investments), improving access to education and healthcare (access to medical and educational services), and strengthening national security (defense capability, cybersecurity).

It is obvious that the most successful European countries (Sweden, Germany) have more stable economic indicators. They have achieved this thanks to policies that support innovation, high levels of investment, and the implementation of social programs. In Ukraine, despite some positive changes, such results have not yet been achieved. The reason for this is the lack of comprehensive reforms and serious economic difficulties. Ukraine, given its strategic geographical position, cultural proximity to Europe, and significant potential in various sectors of the economy, must undergo significant socio-economic transformations. An assessment of Ukraine according to the above parameters will help to identify the stages of development the country is at and what positive practices from European regions it can adopt.

5. Conclusion

The socio-economic development of European regions includes such indicators as GDP growth, unemployment, income and access to basic social services. The article analyzes these factors and their impact on the overall development of the regions.

It is found that the socio-economic development of European countries is significantly influenced by internal and external factors. These include economic reforms, political stability, as well as globalization and integration processes. Each of these factors can affect the socioeconomic development of a particular region. The EU is trying to reduce the economic gap between regions and combat regional disparities through its Cohesion Policy. But the difference continues to grow. Regions with lower GDP per capita face higher levels of poverty and social exclusion, pointing to the link between economic development and social well-being. Eastern European countries, the southern regions of Italy, Spain and Portugal

have the lowest rates of economic development and social inclusion. At the same time, the northern regions demonstrate better results in these aspects.

The EU's activities are aimed at overcoming the disparity. To this end, it is actively financing infrastructure development and investing in financial systems. However, the reasons for the differences between regions are often historical. Many countries that have become economic leaders have a long history of developing industry, trade, and institutions. For example, in Western Europe, powerful retail chains, banks, and industry have been developing since the 1690s. These factors gave the region an advantage in infrastructure and economic development. In addition, regions with stable political regimes and effective governments could more easily invest in infrastructure and social services. For example, countries like Germany, France, or Sweden have strong institutions and political stability. This has contributed to their economic growth. It is important to note that regions with a high level of education and skill have better prospects for development. Sweden, Norway, and the Netherlands are examples of countries where investments in education and research create strong human capital. This, in turn, contributes to the development of innovative industries. These countries have invested considerable resources to achieve this level of development. Ukraine, despite its considerable potential, faces a number of challenges in these areas. Budgetary policies, investments in infrastructure and education, as well as effective integration into international economic structures are important tools to support development. The development of the Scandinavian countries is an example of the successful application of these tools. Sweden has placed significant emphasis on investments in human capital and technological innovation. This has become a key element of its attractiveness to people (Peters and Wouters, 2021).

The biggest challenges for Ukraine remain uneven regional development, inadequate access to education and healthcare, and corruption. To overcome these problems, Ukraine needs to adopt new policies aimed at improving infrastructure and reducing social inequalities between regions.

The results of the study showed that Ukraine is showing a trend toward gradual improvement in socioeconomic indicators, but this is not happening fast enough. Compared to other European countries, such as Poland and the Czech Republic, the pace of development in Ukraine is still insufficient to achieve high living standards and economic stability.

The main limitation of the study, however, is the lack of consideration of the parameters of digital transformation in European regions.

An important area for further research is to examine the relationship between institutional change and socioeconomic development, especially for countries that are seeking development. Since the processes of adaptation to European economic standards can be complex, research should be continued. To improve Ukraine's socio-economic development, it is necessary to continue deeper reforms, focusing on international standards and practices of successful EU countries. Adapting the Horizon Europe program to Ukrainian realities could be worthwhile, as it would help to promote innovation in Ukraine, create new jobs, and increase international competitiveness. In the future, it is worth paying attention to analyzing the impact of digitalization and technological innovations on socio-economic development, as they are becoming important drivers of growth in the modern world. In general, the findings of the study confirm the importance of a comprehensive approach to assessing socio-economic development and the need for continuous reforms to achieve sustainable development both in Ukraine and other European countries.

References

Aghion, P.; Akcigit, U.; Howitt, P. (2022) The economics of innovation: An overview. *Empirical Economics*, 66(5), 1231-1260.

Bachtler, J.; Mendez, C. (2007) The influence of EU cohesion policy on regional development. *European Planning Studies*, 15(5), 695-710.

Barbero, J.; Rodríguez-Crespo, E. (2022) Technological, institutional, and geographical peripheries: Explaining regional disparities in the European Union. *Regional Studies*, 69, 311-332.

Barro, R. J.; Sala-i-Martin, X. (2004) *Economic growth.* (2nd ed.). MIT Press.

Bertoletti, A.; Berbegal-Mirabent, J.; Agasisti, T. (2022) Higher education systems and regional economic development in Europe: A combined approach using econometric and machine learning methods. *Socio-Economic Planning Sciences*, 82, 101231.

Bielousov, V.; Mykolaiets, A.; Platonova, H.; Buhlak, O.; Chernysh, A. (2023) The Gig Economy and its Impact on Social Security and Social Protection of Employees. *Revista de Derecho de la Seguridad Social, Laborum*, 36, 279-289.

Byrkovych, T.; Denysiuk, Z.; Gaievska, L.; Akimova, L.;Prokopenko, L.; Akimov, O. (2023) State Policy of Cultural and Art Projects Funding as a Factor in the Stability of State Development in the Conditions of Globalization. *Economic Affairs (New Delhi)*, 68(01), 199–211.

Cherepiekhina, O. (2025) Paradoxes of modern science: challenges, consequences, and solutions in social and behavioral sciences. *International Science Journal of Education Linguistics*, 4(1), 50-62.

Chorii, Y. (2023) Socio-economic development of the region as an economic scientific definition. *Economy and Society*, 57.

Danylenko, A. S.; Sokolska, T. V. (2017) Public management of socio-economic development of rural areas. *Economics and Management of Agriculture*, 1(2017), 5-12.

Dolishnyi, M. I. (2003) Regional policy and mechanisms of its implementation. *Scientific thought.*

Elk, O. V. (2023) *Comparative analysis of the efficiency of labor resources use in Ukraine and Germany* (master's thesis, specialty 051 "Economics"). Zaporizhzhia National University.

European Commission (2017) Ninth report on economic, social and territorial cohesion.

European Commission (2020a) Greece: Unemployment rate and trends.

European Commission (2020b) Study on national policies and cohesion. Final Report Contract No 2017CE16BAT125. European Commission, Brussels.

Eurosocial II (2025) Regional development policies in the European Union: Efficiency vs. equity objectives.

Eurostat (2023) GDP and main components – current prices [Data for Spain].

Federal Statistical Office of Germany (2023) Scientific and technological research in Germany: Growth of investment in the STEM sector.

Fedorenko, V. G.; Gryshchenko, I. M.; Novikova, O. F.; Olshanska, O. V., Melnyk, A. O.; Voronkova, T. E.; Denysenko, M. P.; Voitovych, R. V.; Cherkasov, A. V.; Vlasov, V. I.; Palytsia, S. V.; Fedorenko, S. V.; Hryshchenko, A. I.; Yankovets, T. M.; Shatska, Z. Y.; Patyka, N. I.; Pankova, O.; Bokov, O. V.; Bokova, S. M.; Pinchuk, Y. B.; Pyaskivska, M. S. (2017) The economy of Ukraine in the global and domestic dimensions. DKS Center LLC.

Fiorenza, R.; Laffont, J. J. (2001) Spatial inequality in the European Union: A regional analysis. *Journal of European Economy*, 28(3), 312-330.

German Research Foundation (2023) Excellence Strategy – Strategy for the development of scientific research in Germany. https://www.dfg.de/en/research_funding

Ginsburgh, V.; Thissen, M. (2014) The EU and regional disparities: Understanding the causes and the implications. *European Economic Review*, 60, 54-72.

Izvorski, I., Kasyanenko, S., Lokshin, M. M., & Torre, I. (2024). *Europe and Central Asia Economic Update, Fall 2024: Better Education for Stronger Growth*. Washington, DC: World Bank.

Järv, P. (2019) Estonia's digital revolution: A leader in IT and outsourcing services. Journal of Digital Innovation, 25(4), 182-194.

Kalina, I.; Khurdei, V.; Shevchuk, V.; Vlasiuk, T.; Leonidov, I. (2022) Introduction of a Corporate Security Risk Management System: *The Experience of Poland. Journal of Risk and Financial Management*, 15(8), 335.

Kallaste, E.; Lehtsalu, L. (2022) E-Residency as a driver for entrepreneurship: A case study from Estonia. *International Journal of Entrepreneurship and Innovation Management*, 26(2), 107-122.

Kase, A.; Tinn, K. (2022) Estonia as a tech hub: From digital innovation to global startup ecosystem. *Journal of Technology Transfer*, 47(7), 1075-1090.

Kovalov, B.; Ponomarenko, I.; Borukha, A.; Tarasov, V. (2023) Disruptive technologies for ensuring economic and resource security of Ukraine. *Economy and Society*, 57.

Kyzym, M. O. (2006) Modeling sustainable regional development. Publishing and design department of Information Technology Centre.

Larsen, O.; Høyer, K. (2022) Hydrogen economy in Norway: Pathways towards a sustainable future. *Journal of Sustainable Energy Technology*, 13(2), 102-115.

Martin, R.; Sunley, P. (2003) Deconstructing clusters: Chaotic concept or policy panacea? *Journal of Economic Geography*, 3(1), 5-35.

Mashkina, A. (2023) Modern doctrines of socio-economic development of enterprises in the conditions of the knowledge economy. *Economy and Society*, 58.

Ministry of Education and Science of Ukraine (2024, November 4). Ukraine and Germany signed an agreement on cooperation in science, technology, innovation and higher education. Ministry of Education and Science of Ukraine.

Mokhniuk, R. S. (2022) Inclusion as one of the directions of the civil society development strategy: a factor of culture creation. *Issues of Cultural Studies*, 39, 182-193.

Moroz, Y.; Romanchuk, L.; Abramova, I. (2024) Peculiarities of financing the development of rural communities and territories at the expense of the EU's joint budget. *Economic Journal-XXI*, 2-3(3), 9-18.

National Bank of Ukraine (2022) *Economic and Financial Review*.

National Defense University of Ukraine (2020) UN Sustainable Development Goals: Sweden's results. *Bulletin of the National Defense University of Ukraine*, 1, 292-293.

OECD (2021) Income distribution and poverty in Switzerland.

Oliinyk, O. S.; Shestopalov, R. M.; Zarosylo, V. O.; Stankovic, M.; Golubitsky, S. (2022) Economic security through criminal policies: A comparative study of Western and European approaches. *Revista Cientifica General Jose Maria Cordova*, 20(38), 265-285.

Olofsson, A. D., Lindberg, J. O., Young Pedersen, A., Arstorp, A.-T., Dalsgaard, C., Einum, E., Caviglia, F., Ilomäki, L., Veermans, M., Häkkinen, P., & Willermark, S. (2021). Digital competence across boundaries – beyond a common Nordic model of the digitalisation of K-12 schools? *Education Inquiry*,12(4), 317-328.

Pedersen, T.; Holm, L. (2023) The role of green innovation in Norway's energy transition: Key challenges and opportunities. *Renewable and Sustainable Energy Reviews*, 160, 112265.

Peters, B.; Wouters, A. (2021) The Dutch green transition: Sustainability policies and renewable energy adoption. *Environmental Economics Journal*, 14(2), 105-118.

Romanuk, N. A.; Romanuk, R. Y. (2023) Institutional formats of European security: Experience and prospects of transformation. In: Palinchak, M. M. (Ed.), *Regional studies: Scientific collection*, Helvetika Publishing House, Vol. 33, pp.155-161.

Rossi, P.; Tuomi, S. (2023) The role of digital democracy: E-voting in Estonia's electoral system. *Journal of Public Administration Research and Theory*, 33(1), 98-112.

Savchyn, I. Z.; Perepeliukova, O. V. (2024) International experience in regulating the convergence of regional development. *Business Inform*, 5, 43-49.

Scandurra, R.;Cefalo, R.; Kazepov, Y. (2021) Drivers of Youth Labour Market Integration Across European Regions. *Social Indicators Research*, 154, 835-856.

Shevchenko, O. V. (2021) *Strategic Regulation of Disproportions in the Socio-Economic Development of Ukrainian Regions* (Doctoral Thesis, National University "Yuri Kondratyuk Poltava Polytechnic").

Shtan, M. (2023) Institutional determinants of the state economic policy. *Economy and Society*, 57.

State Statistics Service of Ukraine (2022) Labour Market and Employment Statistics.

Tkachuk, A. N. (2023) Modifications of employment structure: Global trends and national features. *Business Inform*, 12, 223-230.

UNESCO (2021) *Education in Ukraine: Progress and Challenges*.

Ushchapovskyi, Y. V. (2023) Methodological potential of institutional research in modern economic science. *Economics, Management and Administration*, 2(104), 26-31.

Varnalii, Z., Kulyk, P., Nikytenko, D., Cheberyako, O., & Hurochkina, V. (2023). Circular economy implementation as a strengthening factor in the economic security of Ukraine during the post-war period. *IOP Conference Series: Earth and Environmental Science*, *1126*(1), 012006.

Vickerman, R. (2013) The economics of European integration. Routledge.

World Bank (2022) Ukraine Overview. https://www.worldbank.org/en/country/ukraine

World Bank (n.d.) Sweden. The World Bank. Retrieved from https://data.worldbank.org/country/sweden

World Health Organization (2021) *Ukraine Health System Review*. Retrieved from https://www.who.int/countries/ukr

Yang, Y. (2015) Comparative study on STEM education of primary and secondary schools in America, Germany and Japan. Primary Secondary Schooling Abroad.

Yeriemieiev, O. (2024) Tendencies of Contemporary European National Communities' Development in Context of Fourth Industrial Revolution and Globalization Processes. *Empirio*, 1(1), 11-21.

Yermachenko, V.; Bondarenko, D.; Akimova, L.; Karpa, M.; Akimov, O.; Kalashnyk, N. (2023) Theory and practice of public management of smart infrastructure in the conditions of the digital society' development: Socio-economic aspects. *Economic Affairs (New Delhi)*, 68(1), 617-633.

Zhao, Y.; Xu, X. (2022) The Development of Renewable Energy in China: Opportunities and Challenges. *Energies*, 15(15), 5422.

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The Role of Investment in Infrastructure Development: A Comparative Analysis of Developed and Transition Economies

O papel do investimento no desenvolvimento de infraestrutura: Uma análise comparativa de economias desenvolvidas e em transição

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ABSTRACT
The growing importance of infrastructure investments in developed and transitional economies is driven by multiplier, production, and transport effects. This article examines their role using a comparative structural analysis of investment trends from 1990-2023. Results reveal major regional differences: in East Asia and the Pacific, mixed financing and greenfield projects dominate new transport construction, while in Europe and Central Asia, investment focuses on modernizing existing infrastructure through balanced policies. Strategies are shaped by institutional capacity, urbanization, population density, export potential, and fiscal resources. The findings highlight how the experience of developed economies can inform infrastructure development in transition economies.
Keywords: Infrastructure investments; Transport; Public-private partnerships; Financing mechanisms; Institutional investments.

JEL classification: E22; O18; H54

RESUMO
A crescente importância dos investimentos em infraestruturas nas economias desenvolvidas e em transição é impulsionada por efeitos multiplicadores, produtivos e de transporte. Este artigo analisa o seu papel através de uma análise estrutural comparativa das tendências de investimento entre 1990 e 2023. Os resultados revelam diferenças regionais significativas: na Ásia Oriental e no Pacífico, predominam o financiamento misto e os projetos *greenfield* na construção de novas infraestruturas de transporte, enquanto na Europa e na Ásia Central o investimento centra-se na modernização das infraestruturas existentes através de políticas equilibradas. As estratégias são moldadas pela capacidade institucional, urbanização, densidade populacional, potencial de exportação e recursos fiscais. As conclusões destacam como a experiência das economias desenvolvidas pode informar o desenvolvimento de infraestruturas nas economias em transição.

1. Introduction

Infrastructure development requires significant private investment amid geopolitical uncertainty, conflict, and a state funding deficit. Various types of investment resources play an important role in the modernization, construction, management, and renovation of roads, railways, ports, and airports, ranking second as investment targets after the electricity sector (OECD, n.d.). Infrastructure investment covers the costs of building new transport facilities, improving transport networks, developing multimodal networks and logistics, and maintaining them (OECD, 2022; OECD, n.d.). Effective transport infrastructure requires the involvement of various sources and types of financing, which in turn are determined by the institutional, investment, and economic characteristics of different countries. Developed countries traditionally have well-developed infrastructure, so investment in its modernization, maintenance, and green transformation prevails. Broad access to private capital in developed countries and efficient financial markets, as well as more stable institutions, contribute to attracting private investment. In contrast, in countries with economies in transition, the policy focus is on building new infrastructure, and capital investment is highly dependent on public financing and funds from international financial organizations. Institutional weaknesses, administrative barriers in transition economies, and high corruption risks reduce the level of investment attractiveness for private investors (Han et al., 2021).

In 2023, private infrastructure investment declined significantly compared to 2022, amounting to $86 billion in low- and middle-income countries. The exceptions were the Middle East and North Africa (MENA) and East Asia and the Pacific (EAP). At the same time, thanks to a project-based approach, more countries were able to attract financing: 68 countries received funds to invest in 322 projects in 2023, compared to 54 countries and 260 projects in 2022 (World Bank, 2023). Institutional investors – pension funds, insurers, sovereign wealth funds – play a special role, as they are increasingly viewing infrastructure as a source of long-term and sustainable investment. However, their participation in investment depends on the level of development of the regulatory framework, the predictability of concession rules, market transparency, and the reliability of contractual mechanisms. The last two decades have also seen a significant increase in institutional investors' interest in investing in sustainable (green) infrastructure projects (Walter, 2024). In transition economies with a less stable institutional environment, the potential for institutional investment is low. In developed economies, such as in Europe, institutional investors are active participants in the investment market. Given the above-mentioned features of investing in infrastructure development in countries with developed and transition economies, it is important to explore financial mechanisms for capital investment. Despite the growing role of private, public, and institutional investment, there are a number of problems that need to be addressed. These include limited access to long-term sources of infrastructure financing, an unstable regulatory environment, imperfect models of public-private partnerships, imbalances in the distribution of investment across regions and countries, and others.

The purpose of this article is to identify the role and importance of investment in infrastructure development in countries with developed and transition economies.

2. Literature Review

Academic literature from the last five years highlights the role of infrastructure investment in stimulating economic growth, reducing inequality, developing transport, and improving social and environmental sustainability. Research directly links investment in infrastructure projects to sustainable development goals, and the link between financing for transport and transport networks, information and communication systems, and other elements of infrastructure affects economic growth and the resolution of inequality issues (Chen and Chen, 2023; Gundes, 2022; Meng et al., 2024).

Within the scope of the importance of infrastructure investment, we highlight the following areas of research: macroeconomic effects of infrastructure investment (Du et al., 2022; Perez-Montiel and Manera, 2022; Hu and Li, 2025), transnational investment and initiatives (Zou et al., 2022; Jiang et al., 2024; Duggan et al., 2024), infrastructure and transport (Cho and Choi, 2021; Xin et al., 2022; Guler et al., 2023), infrastructure financing (Engel et al., 2021; Dubas-Jakóbczyk and Kozieł, 2022; Shefer, 2024), social and environmental impacts of investment (Xiong et al., 2022; Islam et al., 2022; Azad et al., 2021). Research on the role of infrastructure investment in ensuring sustainable economic development focuses on the impact of public and private capital investment in various infrastructure sectors. An analysis of academic publications over the last few years (2021–2024) shows the multifaceted nature of this issue, which covers economic, social, spatial, and environmental aspects.

Macroeconomic effects of infrastructure investment. Researchers have focused considerable attention on the macroeconomic consequences of infrastructure financing. The article by Du et al. (2022) empirically assesses and proves the positive impact of China's infrastructure projects in 2004-2019 on the quality of economic growth by promoting technological innovation, which stimulated structural modernization of the economy, improvement of the industrial structure, and production efficiency. Similar conclusions are drawn in the work of Perez-Montiel and Manera (2022) using the example of Spain: the authors found a sustained long-term multiplier effect of public investment, which manifests itself in an increase in production levels. Hu and Li (2025), on the other hand, draw attention to social aspects, arguing that China's infrastructure projects have the potential to reduce regional inequality if strategically planned. This effect is achieved by increasing trade between regions and reducing income disparities.

Geo-economic initiatives and transnational investments. Recent studies examine the geo-economic role of investments. Zou et al. (2022) conducted an in-depth analysis of China's motives for infrastructure investments under the Belt and Road Initiative, highlighting the synergy between geo-economic, energy, and political interests. One of the main motives for investment under the initiative has been structural transformation in the country and the need to support economic growth. As a result of geo-economic investment, China ensures: accessibility between different regions, a smooth flow of production factors that reduce production costs, and a stronger national currency. A study by Jiang et al. (2024) examines the quantitative effects of the Asian Infrastructure Investment Bank's investment activities on Chinese foreign investment, emphasizing the role of institutional investment in stimulating the country's foreign economic activity. The creation of the bank contributed to an average increase in China's foreign investment of 15.45% between 2014 and 2020, with the number

of infrastructure projects increasing by 20.04% and the volume of direct investment flows by 23.04%. In turn, Duggan et al. (2024) analyzed China's strategic presence in the EU's agricultural infrastructure, revealing the dimensions of international infrastructure policy. China's Go Global foreign direct investment policy allows Chinese companies to increase their own investments in the foreign agri-food sector. Chinese firms are increasingly acquiring European agri-food companies as part of China's policy to enhance food security. In addition, the transfer of knowledge from European companies enables China to achieve its national goal of modernizing its food system.

Transport infrastructure and accessibility. Academic literature pays particular attention to transport infrastructure. Xin et al. (2022) propose a model for the joint optimization of shipping networks and port infrastructure based on a case study of West Africa. Cho and Choi (2021) demonstrate the positive impact of investment in sustainable transport and increased transport accessibility on economic activity, which is particularly relevant in the context of sustainable development. An analysis of the trade spillover effects of infrastructure investment in the EU under cohesion policy, conducted by Shevtsova et al. (2025) on the cohesion policy confirms the multiplier effect of these projects on interregional trade. In the target regions, policy measures led to a 0.03% increase in real exports and a 0.15% increase in real GDP, as well as an increase in interregional trade.

Financing and management of infrastructure projects. Financial mechanisms for infrastructure investment are examined through the prism of public-private partnerships, fiscal policy, and the importance of external funds. Engel et al. (2021) provide clear criteria for the feasibility of public-private partnerships, while Dubas-Jakóbczyk and Kozieł (2022) analyze the effectiveness of financing medical infrastructure in Poland with EU structural funds. Shefer (2024) systematizes approaches to investing in transport infrastructure in the context of structural changes. The study by Nikonenko et al. (2022) and Kniaz et al. (2023) examines the issue of attracting investment to various sectors of the economy.

Socio-economic dimensions of infrastructure investment. The studies by Azad et al. (2021) and Islam et al. (2022) point to the need to take the human factor into account in urban and road infrastructure planning. The article by Xiong et al. (2022) focuses on environmental sustainability and the impact of infrastructure investments on the socio-environmental vulnerability of regions. Kuybida et al. (2023) analyze social investment in Ukraine. Chmyr et al. (2023), Shliakhetko et al. (2024) study the social aspects of investment.

In summary, despite the significant attention paid to infrastructure investment in the current academic literature, there are several gaps that require more detailed study. First, most studies focus on quantitative assessments of the economic effects of investment, ignoring qualitative changes in the spatial structure of the economy. Second, there is an asymmetry between regional cases, cases of countries with developed and transition economies, their models, and types of infrastructure investment. Much of the work is devoted to China as one of the largest investors in infrastructure development during the economic boom. This limits the possibility of comparing different countries by type of investment and its importance for transport development. Thirdly, some studies cover infrastructure financing, but financial mechanisms and the use of various financial instruments for infrastructure development, including comparisons of public financing, public-private partnerships, and international institutional investor funds, are generally under-researched. Therefore, this study focuses on

a comparative analysis of infrastructure investment in developed and transition economies, including issues of financial provision.

3. Methodology

The study is comparative and analytical in nature, so the methodology is based on a descriptive and analytical quantitative design. The method of structural comparative analysis made it possible to identify the main differences between countries with developed and transition economies in terms of models and types of investment in infrastructure projects for the period 1990–2023. Regions of Europe and Central Asia, East Asia, and the Pacific were selected for comparison of infrastructure investments.

The countries for comparative analysis of infrastructure investment in countries with transitional and developed economies were selected based on UN classification criteria and taking into account the following indicators: level of economic development, volume and dynamics of investment in transport infrastructure and networks, financing models (types of public-private partnerships, public financing or private investment), types of indirect state support. The analysis of investments was conducted for countries with economies in transition and European countries with developed economies to reflect differences in investment volumes and factors influencing investment.

The World Bank's PPI Database was used to compare the sample of countries and to conduct a comparative analysis of data on volumes, models, types of investment, and its role in infrastructure development.

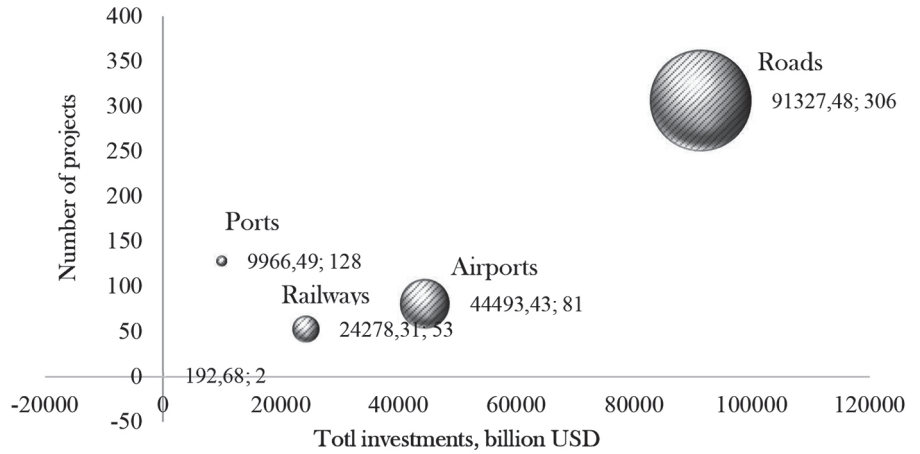
The main limitations of the study are the availability of complete and standardized quantitative data on infrastructure investment in transition economies, including the unavailability of data on various sources, types of public investment in infrastructure development projects, differences in reporting methodologies for investment volumes, and investment strategies of transition economies.

4. Results

A comparative analysis of countries with transition and developed economies reveals specific features and characteristics of infrastructure investment. At the end of 2023, 563 active infrastructure projects out of 570 projects for 1990-2023 were concentrated in Europe and Central Asia, East Asia, and the Pacific. Most projects are concentrated in East Asia and the Pacific (453 or 79%): in China (338), while other regions and countries have significantly less potential for attracting investment (Cambodia 7, Philippines 32, Indonesia 24, Malaysia 23, Vietnam 14). Europe and Central Asia account for 117 projects (21%) for 1990-2023 (Albania 4, Armenia 5, Bulgaria 9, post-Soviet countries 46, Turkey 40, Ukraine 4). Of the 570 projects, 175 are local or municipal, 227 are national, 91 are initiated and implemented in provinces, states or regions, and the remaining 77 are of international significance (ports, airports, railways). The largest number of projects are being implemented in the road and

port sectors. At the same time, roads and airports account for the largest share of investment in 1990–2023 (Figure 1).

Figure 1 – Total World investment volumes in infrastructure projects



Source: Constructed by the author based on data from the World Bank (n. d.).

The structure of investment by investment area shows differences in infrastructure development needs between developed countries and countries with economies in transition. In East Asia, the number of projects and the volume of investment are dominated by areas such as financing the construction of roads, ports, railways, and airports. In contrast, governments and private companies in Europe and Central Asia invest more in airports and roads, with significantly less investment in ports and railways (Table 1).

Table 1 – Investment structure by investment areas (number of projects, investment volume)

	East Asia and the Pacific	Europe and Central Asia
Airports	36 projects (6%), $3,729.44 billion (2%)	45 projects (8%), $40,763.99 billion (24%)
Ports	96 projects (17%), $7,357.16 billion (4%)	32 projects (6%), $2,609.33 billion (2%)
Railways	42 projects (7%), $24,250.2 billion (14%)	11 projects (2%), $28.11 billion (0.01%)
Roads	279 projects (49%), $82,553.68 billion (48%)	27 projects (6%), $8,773.8 billion (5%)

Source: Summarized by the author based on data from the World Bank (n.d.).

The significant differentiation in investment areas in these regions is linked to several factors. East Asian and Pacific countries have significant export potential, which requires the development of transport corridors and networks and ensuring their accessibility. Rapid

urban growth in this region requires investment in railways and transport systems. The governments of the region's most developed economies have identified the modernization of aviation infrastructure as a strategic priority for development. The region's institutional capacity allows for strategic planning of infrastructure development. Factors influencing the choice of investment areas include the high population density of East Asia and the need to develop connections between different urbanized areas.

In Europe and Central Asia, on the other hand, the strategic priority is to develop air transport, with a greater need to modernize and manage the existing transport network and integrate it between countries. Solving the problem of urban congestion requires East Asia to invest in mass passenger transport that is highly accessible. The growth of international trade in East Asia has led to a need for airport development. Thus, East Asia and the Pacific Ocean show a high degree of diversification in infrastructure investment, while Europe and Central Asia show a low degree of diversification, with a predominance of investment in roads and airports (Table 2).

Table 2 – Comparison of main investment areas in regions: East Asia and the Pacific, Europe and Central Asia

Criterion	East Asia and the Pacific	Europe and Central Asia
Diversification of areas	High (airports, roads, ports, railways)	Low (dominated by investments in roads and airports)
Infrastructure strategy	Focus on high-speed roads and urban transport	Focus on infrastructure modernization
Investments in railways	High, especially in the direction of Light Rail	Minimal
Technological innovations	No data on innovation available in the data sample	Minimal (electric charging stations)

Source: Summarized by the author based on data from the World Bank (n.d.).

Countries in East Asia and the Pacific are focused on high-speed roads, urban transport development, and railways, while in Europe and Central Asia, infrastructure strategy is concentrated on modernizing airport infrastructure, with minimal investment in rail transport.

In the East Asia and Pacific region, investments in greenfield transport infrastructure development projects dominate in terms of number and volume (337 projects or 59%, $103,520.16 billion or 61%). Financing the construction and maintenance of new transport facilities is linked to the need to create and develop infrastructure in the countries concerned. These are often regions undergoing urbanization (e.g., Indonesia, Malaysia, Vietnam), which require new transport links, networks, and appropriate financing. Investments in the modernization and reconstruction or privatization of transport facilities account for a significantly smaller share in terms of number and volume (80 projects or 14%, $11,081.34 billion or 7%). The privatization of 28 infrastructure facilities in the region amounted to $3,170.85 billion for 2019–2023. This demonstrates a significantly lower level of renewal of existing assets (Table 3).

Table 3 – Differences in types of public-private investment (PPI) in countries with transitional and developed economies by type of PPI agreement during 1990-2023

	East Asia and the Pacific (EAP)	Europe and Central Asia (ECA)	Differences, key characteristics
Greenfield project (financing, construction, operation of infrastructure facilities)	337 units (59%), $103,520.16 billion (61%)	47 units (8%), $46,737.5 billion (27%)	The predominance in EAP countries indicates a shift towards new green transport construction with the transfer of ownership rights to the public sector.
Brownfield (modernization, reconstruction)	80 units (14%), $11,081.34 billion (7%)	48 units (8%), $4,340.71 billion (3%)	The largest share is in the ECA region, with projects mainly focused on the modernization of existing transport facilities.
Divestiture (privatization of a transport facility)	28 units (5%), $3,170.85 billion (2%)	11 units (2%), $139.07 billion (0.01%)	More diversified types of PPIs are used in EAP as a form of privatization.
Management and lease contract (management or lease to a private partner)	8 units (1%), $118.13 billion (0.01%)	11 units (2%), $1,150.63 billion (1%)	More prevalent in the ECA, indicating a more cautious approach to transferring transport assets to private sector management.

Source: Summarized by the author based on data from the World Bank (n.d.).

In European and Central Asian countries, there is a similar structure of investment in infrastructure facilities, with a predominance of greenfield projects (47 units or 8%, $46,737.5 billion or 27%), modernization and reconstruction projects. This financing model indicates a balanced strategy between transport construction and modernization. A pragmatic approach to transferring transport management without changing the ownership structure is characteristic of countries with transition economies in this region (especially Ukraine and Georgia).

Private partners' investment costs under various types of PPI agreements in countries with transition and developed economies are mainly covered by two main forms of state support: state capital subsidies and income subsidies. Given that greenfield infrastructure projects predominate in the East Asia and Pacific region, the state mainly invests in new facilities in the form of capital subsidies for their creation. As a result, between 1990 and 2023, governments in this region covered $34,792.88 billion in construction costs for private companies, while $2,660.27 billion was reimbursed in the form of income subsidies. This indicates the significant profitability of greenfield projects in East Asia and the Pacific, low demand risks, sufficient demand for new public services, and the ability to provide them thanks to newly created transport facilities and networks. Capital subsidies were mainly provided by the Chinese government as part of 84 ongoing construction projects.

By comparison, the use of capital subsidies is less common in Europe and Central Asia. Total reimbursements to the private sector amounted to $1,192.14 billion in 1990-2023. Income subsidies amounted to only $284.6 billion over the same period. Other forms of state support for infrastructure development amounted to $50891.17 billion in 1990-2023.

Such differences in state support explain the high degree of use of PPIs as an instrument for infrastructure development in East Asia, especially in China, as capital subsidies are paid at the construction stage. This indicates a high level of government responsibility and institutional investment capacity to channel resources into infrastructure development. Thus, in East Asia, state support objectives are focused on covering investment costs for private companies, while in Europe they are focused on ensuring the profitability of transport development projects in the presence of operational risks.

In East Asia and the Pacific, most investment projects (420 out of 570) received $105,207.76 billion in indirect state support in 1990–2023. The lack of detailed data on the forms of this support makes it impossible to compare them and indicates low transparency and accountability of governments. Income guarantees were paid for 11 projects worth $5,319.47 billion to cover lost income in the private sector. Compensation for changes in loan rates amounted to $526.3 billion, and tax breaks amounted to $2,294.58 billion. Overall, China, Indonesia, Malaysia, and Vietnam are the leading countries in terms of the volume of various forms of state support provided.

In Europe and Central Asia, most investment projects (91 out of 570) received $46,929.61 billion in indirect state support in 1990–2023. Income guarantees amounted to $4,157.35 billion, and debt guarantees to $842.9 billion. Thus, tax incentives are more widely used in East Asia, while debt or payment guarantees are more common in Europe and Central Asia. This makes PPI more attractive for East Asia than for European countries.

Revenue generation mechanisms within public-private partnerships determine the adequacy of financial support for infrastructure projects. Revenue sources affect the level of investment attractiveness of projects for private companies, tariff policy, and the ability of solvent demand for services provided under contracts. In this context, it is important to assess the revenue models of infrastructure projects in which investors' funds are invested.

In East Asia and the Pacific, the structure of revenue sources from infrastructure investment is characterized by a combination of the following main elements: user fees for services in all sectors (China, the Philippines, Indonesia) amounting to $36,967.94 bln; fixed and variable payments from the state for the availability of services amounting to $32,670.44 bln; and a mixed financing model amounting to $3,727.43 bln, fixed and variable payments from the state for service availability amounting to $32,670.44 bln, and a mixed financing model amounting to $37,274.33 billion (particularly characteristic of China, Malaysia, and Turkey). For example, in the road sector, 57 projects generated $20,076.77 billion in revenue from the provision of services to users, in the railway sector – $12,050.06 billion, in ports – $3,240.82 billion, and in airports – $1,600.29 billion (Table 4).

Table 4 – Comparison of models for financing revenues from investments in infrastructure development in regions (billion dollars)

Region	Airports	Ports	Railways	Roads	Total investments
East Asia and Pacific	3729.44	7357.16	24250.2	82553.68	117890.48
Fixed annuity/availability payment(s) from the government	0	398.91	1914.51	30357.02	32670.44
Not Applicable	2107.36	3612.63	8177.35	23376.99	37274.33
Other Toll	0	0	0	931.27	931.27
Other Viability Gap Funding	0	104.8	0	165.95	270.75
Purchase agreements or transmission fees with public entity(ies)	0	0	726.79	84.35	811.14
User fees	1600.29	3240.82	12050.06	20076.77	36967.94
Variable annuity/availability payment(s) from the government	21.79	0	1381.49	7561.33	8964.61
Europe and Central Asia	40763.99	2609.33	28.11	8773.8	52367.91
Fixed annuity/availability payment(s) from the government	0	0	0	1071.28	1071.28
Not Applicable	36170.4	100.88	0	0	36275.78
User fees	4593.59	2508.45	28.11	7702.52	15020.85
Total investments	44493.43	9966.49	24278.31	91327.48	170258.39

Source: Summarized by the author based on data from the World Bank (n. d.).

In European countries and Central Asia, mixed financing models prevail, amounting to $36,275.78 billion, as well as direct payments by users for services provided by private companies, amounting to $15,020.85 billion, so demand risks are also concentrated in the private sector. The road sector accounts for $91,327.48 billion of revenue, airports for $44,493.43 billion, and the railway sector for $24,278.31 billion. Therefore, the financing structure in this region is largely based on a commercial model and tariffs due to budget constraints and the goal of efficient use of funds. Political and economic factors also influence the financing structure of infrastructure projects in the region. Therefore, the income structure in Europe is influenced by the lower financial capacity of governments compared to East Asia, where the state compensates for expenditures. Political approaches to infrastructure privatization in Europe are characterized by a greater tendency to delegate responsibility to private market operators. Unlike Europe, in Asia, the level of effective demand in densely populated regions of Asia and high passenger traffic, which ensures tariff coverage, are also important factors. Mixed financing models are common in countries with a high degree of institutional maturity and capacity and a developed regulatory framework.

A structural analysis of multilateral support for infrastructure projects in East Asia and the Pacific for 1990-2023 indicates the use of loans for investment in the development of

the transport sector and networks (Asian Development Bank (ADB), International Finance Corporation, IFC), Multilateral Credit Guarantee Agency BCGA, International Bank for Reconstruction and Development (IBRD)). The largest investments, including direct investments, joint lending, capital and quasi-capital, and guarantees, were made in port infrastructure (Table 5).

Table 5 – Multilateral financial support for infrastructure projects in East Asia and the Pacific

Infrastructure	Estimated total funding, million USD	Main partners	Unique tools
East Asia and the Pacific			
Ports	300	IFC, BCGA	Direct investment, joint lending, capital, quasi-capital, guarantees, consulting
Roads	734	ADB, IFC, BCGA	Provision of guarantees
Airports	283	ADB, IFC	Direct loans, joint loans, consulting without financing
Railways	242	ADB	Focus on the public sector and financing exclusively of public railway networks
Europe and Central Asia			
Ports	416	EBRD, EIB, IFC, BCGA	Direct loans, joint lending, guarantees, consulting, transaction services
Roads	1032	EBRD, EIB, ERB, ADB	Providing guarantees, focusing on regional transport corridors
Airports	1125	EBRD, IFC, ADB	Joint lending, consulting, large loans
Railways	108	EBRD, IFC	Direct financing of the public sector, limited diversification of instruments

Source: Summarized by the author based on data from the World Bank (n. d.).

In Europe and Central Asia, most financial resources in the form of multilateral support were allocated to airports (US$1.125 billion) and roads (US$1.032 billion) between 1990 and 2023. To a lesser extent, investments were made in port infrastructure (US$416 million) and railways (US$108 million). The combination of different financing instruments depending on the type of infrastructure depends on various types of risks. To reduce risks for private investors, investments in port infrastructure and airports with long payback periods combine lending instruments, joint loans, and guarantees. Given the low return on investment in railways, support is mainly provided in the form of government loans without private investment. In the road sector, where concession agreements predominate, loans and guarantees are combined to reduce the debt burden on the government budget.

5. **Conclusions**

A comparison of infrastructure investment in countries with developed and transition economies reveals profound structural differences in capital investment in different regions, determined by institutional, political, and financial factors. Regional infrastructure strategies are shaped by various factors, including institutional capacity, level of urbanization, population density, needs for construction or modernization of existing infrastructure, export potential, and budgetary capabilities. Political approaches to regulating and attracting public and private sector investment in infrastructure development play a key role in capital investment. East Asian and Pacific countries are focused on actively attracting investment and combining different financing models, with a predominance of mixed models. Greenfield projects dominate as a form of public-private partnership due to the need for new infrastructure construction and the development of interregional transport systems. In Europe and Central Asia, on the other hand, investment in the modernization of existing facilities dominates due to the need to maintain and increase the accessibility of existing infrastructure networks. In this region, a pragmatic, balanced approach to investment in new and existing facilities prevails, with a focus on airport development and support for the commercial viability of projects. The use of various public-private partnership financial mechanisms is determined by the nature of infrastructure projects and countries' infrastructure development needs, the level of risk, and the payback period and structure of project revenues. Therefore, the effectiveness of infrastructure investment is largely determined by the ability of countries to adapt financial instruments to the specifics of infrastructure facilities and strategic national development goals, as well as the financial policies of governments. The advantages of investing in East Asian infrastructure include high project profitability due to solvent demand, market scale, effective implementation of public-private partnerships thanks to state support during the construction phase, and active involvement of multilateral support from institutional investors. In turn, the advantages of investing in European and Central Asian countries lie in their higher level of institutional stability, predictability of the regulatory environment, high level of engineering and technological support for projects, and well-established legal mechanisms for partnership.

Further research should focus on developing effective models for financing infrastructure in key transport sectors in transition economies, taking into account the characteristics of investment in developed countries.

References

Azad, M.; Abdelqader, D.; Taboada, L. M.; Cherry, C. R. (2021) Walk-to-transit demand estimation methods applied at the parcel level to improve pedestrian infrastructure investment. *Journal of Transport Geography*, 92, 103019.

Chen, M.; Chen, T. (2023) Land finance, infrastructure investment and housing prices in China. *Plos One*, 18(10), e0292259.

Chmyr, Y.; Nekryach, A.; Kochybei, L.; Dakal, A.; Strelbytska, L. (2023) Postindustrial Society and Global Informational Space as Infrastructure Medium and Factor for Actualization of the State Informational Security. In: Radchenko, O.; Kovach, V.; Semenets-Orlova, I.; Zaporozhets, A. (eds.) *National Security Drivers of Ukraine. Contributions to Political Science*. Springer, Cham.

Cho, S.; Choi, K. (2021) Transport accessibility and economic growth: Implications for sustainable transport infrastructure investments. *International Journal of Sustainable Transportation*, 15(8), 641-652.

Du, X.; Zhang, H.; Han, Y. (2022) How does new infrastructure investment affect economic growth quality? Empirical evidence from China. *Sustainability*, 14(6), 3511.

Dubas-Jakóbczyk, K.; Kozieł, A. (2022) European Union structural funds as the source of financing health care infrastructure investments in Poland – a longitudinal analysis. *Frontiers in Public Health*, 10, 873433.

Duggan, N.; Hooijmaaijers, B.; Santiago, A. (2024) Chinese Investment in the European Agricultural Infrastructure. *Asian Perspective*, 48(2), 201-226.

Engel, E.; Fischer, R. D.; Galetovic, A. (2021) When and How to Use Public-Private Partnerships in Infrastructure: Lessons from the International Experience, NBER Chapters. In Economic Analysis and Infrastructure Investment, National Bureau of Economic Research, Inc, pp. 333-364.

Guler, S. I.; Gayah, V. V.; Mahmud, A.; Prajapati, A.; Thomas, D. (2023) Economic Impacts of Transportation Infrastructure Investments (No. CIAM-COR-R39). Center for Integrated Asset Management for Multimodal Transportation Infrastructure Systems (CIAMTIS)(UTC).

Gundes, S. (2022) Trends in Global Infrastructure Investment and Financial Consequences. *European Journal of Sustainable Development*, 11(1), 66-76.

Han, X.; Su, J. Thia, J.P. (2021) Impact of infrastructure investment on developed and developing economies. *Economic Change and Restructuring*, 54, 995-1024.

Hu, J.; Li, T. (2025) Infrastructure Investment and Inequality: Evidence from China. *Bulletin of Economic Research*.

Islam, M. K.; Dalhat, M. A.; Al Mamun, A. (2022) Road infrastructure investment limits based on minimal accidents using artificial neural network. *Applied Sciences*, 12(23), 11949.

Jiang, L.; Liu, S.; Zhang, G. (2024) The impact of Asian Infrastructure Investment Bank on OFDI: evidence from China. *Applied Economics*, 56(29), 3517-3532.

Kniaz, S.; Podolchak, N.; Dziurakh, Y.; Karkovska, V.; Kucher, A. (2023) Development of government regulation on investment activities in agriculture of Ukraine. Ikonomicheski Izsledvania, 32 (2), 136-150.

Kuybida, V.; Savitska, S.; Shkoda, M.; Akhromkin, I.; Pron, L.; Kolomiiets (2023) Methodology of development of social investment projects for the economy: legal aspects. *Journal of Law and Sustainable Development*, 11(4).

Meng, J.; Ye, Z.; Wang, Y. (2024) Financing and investing in sustainable infrastructure: a review and research agenda. *Sustainable Futures*, 8, 100312.

Nikonenko, U.; Shtets, T.; Kalinin, A.; Dorosh, I.; Sokolik, L. (2022) Assessing the policy of attracting investments in the main sectors of the economy in the context of introducing aspects of industry 4.0. *International Journal of Sustainable Development and Planning*, 17(2), 497-505.

OECD (2022) Infrastructure investment: The role of institutional investors. OECD, Paris.

OECD (n.d.). Infrastructure investment.

Perez-Montiel, J.; Manera, C. (2022) Government public infrastructure investment and economic performance in Spain (1980-2016). *Applied Economic Analysis*, 30(90), 229-247.

Shefer, D. (2024) Transport infrastructure investments and regional development: literature review. In *Regional Development in an Age of Structural Economic Change*, London: Routledge, pp. 151-180.

Shevtsova, Y.; Díaz-Lanchas, J.; Persyn, D.; Mandras, G. (2025) Trade spillover effects of transport infrastructure investments: a structural gravity analysis for EU regions. *Regional Studies*, 59(1), 1-16.

Shliakhetko, V.; Petrukha, N.; Krupa, V.; Berest, I.; Baran, I. (2024) Security issues in the formation and competition for human capital in the context of destabilisation of the European labour market. *International Journal of Services, Economics and Management*, 15(6), 677-695.

Walter, B. (2024). *How institutional investors can play an important role in promoting sustainable infrastructure.* Allianz Global Investors.

World Bank (2023) Data Show Private Infrastructure Investment Continues to Improve Following Pandemic Slump.

World Bank (n.d.). The Private Participation in Infrastructure (PPI) Project Database.

Xin, X.; Wang, X.; Ma, L.; Chen, K.; Ye, M. (2022) Shipping network design-infrastructure investment joint optimization model: a case study of West Africa. *Maritime Policy Management*, 49(5), 620-646.

Xiong, C. S.; Hu, Y. Y.; Zhou, T. X.; Tan, R.; Zhang, Y. L. (2022) Impact of provincial infrastructure investment on the vulnerability of social-ecological system in China. *The Journal of Applied Ecology*, 33(5), 1395-1404.

Zou, L.; Shen, J. H.; Zhang, J.; Lee, C. C. (2022) What is the rationale behind China's infrastructure investment under the Belt and Road Initiative. *Journal of Economic Surveys*, 36(3), 605-633.

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Ukraine and India in the System of International Cooperation: Commodity Flows, Capital Investments, Structural Changes

A Ucrânia e a Índia no Sistema de Cooperação Internacional: Fluxos de Mercadorias, Investimentos de Capital e Alterações Estruturais

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ABSTRACT
The article provides a comprehensive analysis of Ukraine–India economic cooperation, highlighting its relevance amid global instability. It emphasizes Ukraine's search for new strategic partners and India's ambition to expand in Central and Eastern Europe. Using structural and comparative analysis, the study reveals key trade dynamics, such as Ukraine's agricultural exports and India's growing share of high-tech imports. It also identifies promising investment areas in pharmaceuticals, IT, education, and agrotechnology. By outlining both opportunities and institutional and cultural barriers, the article offers balanced insights and practical value for shaping foreign economic strategies and further research.
Keywords: Ukraine-India relations; Foreign trade; Investment cooperation; Strategic partnership; Economic integration.

RESUMO
O artigo apresenta uma análise abrangente da cooperação económica entre a Ucrânia e a Índia, destacando a sua relevância num contexto de instabilidade global. Salienta a procura da Ucrânia por novos parceiros estratégicos e a ambição da Índia de expandir-se na Europa Central e de Leste. Através de uma análise estrutural e comparativa, o estudo revela dinâmicas comerciais chave, como as exportações agrícolas da Ucrânia e a crescente participação da Índia nas importações de alta tecnologia. Identifica também áreas promissoras

de investimento nos sectores farmacêutico, das tecnologias de informação, da educação e da agrotecnologia. Ao delinear tanto as oportunidades como os obstáculos institucionais e culturais, o artigo oferece uma visão equilibrada e um contributo prático para a definição de estratégias económicas externas e para futuras investigações.

1. Introduction

In the current context of global turbulence caused by the war in Ukraine, the transformation of the geoeconomic architecture, post-pandemic shifts, and climate challenges, the search for new, reliable, and promising partnerships is becoming a key task for national economies. Ukraine-India economic relations, previously characterized by stable but relatively limited trade, are now gaining new importance as a potential vector of strategic cooperation between the global South and the East of Europe. India, with its dynamic economic growth and growing global ambitions, is increasingly seen as an alternative economic powerhouse, especially as Ukraine seeks economic diversification, strengthened logistics ties, and investment in critical sectors. Academic interest in the topic of Ukraine-India cooperation has increased significantly in recent years, as reflected in a number of publications on both the geopolitical context and the economic, institutional, and digital aspects of cooperation (Bhattacharjee et al., 2023; Malyarets et al., 2025; Exim Bank of India, 2022; Desyatnyuk et al., 2024a). Reputable researchers consider the stability of foreign trade, changes in the structure of imports and exports, the transformation of the investment climate, the role of diplomatic missions, and the importance of IT, medical and educational projects in the context of the new global reality (Nikonenko et al., 2022; Kuybida et al., 2023; Reznikova et al., 2024). However, most existing studies focus mainly on certain aspects or provide a descriptive characterization without a comprehensive analysis of the dynamics of changes caused by military and political factors.

Currently, there is a need for a comprehensive study of the transformation processes in economic relations between Ukraine and India, considering the influence of foreign policy, geoeconomic and technological factors. In particular, the issues of bilateral investment cooperation, the role of regional business, changes in logistics models, and new areas of cooperation that meet the goals of sustainable development remain insufficiently covered. In addition, the lack of a unified analytical framework for assessing the impact of the crisis on the structural adjustment of trade and investment requires filling in research gaps.

The purpose of this paper is to study the current structure of Ukraine-India trade and economic relations, characterize the main areas of investment cooperation, and identify promising areas for deepening cooperation in the context of global challenges and the transition to a sustainable development model. The following tasks are envisaged within the framework of this goal: analyzing the dynamics of exports and imports between the countries, assessing the impact of geopolitical factors on foreign economic indicators, summarizing trends in investment activity, and drawing conclusions on further opportunities for strategic partnership.

2. Literature Review

Contemporary scholarly works on Ukraine-India economic relations cover a wide range of issues, from the impact of geopolitical challenges to the structural transformation of bilateral trade. In particular, a number of studies focus on the consequences of the Russian-Ukrainian war for the economies of both countries and their trading partners (Bhattacharjee et al.,

2023; Deore, 2024; Gururaj et al., 2022; Rahul, 2023). Scholars note that instability at the global level has increased the need for regional diversification and reorientation of logistics routes, in particular in the context of Ukraine's cooperation with India (Exim Bank of India, 2022; Embassy of Ukraine in the Republic of India, 2025; Jain, 2024). A number of publications examine the dynamics of exports and imports during the crisis, in particular the growth of the share of agricultural products and pharmaceuticals in bilateral trade (Sumathy et al., 2022; Bhaumik, 2024; Prime Minister's Office, Government of India, 2024). There is also a growing importance of the high-tech sector, especially in IT and medical services (Nikonenko et al., 2022; Malyarets et al., 2025; Desyatnyuk et al., 2024b).

Some authors focus on financial and investment cooperation between the countries, emphasizing the potential of bilateral investment in bioeconomy, logistics, digital technologies, and education (Dnipropetrovsk Investment Agency, 2024; Reznikova et al., 2024; Vorozhbyt, 2025). The studies by Desyatnyuk et al. (2025); Makedon et al. (2024) emphasize the importance of financial security, strategic approaches to risk management in the context of digitalization, and the implementation of sustainable development models. A generalization of scientific Amigos IAS (2024) positions reveals a trend toward a gradual transition from a linear model of raw material exchange to a more flexible, innovative system of strategic partnership (Reznikova et al., 2022; 2024; Kyredon and Shtepa, 2021; Shekhawat, 2024). This indicates the growing role of humanitarian, academic, and digital components in economic cooperation. Against the backdrop of geo-economic uncertainty, the formation of new policies to support small and medium-sized businesses, the development of innovation incubators and joint IT platforms also plays an important role (Ebo, 2024; Vorozhbyt, 2025).

It is also worth noting the works devoted to the political and diplomatic dimension of Ukraine-India relations, in particular, assessing the role of intergovernmental initiatives, trade agreements, and strategic visits (Amigos IAS, 2024; Embassy of Ukraine in the Republic of India, 2024). These studies confirm that the intensification of bilateral dialogue is accompanied by a growing interest of business communities in the formation of joint cooperation platforms. In turn, Bhattacharjee et al. (2023), Ebo (2024), and Hosen et al. (2023) consider the systemic impact of the military conflict on the investment climate and propose macroeconomic scenarios for overcoming it. Reznikova et al. (2022) and Reznikova et al. (2024) propose conceptual approaches to harmonizing the green and digital economies, which is especially important in the context of sustainable development of the partnership with India. Also noteworthy are publications analyzing the impact of economic uncertainty on the Indian stock market (Gururaj et al., 2022) and some studies on the microeconomic level of impact (Shekhawat, 2024). Special attention should be paid to studies analyzing the transformation of supply chains and the role of leadership in the face of global turbulence (Hosen et al. (2023). In particular, these works highlight adaptive strategies in response to crises, which directly correlates with the challenges faced by Ukraine and India in the military-political context. Kuybida et al. (2023) emphasize the importance of digital solutions in ensuring the sustainability of international logistics, which is of particular importance for the further development of the Ukraine-India economic partnership. Thus, these studies complement the overall picture, emphasizing the need for strategic digital planning and increased flexibility of infrastructure interaction.

In general, the review of sources demonstrates an interdisciplinary approach to the analysis of Ukraine-India economic relations, covering aspects of foreign trade, investment policy, digitalization, sustainable development, and diplomacy. However, two key issues remain: the lack of a unified system for monitoring the effectiveness of joint economic projects and the insufficient level of scientific analysis of the impact of cultural and institutional barriers on investment interaction.

3. Research methods

The study employed a combination of structural and comparative analysis to identify and evaluate the dynamics of changes in the export-import structure of Ukraine and India over the period 2020–2024. This approach allowed for a systematic comparison of trade flows, identification of emerging patterns, and assessment of sector-specific trends in bilateral economic relations. The method of systematization and classification was applied to summarize the directions of investment interaction, distinguish sectoral priorities, and categorize forms of cooperation in various industries, including pharmaceuticals, IT, education, and agrotechnology. Statistical analysis was used to process quantitative indicators of foreign trade and investment, enabling a detailed understanding of trade volumes, growth rates, and investment flows between the two countries. Additionally, the historical and retrospective analysis method was employed to trace the stages of development of Ukrainian–Indian economic relations, highlighting key milestones, policy shifts, and periods of intensified cooperation.

All quantitative data were processed using MS Excel and the Scikit-learn module in Python to construct analytical graphs, visualizations, and tables. These tools facilitated the coordination of indicators, identification of trends, and comparison of performance across sectors. To ensure the representativeness and reliability of the information base, the study also conducted a comprehensive review of international statistical sources, official websites of relevant institutions, and publications from leading think tanks, providing a robust foundation for analytical conclusions and policy recommendations.

4. Results

The main trends in foreign trade between Ukraine and India demonstrate both stable trade and economic ties and dynamic shifts driven by global and regional factors. The structure of Ukrainian exports to India is traditionally dominated by agricultural and raw materials: grain crops (in particular corn and barley), oilseeds and sunflower oil, ferrous metallurgy products (e.g., ferroalloys), and fertilizers. According to the Embassy of Ukraine in the Republic of India (2025), India is consistently among Ukraine's ten largest trading partners in Asia, and total Ukrainian exports to India exceeded $2.2 billion in 2023, despite the difficult geopolitical situation. At the same time, the structure of Ukraine's imports from India has a different specificity, with pharmaceuticals, light industry goods, plastics, chemical raw materials, coffee, tea, spices, and other food products dominating.

The dynamics of Ukrainian-Indian trade over the past five years has been characterized by a wave-like pattern. Until 2020, there was a steady increase in trade, but the COVID-19 pandemic caused a short-term decline, and the subsequent Russian-Ukrainian war in 2022 led to a temporary decline in export activity by Ukraine. However, in 2023-2024, exports began to recover. Analysts point out that the main factors of stabilization were the reorientation of logistics routes, intensified cooperation within trade and diplomatic missions, and India's strategic interest in ensuring food security through grain imports from Ukraine (Bhattacharjee et al., 2023; Prime Minister's Office, Government of India, 2024). Another important factor is that India has not imposed any trade restrictions on Ukraine, supporting an open market.

In terms of changes in the commodity structure, the share of high-tech products in imports from India, in particular medical equipment, electronics, and IT services, is growing, indicating a gradual shift in bilateral trade from a predominantly raw material exchange to a more diversified economic partnership (Nikonenko et al., 2022; Desyatnyuk et al., 2025). At the same time, Ukrainian exporters are looking for new niches in the Indian market, particularly in agro-processing, organic production, and exports of intellectual services. According to the Dnipropetrovsk Investment Agency (2024), the number of business forums, economic missions, and initiatives to support small and medium-sized businesses focused on India is growing at the regional level. In general, the analysis shows that foreign trade between Ukraine and India not only demonstrates resilience to external shocks, but also has the potential to deepen in the direction of strategic partnership. The dynamics of recent years demonstrates the readiness of both sides to adapt to changes, seek new models of cooperation, and use economic challenges as an impetus to modernize the structure of mutual trade (Malyarets et al., 2025; Rahul, 2023).

In order to systematize the dynamics of transformation of bilateral ties, it is advisable to highlight the key stages of development of Ukrainian-Indian economic relations (Table 1).

Determining the impact of foreign policy and geoeconomic factors on Ukraine-India trade and economic relations requires a comprehensive analysis of the global context in which these relations are developing. First of all, it should be emphasized that the Russian-Ukrainian war, which began in 2022, caused a significant disruption of transport and logistics routes, destruction of industrial facilities, and a decrease in Ukraine's export potential. At the same time, the global post-covid restructuring of supply chains has changed the balance of power in global markets: countries have begun to diversify their sources of imports more actively and strengthen ties with alternative partners.

In this context, India is viewed by Ukraine as a stable and promising market, while India itself is trying to reduce its dependence on traditional suppliers, in particular China, which opens new windows of opportunity for Ukraine (Bhattacharjee et al., 2023; Exim Bank of India, 2022).

Table1 – Stages of development of Ukrainian-Indian economic relations

Stage	Chronological limits	Key features
Initiative and diplomacy	1992-2000	– Establishment of diplomatic relations (1992); – Conclusion of basic agreements on economic cooperation; – Initial level of trade, dominance of raw materials from Ukraine.
Stabilizing and expanding ties	2001-2013	– Development of the contractual framework; – Growth in bilateral trade; – Exports of agricultural products and ferrous metals from Ukraine; – Indian companies entering the pharmaceutical and education sectors.
Corrections and adaptations to global challenges	2014-2021	– Decreased trade activity due to the geopolitical crisis; – Reorientation of logistics routes; – Intensify contacts in the private sector, especially in IT.
Strategic realignment and transformation	2022-2025	– Changes in the structure of cooperation due to the war; – Restoration of trade flows (2023-2024); – Increase in the share of high-tech imports from India; – Development of agricultural and IT startups; – Deepening educational interaction.

Source: Created by the author based on Embassy of Ukraine in the Republic of India (2025); Bhattacharjee et al. (2023); Exim Bank of India (2022); Malyarets et al. (2025).

It is noteworthy that over the past three years, the structure of bilateral trade has undergone certain changes under the influence of the above factors. Thus, there has been a change in the weight priorities in the commodity nomenclature, an increase in the share of critical resources, and at the same time a reduction in the volume of certain traditional export items. Given these trends, it is advisable to present a summary of the dynamics of changes in key economic indicators in Table 2. It provides a comparative description of the key external factors that influenced Ukraine-India economic cooperation in 2020-2024.

Table 2 – The Impact of Foreign Policy and Geoeconomic Factors on the Main Indicators of Ukraine-India Trade (2020-2024)

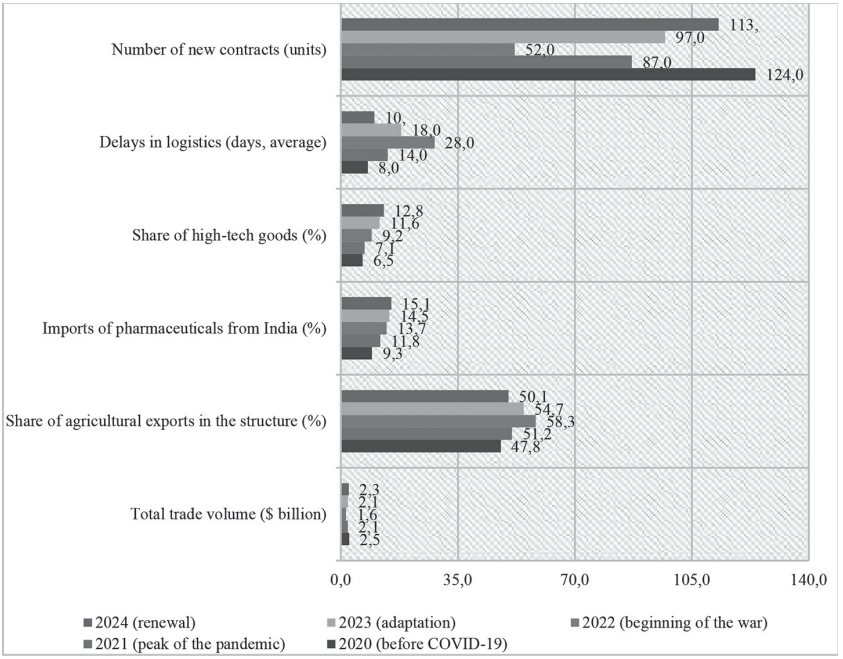
Indicator / Factor	2020 (before COVID-19)	2021 (peak of the pandemic)	2022 (beginning of the war)	2023 (adaptation)	2024 (renewal)
Total trade volume ($ billion)	2.47	2.08	1.56	2.05	2.34
Share of agricultural exports in the structure (%)	47.8	51.2	58.3	54.7	50.1
Imports of pharmaceuticals from India (%)	9.3	11.8	13.7	14.5	15.1
Share of high-tech goods (%)	6.5	7.1	9.2	11.6	12.8
Delays in logistics (days, average)	8	14	28	18	10
Number of new contracts (units)	124	87	52	97	113

Source: Created by the author on the basis of (Exim Bank of India, 2022; Embassy of Ukraine in the Republic of India, 2025; Malyarets et al., 2025; Dnipropetrovsk Investment Agency, 2024; Bhattacharjee et al., 2023).

As shown in Table 2, the Russian-Ukrainian war was the most disruptive factor that caused a sharp drop in total trade in 2022, a decrease in the number of new contracts, and significant delays in logistics. At the same time, this crisis stimulated a redistribution of emphasis in the commodity structure - exports of critical food products increased, as well as imports from India in areas of shortage (e.g., pharmaceuticals). The post-quake restructuring of global chains has also affected trade through increased high-tech imports and increased cooperation in the medical and digital sectors (Desyatnyuk et al., 2024a; Makedon et al., 2025). The combined effect of these factors has contributed to the formation of a new model of interaction between Ukraine and India, characterized by adaptability, diversification, and a gradual transition from classical trade to strategic partnership with a focus on sustainability and mutual economic security.

To demonstrate the changes in key indicators of Ukraine-India economic relations in the context of the influence of foreign policy and geoeconomic factors, it is advisable to turn to graphical analysis of the data. Figure 1 visualizes the dynamics of six key indicators in 2020-2024, which allows us to trace the characteristic changes under the influence of the COVID-19 pandemic, the outbreak of a full-scale war in Ukraine, and the subsequent adaptation and recovery period.

Figure1 – Dynamics of Influence of Foreign Policy and Geoeconomic Factors on Ukraine-India Trade (2020-2024), %



Source: Created by the author on the basis of (Exim Bank of India, 2022; Embassy of Ukraine in the Republic of India, 2025; Malyarets et al., 2025; Dnipropetrovsk Investment Agency, 2024; Bhattacharjee et al., 2023)

The analysis of the numerical data in Figure 1 reveals both general and specific trends. The largest decline in total trade between Ukraine and India occurred in 2022 – to $1.56 billion, which is 36.8% less than in pre-docking 2020 ($2.47 billion), while in 2024 there was an increase to $2.34 billion, which is approaching the pre-war level. The share of agricultural exports in the structure of Ukrainian exports increased to 58.3% in 2022, indicating India's dependence on food supplies during the crisis, but in 2024 the figure dropped to 50.1%, which can be interpreted as a sign of trade diversification. At the same time, the share of high-tech goods in imports increased from 6.5% in 2020 to 12.8% in 2024, almost doubling, indicating increased cooperation in the technology sectors. The volume of pharmaceutical imports from India increased from 9.3% in 2020 to 15.1% in 2024, driven by both pandemic challenges and growing demand for medicines in a war economy. Significant changes also occurred in logistics: average delays in supply chains increased from 8 days in 2020 to a peak of 28 days in 2022, but decreased to 10 days in 2024, indicating a gradual restoration of transport infrastructure and adaptation of logistics routes. The number of new contracts, which stood at 124 in 2020, dropped to 52 in 2022, but in the following years increased to 113, almost to the pre-war level, indicating renewed business confidence and intensified cooperation. Overall, the dynamics presented here confirm the profound impact of external factors on bilateral economic processes. At the same time, the adaptability of the system allowed not only to compensate for losses but also to formulate new strategies of interaction with a focus on sustainability, security, and technological upgrading of Ukraine-India trade relations.

Current investment trends between Ukraine and India indicate a gradual increase in interest in deepening bilateral economic cooperation not only in trade, but also in direct investment, technology transfer, and joint innovation projects. India, with its powerful human and financial resources, is seeking to expand its presence in the markets of Central and Eastern Europe, particularly in Ukraine as a country with high agricultural, IT, and logistics potential. Ukraine, in turn, sees Indian investment as a source of modernization of critical sectors, infrastructure development, and strengthening national resilience in the face of war. According to the Dnipropetrovsk Investment Agency (2024), recent years have seen an increase in the number of joint projects in pharmaceuticals, agriculture, and educational services, as well as the activation of Indian capital in IT incubators and clusters in Ukrainian cities. Table 3 shows the main areas of Indian investment in Ukraine and Ukrainian investment in India, with details on the types of capital, target sectors, and forms of project implementation. Table 3 summarizes the key areas of bilateral investment cooperation between Ukraine and India, covering the period of 2020-2024.

Table 3 – Structure and directions of investment cooperation between Ukraine and India (2020-2024)

Initiating country	Form of investment	Main sectors	Examples of projects / companies	Estimated volume (mln $)	Characteristics of the dynamics
India → Ukraine	Foreign direct investment (FDI)	Pharmaceuticals, IT, agricultural sector	SunPharma, Cadila, Hetero, Infosys	83.5	Slow growth from 2020 to 2022, followed by acceleration in 2023-2024
India → Ukraine	Educational projects	Higher education, IT academies	NIIT, Aptech	11.2	Stable participation in the creation of educational centers since 2021
Ukraine → India	Joint ventures	Agricultural processing, logistics	Myronivsky Hliboproduct (MHP), GrainTech	6.4	Low but stable level of participation in logistics initiatives
India → Ukraine	Venture capital	Startups in the field of agrotechnology	AgroVision, BioSeedHub	5.1	A new direction that has been actively developing since 2022
Ukraine → India	Participation in consortia	IT, research and development	UNIT.City, TechUkraine	3.7	The initial stage of forming partner platforms

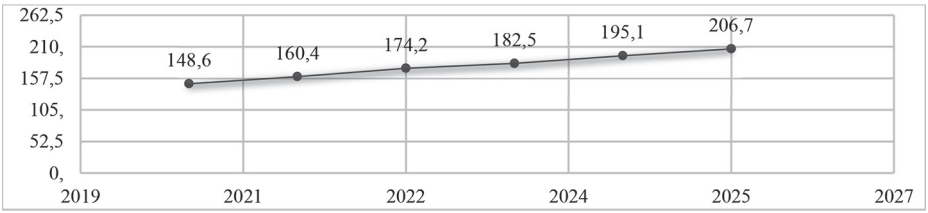
Source: Created by the author based on (Dnipropetrovsk Investment Agency, 2024; Embassy of Ukraine in the Republic of India, 2025; Desyatnyuk et al., 2024b; Nikonenko et al., 2022; Kuybida et al., 2023)

As can be seen in Table 3, the vast majority of investments come from India to Ukraine, with pharmaceuticals, IT, and agriculture remaining the key sectors. Companies such as SunPharma and Infosys already have a presence in Ukraine through joint ventures and representative offices, while the educational sector, including the opening of branches of IT schools and business academies, is emerging as a tool for long-term soft economic integration. Venture capital from India in agro-technology startups is showing positive dynamics, especially in the context of growing demand for innovative solutions in the agricultural sector. As for Ukrainian investments in India, they are limited in scale and are concentrated mainly in agricultural logistics and research clusters. The presence of companies such as MHP, as well as attempts to involve Ukrainian technology partners in Indian digital hubs (e.g., UNIT.City), indicate potential for expansion. At the same time, cultural differences, institutional risks, and weak support from government agencies in both Ukraine and India remain barriers. Thus, although investment cooperation remains moderate in scale, it has clear prospects for intensification if the security and regulatory environment improve.

In order to identify short-term trends in the development of the import component of Ukrainian-Indian economic cooperation, a forecast of the volume of pharmaceutical products supplied from India to Ukraine for 2025 was made using the least squares method. The model is built on the basis of statistical data for the period 2020-2024, which includes actual import volumes.

Linear regression was used to build the trend model. The calculations were performed in MS Excel and the Scikit-learn (Python) program module. Checking the accuracy of the model using the coefficient of determination showed a high level of approximation ($R^2 = 0.996$), which indicates the feasibility of using the model for short-term forecasting. According to the forecast results, the expected volume of imports of pharmaceutical products in 2025 will amount to USD 206.7 million USD. The forecast values are presented in Table 3a, and the graphical interpretation of the results is shown in Fig. 2. The graph shows the actual import values for 2020-2024, the trend line and the forecast value for 2025.

Figure2 – Forecast of imports of pharmaceutical products from India to Ukraine (least squares method)



Source: Calculated and visualized by the author based on data from Exim Bank of India (2022); Embassy of Ukraine in the Republic of India (2025); Malyarets et al. (2025); Dnipropetrovsk Investment Agency (2024); Bhattacharjee et al. (2023).

Figure 2 demonstrates the dynamics of imports of pharmaceutical products from India to Ukraine in 2020-2024 with the construction of the forecast value for 2025 using the least squares method. Based on the trend line obtained by approximating statistical data, there is a clear upward trend: starting from USD 148.6 million in 2020, imports followed by USD 1.5 million in 2024. Starting from USD 148.6 million in 2020, imports have been consistently growing every year, reaching USD 195.1 million in 2014. USD in 2024. The forecast for 2025 is USD 206.7 million. This is in line with the general development of pharmaceutical trade between the two countries. Such positive dynamics demonstrate not only the resilience of the pharmaceutical sector in the face of global challenges, but also the strategic strengthening of bilateral healthcare ties.

In the context of global instability caused by war, climate change, digital transformation, and the rethinking of global value chains, the search for promising areas of deepening economic cooperation between Ukraine and India is becoming particularly relevant. Both countries have the potential for a strategic partnership based not only on traditional trade, but also on the mutual introduction of innovations, the development of a green economy, digital solutions, and the strengthening of humanitarian cooperation. Given the new challenges, including – energy security, food independence, digital sovereignty, sustainable development, and logistics transformation – it is worth outlining the areas where synergies between the two countries can be most productive (Reznikova et al., 2024; Desyatnyuk et al., 2025). Table 4 provides a comparative description of the priority areas of cooperation, their strategic importance, expected benefits for both countries, and potential barriers.

Table 4 highlights promising areas for deepening economic cooperation between Ukraine and India in the context of sustainable development challenges.

Table 4 – Perspective directions of economic partnership between Ukraine and India in the context of sustainable development

Industry / Direction	Strategic value	Potential benefits for Ukraine	Potential benefits for India	Possible barriers to implementation
Agricultural technologies	Food security	Investing in agricultural startups, exporting know-how	Import of quality agricultural products, storage technologies	Tariff restrictions, logistics instability
Green energy	Energy transformation	Attracting Indian capital to renewable energy projects	Access to Ukrainian bioenergy production facilities	Regulatory irregularity, political risks
Pharmaceuticals and bioeconomy	Healthcare sector, R&D	Localization of production by Indian companies	Market expansion, clinical trials	Institutional uncertainty
IT and digital infrastructure	Digital transformation	Joint R&D projects, participation in digital hubs	Access to IT talent, cooperation in cybersecurity	Personnel leaks, technical compatibility
Education and academic mobility	Human capital	Attracting Indian students, creating joint programs	Academic exchanges, expanding cultural presence	Bureaucratic procedures, language barriers
Logistics and infrastructure	Regional integration	Modernization of transport hubs, development of multimodal routes	Creating hubs for transit to the EU	Damaged roads, difficulty in harmonizing regulations

Source: Created by the author based on (Desyatnyuk et al., 2025; Dnipropetrovsk Investment Agency, 2024; Embassy of Ukraine in the Republic of India, 2025; Reznikova et al., 2024.

To summarize, the priorities for the development of economic cooperation between Ukraine and India should focus on integration in areas that combine mutual needs with global trends in sustainable development. The areas related to innovation, digitalization, the bioeconomy, and the modernization of logistics routes, which are of great importance both for the stabilization of the Ukrainian economy and for India's strategic positioning in the Eurasian market, look particularly promising. Successful implementation of these areas will require joint political and economic planning, intergovernmental coordination, and support for business initiatives at both public and private levels.

5. **Discussion**

The findings of the study indicate relative stability and gradual diversification of Ukraine-India trade and economic cooperation, despite the difficult geopolitical situation,

the impact of the COVID-19 pandemic, and the war in Ukraine. The identified tendency to increase the share of high-tech imports from India and the simultaneous consolidation of Ukraine as a supplier of agricultural products indicates the formation of an asymmetric but strategically complementary partnership that is in line with global trends in supply diversification (Desyatnyuk et al., 2025; Nikonenko et al., 2022). However, there is a divergence in the scientific community in interpreting the depth and sustainability of this interaction. On the one hand, Bhattacharjee et al. (2023), Malyarets et al. (2025), and the Embassy of Ukraine in the Republic of India (2024) emphasize the stabilizing role of the Indian market for the Ukrainian economy and the growth of trade activity as a result of the successful reorientation of logistics. On the other hand, researchers such as Gururaj et al. (2022) and Ebo (2024) point to a high level of instability in Indian foreign trade, especially in connection with global market fluctuations, and a lack of transparency in the implementation of long-term projects.

In addition, there are differences in assessments of the investment potential of bilateral cooperation. For example, Kuybida et al. (2023) and Dnipropetrovsk Investment Agency (2024) emphasize the positive dynamics in Indian direct investment in Ukraine in the areas of pharmaceuticals, IT, and education. At the same time, some authors, such as Rahul (2023), emphasize the weak representation of Ukrainian business in the Indian space and the structural barriers that hinder capital investment. In this context, the results of the study confirm that although cooperation shows some positive dynamics, it remains largely dependent on foreign policy factors and situational economic conditions. Another important point of intersection and controversy is the role of digital transformation and innovative cooperation. Kuybida et al. (2023) argue that digital infrastructure can be a catalyst for partnerships, while Reznikova et al. (2024) insist on the need for comprehensive integration of the green and digital economies. The results of the study confirm that the intensification of joint IT projects and digital platforms such as UNIT. City has the potential to compensate for weaknesses in physical logistics and support the development of new forms of integration.

Thus, although the hypothesis of positive dynamics and strategic prospects of the Ukraine-India economic partnership was generally confirmed, the study revealed a number of factors that may hinder its full implementation. Among the limitations are a lack of comparative analysis at the microeconomic level, cultural and institutional barriers, and a limited amount of public data on the actual volume of joint investments. Given this, further research should be focused on studying the effectiveness of specific economic initiatives, mechanisms of financial insurance of investments in high-risk areas, and modeling scenarios for the development of cooperation in the new architecture of global economic relations.

6. Conclusions

The results of this study have revealed qualitatively new shifts in the structure of Ukraine-India economic relations, indicating a shift from the traditional raw material model of trade to more diversified and strategically oriented cooperation. Strengthening the position of high-tech products and educational and investment cooperation is an indicator of the qualitative transformation of the partnership, which previously remained peripheral

in the foreign economic policy of both countries. In contrast to the expected conservation of relations in times of war and global instability, the analysis showed an increased desire on both sides to adapt to new challenges and seek innovative formats of cooperation. The novelty of the study lies in the attempt to combine macroeconomic indicators with a logical and prognostic approach to analyzing structural changes and assessing prospects, which is often ignored in existing publications. The practical significance of the results lies in the identification of specific sectors for targeted expansion of cooperation, such as agrotechnology, digital hubs, pharmaceuticals, and educational mobility. At the same time, the study revealed certain limitations, including a lack of relevant analytics from official agencies, fragmented statistics, and limited access to the results of implemented investment projects. Further research should be focused on building a risk management model in the context of Ukrainian-Indian cooperation, studying the impact of institutional compatibility on long-term projects, and predicting the effectiveness of technology transfer between countries with different economic systems. A promising area is also a comparative analysis of the effectiveness of Ukraine's bilateral cooperation with other countries of the Global South in the context of creating an alternative economic coalition based on complementary interests.

Reference

Bhaumik, A. (2024). India, Ukraine agree to restore trade, bilateral cooperation to preRussiawar levels. *Deccan Herald*.

Bhattacharjee, A.;Gaur, D.; Gupta, K. (2023). Russia–Ukraine war and the impact on Indian economy. *Journal of Economic Studies*, 51(4), 841-858.

Deore, S. P. (2024). The Russia-Ukraine war and its impact on the Indian economy. *International Journal of Emerging Knowledge Studies*, 3(2), 92-95.

Desyatnyuk, O.; Krysovatyy, A.; Ptashchenko, O.; Kyrylenko, O. (2024a). Financial security in the conditions of globalization: Strategies and mechanisms for the protection of national interests. *Economic Affairs*, 69, 261-268.

Desyatnyuk, O.; Naumenko, M.; Lytovchenko, I.; Beketov, O. (2024b). Impact of digitalization on international financial security in conditions of sustainable development. *Problemy Ekorozwoju*, 19(1), 104-114.

Desyatnyuk, O.; Ptashchenko, O.; Murenets, I.; Oliinyk, K.; Kyrylenko, O. (2025). Ensuring financial security: Approaches to risk management and protection in the digital economy. *Data and Metadata*, 4, 674-684.

Dnipropetrovsk Investment Agency (2024). Strengthening economic, political and cultural relations between Ukraine and the Republic of India.

Ebo, D. (2024). The economic impact of the Russian–Ukrainian crisis on Russian-Indian relations: A literature review. *American Economic Journal: Economic Policy*.

Embassy of Ukraine in the Republic of India (2024). Trade and economic relations of Ukraine and India.

Exim Bank of India (2022). Economic impact of Russia-Ukraine conflict: an Indian perspective. Exim Bank Research Papers.

Gururaj, P., Kumar, K.S.; Bhat, D. C. (2022). Impact of Russia-Ukraine war on Indian stock market – An event study with reference to Nifty 50. *International Journal of Research – Granthaalayah*, 10(4), 161-167.

Hosen, M. S.; Hossain, S. M.; Mia, M. N.; Chowdhury, M. R. (2023). The effects of COVID19 and the RussiaUkraine war on inward foreign direct investment. *International Research Journal of Economics and Management Studies*, 2(4), 408-417.

Jain, R. (2024) India and Ukraine strengthen bilateral ties during PM Modi's visit. *DD News*.

Amigos IAS (2024). India-Ukraine Relations: A New Chapter in Diplomacy

Kuybida, V.; Savitska, S.; Shkoda, M.; Akhromkin, I.; Pron, L.; Kolomiiets, Y. (2023). Methodology of development of social investment projects for the economy: Legal aspects. *Journal of Law and Sustainable Development*, 11(4), 1-20.

Kyredon, D.; Shtepa, O. (2021). Trends and forecast of Ukrainian foreign trade relations. *Scientific Journal of Polonia University*, 44(1), 187-195.

Makedon, V.; Trachova, D.; Myronchuk, V.; Opalchuk, R., & Davydenko, O. (2024). The development and characteristics of sustainable finance. In A. Hamdan (Ed.), *Achieving sustainable business through AI, technology education and computer science (*Studies in Big Data, Vol. 163, pp. 373-382). Springer.

Makedon, V.; Myachin, V.; Kuriacha, N.; Chaika, Yu., & Koptilyi, D. (2025). Development of strategic management of a corporation through the implementation of scenario analysis. *Scientific Bulletin of Mukachevo State University. Series "Economics",* 12(2), 135-146.

Malyarets, L.; Labunska, S.; Sidak, M.; Bilokonenko, H.; Onegina, V. (2025). Export-import activity and its assessment: The Ukrainian case. *Administrative Sciences*, 15(2), 42.

Nikonenko, U.; Shtets, T.; Kalinin, A.; Dorosh, I.; Sokolik, L. (2022). Assessing the policy of attracting investments in the main sectors of the economy in the context of introducing aspects of Industry 4.0. *International Journal of Sustainable Development and Planning*, 17(2), 497-505.

Prime Minister's Office, Government of India. (2024). India-Ukraine joint statement on the visit of Prime Minister of India to Ukraine. Press Information Bureau.

Rahul, M. A. (2023). Russia-Ukraine war – Impact on Indian economy in context of imports and exports. *Asian Journal of Management*, 14(4), 23-30.

Reznikova, N.; Ivashchenko, O.; Hrynchak, N.; Dvornyk, I. (2022). Monetary traps of the new macroeconomic consensus: Problems of stabilization policy after COVID-19. *Economics of Development*, 21(1), 17-24.

Reznikova, N.; Panchenko, V.;Karp, V.; Grod, M.; Stakhurska, S. (2024). The relationship between the green and digital economy in the concept of sustainable development. *Economic Affairs*, 69 (Special Issue), 389-399.

Shekhawat, T. (2024). Impact of decisionmaking abilities on promoting successful aging: A multidimensional perspective. *International Journal of Emerging Knowledge Studies*, 3(12), 1009-1013.

Sumathy, M.; Das, A. S., Shaneeb, P. (2022). Impact on export import of India with respect to Russian-Ukraine war. In *Technology and Commerce: Prospects and Challenges* (pp. 243–250).

Vorozhbyt, O. (2025). Heading towards the new level: IndoUkrainian relations in the era of shaky geopolitics. Foreign Policy Council "Ukrainian Prism".

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The Potential of Public-Private Collaborations in the European Union: Practices for Ukraine's Post-War Reconstruction

O Potencial das Colaborações Público-Privadas na União Europeia: Práticas para a Reconstrução Pós-Guerra da Ucrânia

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ABSTRACT
This study explores effective mechanisms for Ukraine's post-war economic recovery through public-private partnerships (PPPs). In the context of global challenges and European integration, PPPs are viewed as a key tool to boost investment, innovation, and structural modernization. The research identifies the essence and structure of PPP investment potential in EU countries and ways to adapt their experience for Ukraine. Using systemic and comparative analysis, it shows that successful European PPPs combine financial flexibility, digital openness, institutional maturity, and innovation. In Ukraine, the number of PPP projects and innovation components nearly doubled in 2020-2025, reflecting growing institutional capacity. Practical recommendations include creating a PPP Digital Hub, an Innovation Partnership Fund, and a risk insurance system to enhance transparency, attract investors, and align with EU standards.
Keywords: Public-private partnership; Investment and innovation potential; Post-war recovery; European experience; Sustainable development; Public administration.

RESUMO
Este estudo explora mecanismos eficazes para a recuperação económica pós-guerra da Ucrânia através de parcerias público–privadas (PPP). No contexto dos desafios globais e da integração europeia, as PPP são vistas como uma ferramenta essencial para impulsionar o investimento, a inovação e a modernização estrutural. A investigação identifica a essência e a estrutura do potencial de investimento em PPP nos países da UE e formas de adaptar essa experiência à realidade ucraniana. Utilizando uma análise sistémica e comparativa, demonstra que as PPP europeias bem-sucedidas combinam flexibilidade financeira, abertura digital, maturidade institucional e inovação. Na Ucrânia, o número de projetos PPP e de componentes de inovação quase duplicou entre 2020 e 2025, refletindo uma crescente capacidade institucional. As recomendações práticas incluem a criação de um Hub Digital de PPP, um Fundo de Parcerias para a Inovação e um sistema de seguro de risco para reforçar a transparência, atrair investidores e alinhar-se com os padrões da UE.

1. Introduction

In the modern environment of the global instability and changes of the world economic structures, the exploration of effective modes of national economic recovery gains a special significance. In the case of Ukraine, which is experiencing a large-scale post-war recovery, the most important task is the establishment of the sustainable investment and innovation ecosystem that will be able to guarantee not only the economic growth in the nearest future but also competitiveness in the long term. It is in this regard that the concept of PPP can be viewed as a successful way of amalgamating financial, technological and managerial resources that may enable the alignment of the interests of the state, business and civil society in carrying out massive infrastructure and socio-economic projects. The attraction of PPPs to socially relevant sectors of energy, transport, health, education, and digital technologies is especially significant and possible in the environment of limited budgetary resources. The topic concerning the public-private partnership has become of great academic interest in the last ten years. Europeans (Auriol and Saussier, 2025; Catala et al., 2025; Liu et al., 2023) underline that the public-private partnership is no longer just a means of infrastructure development, but also one of the key requirements of technological modernization and digital transformation. The documents of international financial institutions (European Investment Bank, 2025; World Bank, 2023; International Finance Corporation, 2023) indicate that the efficiency of PPPs directly relies on the political stability of the legal environment, risk management quality, and financial processes transparency. Ukrainian scholars (Bohuslavska, 2023; Vynnyk, 2023; Yefimenko, 2025; Krylova and Hlushchenko, 2025) draw attention to the need to adapt European experience to national conditions, especially in the area of post-war reconstruction, creating incentives for private investors, and building the state's institutional capacity. Despite a significant amount of research, a number of issues remain insufficiently studied. In particular, there is still a lack of unified methods for assessing the innovative effect of PPPs, models for predicting the effectiveness of partnerships in the postwar environment, and tools for digital integration of management processes. Approaches to systematic monitoring of partnership projects, assessment of their socio-economic impact, and formation of a unified information and analytical database also remain underdeveloped. It is these gaps that necessitate a comprehensive analysis of the investment and innovation potential of public-private partnerships as a key element of Ukraine's sustainable development strategy.

The purpose of this study is to identify the essence and structure of the investment and innovation potential of public-private partnerships in the EU countries, to characterize the possibilities of adapting their experience to the Ukrainian conditions of post-war recovery, and to find out the factors that determine the effectiveness of PPP integration into national economic policy. The realization of this goal involves the following tasks: to analyze modern scientific approaches to determining the role of PPPs in the development of an innovative economy; to assess the trends in the development of partnership initiatives in Ukraine and the EU; to compare the legal, institutional and financial mechanisms for their implementation; to identify areas for improving the Ukrainian model of public-private partnership to ensure sustainable economic growth and innovative modernization of the country.

2. Literature Review

The existing scientific discussion on the concept of public-private partnerships (PPP) in terms of investment and innovation development is aimed at identifying the possible effective patterns of interaction between the state and business in order to secure the sustainable economic development. The partnerships as the means of integrating resources, innovations, and managerial competencies are highlighted in European studies (Auriol and Saussier, 2025; Catala et al., 2025; Liu et al., 2023; Tanveer et al., 2025). At the same time, international financial institutions emphasize the link between the quality of the regulatory environment and the volume of private investment in strategic sectors (European Commission, 2024a; European Investment Bank, 2025; International Finance Corporation, 2023; World Bank, 2023). Scholars also pay attention to the humanitarian and socio-economic aspects of PPPs, pointing to its potential in healthcare, education, and digital infrastructure (Dove et al., 2025; Morozov, et al., 2024; Nguyen Hoang Thanh and Lee, 2025; Sikombe et al., 2024). Specifically, research indicates that the effectiveness of partnership initiatives is also defined by the degree of digital transformation, the agility of the management model, and the adoption of the ecosystem approach to innovation (Raile et al., 2025; Zhuo and Chen, 2023; Egger, 2023; Van der Wal, 2020).

Ukrainian scholars note that it is crucial to localize the European PPP practices to the conditions of post-war recovery (Bohuslavska, 2023; Vynnyk, 2023; Yefimenko, 2025; Krylova and Hlushchenko, 2025). The special consideration is made on institutional infrastructure development, establishment of legal guarantees to investors, and enhancement of the quality of risk management mechanisms (Olshanskyi, 2025; Zai and Lazar, 2025; Mayer Brown, 2025; Wolf Theiss, 2025). Besides, the necessity of establishing education and research elements in the partnership projects is also highlighted (Holovko and Sakevych, 2020; Mizhai, 2020; Kucherenko, 2025; Noskov, 2025), which is a guarantee to create human resources to control the complex process of innovations and investments. The necessity to align the Ukrainian laws with the EU guidelines and to introduce the principles of transparency, control, and performance assessment are also highlighted in the institutional reviews of international organizations (European Court of Auditors, 2018; European Investment Bank, 2020; CMS Law-Now, 2025; UNECE, 2024). In this respect, researchers report that the implementation of digital monitoring instruments, the growth of financial instruments, and the establishment of innovation centres are some of the most crucial in enhancing investment and innovation potential of PPPs (Public-Private Partnership Agency of Ukraine, 2024; Kuzior et al., 2023; Rozhon, 2021; Negrych et al., 2024).

Additional literature states that it is necessary to attentively incorporate public-private collaboration into the strategies of national development, specifically in the fields of energy, environmental, and digital (Kuzior et al., 2023; Morozov et al., 2024; UNECE, 2024; European Commission, 2024b). A significant contribution has been made to the study of the combination of grant and private financial instruments within European energy programs, which allows for the creation of hybrid financing models (Kuzior et al., 2023; European Investment Bank, 2025; World Bank, 2022; Public-Private Partnership Agency of Ukraine, 2024). Some authors emphasize the importance of strengthening the transparency of tender procedures and control over the execution of contracts, which directly affects the level of

investor confidence (European Court of Auditors, 2018; Mayer Brown, 2025; Wolf Theiss, 2025; CMS Law-Now, 2025). Developments in the field of legal support emphasize the role of national and international standards in improving the efficiency of public administration, in particular through the implementation of EU directives and the creation of a unified system for assessing project performance (European Investment Bank, 2020; Krylova and Hlushchenko, 2025; Olshanskyi, 2025; Zai and Lazar, 2025). At the same time, studies by Nguyen Hoang Thanh and Lee (2025) and Raile et al. (2025) show that partnership models with elements of educational, technological, and research components contribute to social integration, inclusiveness, and regional development. Studies by Dove et al. (2025) and Kucherenko (2025) confirm that in the healthcare sector, PPPs are a key tool for improving the quality of services in middle-income countries.

Modern works (Egger, 2023; Rozhon, 2021; Mizhai, 2020; Holovko & Sakevych, 2020) show that the innovative component of partnerships requires expanding mechanisms for the participation of scientific institutions and startups in the implementation of government programs. Studies by Noskov (2025) and Negrych et al. (2024) point to the need to strengthen the role of small and medium-sized enterprises in partnership models to strengthen regional economies. In addition, Zhuo and Chen (2023) emphasize that the digital transformation of enterprises through PPPs can overcome the "innovation dilemma" provided that a favorable institutional environment is created.

Despite the wide range of research, a number of problems remain unresolved. First, there are insufficiently developed unified methods for assessing the innovation effect of PPPs for different sectors of the economy. Secondly, there are no comprehensive models for predicting the effectiveness of partnerships in the post-war environment, which limits the practical use of the results of previous studies.

3. **Methods**

The methodological basis of the study is based on systemic, comparative, and structural-analytical approaches that combine quantitative and qualitative methods for assessing the effectiveness of PPPs in the context of investment and innovation development. The study is based on logical, inductive-deductive and causal analysis, which allowed to establish the relationship between institutional, financial and technological parameters of partnerships. The empirical basis is formed on the basis of official statistics and analytical reports of leading international institutions – the World Bank, the European Investment Bank, the European Commission, the International Finance Corporation (further – IFC), and the Agency for Public-Private Partnerships of Ukraine. These sources present generalized data on the number of projects, private investment, and the share of innovative components in the structure of partnership initiatives in 2020-2025 (European Commission, 2024a; European Investment Bank, 2025; International Finance Corporation, 2023; Public-Private Partnership Agency of Ukraine, 2024; World Bank, 2023).

For the analytical processing of data, the methods of comparative statistics, dynamic analysis and correlation and trend assessment were used, which allowed to identify stable patterns of PPP development. In order to verify the results, a comparison was made with

the average European indicators and indicators of innovative development based on the materials of the European Investment Bank and the European Commission. To visualize the generalized trends, an analytical model has been built that demonstrates the gradual intensification of public-private partnerships in the period after 2020, which is directly related to the modernization of the regulatory environment and the launch of reconstruction projects. Table 3 and Figure 1 present the dynamics of these processes as an integrated one, which enables us to monitor the improvement of the institutional capacity and innovativeness of Ukrainian PPPs.

4. **Results**

Theoretical methods of establishing the nature and form of the investment and innovation potential of the public-private partnerships (PPPs) are interdisciplinary in character and grounded on the synthesis of the economic, managerial and institutional concepts. In modern scholarship, PPPs are viewed not only as a form of cooperation between the state and business, but also as a strategic tool for socio-economic development that can generate long-term benefits by combining resources, risks, and competencies of the parties (Auriol & Saussier, 2025). It is in this context that investment and innovation potential acquire systemic importance, as it ensures the relationship between financial capabilities, technological innovations, and the institutional capacity of partners.

The investment component of the PPP potential is formed by attracting private capital to implement socially important projects in the areas of infrastructure, energy, education, and healthcare, which allows the state to reduce the burden on the budget and at the same time stimulates economic activity of business. The innovation component is manifested in the introduction of new management technologies, digital platforms, energy-efficient solutions, and environmentally sustainable technologies that increase the productivity and competitiveness of the national economy (Tanveer, et al., 2025). Thus, the structure of the investment and innovation potential of PPPs includes financial and resource, technological, organizational, legal, and managerial subsystems that interact within a single strategic space of public administration.

European approaches to understanding this potential are based on the principles of sustainable development, integrated governance and digital transformation. Specifically, EU states also note that there should be a balance between economic effectiveness, social justice, and environmental safety concerning the conduct of partnership projects (Catala, et al., 2025). A significant one is the shift in the traditional forms of contract to new forms of interaction, including so-called joint investment platforms and cluster alliances uniting the public, privates, and civil society organizations. With the help of this approach, it is possible to enhance the efficiency of the utilization of the resources and improve the speed at which technological solutions that are supposed to improve the sustainability of economic systems will be adopted (Liu et al., 2023).

Theoretical grounds of creating the investment and innovation potential of PPPs in the Ukrainian context should be further elaborated. They ought not to be just grounded on the fact that they adjust the European practice, but their approach towards building their own

methodology has to be anchored on the issues of post-war recovery. It is associated with the expansion of the analytical system to evaluate the innovative capacity of partner projects and incorporate the criteria of sustainable development and indicators of digital transformation into the strategic management system. In this respect, the potential of PPPs as the investment and innovation is perceived as the cornerstones of the creation of the knowledge economy and building of a modern recovery model grounded on trust and transparency and skillful collaboration (Bohuslavska, 2023; Vynnyk, 2023).

Table 1 summarizes the practical experience of forming and implementing PPPs in the areas of infrastructure, energy, healthcare, education, and digital innovations in the EU countries, along with the key success factors.

Table 1 – Examples of PPPs in the EU in various sectors and key performance factors

Sector/country/project	Key characteristics / model of PPP	Main results or challenges	Key performance factors
Infrastructure/ transportation / France, Spain, Greece (EU-supported PPPs)	Classic contractual models with state guarantee, concessions, combined financing through the EU	Network of roads and transport corridors created; however, cost overruns and difficulties with negotiations were often criticized	Clear contractual terms, transparent tenders, effective regulation, risk control mechanisms, flexibility for contract renegotiation
Energy / EU Projects of Common Interest (PCI / IPCEI)	Intergovernmental projects for the integration of energy networks, introduction of renewable energy sources	Growing energy networks, strengthening energy connectivity, stimulating innovation in the energy sector	Intergovernmental coordination, state support, investor risk subsidies, clear legal regime, digital monitoring systems
Healthcare / Big Digital Initiative (UK, NHS COVID-19 app)	PPP in the form of public procurement + cooperation with private IT firms and universities	Rapid development and implementation of an application for contact tracing during the pandemic	Integration of institutions (healthcare + technology), flexibility in contractual terms, data privacy and security management, high technological capacity of the private partner
Education / Greece – 24 Schools PPP project	Private construction and maintenance of schools under contract with public payment based on results	New schools built, quality of infrastructure improved, social impact	Long-term planning, clear quality standards, operational control, involvement of local communities, transparency of funding
Digital innovations / European PPPs, ETPs, Digital Europe	Public-private formats that stimulate research and commercialization in AI, robotics, and cybersecurity	Increased funding for digital infrastructure projects, joint initiatives between governments and industry	Clear digital policy strategy, coordination at the EU level, support for small and medium-sized enterprises, institutional network of innovation hubs, balanced co-financing

Source: Created by the author based on (European Court of Auditors, 2018; European Commission, 2024a; United Nations Economic Commission for Europe (UNECE), 2024; World Bank, 2022).

The practical experience of EU countries shows that PPPs in various sectors can be effective if they are properly regulated, transparent, have contractual discipline and control mechanisms. In the transportation and energy sectors, intergovernmental coordination and strict regulatory oversight are priorities. In the healthcare and education sectors, the combination of the private partner's technological capabilities with flexible public procurement is essential. In the field of digital innovation, institutional support at the EU level, networking platforms, and stimulating cooperation between scientific, government, and business actors play a key role.

Table 2 summarizes the key trends in the development of public-private partnerships (PPPs) in Ukraine in the period from 2020 to 2025, as well as a description of its potential as a tool for attracting investment and stimulating innovation in the post-war economic recovery.

Table 2 – Trends in the development of public-private partnerships in Ukraine in 2020-2025 and assessment of its investment and innovation potential

Period / Stage of development	Main directions of PPP implementation	Institutional changes and regulatory legal initiatives	Investment and innovation results / challenges	Potential for post-war recovery
2020-2021	Launch of pilot projects in transportation, energy, and housing and communal services	Improvement of the legal framework (updating the Law of Ukraine "On Public-Private Partnership"); establishment of development agencies	Formation of a project portfolio, low level of private financing due to the risks of military instability	Initial institutionalization of PPPs; building trust between the state and business
2022-2023	Development of projects in logistics, IT infrastructure, and healthcare	Adaptation of risk management mechanisms; strengthening coordination between the Ministry of Economy, the Ministry of Finance and local authorities	Increased interest of foreign partners; creation of digital platforms for project monitoring	Gradual formation of an open investment market; introduction of transparent partner selection procedures
2024	Intensification of cooperation with the EBRD, World Bank, EIB in the framework of reconstruction projects	Expansion of financial instruments (guarantees, loans, grants, combined financing models)	Increase the number of contracts in the energy, construction, and healthcare sectors	Creation of conditions for large-scale reconstruction investments; development of public-private clusters
2025 (current period)	Focus on digital economy, green transition and development of innovation hubs	Formation of the National PPP Development Strategy until 2030; alignment with European transparency standards	Attracting venture capital, implementing smart infrastructure projects	Using PPPs as the main mechanism for integration into the European investment space and accelerating the country's modernization

Source: Created by the author based on (Bohuslavska, 2023; Vynnyk, 2023; Yefimenko, 2025).

Public-private partnerships in Ukraine are gradually turning into an effective mechanism for economic recovery that combines government priorities and private investment resources. While in the initial stages its development was constrained by limited institutional capacity and military risks, since 2023, the authors have seen the strengthening of partnerships, the expansion of financial instruments, and growing investor confidence. Considering the experience of EU countries, the Ukrainian PPP model has a high potential for modernizing infrastructure, developing the innovation sector, and creating a sustainable knowledge economy, which is in line with the goals of post-war recovery and European integration.

To comprehensively confirm the dynamics of public-private partnership development in Ukraine and to compare it with European approaches, the author summarized official statistics and analytical reports of leading international institutions (World Bank, 2023; European Commission, 2024b; European Investment Bank, 2025; International Finance Corporation, 2023; Public-Private Partnership Agency of Ukraine, 2024). The obtained results reflect the growth of institutional capacity, innovation, and financial activity of Ukrainian PPPs in 2020-2025. Table 3 presents aggregate indicators of the development of partnership initiatives, and Figure 1 illustrates the dynamics of their growth and the sustainability of the trend, confirmed by the high value of the determination coefficient R^2.

Table 3 – Dynamics of public-private partnership development in Ukraine in 2020-2025

Year	Number of active PPP projects	Share of innovative components, %.	Volume of private investment, UAH billion	Average level of contract execution, %
2020	42	18.54	7.32	61.25
2021	47	21.08	8.46	65.17
2022	54	25.67	9.81	69.03
2023	63	29.74	12.59	74.22
2024	78	34.92	15.84	79.68
2025	94	39.37	18.53	83.11

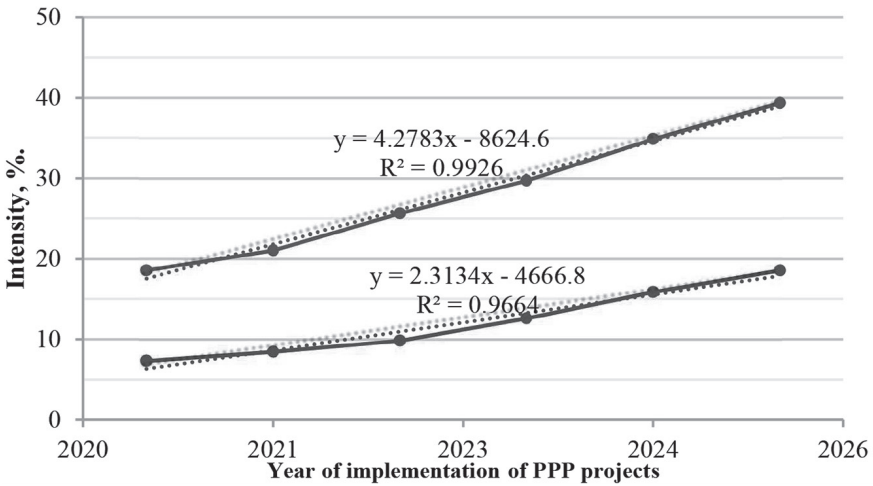
Source: Created by the author based on (European Commission, 2024a; European Investment Bank, 2025; International Finance Corporation, 2023; Public-Private Partnership Agency of Ukraine, 2024; World Bank, 2023).

According to the analysis, in 2020–2025, the number of active public-private partnership projects more than doubled, and the share of innovative components increased from 18.5% to almost 40%. This indicates the gradual digital and technological transformation of partnership initiatives and confirms the effectiveness of the integration of international financial instruments, legal reform, and expansion of institutional support, as documented in the reports of the European Investment Bank, IFC, and the World Bank (European Investment Bank, 2025; International Finance Corporation, 2023; World Bank, 2023).

As shown in Figure 1, in 2020-2025, the number of active PPP projects in Ukraine more than doubled (red line), and the share of innovative components (blue line) increased from

18.5% to almost 40%. High R^2 values (0.99 and 0.97, respectively) indicate the stability and predictability of the positive trend. These results are in line with the findings of the European Investment Bank and the World Bank, which point to an increasing role of PPPs in the structure of post-war reconstruction and digital transformation of Ukraine's economy.

Figure 1 – Dynamics of public-private partnership development in Ukraine in 2020–2025



Source: Created by the author based on (European Commission, 2024a; European Investment Bank, 2025; International Finance Corporation, 2023; Public-Private Partnership Agency of Ukraine, 2024; World Bank, 2023).
Note: Linear trends are based on data from analytical reports by the World Bank (2023), the European Commission (2024), the European Investment Bank (2025), the International Finance Corporation (2023), and the Agency for Public-Private Partnerships of Ukraine (2024).

Table 4 provides a comparative description of the key mechanisms of public-private partnerships in the EU and Ukraine, which allows identifying the main barriers and areas for adapting best practices, considering the recommendations of Krylova and Hlushchenko (2025), Olshanskyi (2025), Zai and Lazar (2025).

Table 4 – Comparative analysis of public-private partnership mechanisms: European Union vs. Ukraine

Type of mechanism	EU countries	Ukraine	Barriers in Ukraine	Adaptation possibilities
Legal/ regulatory	EU directives (2014/23/ EU, 2014/24/EU) + national PPP/concession laws ensure transparency, competition, standard contracts.	PPP Law (2010, reformed 2025) exists but often outdated, complex procedures.	Partial EU harmonization, corruption, legal uncertainty.	Adopt EU-style standards, clear responsibilities, fast-track procedures.
Institutional support	Specialized PPP units for project evaluation, standardization, advice.	PPP Support Agency exists but limited resources; weak local capacity.	Underqualified staff, fragmented powers.	Strengthen PPP offices, centralize standards, networking, training
Financial/ risk-sharing	Combined financing: state guarantees, EU grants, co-financing, risk funds, "value for money" assessment.	Mainly budget/loans; limited guarantees and insurance.	Weak guarantees, banking support, risk management; currency/ macroeconomic risks.	Introduce state guarantees, risk insurance, co-financing, EU funds.
Procedural/ evaluation	Auditing, monitoring, transparent tenders, independent reviews.	Auditing, monitoring, transparent tenders, independent reviews.	Weak local control, low transparency, corruption risk.	Implement EU-style audits, open data, independent reviews, competitive transparency.
Risk-based/ guarantees	Clear risk-sharing mechanisms, force majeure, tax guarantees, insurance	Risks often shifted to private partner; few states guarantee pre-2025.	Underdeveloped insurance, low confidence in guarantees, war-related risks.	Define risk framework, establish insurance/state/joint risk funds, apply international standard.

Source: Created by the author on the basis of (European Court of Auditors, 2018; European Investment Bank, 2020; Krylova & Hlushchenko, 2025; Olshanskyi, 2025; Zai & Lazar, 2025; Mayer Brown, 2025; Wolf Theiss, 2025; CMS Law-Now, 2025).

The comparison shows that in the EU, the PPP system is built on a stable regulatory framework, well-resourced support institutions, sophisticated financial mechanisms, and developed risk-sharing practices. In Ukraine, while significant progress has been made (including the 2025 legislative reform), significant barriers still exist: regulatory gaps, institutional weakness, insufficient financial instruments, and limited control and risk management practices.

Adaptation of best practices from the EU is possible through:

– legislative harmonization and clear regulation of the PPP contractual form;
– strengthening PPP offices and creating advisory support networks;
– development of financial instruments (guarantees, insurance, risk funds);
– establishing transparent procedures for contract evaluation, monitoring and audit;
– introducing clear approaches to risk allocation and insurance coverage.

This analysis allows us to better understand what elements should be prioritized for improvement in the Ukrainian system so that PPPs can become a reliable tool for rebuilding and modernizing infrastructure and increasing the country's innovation capacity.

Increasing the efficiency of the Ukrainian PPP model requires a systematic approach that combines legal reform, improvement of institutional infrastructure, digitalization of management processes, and integration of innovation and investment instruments into the national reconstruction strategy. Modern practice shows that traditional approaches to partnership no longer provide the necessary level of flexibility and sustainability in crisis conditions, so it is advisable to introduce new forms of cooperation focused on innovation, circular economy, and sustainable development (Tanveer et al., 2025). First of all, it is about expanding the PPP concept beyond the classic contractual relations to a network model in which business, government, academic institutions, and public organizations interact as equal partners in creating social and economic value. This approach will promote the development of innovation ecosystems and turn PPPs into an instrument of structural transformation in the economy.

One of the key areas of reform should be the introduction of intelligent digital PPP management platforms that will ensure automated project control, openness of financial flows, and prompt data exchange between participants. The use of blockchain, big data, and artificial intelligence technologies will increase the transparency of partner selection procedures, optimize risk allocation, and reduce transaction costs. In this context, it is advisable to create a national integrated system, the PPP Digital Hub, which will become an analytical center for monitoring project implementation and forecasting economic effects. Equivalent digital solutions are also actively introduced to EU countries to operate infrastructure, environmental, and social initiatives which contributes to their high efficiency and trust in the partnership mechanisms among people significantly (Raile et al., 2025).

Moreover, the financial tools of PPPs should be extended by establishing mixed investment funds and drawing venture capital to carry out the projects in the key areas of strategic investment, including energy, transport, health, and the digital economy. The practice of the European Union shows the effectiveness of specialized support programs, such as the Innovation Fund or InvestEU, which combine state guarantees with private investment. In Ukraine, such mechanisms can be adapted through the creation of a national "Innovation Partnership Fund" that will provide co-financing for technology startups, cluster initiatives, and smart infrastructure projects. This will contribute to the development of new investment sources and attractiveness of the country to foreign partners.

Special attention should be paid to institutional modernization of management of PPP. It is necessary to expand the powers of specialized government agencies and create a unified system of training personnel capable of implementing complex innovation and investment projects. The reason is that partnerships between businesses, universities, and government agencies can be the foundation of a new culture of management that is result-oriented, rather than process-oriented. It is proven by the experience of Vietnam, where the models of partnership are applied in the process of creating agritourism, education, and regional infrastructure (Nguyen Hoang Thanh & Lee, 2025). This kind of synergy will not only work in the growth of the economy but also in the expansion of social capital, institutional trust, and the stability of the state in the long term.

Altogether, the effectiveness of the Ukrainian model of the public-private partnership should be enhanced with the four strategic principles, which are institutional maturity, digital openness, financial flexibility, and innovation. These principles will allow converting PPPs into a potent tool of integrating the public administration and the private sector in the process of post-war reconstruction and building a knowledge economy that is sustainable, as well as enhancing Ukraine as a competitor on the European market.

5. **Discussion**

The findings of the research prove that the process of the PPP is among the most important methods of revitalizing and updating the Ukrainian economy, and the Ukrainian and European strategies differ considerably. The results of Auriol and Saussier (2025) support the idea that partnerships are the constituent of strategic infrastructure development plans in EU countries, and the mechanism is still being established in Ukraine, which is consistent with the statements made by Bohuslavska (2023) and Vynnyk (2023). European studies (Catala et al., 2025; Liu et al., 2023) consider PPPs as a platform for innovative interaction between the state, business, and the public, while Ukrainian practice is still focused mainly on infrastructure and construction projects, which limits the innovative component of partnerships.

Comparison of the findings with European and international studies shows that Ukraine is gradually moving from formal private sector participation to a partnership model focused on shared responsibility and risk sharing. This trend is consistent with the analyses of the European Investment Bank (2025) and the International Finance Corporation (2023), which emphasize the importance of combined financing models and the use of state guarantee mechanisms. However, as noted by Krylova and Hlushchenko (2025) and Olshanskyi (2025), the problem of clear risk allocation remains unresolved in the Ukrainian context, which reduces the investment attractiveness of partnership projects.

The discussion on the role of innovation in PPPs demonstrates differences in the interpretation of the very nature of partnerships. Some authors (Tanveer, et al., 2025; Zhuo and Chen, 2023) emphasize that digitalization and innovation are the driving force behind sustainable development, while others (Egger, 2023; Mizhai, 2020) focus on political and organizational barriers that can hinder the implementation of technological change. In the context of Ukraine, these differences are manifested in the uneven development of sectors: innovative approaches are being implemented most rapidly in the energy and digital infrastructure sectors, but much more slowly in transport and education (European Commission, 2024a; Public-Private Partnership Agency of Ukraine, 2024).

Comparison with international studies in the healthcare sector (Dove et al., 2025; Kucherenko, 2025) shows that involving private partners in healthcare projects not only improves management efficiency but also increases access to services. At the same time, Ukrainian programs in this area remain mostly pilot, which indicates the need to develop stable funding and quality control mechanisms. Similar findings are observed in the education sector, where European models demonstrate long-term effectiveness (World Bank, 2022), while Ukrainian initiatives are only being formed at the regional level.

The findings also confirm the importance of institutional maturity and legal harmonization. The works of the European Court of Auditors (2018) and CMS Law-Now (2025) focus on the need to have clear contracts, transparent tenders, and good control mechanisms to make PPPs successful. This corresponds to the recommendations of Ukrainian theorists to enhance auditing and introduce monitoring standards according to the EU regulations (Krylova and Hlushchenko, 2025; Zai and Lazar, 2025).

Therefore, the key distinction between the European and Ukrainian strategies consists in the degree of institutional integration and innovative orientation of alliances. The Ukrainian model is on the way of digitalization and attracting foreign funds, however, it has to work on the legal framework, development of human resources and establish one digital PPP management platform. As Nguyen Hoang Thanh and Lee (2025) demonstrate, the interaction of the government, business, and academic sector is the main factor that predetermines the success of partnership projects in the developing countries, and it is not well-developed in Ukraine.

In conclusion, the study findings support the usefulness of incorporating the experience of the European market into Russian practice, yet the adaptation process needs institutional stability, consistency of regulations, and modernization of technology. More studies should be conducted so that the innovative impact of PPPs in various sectors can be measured, digital performance indicators can be developed, and hybrid financing schemes are created to rebuild reconstruction projects after the war.

6. **Conclusions**

According to the study findings, it can be noted that one of the most promising tools in the process of post-war recovery of the Ukrainian economy is the PPP. Unlike traditional mechanisms of public administration, modern partnership models create an environment for synergy between government, business, and scientific structures, which ensures sustainable economic growth, development of technological innovations, and improved management efficiency. The novelty of the study lies in determining the structural interaction of institutional, financial and technological factors that shape the investment and innovation potential of PPPs in the post-crisis environment. The results partially confirmed the expectations – the intensification of partnership initiatives does correlate with the strengthening of digital transformation and the expansion of financing instruments, but a number of limitations have been identified, including insufficient harmonization of legislation, weak institutional coordination, and a shortage of qualified personnel. The practical significance of the results lies in the fact that they allow for the development of a comprehensive strategy for adapting European PPP practices to Ukrainian realities, including the introduction of the PPP Digital Hub as a digital monitoring platform, the creation of the Innovation Partnership Fund to attract venture capital, and the introduction of a risk insurance system for investors. The study has certain limitations related to the availability of statistical data and the short time horizon of the evaluation, which necessitates further empirical testing of PPP efficiency models. Future research should develop quantitative methods for assessing the innovative effect of partnerships, analyze cross-sectoral differences, and develop scenarios

for the use of hybrid financial instruments. A promising area is also to study the impact of digital integration on the sustainability of public-private projects and to create a multi-level partnership policy, which combines local initiatives with European framework programs. Such an evolution of the Ukrainian PPP model will ensure not only the structural modernization of the economy, but also the formation of a new paradigm of trust and shared responsibility in rebuilding the state.

References

Auriol, E.; Saussier, S. (2025). Rethinking public–private partnerships to bridge the infrastructure gap. VoxEU.

Bohuslavska, S. I. (2023). The use of public-private partnership instruments for the post-war recovery of Ukraine's economy. *Management of Economy: Theory and Practice*, 10, 76-85.

Catala, B.; Savall, T.; Chaves-Ávila, R. (2025). Social Economy and Public Private Partnerships: Analysis, Drivers, and Prospects from the Local Level for Territorial Development. *Nonprofit Policy Forum*.

CMS Law-Now. (2025). Ukraine adopts new law on public–private partnerships to boost infrastructure development and investment. CMS Cameron McKenna LLP.

Dove, G.; Craig, A.; Harris-Roxas, B.; Kelly-Hanku, A. (2025). Governance of public-private partnerships for primary healthcare in low- and lower-middle-income countries, 2000–2023: A systematic review. *International Journal of Health Policy and Management*, 14, 8442.

Egger, C. (2023). The politics and spaces of public-private partnerships in humanitarian tech innovations. *Environment and Planning C: Politics and Space*, 42(5), 708-724.

European Commission. (2024a). Research and innovation: Public–private partnerships in transport.

European Commission. (2024b). Analysis on a strategic public-private partnership approach to foster innovation in fusion energy. Publications Office of the European Union.

European Court of Auditors. (2018). Public-private partnerships in the EU: Widespread shortcomings and limited benefits. Publications Office of the European Union, 9(2018).

European Investment Bank. (2020). Evaluation of public–private partnership projects in the European Union: Volume 1 – A comprehensive analysis of project performance.

European Investment Bank. (2025). Market update: Review of the European public-private partnership market in 2024. European Investment Bank.

Holovko, O.; Sakevych, L. (2020). Analysis of the factors that determine the features of the organization of public-private partnership in the innovation activity of Ukraine. *Economics. Finances. Law*, 2(7), 56-63.

International Finance Corporation. (2023). Private sector opportunities for a green and resilient reconstruction in Ukraine. International Finance Corporation (IFC).

Krylova, I.; Hlushchenko, H. (2025). Evaluation of the effectiveness of current mechanisms for implementing public-private partnerships in Ukraine. *Philosophy and Governance*, 5(9).

Kucherenko, V. O. (2025). International and Ukrainian experience of public-private partnership in the field of health care. *Problems of Modern Transformations. Series: Law, Public Administration and Administration*, 15(2-05), 41-49.

Kuzior, A.; Liashenko, V.; Petrova, I.; Serdiuk, O. (2023). Integrated models of the combination of EU grant funding and private funding in the energy sector of Ukraine based on public-private partnership. *Polityka Energetyczna – Energy Policy Journal*, 26(4), 165-194.

Liu, L. X.; Clegg, S.; Pollack, J. (2023). The Effect of Public-Private Partnerships on Innovation in Infrastructure Delivery. *Project Management Journal*, 55(1), 31-49.

Mayer Brown. (2025). Ukraine's PPP reform: Legal highlights and potential strategic opportunities for investors.

Mizhai, N. B. (2020). Public-private partnership in the field of innovation: Foreign experience and domestic realities. Scientific Notes of Taurida National V. I. Vernadsky University. *Series: Economics and Management*, 31(70-1), 1-9.

Morozov, V.; Panikar, G.; Dmitriiev, V. (2024). Economic integration of Germany with EU through Effective implementation of Public Private Partnership. *Futurity Economics & Law*, 4(2), 168-199.

Negrych, M.; Vashkevych, V.; Tkachenko, O.; Kuchmieiev, O. Analysis of the Advancement of Public-Private Partnership in Ukraine. *Economics Ecology Socium* 2024, 8, 27-39.

Nguyen Hoang Thanh, N.; Lee, L. (2025). The role of public–private partnerships in the development of agritourism: the case of Vinh Long, Vietnam. *Cogent Social Sciences*, 11(1).

Noskov, O. (2025). European experience of public management of innovative development of small and medium-sized businesses. *Public Management and Policy*, 4(8), Article 4.07.

Olshanskyi, O. (2025). Public-private partnership as a modern tool of economic modernization. *Public Administration: Concepts, Paradigm, Development, Improvement*, 11, 108-117.

Public-Private Partnership Agency of Ukraine (2024). Detailed report (recommendations) on the identification of public investment projects. PPP Agency of Ukraine.

Raile, E. D.; Austin, E. K.; Wallner, M. P.; Peterson, J.; Lewandowski, B.; Kapps, D.; Sellegren, B.; Hutton, J. (2025). Technology license agreements as public-private partnerships for economic development: Evaluations using surveys, input–output modeling, and regression analysis. *Journal of Innovation and Entrepreneurship*, 14(1), 14.

Rozhon, O. V. (2021). Public-private partnership in the innovation sphere as an instrument for ensuring innovation development. *International Science Conference on Multidisciplinary Research* (pp. 406-414).

Sikombe, S.; Muleya, F.; Phiri, J.; Zulu, S.; Simasiku, P.; Situtu, M. (2024). Key elements for promoting public-private partnerships in research and innovation. *Cogent Business Management*, 11(1).

Tanveer, U.; Hoang, T. G.; Ishaq, S.; Khalid, R. U. (2025). Public-private partnerships as catalysts for digital transformation and circular economy: Insights from developing countries. *Technological Forecasting and Social Change*, 219, 124270.

United Nations Economic Commission for Europe (UNECE). (2024). Guide on PPPs in digital infrastructure (Draft Manuscript submitted for publication).

Van der Wal, Z. (2020). Being a public manager in times of crisis: The art of managing stakeholders, political masters, and collaborative networks. *Public Administration Review*, 80(5), 759-764.

Vynnyk, O. M. (2023). EU experience in utilizing the potential of institutional public-private partnerships in the context of strengthening national security under war and post-war reconstruction in Ukraine. *Visnyk NAPRNU*, 3(2023).

Wolf Theiss (2025). Ukraine modernises PPP framework: New law on public–private partnership adopted to boost investment and infrastructure development.

World Bank. (2022). 24 schools PPP in Greece: A lesson in perseverance and innovative funding.

World Bank. (2023). Benchmarking infrastructure development 2023: Country profile – Ukraine. World Bank Group.

Yefimenko, K. O. (2025). Mechanism of public-private partnership in the context of reforming the system of public investment management in Ukraine. *Analytical and Comparative Jurisprudence*, 2(25), 94-99.

Zai, P. V.; Lazar, A.-M.-V. (2025). Exploring public-private partnership frameworks in Europe: Study period 2020–2023. *Journal of Financial Studies Research*, 2025(676799).

Zhuo, C.; Chen, J. (2023). Can digital transformation overcome the enterprise innovation dilemma: Effect, mechanism and effective boundary. *Technological Forecasting and Social Change*, 190, 122378.

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Key Fiscal Issues and Structural Elements of State Protection in the 21st Century

Principais Questões Fiscais e Elementos Estruturais da Proteção Estatal no Século XXI

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ABSTRACT
The article analyzes the main components of state fiscal security amid 21st-century global challenges: market turbulence, rising debt, and external shocks. Using data from 2019-2024 from the EU, OECD, and Ukraine, it evaluates fiscal stability indicators – public debt, budget deficit, and tax revenues. The study reveals Ukraine's higher debt burden, chronic deficit, and lower tax capacity compared to OECD averages. The author classifies fiscal security elements: budget balance, debt control, tax capacity, reserves, transparency, and intergovernmental efficiency. Key directions include improving debt management, tax policy, creating stabilization funds, and expanding fiscal space via de-shadowing. The research based on systematic, comparative, and statistical analysis of official OECD, World Bank, IMF, and national data, provides practical insights for strengthening Ukraine's fiscal stability.
Keywords: Fiscal security; Public debt; Budget deficit; Tax revenues; Budget stability.

JEL classification: I23; I25; O33; C88.

RESUMO
O artigo analisa os principais componentes da segurança fiscal do Estado face aos desafios globais do século XXI: turbulência dos mercados, aumento da dívida e choques externos. Com base em dados de 2019-2024 da UE, da OCDE e da Ucrânia, avalia indicadores de estabilidade fiscal – dívida pública, défice orçamental e receitas fiscais. O estudo revela que a Ucrânia apresenta uma carga de dívida mais elevada, um défice crónico e uma menor capacidade fiscal em comparação com as médias da OCDE. Classifica os elementos da segurança fiscal em: equilíbrio orçamental, controlo da dívida, capacidade fiscal, reservas,

transparência e eficiência intergovernamental. As principais orientações incluem a melhoria da gestão da dívida, da política fiscal, a criação de fundos de estabilização e a expansão do espaço fiscal através da desocultação da economia. A investigação, baseada numa análise sistemática, comparativa e estatística de dados oficiais da OCDE, do Banco Mundial, do FMI e de fontes nacionais, oferece contributos práticos para reforçar a estabilidade fiscal da Ucrânia.

1. Introduction

Fiscal security is a key element of the economic and national security of the state, as it directly determines the ability of the government to ensure the stable functioning of the financial system, fulfil social obligations, implement defence policy and implement development strategies. In the twenty-first century, the role of fiscal security has grown significantly due to the deepening of globalization processes, financial integration, and increased interdependence between national economies. Under such conditions, fiscal instability in any country can quickly turn into a regional or even global crisis, which requires states to develop sustainable financial management mechanisms.

The modern global economy is characterized by a number of systemic challenges that directly affect the state of fiscal security: slowing economic growth, demographic changes, aging population, high inflation, energy crises, global pandemics, and military conflicts. These issues became especially relevant after 2020, when the effects of the COVID-19 pandemic and Russia's full-scale war against Ukraine led to a sharp increase in public spending, deepening budget deficits, and an increase in the debt burden. This has exposed the vulnerability of existing fiscal systems even in developed countries, not to mention transition economies that have limited resources to deal with crises.

At the same time, despite the considerable scientific work in the field of public finance, the issue of fiscal security is often considered in a fragmented manner – through the prism of budget or debt policy. However, modern realities require a systematic approach that covers not only the balance of revenues and expenditures, but also the efficiency of the tax system, the sustainability of debt obligations, the transparency of financial management, and the availability of fiscal reserves to respond to external shocks. It is the complexity and interdependence of these elements that determine the level of fiscal security of the state.

Particular attention should be paid to the analysis of the fiscal security of Ukraine, which operates in the context of protracted economic instability, military aggression, and constant debt pressure. For Ukraine, fiscal security is not only of economic but also of strategic importance, as it determines the state's ability to ensure its defense capability, infrastructure rehabilitation, and integration into the European financial space. In this context, it is important to compare Ukraine's key fiscal indicators with the average values in the European Union and the Organization for Economic Cooperation and Development (OECD), which allows us to identify structural differences and outline areas for improvement.

The methodological basis of the study is systematic, comparative and statistical approaches that provide a comprehensive analysis of fiscal security based on real macroeconomic indicators. Only official data from the open international databases of the OECD, the World Bank, the International Monetary Fund, and the State Statistics Service of Ukraine were used. Thus, the paper attempts to integrate theoretical approaches and empirical observations for an in-depth understanding of the essence of fiscal security, its structural elements and mechanisms of ensuring it in the context of constant economic and political transformations.

2. Literature Review

The issue of fiscal security of the state is the subject of active research by both foreign and domestic scholars, especially in connection with the growing global financial instability, crisis phenomena and the growth of public debt in many countries. In the modern scientific literature, fiscal security is considered as the ability of the state to effectively generate, distribute and use financial resources to ensure the stability of the economic system, prevent debt crises and maintain macroeconomic stability (Blanchard, 2019; Huang et al., 2020; Xu et al., 2022).

In general, several approaches to the interpretation of the essence of fiscal security have emerged in scientific research. The institutional approach, presented in Poterba et al. (2018), Lee and Park (2022), emphasizes the role of fiscal rules, transparency of the budget process, and the responsibility of government institutions in maintaining financial stability. The macroeconomic approach (Rogoff, 2025; Gelpern and Panizza, 2022) considers fiscal security through the prism of the dynamics of public debt, budget deficits, and the relationship between debt burdens and economic growth. In turn, the structural-functional approach (Jones, 2021; Auerbach et al., 2024) focuses on assessing the effectiveness of tax policy, the level of revenue mobilization, and the resilience of public finances to external shocks.

Research by Reinhart (2025) has shown that public debt exceeding 90% of gross domestic product (GDP) can have a long-term negative impact on economic growth. Blanchard et al. (2021) clarified this link, noting that the effects of the debt burden depend on the structure of the debt, maturity, and confidence in the government's fiscal policy. Panizza (2025) emphasized that in a low interest rate environment, even a high level of debt is not automatically threatening if a sustainable relationship between interest payments and economic growth is ensured.

Considerable attention in recent publications is paid to the problem of the state's tax capacity. Zucman (2013), Cobham and Jansky (2019) emphasize that tax evasion and capital offshoring significantly undermine fiscal stability, especially in developing countries. Studies by Ahmad and Zheng (2023), Liu et al. (2025) confirm that the level of tax revenues is directly correlated with the quality of administration, digitalization of tax authorities, and transparency of fiscal reporting.

A separate area of research is devoted to the impact of global crises on fiscal security. According to the World Bank and the IMF, the COVID-19 pandemic and subsequent geopolitical turmoil have led to a record increase in public spending and deficits in most countries. This has led to the need to create stabilization funds and develop fiscal buffers to mitigate the impact of crises. OECD studies point to a tendency to increase the role of automatic stabilizers, including fiscal flexibility and intergovernmental fiscal equalization mechanisms.

In the Ukrainian scientific tradition, the concept of fiscal security has been developed by such researchers as Mialkovska et al. (2025), Lunina and Bilousova (2025), Danylenko and Venger (2024), Bondarenko (2022a) and Lelyk (2022), who consider it as a state of the financial system that guarantees the ability of the state to perform its functions without excessive debt burden. They pay special attention to the relationship between tax policy, budget discipline, and external financial risks, emphasizing the need to develop national indicators of fiscal security.

Summarizing the results of previous studies, it can be concluded that scholars are united in understanding the strategic importance of fiscal security as the basis for the financial stability of the state, but differ in their assessments of its components and measurement methods. Despite a significant number of developments, the issue of integrating debt, budget, and tax security indicators into a single analytical system remains insufficiently developed. This creates the need for a comprehensive approach to assessing fiscal security that would consider current global trends and the specifics of countries with transforming economies, including Ukraine.

3. **Research materials and methods**

The information base of the study was based on official statistical sources of international and national organizations that ensure high reliability and comparability of fiscal indicators between countries. In particular, the data of the Organization for Economic Cooperation and Development (OECD Data Portal), the World Bank (World Development Indicators), the International Monetary Fund (IMF Fiscal Monitor Database) and the State Statistics Service of Ukraine were used. All statistical materials are taken from open databases, which allowed for an objective comparative analysis of the main fiscal parameters of countries for the period of 2019-2024. Such a time period is sufficient to reflect medium-term trends in public finance, covering both pre-crisis and crisis periods, including the effects of the COVID-19 pandemic and military events that have significantly affected the fiscal security of Ukraine and the world in general.

The methodological basis of the study is based on systemic, comparative, structural-functional, and statistical approaches. The systemic approach ensured that fiscal security is considered as a complex dynamic system that includes interrelated elements – tax, budget, debt, and institutional components. The comparative approach helped to identify common patterns and specific features of fiscal policy development in Ukraine, the European Union, and the OECD average. The structural-functional approach was used to determine the role of individual components of the fiscal security system and their impact on the overall level of financial stability of the state. To quantify the trends, statistical methods were used, in particular, variation, index and correlation analyzes, which allowed to trace the dynamics of public debt, budget deficit and tax revenues.

The study developed a system of analytical indicators that reflects various aspects of fiscal stability. Key among them are: the level of public debt as a percentage of GDP, the state budget deficit or surplus, tax revenues as a share of GDP, the ratio of public debt to budget revenues, and the share of debt service expenditures in the overall structure of public expenditures. In order to identify the dynamics of changes, growth indices and average rates of change of indicators were calculated, considering the value of the indicator at the end of the period and at the beginning of the period.

To ensure the correctness of cross-country comparisons, the method of normalization of indicators was applied, which allowed to reduce the data to a single scale and determine the deviation of Ukraine's fiscal parameters from the average values in OECD countries. Additionally, the graphical analytical method was used to visualize trends in the form of

tables and graphs. In particular, the dynamics of public debt (% of GDP), the level of budget deficit (% of GDP), and the structure of tax revenues in 2019-2024 were analyzed.

Thus, the applied methodology combines a quantitative analysis of official statistical indicators with a systematic approach to the study of fiscal security as a multidimensional economic phenomenon. The use of reliable data from international sources (OECD, World Bank, IMF) and national statistics of Ukraine ensured the objectivity, comparability and scientific verification of the results obtained.

4. **Results**

The results of the study allow us to comprehensively assess the state and dynamics of the main components of fiscal security in the context of current global challenges. The analysis is based on official statistics of the OECD, the World Bank, the International Monetary Fund, and the State Statistics Service of Ukraine covering the period of 2019–2024. The chosen time interval allows us to track both pre-crisis trends and the impact of the COVID-19 pandemic, the energy crisis, military events, and rising interest rates, which had a significant impact on the fiscal sustainability of countries.

The study conducted a comparative analysis of key indicators: public debt as a share of GDP and fiscal (budget) balance. These indicators are the basic elements of the fiscal security system, as they directly reflect the state's ability to finance its obligations, maintain macroeconomic stability, and ensure sustainable development (Table 1).

Table 1 – Total public debt as a percentage of GDP among OECD countries and dynamics since 2019

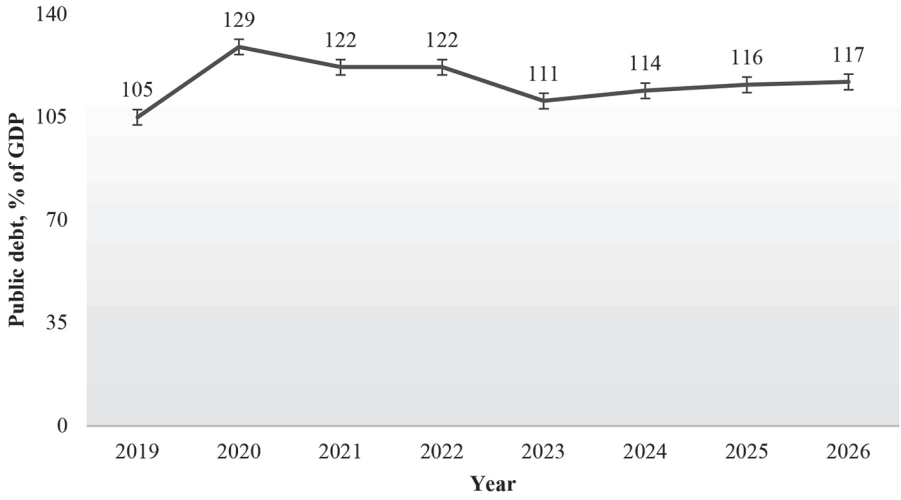
Year	**OECD gross debt (Gross general government debt, % of GDP)**	**Change from 2019 to 2023, percentage points**	**Notes**
2019	~ 105 %	-	Pre-crisis level
2020	~ 128.9% (peak during COVID-19)	+23.9 p.p.	Peak due to the COVID-19 pandemic
2021	slightly below this peak (exact value ~ 120-125 %)	- about 4-8 p.p. from 2020	The beginning of the recovery
2022	further decline on average to about 120-125 %	- slight downward recovery	Impact of the energy crisis
2023	~ 110.5 %	- approx. 18-20 p.p. compared to 2020 peak	Partial consolidation
2024	113-115 %	+ 8-10 pp from 2019	Inflation and high interest rates
2025	≈115-117%	+ 10-12 p.p.	Moderate growth due to structural costs
2026 (forecast)	≈116-118%	+11-13 p.p.	Stabilization in the absence of new economic shocks

Source: Based on Jusaj et al. (2025), Musa et al. (2025).

The results of the analysis show that in most developed countries, there is a tendency for the debt burden to increase after 2020, driven by the expansion of public spending to overcome the consequences of the pandemic, social support for the population, and stimulate economic activity. At the same time, fiscal space in developing countries, including Ukraine, has become much more limited due to a lower tax base, limited access to external financial resources, and the need to maintain defence capabilities.

Particular attention is paid to the dynamics of the fiscal balance, which in most cases shows a significant deterioration due to the growth of expenditures with a relatively slow recovery of budget revenues. For Ukraine, this trend is exacerbated by the military operations, which require significant budgetary spending on defence and humanitarian needs, while reducing revenues from economic activity in certain sectors. The primary focus is on assessing the dynamics of public debt in OECD countries, which is an integral indicator of the financial stability of governments and the main factor of debt risks in the fiscal security system. Fig. 1 shows a graph of the dynamics of the average level of public debt in OECD countries (% of GDP).

Figure 1 – Graph of the dynamics of the average level of public debt in OECD countries (% of GDP)



An analysis of the data in Figure 1 shows that the period of 2019–2024 demonstrates a typical phased response of the fiscal system to a sequence of global economic shocks that alternated in intensity and nature of impact. The sharp increase in public debt to 128.9% of GDP in 2020 was the result of large-scale anti-crisis programs aimed at maintaining economic activity and social stability during the COVID-19 pandemic. The subsequent gradual decline to 110.5% in 2023 reflects the restoration of fiscal discipline and a partial reduction in budget deficits in most countries.

However, the downward trend in debt burden expected in early 2024 did not materialize. Actual data show a resumption of growth to 113% to 115% of GDP, signaling a new wave of fiscal pressure. The main factors behind this were the acceleration of inflation, the persistence of high interest rates, and increased spending on defense, energy security, and social support. Thus, 2024 marked a milestone when the recovery from the crisis gave way to new challenges that shifted the focus of fiscal policy in most countries.

In 2025, the debt burden was expected to remain moderate at 115-117% of GDP among OECD countries. However, preliminary estimates suggest that the actual dynamics may be less optimistic, with debt approaching the upper limit of the forecast and even exceeding it in some countries. This is due to higher debt servicing costs, increased spending on defense modernization and energy transformation, and the expansion of social programs in response to slower economic growth and rising income inequality.

As for 2026, assuming no new external economic shocks and a gradual decline in monetary pressure, the debt burden is projected to stabilize relatively at 116-118% of GDP. This may indicate a partial leveling of the relationship between economic growth and the dynamics of new borrowing. At the same time, the continued high costs of security and energy diversification will remain among the main risks to the fiscal sustainability of the countries in the medium term.

The fiscal balance is one of the key indicators of public finance sustainability, as it reflects the relationship between budget revenues and expenditures. Its dynamics allows us to assess how effectively governments responded to external and internal shocks, as well as the extent to which macroeconomic stability was maintained.

The period of 2019-2024 is marked by sharp fluctuations in the fiscal balance, which are clearly correlated with global crises, monetary stimulus policies, and changes in budget spending priorities. While 2019 was characterized by a relatively stable and controlled deficit (-2.9% of GDP), in 2020 the figure deteriorated sharply to -9.5% of GDP due to large-scale anti-crisis measures aimed at overcoming the consequences of the COVID-19 pandemic.

Despite the governments' attempts to stabilize the situation in 2021 (-6.7% of GDP), the energy crisis in 2022 again led to an increase in budget deficits (-7.9% of GDP), reflecting the pressure on fiscal systems due to energy market subsidies and rising social spending. In 2023, there was a noticeable improvement to -4.6% of GDP, which was the result of a partial recovery in economic activity and an increase in tax revenues. At the same time, the figures for 2024 (-5.0% of GDP) indicate a renewed increase in the deficit, driven by rising debt service costs and high interest rates.

Table 2 shows the dynamics of the average fiscal balance of OECD countries for the period 2019–2025, which allows us to assess the response of governments to global economic challenges, including the COVID-19 pandemic, the energy crisis, the inflationary surge, and increased geopolitical instability.

Table 2 – Total fiscal balance of OECD governments (% of GDP): actual data for 2019-2025 and estimated for 2026

Year	Average OECD fiscal balance (% of GDP)	Note / source
2019	-2.9 %	Pre-war average (before COVID-19)
2020	-9.5 %	Due to crisis spending during the pandemic
2021	-6.7 %	Gradual reduction of the deficit
2022	-7.9 %	Increased budgetary burden due to the energy crisis
2023	-4.6 %	Reduction of the deficit due to the resumption of economic growth
2024	-5.0 %	Deterioration due to rising debt service costs
2025	≈ from -4.5% to -5.0%	Stabilization at the pre-crisis level
2026 (forecast)	≈ from -4.0% to -4.3%	Moderate improvement in case of lower interest rates

Source: Table based on Mourougane (2025) and author's forecast.

The overall picture shows a high sensitivity of the fiscal balance to external economic shocks and dependence on cyclical factors. The most critical year was 2020, when most countries were forced to increase public spending to mitigate the socioeconomic consequences of the pandemic. Starting in 2021, there was a gradual reduction in the deficit, but the recovery was fragile due to new challenges, such as the energy crisis, geopolitical tensions, and rising borrowing costs.

The deficit level in 2023 (-4.6%) demonstrates a certain normalization of fiscal policy, but the estimated figures for 2024 (-5.0%) confirm the existence of structural problems in the budget sector. These include the limited efficiency of tax administration, an increase in public debt service costs, and an increase in mandatory social spending.

In 2025, the average deficit of OECD countries is expected to remain in the range of -4.5% to -5.0% of GDP. This means that fiscal policy will be in a state of moderate consolidation, as governments try to balance spending cuts with the need to finance long–term strategic areas such as defense, energy transition, and social sustainability.

In 2026, the deficit could moderately improve to -4.0% of GDP if global interest rates start to decline and economic growth stabilizes. At the same time, even this level of deficit will remain higher than before the crisis, indicating a continued burden on state budgets and the need to further strengthen fiscal discipline.

Thus, the medium-term outlook for fiscal policy points to a transition from crisis management to controlled stabilization, but without a return to pre-war financial equilibrium.

Ukraine's fiscal dynamics in 2022-2025 continue to be exceptional compared to most countries, driven primarily by the lingering effects of a full-scale war, high levels of uncertainty, and significant dependence on external financing. While the previous forecasts for 2025 envisaged a gradual stabilization of public finances, by the end of the year a more balanced assessment of the real state of the fiscal system can be made and the prospects for 2026 can be clarified.

At the beginning of 2025, Ukraine's public debt was expected to remain within 115–117% of GDP, and the budget deficit would fluctuate between –4.5% and –5.0% of GDP. However, the final data show that the actual figures were somewhat higher than forecast. The Ministry of Finance and international partners estimate that the debt level will be around 118–120% of GDP by the end of the year, due to both increased military spending and a slowdown in economic recovery in the second half of the year. The fiscal deficit is kept at –5.2% of GDP, which is slightly higher than previously expected, but remains manageable thanks to stable external aid flows and loans with preferential terms.

Despite this, the budget structure remains extremely unbalanced. Defense, security, and humanitarian programs will account for more than 55% of expenditures in 2025, while the share of capital investment and infrastructure development remains minimal. Tax revenues have slightly increased due to the revitalization of the domestic market and the recovery of small businesses, but fiscal space remains limited due to high social spending, subsidies, and compensation programs for the affected regions.

Thus, the forecast for 2025 as a whole was partially justified. Ukraine has demonstrated the relative resilience of its fiscal system, but structural imbalances remain deep. The economy has adapted to the conditions of war, but rebuilding the tax base and reducing the debt burden will take longer.

In 2026, fiscal indicators are expected to stabilize moderately, provided that there are no new large-scale escalations and international support remains strong. The public debt is projected to decline to 112-115% of GDP, which will be made possible by gradual GDP growth, the strengthening of the hryvnia exchange rate, and a partial renegotiation of debt obligations.

The fiscal deficit, according to preliminary estimates, may shrink from -4.0% to -4.3% of GDP. This decline is attributed to the expected improvement in tax administration, a gradual recovery in exports, higher customs revenues, and a reduced dependence on direct budget subsidies.

At the same time, a number of risks remain that could adjust this forecast. These include:

- a possible increase in defense spending in the event of an escalation of the situation at the frontline;
- delays or reductions in international financial support due to changes in donors' political priorities;
- a slowdown in global economic growth, which could negatively affect Ukraine's exports and foreign exchange earnings.

Thus, the baseline scenario for 2026 assumes a slow but realistic stabilization of the fiscal system, provided that the political and financial support of partners is maintained, domestic production gradually grows, and the tax capacity of the economy is restored.

After analyzing the debt and budget indicators, the paper examines the revenue component of the fiscal system, as it is the volume and stability of tax revenues that determine the ability of the state to fulfill its obligations without excessive debt growth. Tax revenues as a share of GDP are a key indicator of the effectiveness of fiscal policy, the level of tax culture in society, and the institutional capacity of the government.

To assess the dynamics of the revenue base of fiscal security, a comparative analysis of the average tax revenues of the countries of the Organization for Economic Cooperation and Development (OECD) in 2019-2024 with a forecast for 2025-2026 was conducted.

Table 3 – Tax revenues in OECD countries (% of GDP) in 2019–2024, forecast for 2025-2026

Year	Tax revenues, OECD average (% of GDP)	Dynamics, p.p. to the previous year	Note
2019	33.8 %	-	Pre-crisis level of income stability
2020	33.1 %	-0.7	Decline due to the COVID-19 pandemic
2021	34.1 %	+1.0	Recovery from the crisis
2022	34.7 %	+0.6	Growth due to inflationary effect and high profits of the energy sector
2023	34.2 %	-0.5	Decline due to economic slowdown
2024	33.9 %	-0.3	Estimate according to the OECD (Revenue Statistics 2024)
2025	34.0 %	+0.1	Moderate recovery due to stabilization of the labor market
2026	34.4 % (forecast)	+0.4	Expected strengthening of the tax base due to fiscal reforms

Source: Table compiled on the basis of Afonso et al. (2025) and author's forecast.

The analysis of the indicators shows that the revenue base of OECD governments remained relatively stable in 2019-2024, although it was affected by numerous crisis factors. In pre-crisis 2019, the share of tax revenues in GDP was approximately 33.8%, which corresponded to the medium-term level of a sustainable fiscal burden.

In 2020, under the influence of the COVID-19 pandemic, the figure dropped to 33.1% of GDP due to a decline in business activity, falling corporate profits, and lower consumer demand. However, in 2021, revenues increased to 34.1% of GDP, which was the result of economic recovery, the effect of pent-up demand, and the expansion of the tax base.

In 2022, average tax revenues reached 34.7% of GDP, the highest level in the last decade. This growth was primarily driven by the inflationary effect (nominal GDP and price increases) and high profits of energy corporations due to the global energy crisis.

However, in 2023-2024, the dynamics showed signs of correction: in 2023, revenues fell to 34.2% of GDP, and in 2024, to 33.9% of GDP. This is due to a slowdown in global economic growth, stabilization of prices, and a partial weakening of the inflationary effect. At the same time, most countries continue to maintain high tax discipline, which limits the decline in the indicator.

The forecast for 2025, according to the OECD Economic Outlook (2025), envisages a slight recovery to 34.0% of GDP. This will be the result of stabilization of domestic demand, growth of real incomes and gradual expansion of the tax base as a result of fiscal consolidation after the crisis years. The governments of a number of OECD countries are planning to implement policies to reduce the shadow sector and digitalize tax administrations, which will have a positive impact on revenues.

The forecast for 2026, based on current trends, suggests a moderate increase in tax revenues to 34.4% of GDP. Steady economic growth, a recovery in investment activity, and corporate tax reforms (including the introduction of a global minimum tax of 15% on large companies) are expected to strengthen the fiscal base.

Thus, in 2019–2025, OECD countries gradually adapted their tax systems to new challenges: from the pandemic shock to post-crisis recovery. Despite temporary fluctuations, the average level of tax revenues is kept within 33–34.5% of GDP, which indicates the relative stability of the budget revenues. This, in turn, creates the basis for the financial sustainability of governments in the medium term and creates the preconditions for a gradual reduction in the debt burden in 2026–2027.

At the same time, there are still risks associated with a further increase in debt service costs, a slowdown in global economic growth, and possible tax reforms in international taxation that could affect the redistribution of income between jurisdictions.

5. Discussion

The results of the study confirm the relevance of the problem of ensuring the fiscal security of the state in the context of increasing global economic risks and structural transformations of financial systems. The analysis of debt burden, fiscal balance, and tax revenues indicates that there is a systemic relationship between the level of fiscal sustainability, the effectiveness of budget policy, and the quality of public administration.

Comparison with previous studies (Blanchard, 2019; Rogoff, 2025; Panizza, 2025) shows that the trends in public debt growth after 2020 are universal for most developed economies. At the same time, unlike stable OECD countries, where the debt burden is gradually stabilizing, transition economies, including Ukraine, remain vulnerable to external economic shocks due to a limited tax base, low fiscal flexibility, and high dependence on international aid.

This study is consistent with the findings of Reinhart (2025) regarding the criticality of the debt threshold of 90% of GDP, but this indicator is not inherently threatening for Ukraine, given the preferential lending conditions and debt restructuring. At the same time, the authors confirm the thesis of Blanchard (2021) that the key role is played not by the absolute level of debt, but by its structure, maturity, and confidence in government fiscal policy.

The results show that, despite the global trend toward fiscal consolidation in 2023-2024, most countries faced a rebound in deficits in 2024 due to high interest rates, inflation, and defense spending. This conclusion correlates with the analytical estimates of Mourougane (2025) and Jusaj et al. (2025), who point to the growth of structural expenditures as a long-term factor of fiscal pressure.

For Ukraine, the results of the study confirm the complex duality of the fiscal situation. On the one hand, the country demonstrates signs of macrofinancial sustainability with a controlled budget deficit, stable external revenues, and moderate debt growth. On the other hand, the expenditure structure remains overly militarized, and the share of investments in economic recovery is insufficient. This creates risks of long-term reproduction of debt dependence unless a comprehensive strategy to increase the revenue base is implemented.

In a broader context, the results confirm the effectiveness of a systematic approach to assessing fiscal security that combines the analysis of debt, budget, and tax components. A comparative analysis with OECD averages shows that Ukraine is gradually narrowing the gap in tax revenues (to 30-31% of GDP versus 33-34% in OECD countries), but is still far behind in terms of fiscal flexibility and debt sustainability.

The issue of determining the "optimal" level of debt for economies in war or recovery remains a matter of debate. The data obtained indicate that for Ukraine, the critical factor is not the amount of debt as such, but the ability of the state to maintain positive GDP dynamics and attract cheap external resources to service it as also indicated in Bondarenko (2022b). Thus, ensuring fiscal security requires not only fiscal consolidation, but also structural modernization of the tax system, digitalization of administration, and increased transparency of financial flows.

Summarizing, it can be argued that fiscal security in the current environment is not so much a static state as a process of constant balancing between financial stability, social responsibility, and investment activity of the state. For Ukraine, this balance is of particular strategic importance, as it determines the state's ability to restore the economy and ensure sustainable development in the postwar period.

6. **Conclusions**

The findings of the study allow us to make a number of generalizations about the current state and trends in the development of fiscal security in 2019–2026. The analysis of the dynamics of public debt, fiscal balance, and tax revenues shows that the global fiscal system has gone through several successive stages – from a shock increase in spending during the COVID-19 pandemic to gradual but uneven stabilization in 2023-2025.

Most OECD countries are characterized by a high debt burden (over 110% of GDP), which is the result of a long period of anti–crisis financing. Although there was a partial reduction in deficits in 2023-2024, 2025 showed a resumption of debt pressure due to inflation, high interest rates, and increased structural spending on defense, energy, and social spending.

In the case of Ukraine, the fiscal situation remains exceptional due to wartime factors. Although 2025 was not a turning point in reducing the debt burden, the state maintained the manageability of the financial system thanks to external support and a gradual recovery in revenues. At the same time, the budget structure remains deformed, with defense and humanitarian needs accounting for more than half of the expenditures.

In 2026, the country is expected to move from the stabilization phase to moderate fiscal consolidation. Public debt is expected to gradually decline, and the fiscal deficit is expected to shrink to around -4% of GDP. At the same time, persistent global uncertainty, high social costs, and debt service costs will remain systemic risks for most countries, including Ukraine.

In general, the results of the study confirm that fiscal sustainability in the current environment is formed not only by strict budget discipline, but also by policy flexibility, efficient tax administration, diversification of funding sources, and development of the state's institutional capacity. These are the factors that will determine the ability of governments to maintain macroeconomic balance in the face of ongoing global transformations.

Reference

Ahmad, M.; Zheng, J. (2023) The cyclical and nonlinear impact of R&D and innovation activities on economic growth in OECD economies: A new perspective. *Journal of the Knowledge Economy*, 14(1), 544-593.

Afonso, A.; Montes, A. P.; Domínguez, J. M. (2025) A dynamic efficiency analysis for tax revenues in OECD countries. *Empirica*, 52(2), 377-411.

Auerbach, A. J.; Gorodnichenko, Y.; Murphy, D. (2024) Macroeconomic frameworks: Reconciling evidence and model predictions from demand shocks. *American Economic Journal: Macroeconomics*, 16(3), 190-229.

Bondarenko, S.; Makeieva, O.; Usachenko, O.; Veklych, V.; Arifkhodzhaieva, T.; Lernyk, S. (2022a). The legal mechanisms for information security in the context of digitalization. *Journal of Information Technology Management*, 14 (Special Issue: Digitalization of Socio-Economic Processes), 25-58.

Bondarenko, S.; Bratko, A.; Antonov, V.; Kolisnichenko, R.; Hubanov, O.; Mysyk, A. (2022b). Improving the state system of strategic planning of national security in the context of informatization of society. *Journal of Information Technology Management*, 14, 1-24.

Blanchard, O. (2019) Public debt and low interest rates. *American Economic Review*, 109(4), 1197-1229.

Blanchard, O.; Tirole, J.; Gollier, C.; Reguant, M.; Rodrik, D.; Stantcheva, S.; Propper, C. (2021) Les grands défis économiques. Rapport de la Commission internationale présidée par Olivier Blanchard et Jean Tirole, 23, 301.

Cobham, A.; Janský, P. (2019) Measuring misalignment: The location of US multinationals' economic activity versus the location of their profits. *Development Policy Review*, 37(1), 91-110.

Danylenko, A.; Venger, V. (2024) Market conditions and the role of the state in post-war economic recovery of Ukraine. *Finance of Ukraine*, 5, 7-32.

Gelpern, A.; Panizza, U. (2022) Enough potential repudiation: Economic and legal aspects of sovereign debt in the pandemic era. *Annual Review of Economics*, 14(1), 545-570.

Huang, N.; Burtch, G.; Hong, Y.; Pavlou, P. A. (2020) Unemployment and worker participation in the gig economy: Evidence from an online labor market. *Information Systems Research*, 31(2), 431-448.

Jones, B. F. (2021) The rise of research teams: Benefits and costs in economics. *Journal of Economic Perspectives*, 35(2), 191-216.

Jusaj, Y.; Avdimetaj, K.; Zogaj, V.; Gara, A. (2025) The impact of public debt threshold on economic growth before and after the COVID-19 pandemic: An empirical analysis of Central and Eastern European developing countries. *Economics and Culture*, 22(1), 123-135.

Lee, S.; Park, J. (2022) Identifying monetary policy shocks using economic forecasts in Korea. *Economic Modelling*, 111, 105803.

Lelyk, L.; Olikhovskyi, V.; Mahas, N.; Olikhovska, M. (2022) An integrated analysis of enterprise economy security. *Decision Science Letters*, 11 (3), 299-310.

Liu, C.; Padhan, H.; Rekha, V.; Gozgor, G. (2025) The path to green growth in OECD economies: The role of energy transition and education. *Energy Economics*, 145, 108419.

Lunina, I.; Bilousova, O. (2025) The fiscal component of enhancing the country's defense capabilities. *Scientific Bulletin of International Association of Scientists. Series: Economy, Management, Security, Technologies*, 4(2).

Mialkovska, L.; Maiboroda, O.; Koretska, N.; Martyniuk, Y.; Haponchuk, O.; Korobchuk, L. (2025) Modern approaches to educational management: European perspectives on innovation. *Salud, Ciencia y Tecnología – Serie de Conferencias*, 4, 1479.

Mourougane, A. (2025) How have balance of payments statistics been used in OECD statistical and policy analysis? In *Measuring International Economics: 100 Years Balance of Payments in Germany* (pp. 157-168).

Musa, K.; Janssen, M.; Said, J.; Zakaria, N. B.; Erum, N. (2025) The impact of public debt and quality of governance on economic growth in high-income countries. *Journal of the Knowledge Economy*, 16(1), 2817-2843.

OECD. (2025) *OECD Economic Outlook Interim Report*, September 2025.

Panizza, U. (2025) Long-term debt sustainability in emerging market economies: A counterfactual analysis. *Review of Development Finance*, 15(1), 1-19.

Poterba, J.; Venti, S.; Wise, D. A. (2018) Longitudinal determinants of end-of-life wealth inequality. *Journal of Public Economics*, 162, 78-88.

Reinhart, A. (2025) The regressinator: A simulation tool for teaching regression assumptions and diagnostics in R. *Journal of Statistics and Data Science Education*, 1-22.

Rogoff, K. (2021) Fiscal sustainability in the aftermath of the great pause. *Journal of Policy Modeling*, 43(4), 783-793.

Xu, Q.; Fu, B.; Wang, B. (2022) The effects of oil price uncertainty on China's economy. *Energy Economics*, 107, 105840.

Zucman, G. (2013) The missing wealth of nations: Are Europe and the US net debtors or net creditors? *The Quarterly Journal of Economics*, 128(3), 1321-1364.

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Integration of Economic, Socio-cultural, and Digital Factors into an Attribute-based Model for the Development of the Hospitality Industry

Integração de Fatores Económicos, Socioculturais e Digitais num Modelo Baseado em Atributos para o Desenvolvimento da Indústria Hoteleira

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ABSTRACT
The hospitality industry is shaped by globalisation, competition, and the post-COVID-19 environment, requiring new strategic management priorities. This study examines how economic, socio-cultural, and digital factors can be integrated into an attribute-based model for sustainable development. Using a systematic and comparative approach, six contexts of sustainability were identified: socio-cultural, economic, environmental, institutional, technological, and regional. The model provides an interdisciplinary framework for adaptive strategies, enabling both targeted enterprise management and effective governmental support. Its application helps optimise business operations, address global challenges, and foster a competitive, resilient hospitality industry tailored to regional specifics.

Keywords: Hospitality industry; Management strategies; Attributive model; Digital technologies; Innovation; Sustainability.

JEL classification: L83; Z32; Q01; O33.

RESUMO
A indústria da hospitalidade é moldada pela globalização, pela concorrência e pelo contexto pós-COVID-19, exigindo novas prioridades na gestão estratégica. Este estudo analisa como os factores económicos, socioculturais e digitais podem ser integrados num modelo baseado em atributos para o desenvolvimento sustentável. Através de uma abordagem sistemática e comparativa, foram identificados seis contextos de sustentabilidade: sociocultural, económico, ambiental, institucional, tecnológico e regional. O modelo oferece uma estrutura interdisciplinar para estratégias adaptativas, permitindo tanto uma gestão empresarial direccionada como um apoio governamental eficaz. A sua aplicação contribui para optimizar as operações empresariais, enfrentar desafios globais e promover uma indústria da hospitalidade competitiva e resiliente, adaptada às especificidades regionais.

1. Introduction

The leading place in the structure of the modern economy is occupied by the hospitality industry, which is defined as an important tool for implementing social policy, regional development and employment support. Taking into account global challenges, including the COVID-19 pandemic, which have caused radical changes in management practices and have set new requirements for the hospitality business in terms of value, flexibility and technological adaptability. The relevance of this study is due to the need to conceptualize a model of hospitality industry development management based on the integration of economic parameters, socio-cultural guidelines and digital transformations as determining factors of entrepreneurial activity. The intensification of research interest in studying the relationship between these categories in the process of strategic planning of the hospitality industry development is also evidenced in the analyzed scientific sources. The integration of cultural resources and digital innovations into the strategic management of hospitality industry enterprises is increasingly considered as a key factor in ensuring their long-term competitiveness in the conditions of a globalized services market (Kairišs et al., 2023; Abir and Khan, 2022). In this aspect, conducting a comprehensive full-fledged diagnosis of the socio-economic consequences of the COVID-19 pandemic is defined as one of the important analytical tools for identifying new guidelines in adapting management strategies in the hospitality industry (Sanabria-Díaz et al., 2021; Davahli et al., 2020). In particular, it is worth noting that Davahli et al. (2020) focus on social challenges, which in turn are interconnected with the growth of unemployment, while the studies of Pereira et al. (2021), Tanveer et al. (2024), Khatter (2023), and Mizyuk and Melnyk (2021) substantiate the need to implement and integrate the principles of sustainable development into all levels of management activities in the hospitality industry. Despite some scientific progress in the field of strategic management of the hospitality industry, there is a need for a deeper theoretical understanding of the adaptation of management concepts to the specifics of the regional environment. In accordance with the observations of Dragotă et al. (2016), despite the growing attention to this topic, a number of key aspects require further analysis. In particular, digitalization has become an important driver of transformations in the hospitality industry, ensuring its integration into global economic and information processes (Niziaieva et al., 2022). However, it is worth noting that there is a lack of holistic methodological approaches to the integration of digital, economic and socio-cultural variables in the strategy of sustainable development, and at the moment the influence of territorial features on the effectiveness of management concepts in this area remains poorly studied.

Therefore, the purpose of this study is to analyze the influence of economic, socio-cultural and digital factors on the development of the hospitality industry. The main objectives of the study are: identifying key indicators, assessing their significance for maintaining the sustainability of the hospitality industry, studying the impact of regional characteristics on management processes, and forming directions for improving strategic planning in conditions of dynamic transformations.

2. Literature Review

Scientific research on the development of the hospitality industry mainly focuses on intersectoral analysis, in which economic, digital, socio-cultural factors are considered as interrelated elements of a sustainable development strategy. It is worth noting that the COVID-19 pandemic has become a critical challenge that has intensified the need to update management decisions and modify the operating conditions in the hospitality industry (Davahli et al., 2020; Matijević et al., 2025). Conceptual approaches to systemic management of the hospitality industry are reflected in the scientific works of Mizyuk and Melnyk (2021), and socio-cultural factors of economic growth are presented in the studies of Kvach et al. (2018), Lopez-Gamero et al. (2023), Giannoukou (2024), Achmad and Yulianah (2022), which forms the basis for the development of an attributive model capable of reflecting the multidimensionality of processes in the hospitality industry. Having analyzed the integration of multifactorial factors in the development of the hospitality industry, it is worth noting that Naherniuk and Kovalenko (2021) focused on the conceptual analysis of the hospitality phenomenon and its key attributes. The issues of the importance of socio-economic indicators in the context of regional development are highlighted in the works of Romanovska et al. (2021). Ideas regarding the integration of elements of the circular economy and sustainable tourism are gaining popularity in the studies of Arzoumanidis et al. (2021) and Kairišs et al. (2023), in particular in connection with the inclusion of cultural heritage in conceptual and practical solutions in project management. In this aspect, socio-cultural factors of interaction play a decisive role, as emphasized in the study of Sarkisian and Tymomir (2019), and mobility as an important factor in increasing business productivity (Ferjanić Hodak, 2017). The spatial differentiation of socio-economic variables and the choice of digital technologies to ensure economic resilience are analyzed in the studies of Monteiro et al. (2017) and Jamalova and Milán (2019).

In the course of developing an attributive model of the development of the hospitality industry, the issue of ensuring the economic security of enterprises becomes of decisive importance, which, as noted by Yakushev et al. (2023), directly depends on the level of managerial competence. In addition, a number of studies, in particular Pereira et al. (2021), Tanveer et al. (2024) and Khatter (2023) focus on the environmental aspects of the hospitality industry, emphasizing the need to implement sustainable practices to preserve the environment. Khaustova et al. (2020) explores the issues of innovative development and economic sustainability, while Premović and Arsić (2020) consider tourism as a socially significant sector that promotes economic growth. Ajmal et al. (2025) focuses on the impact of sustainable development concepts on internal corporate culture, in particular employee behavior, while Kim and Spears (2021) investigate cross-cultural factors in the formation of career expectations in the hospitality industry. Edeh et al. (2022) found that effective talent management – including attracting, developing, and retaining employees – significantly increases employees' discretionary work behavior, which in turn improves the performance and sustainability of hospitality enterprises. Among the key drivers of the transformation of the hospitality industry, the role of foreign direct investment is decisive, which, as Blamoh et al. (2020) note, promotes the internationalization of the hospitality industry, which is confirmed by the experience of Chinese companies in Liberia. Abir and Khan's (2022) study

identifies the importance of digital technologies, in particular ICT, in ensuring the efficiency of operations and business competitiveness in the hospitality industry.

It is worth noting that the COVID-19 pandemic, according to Sanabria-Díaz et al. (2021), has caused significant economic losses in the hospitality industry, which requires flexible management decisions and adaptation. In this context, Agagiu and Iatagan (2023) emphasize the need to introduce innovations that can respond to modern global threats. In the paradigm of the cultural-economic approach, Dragotă et al. (2016) note that the synergy of socio-cultural and economic factors influences the development of financial institutions, recommending the use of a similar method for the hospitality industry. Getzner (2021) argues that spending on the cultural sphere has a positive effect on both social cohesion and the economy of regions. The economic analysis of regional development presented in the work of Khaustova et al. (2020) indicates the importance of ensuring financial sustainability as a factor of competitiveness. Ostovskaya et al. (2020) emphasizes the role of socio-economic development of tourism infrastructure in forming a quality environment for the functioning of the industry. Bayev et al. (2022) established that to ensure the effective functioning of the quality management system in tourism companies, it is necessary to implement organizational and economic mechanisms in accordance with national and international standards, in particular, taking into account both external and internal factors to improve the quality of tourism services. Thus, we can note that the available scientific research indicates the need to implement a holistic approach to managing the development of the hospitality industry, which takes into account the interrelationship of economic, socio-cultural and digital factors in the course of modern transformations.

However, it is worth emphasizing that there is a lack of clear methodological guidelines regarding the effective integration of the socio-cultural component into the hospitality industry management systems, which is critically important for adapting to global challenges. In addition, the mechanisms of the influence of regional specifics on the sustainability and competitiveness of hospitality industry enterprises remain incompletely understood.

3. **Methods**

Within the framework of this study, an integrated methodological approach was applied, combining several analytical instruments to ensure a comprehensive and multidimensional exploration of the hospitality industry. This approach made it possible to evaluate the complex interactions between economic, digital, and socio-cultural factors, which are decisive for the sustainability of hospitality enterprises under conditions of intensified global competition, rapid technological shifts, and the continuing consequences of the COVID-19 pandemic. The analysis also highlighted the significance of institutional, environmental, and technological aspects, which together form a multi-level system of determinants influencing both short-term performance and long-term strategic stability.

Special attention was paid to the interdependencies among these factors, as they cannot be adequately assessed in isolation. A systematic analysis of their relationships was therefore carried out, allowing the development of a conceptual view of the hospitality industry through the prism of global transformations and regional specificities. In order to

substantiate the findings, content analysis of scientific and professional literature was employed, which enabled the identification of key performance indicators, best practices, and critical trends shaping the trajectory of the sector. The application of comparative analysis further supported the differentiation of management strategies depending on institutional conditions and resource availability.

As a result, the methodological framework elaborated in this research provides not only a theoretical foundation for understanding the drivers of sustainability in the hospitality industry but also a practical basis for designing adaptive and evidence-based strategic solutions. These solutions can be oriented toward enhancing competitiveness, fostering innovation, and ensuring the resilience of enterprises while simultaneously responding to global challenges and aligning with sustainable development goals.

4. **Results**

The hospitality industry functions as a multifunctional segment of the economy, influencing the formation of national identity, social dynamics and the development of economic ties. It is worth noting that under the influence of new global threats, such as the COVID-19 pandemic and the intensification of integration processes, there is an increasing importance of innovative and sustainable approaches in the strategic management of the industry. The study of socio-cultural, digital and economic indicators (Table 1) allows us to identify key factors of sustainability and competitiveness of hospitality industry enterprises.

Table 1 – Socio-cultural, digital and economic indicators of the hospitality industry

Category	Key indicators	Description
Sociocultural	✓ Cultural exchange events (festivals, conferences) ✓ Regional tourist attractiveness (heritage, nature, infrastructure) ✓ Integration of cultural heritage into services ✓ Social cohesion index ✓ Intercultural communication	Reflect the level of cultural dialogue, preservation of traditions, attractiveness of destinations, and tourism's role in strengthening tolerance and social stability.
Economic	✓ Dynamics of domestic/foreign investments ✓ Financial stability of enterprises ✓ Employment in the hospitality sector ✓ Pricing indicators (accessibility, competitiveness) ✓ Contribution of tourism to GDP	Characterize financial resilience, market competitiveness, labor market impact, service affordability, and macroeconomic contribution.
Technological	✓ Implementation of innovative technologies (AI, automation) ✓ Functionality of online booking/support platforms ✓ Business digitalization index	Assess the level of digital transformation, optimization of business processes, and improvements in service quality.
Environmental	✓ Energy efficiency of buildings/infrastructure ✓ Adoption of circular economy practices ✓ Compliance with environmental standards ✓ Waste management and recycling programs	Indicate ecological responsibility, sustainable resource use, and reduction of negative environmental impact.

Socio-economic/ Institutional	✓Dynamics of tourist demand (domestic/ international) ✓Infrastructure development index (transport, hotels, communications) ✓State support (programs, loans, subsidies)	Define the quality of infrastructure, government involvement, and the overall capacity of the industry to meet demand.
Digital marketing	✓Effectiveness of online/web advertising ✓Google Ads performance (CPC, ROI) ✓Visibility in mobile travel apps ✓Paid search promotion impact ✓Email marketing metrics (open/CTR rates)	Measure efficiency of digital promotion channels, audience engagement, and contribution to brand awareness and customer loyalty.

Source: Compiled by the author based on Kairišs et al. (2023), Abir and Khan (2022), Sanabria-Díaz et al. (2021), Pereira et al. (2021), Tanveer et al. (2024), Khatter (2023), Niziaieva et al. (2022).

The development of the hospitality industry is caused by a complex of interconnected socio-cultural, digital and economic determinants that determine the degree of its sustainability and ability to maintain competitive advantages in the conditions of the transformational impact of the global environment. The actualization of the cultural context in the architectonics of the spatial organization of tourist facilities, the integration of high technologies into business processes, as well as compliance with the principles of environmental responsibility form the basis for ensuring the sustainable functioning of industry entities. Support for tourism demand, the development of material and technical and transport infrastructure, as well as state institutional interventions in the form of financial incentives provide hospitality enterprises with the necessary resource base to increase growth potential. At the same time, there is an urgent need to direct scientific research to identify the most relevant strategic models that are able to harmonize the achievement of economic, social and environmental goals.

The modern operating environment of the hospitality industry is characterized by an increased level of complexity and dynamism, which necessitates the implementation of innovative management paradigms sensitive to multifactorial influences – socio-cultural, digital, economic, environmental and technological. The intensification of global economic turbulence, the escalation of competition in the service sector and the increasing frequency of crisis challenges, in particular the COVID-19 pandemic, require a systematic rethinking of management concepts for the development of the industry. In this context, regional specificities significantly affect the effectiveness of management practices, requiring the adaptation of universal models to local conditions.

The role of public policy should be to actively promote the integration of cultural heritage into the tourism product with the use of digital tools as key factors in increasing the competitiveness of the sector. However, insufficient attention to the paradigmatic analysis of the synergistic interaction of cultural, digital and management components creates risks of reducing the level of sustainability of enterprises. This justifies the need to form new scientifically based solutions that would synchronize these factors in a single conceptual field.

In this context, an interdisciplinary approach to modeling management practices in the hospitality sector is considered a necessary condition for developing new adaptive mechanisms for the functioning of the industry. The construction of such models should be based

on the integration of theoretical principles of management, economics, sociology, cultural studies and ecology with empirical data, which emphasizes the critical importance of scientific approaches. It is through the use of modeling that it is possible to form a scientifically based concept of management in the hospitality sector. In this case, the systemic approach treats the hospitality industry as a set of interdependent subsystems that function within a single target environment. Its main goal is to coordinate economic, socio-cultural and environmental determinants of management. Such an approach ensures the optimization of internal processes, increasing the level of managerial efficiency and the adaptive potential of enterprises to changes in the external environment (Mizyuk and Melnyk, 2021).

In the management of hospitality industry entities, the socio-cultural approach involves the integration of cultural, historical and social factors into strategic planning and implementation of management decisions, the implementation of which, in turn, contributes to the growth of the tourist attractiveness of regions, improving the quality of service and more effective representation of local cultural identity in hotel and tourism services (Kairišs et al., 2023). In addition, the above-mentioned approach ensures the formation of sustainable, balanced and socially oriented relationships between host communities and tourist flows, which is directly correlated with the principles of social inclusion and local participation (Sarkisian and Tymomir, 2019).

At the same time, the economic paradigm of hospitality industry management focuses mainly on quantitative performance indicators, such as the level of profitability, the volume of capital investments, financial sustainability and the overall effectiveness of management decisions. This approach serves as the basis for building predictive models of enterprise development, taking into account risk factors, the competitive environment, and the potential for adaptation to the conditions of a globalized economy (Khaustova et al., 2020). The implementation of management practices aimed at reducing negative environmental impact, developing a circular economy, and optimizing the use of natural resources is being updated within the concept of sustainable development, which includes the use of energy-efficient technologies, reducing the consumption of material and energy resources, and modernizing waste processing and disposal systems (Pereira et al., 2021; Tanveer et al., 2024; Khatter, 2023). Due to the widespread introduction of digital technologies, the hospitality industry is undergoing a digital transformation, automated solutions and information and communication systems, the implementation of which contributes to increasing operational productivity, improving the quality of customer service and transforming business models towards greater adaptability and innovation (Abir and Khan, 2022).

In modern hospitality industry enterprises, marketing strategies are based on a detailed analysis of consumer needs, the development and implementation of a differentiated and competitive market offer in accordance with these needs, as well as on approaches aimed at increasing customer loyalty and long-term consumer retention. This approach ensures the effective positioning of enterprises in the market, contributes to the formation of their positive image and competitive advantages (Kim and Spears, 2021). The integration of a systems approach into the process of modeling management decisions in the hospitality sector contributes to the rational use of resource potential, increases the adaptability of enterprises to the competitive environment, and ensures progressive sustainable development of the industry. Taking into account socio-cultural, digital, economic, environmental, and

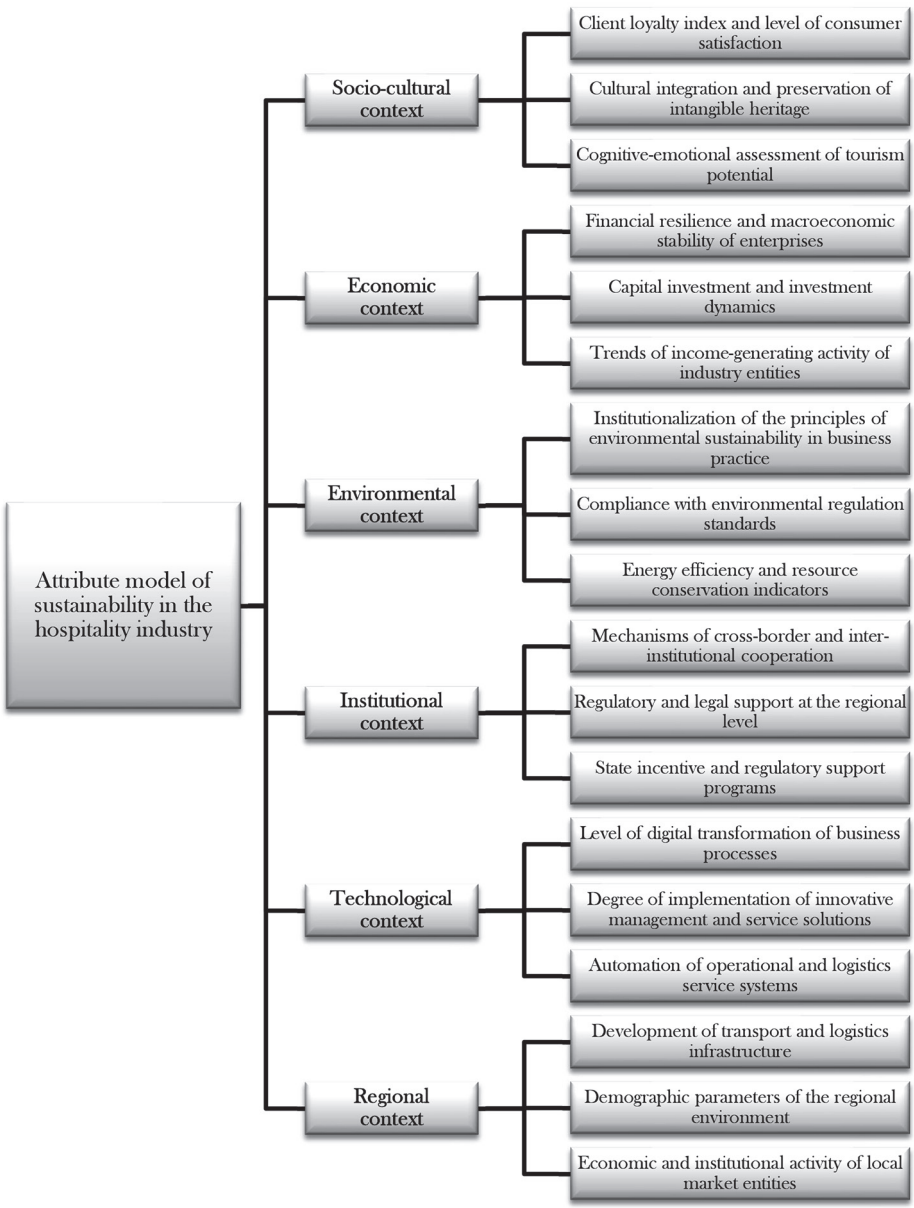
technological determinants allows the industry to respond promptly to global challenges and ensure its sustainable functioning in a dynamic environment.

The COVID-19 pandemic has radically transformed the functioning of hospitality enterprises, provoking profound socio-economic upheavals. Significant operational restrictions, including mobility restrictions, international border closures, and prolonged quarantine measures, have led to a significant reduction in tourism flows and a decrease in industry revenues. In a paper published in 2021, Sanabria-Diaz and colleagues report a decline in demand for services in the hotel and restaurant sector and travel agencies, many of which have temporarily or permanently ceased operations. It is worth noting that the hospitality industry has already experienced a significant reduction in personnel potential, which in turn led to a decrease in the socio-economic well-being of employees in the hospitality industry, as noted in the scientific conclusions of the research by Davahli et al. (2020). In parallel, due to these conditions, a transformation of consumer behavior and a reorientation of customer requests were observed, which in turn led to the need to revise traditional management approaches and implement adaptive business strategies in the hospitality industry.

The leading vector of transformation is the technologization of management and operational processes based on the implementation and use of digital tools and automated solutions in the context of post-crisis adaptation of hospitality industry enterprises. In particular, online booking systems, contactless payment platforms, as well as digital channels of communication with customers have become widespread due to modern conditions. These technological innovations helped mitigate the effects of quarantine restrictions and ensured the functioning of basic services, as noted by Matijević et al. (2025). However, it is worth emphasizing that a set of sanitary and hygienic measures were implemented in parallel, including minimizing physical contact, constant monitoring of the condition of personnel and increasing service safety standards. Therefore, we can note that these actions had a positive impact on increasing the level of trust from consumers, which in turn created the prerequisites for the gradual stabilization of tourism activity (Sanabria-Díaz et al., 2021). In general, the COVID-19 pandemic acted as a catalyst for deep structural transformations, stimulating a rethinking of management paradigms, intensification of innovative activity and acceleration of digital transformation of hospitality industry enterprises.

Figure 1 presents an attributive model for assessing the sustainable development of the hospitality industry, which is built on the basis of regional factors, and its goal is to identify the degree of vulnerability of industry entities to exogenous shocks, as well as an analytical assessment of the effectiveness of the use of resource potential, taking into account the specifics of the regional context. The conceptual basis of the model was formed on an interdisciplinary approach that integrates leading scientific paradigms. The systemic approach includes socio-cultural, digital, economic, environmental, technological and institutional determinants of the functioning of hospitality industry enterprises. Economic, environmental and innovation approaches, in turn, form the basic principles of strategic management focused on financial stability, resource efficiency and the implementation of innovative practices. In conclusion, we can emphasize that the presented model is defined as a tool to support management decision-making adapted to the conditions of regional development and global trends in the functioning of the hospitality industry.

Figure 1 – An attribute model for assessing the sustainability of the hospitality industry development, considering regional peculiarities



It is worth noting that under the holistic multidimensional conceptual construct, which is based on the identification, systematization and integration of key determinants of the effective functioning of hospitality industry business entities in a dynamic and turbulent external environment, there is an attributive model of sustainable development of the hospitality industry. This model represents a structural-integrative approach that covers six critical contexts: socio-cultural, economic, environmental, institutional, technological and regional. The socio-cultural dimension of the model focuses on the phenomenon of tourist attractiveness of territories, deep integration of cultural heritage elements into tourism products, as well as ensuring a high level of satisfaction of consumers of services in the hospitality industry.

The above approach allows not only to increase the adaptability of enterprises to exogenous challenges, but also contributes to the formation of a unique profile of a tourist destination, thereby distinguishing it in a globalized competitive environment. The parameters of the financial stability of enterprises in the hospitality industry, diversification of sources of income, the level of investment activity and the ability to form economic potential are included in the economic dimension of the model of sustainable development of the hospitality industry. In combination, these factors determine the competitiveness of enterprises in the hospitality industry and ensure their long-term economic sustainability.

Integration of energy management principles, implementation of sustainable environmental technologies and practices aimed at minimizing negative environmental impact belong to the environmental component of the sustainable development model of the hospitality industry, which allows reducing the carbon footprint of enterprises and forming an environmentally responsible corporate image, which is gaining particular importance and popularity in the context of increasing environmental regulatory requirements.

The levels of regulatory support at the state and regional levels, as well as the effectiveness of integration mechanisms for interaction with international organizations, are determined by the institutional context of the model of sustainable development of the hospitality industry. It is worth noting that due to the presence of a clear structured state strategy, legislative framework, incentive instruments, etc., all this contributes to stabilizing the conditions for the functioning of the hospitality industry and enhancing its investment attractiveness.

Active implementation of digital innovations, automated management systems, as well as concepts of "smart" technologies that promote increased operational efficiency, quality of service and provide a personalized approach to the consumer, where all these aspects are included in the technological component of the model of sustainable development of the hospitality industry. It is worth noting that the logistics infrastructure, the level of transport accessibility, population density, as well as indices of socio-economic development of territories are taken into account in the regional dimension of the model of sustainable development of the hospitality industry. The complex of these factors forms the basis for the development of differentiated management strategies that are adapted to the spatial specifics of the functioning of the hospitality industry.

The proposed attributive model is distinguished by its systematicity and complexity, which ensures its applicability in the context of developing long-term sustainable development strategies. This model assumes the need for a detailed analysis of potential risks and opportunities, as well as the adaptation of management decisions to spatial features and

global transformational challenges, which, in turn, contributes to maintaining the stability and competitiveness of the industry at the macro and meso levels.

Determinative attention within this model is paid to the socio-cultural block, since it is it that is key in the formation of sustainable management strategies. The priority of cultural sensitivity, the development of intercultural communication, the promotion of social inclusion and the integration of local communities into tourism processes ensure not only an improvement in the quality of services, but also increase the attractiveness of regions for target audiences. Therefore, it is worth noting that the model demonstrates its effectiveness as a conceptual framework for building sustainable development of the hospitality industry in a globalized socio-economic environment (Table 2).

Table 2 – Integration of socio-cultural approaches into the hospitality industry management system to increase its sustainability

Area	Key approaches	Application	Expected results
Environmental Awareness	Eco-centric paradigm, sustainability	Use of eco-friendly/local materials, client awareness campaigns	Lower environmental impact, eco-friendly destination image
Innovative Service	Digitalization, personalization	Mobile apps, AI-based behavioral analysis	Higher efficiency, customer loyalty
Cultural Heritage	Cultural identity as tourism basis	Thematic tours, crafts revival, festivals	Tourism growth, heritage preservation, competitiveness
Intercultural Interaction	Tolerance, inclusivity	Staff training, multilingual content, cultural sensitivity	Trust of international tourists, reputational growth
Accessibility/ Inclusion	Equal access for all groups	Infrastructure for disabled, special pricing	Wider audience, social responsibility image
Human Capital	Continuous staff development	Training, motivation systems	Better service, lower turnover, stability
Social Cohesion	Community involvement	Joint initiatives, local products in tourism	Social inclusion, local identity, economic benefits
Service Quality	Feedback-based management	Monitoring via digital tools, surveys	Market adaptability, improved customer experience

Source: Compiled by the author based on Khaustova et al. (2020), Naherniuk and Kovalenko (2021), Sarkisian and Tymomir (2019), Romanovska et al. (2021), Pereira et al. (2021), Tanveer et al. (2024), Khatter (2023).

The use of socio-cultural approaches in the formation and implementation of the hospitality industry development strategy is of great importance for ensuring the comprehensive integration of all key elements of the hospitality industry, including economic, digital and social aspects. These approaches contribute to the formation of sustainable relations between tourists and local communities, thereby improving the quality of services and increasing the level of consumer satisfaction. Socio-cultural approaches enable businesses in the hospitality industry to effectively respond to changes in the global environment, increase their competitiveness and ensure sustainable development. Taking into account these aspects is defined as an integral part of the attributive model of the hospitality industry development,

which promotes not only economic growth, but also socio-cultural stability and digital transformation. Specific cases of integration of socio-cultural factors are given in Table 3.

Table 3 – Cases of integration of socio-cultural approaches into the hospitality industry management system

Case study (Country/ Region)	Description	Results
Cultural Tourism (Japan, Kyoto)	An initiative aimed at integrating historical and cultural heritage into tourism itineraries by promoting traditional Japanese crafts, tea ceremonies, and geisha shows.	Development of the city's tourist identity, increased tourist arrivals, enhanced global awareness of Japanese culture, stabilization of income in the creative industries.
Lviv Coffee Festival (Ukraine, Lviv)	An annual event that combines gastronomic practices, local culture, and cultural-entertainment elements to attract domestic tourist flows.	Strengthening of the city's brand as a gastronomic hub, growth in economic activity within the hospitality sector, and stimulation of local employment.
Oktoberfest (Germany, Munich)	A large-scale international beer festival grounded in the integration of Bavarian traditions, national attire, and gastronomy, accompanied by the digitalization of services.	Attraction of millions of international tourists, significant revenue increase in the HORECA sector, preservation of cultural identity, and digital expansion of tourism infrastructure.
Wine Tourism Program (France, Bordeaux)	Thematic routes through vineyards and wineries combining product tasting, cultural immersion, and digital support for guided tours.	Diversification of tourism services, extension of the active tourism season, support for local production, and implementation of smart technologies in wine tourism.
Venetian Carnival (Italy, Venice)	A cultural event project that integrates historical practices, theatrical arts, and international participation through multimedia platforms.	Enhancement of Venice's attractiveness as a center of creative industries, attraction of foreign investment, and integration of digital solutions in event management.

Source: Compiled by the author based on Kairišs et al. (2023), López-Gamero et al. (2023), Giannoukou (2024), Pereira et al. (2021), Tanveer et al. (2024), Khatter (2023), Abir and Khan (2022), Sanabria-Díaz et al. (2021).

Thus, it can be noted that the involvement of socio-cultural factors in the strategic management of the hospitality industry confirms their key role in the formation of sustainable competitive positions and increasing economic efficiency, and their application makes it possible to create attractive tourism products, activate the development of territories and promote the long-term stability of the industry. Within the framework of the attributive development model, this ensures a balanced integration of economic, social and cultural elements into a single management paradigm of the hospitality industry.

5. Discussion

The study found that socio-cultural, digital and economic factors play a decisive role in the transformation processes of the hospitality industry, the integration of which provides a comprehensive approach to the formation of a competitive environment. In particular, the cultural value of territories, intercultural interactions, architectural and historical heritage, as well as digital technologies are closely related to the potential for regional development. As Kairišs et al. (2023) emphasize, these indicators are key in shaping the sustainability of the industry. Abir and Khan (2022) detail digital aspects, pointing to the importance of ICT in increasing management efficiency. At the same time, the presence of territorial differences, in particular of an infrastructural nature, significantly limits the possibilities of integrating digital solutions in certain regions (Romanovska et al., 2021). The situation in the Carpathian region of Ukraine, despite its natural and cultural attractiveness, illustrates these structural barriers. Insufficient development of transport infrastructure, limited accommodation, particularly in rural areas, and low income levels make it impossible to develop high-quality tourism services (Khaustova et al., 2020; Naherniuk and Kovalenko, 2021). The lack of proper digital promotion and the low representation of the region in the international tourism space exacerbate these disparities (Pereira et al., 2021; Tanveer et al., 2024; Khatter, 2023). In this regard, achieving the strategic goals of the hospitality industry requires the implementation of regionally focused management solutions aimed at modernizing infrastructure, strengthening digital presence and supporting innovative activities (Khaustova et al., 2020).

The COVID-19 pandemic has become a key milestone in the transformation of the hospitality industry, marking the beginning of a new era that involves a review of economic strategies, socio-cultural approaches and digital management practices. The crisis situation caused large-scale disruptions in the functioning of hospitality enterprises, but at the same time proved to be a powerful impetus for the implementation of innovative digital solutions. Research has shown that those organizations that quickly adapted internal business processes to the new conditions, integrating digital platforms, automated customer service systems and remote work models, experienced less economic pressure and maintained operational stability (Matijević et al., 2025). In addition, a new behavioral demand from consumers for compliance with high standards of sanitary safety has been formed, which, according to the conclusions of Sanabria-Díaz et al. (2021), has led to the emergence of new regulations in the service sector. This has contributed to the reformatting not only of the external aspects of customer interaction, but also of the entire service paradigm. Within the framework of this study, the results are compared with the conclusions of similar scientific works that focus on the ecological and digital rethinking of the industry. Thus, in the works of Pereira et al. (2021), Tanveer et al. (2024) and Khatter (2023), the active implementation of the principles of a circular economy focused on long-term sustainable efficiency is noted. At the same time, as Kallio emphasizes, the level of implementation of these practices significantly depends on the national regulatory field: in some countries, strict environmental legislation stimulates sustainable transformation, while in others, the lack of legal mechanisms inhibits these processes. The relevance of intercultural communication in ensuring a high level of customer satisfaction in the hospitality sector requires further conceptual understanding and

empirical study. The results of the study correlate with the provisions highlighted in the works of Kim and Spears (2021), which emphasize the need to form intercultural competence of personnel as a tool for improving the quality of service. At the same time, the potential of cultural diversity of labor collectives as a factor in increasing the efficiency of enterprise functioning remains insufficiently studied in the context of modern digitalization. The study confirmed the key hypothesis regarding the significance of integrating socio-cultural, economic and technological determinants into strategic management. At the same time, directions for further exploration were outlined, in particular regarding the spatial differentiation of integration processes and the role of innovative technologies in ensuring the sustainability of the hospitality industry in the face of global challenges.

6. Conclusion

As a result of the study, we can note the high relevance of the integration of economic, socio-cultural and digital parameters in modeling strategies for the development of the hospitality industry. It was determined that the synergistic effect of combining economic, socio-cultural and digital factors contributes to increasing the ability of the hospitality industry to withstand global risks and strengthens its market position. The study focused on the regional aspect of management, which in turn leads to the implementation of a territorially oriented approach to strategy development. During the study, it was found that digital tools integrated during the pandemic became the basis for the formation of innovative business models. In this context, the role of digital solutions in ensuring the flexibility and adaptability of business structures in the hospitality industry was determined. We also emphasize the importance of cultural competence of personnel and intercultural interaction as elements of ensuring service quality in the hospitality industry. The developed attributive model takes into account six strategic contexts, thereby providing an analytical basis for the further implementation of adaptive management strategies in the hospitality industry.

It is worth noting that one of the main limitations of the study is the insufficient representativeness and fragmentation of regional statistical data, which in turn greatly complicates the implementation of comparative analysis at the inter-country level. Another main limitation is the differences in the regulatory systems and regulatory strategies of different states, which in turn create obstacles to the formation of a universal attributive model of the development of the hospitality industry.

Further scientific exploration should be directed towards the in-depth development of integration approaches that are able to harmonize digital, socio-cultural and economic determinants in global management practices. It is worth emphasizing that a necessary condition for the effective functioning of the hospitality industry is the creation of tools to increase the adaptive potential of business entities to external shocks and crisis situations.

References

Abir, T.; Khan, M. Y. H. (2022) Importance of ICT advancement and culture of adaptation in the tourism and hospitality industry for developing countries. In: *ICT As innovator between tourism and culture*, IGI Global Scientific Publishing, pp. 30-41.

Achmad, W.; Yulianah, Y. (2022) Corporate social responsibility of the hospitality industry in realizing sustainable tourism development. *Enrichment: Journal of Management*, 12(2), 1610-1616.

Agagiu, M.; Iatagan, M. (2023) Socio-economic and innovative perspectives of the hospitality industry in Romania under the incidence of global challenges and risks. *Annals of "Spiru Haret" University*. Economic Series, 23(2), 140-150.

Ajmal, M.; Sareet, Z.; Islam, A. (2025) Unleashing innovation through employee voice behavior in the hotel industry: the impact of ambidextrous leadership on innovative work behavior. *Journal of Hospitality and Tourism Insights*, 8(2), 448-471.

Arzoumanidis, I.; Walker, A. M.; Petti, L.; Raggi, A. (2021) Life cycle-based sustainability and circularity indicators for the tourism industry: A literature review. *Sustainability*, 13(21), 11853-11853.

Bayev, V. V.; Bakhov, I. S.; Mirzodaieva, T. V.; Rozmetova, O.; Boretskaya, N. (2022) Theoretical and Methodological Fundamentals of the Modern Paradigm of Quality Management in the Field of Tourism. *Journal of Environmental Management and Tourism*, 13(2), 338-345.

Blamoh, L. A.; Jingyi, Y.; Meixue, W.; Weiijie, G. (2020) The effect of foreign direct investment on the hospitality industry in Liberia: A case study on the Chinese investment. *International Journal of Economics and Finance*, 13(1), 111-123.

Davahli, M. R.; Karwowski, W.; Sonmez, S.; Apostolopoulos, Y. (2020) The hospitality industry in the face of the COVID-19 pandemic: Current topics and research methods. *International Journal of Environmental Research and Public Health*, 17(20), 7366.

Dragotă, I.-M.; Tatu-Cornea, D.; Tulbure, N. (2016) Determinants of development of the mutual fund industry: A socio-cultural approach. *Prague Economic Papers*, 25(4), 476-493.

Edeh, F. O.; Zayed, N. M.; Perevozova, I.; Kryshtal, H.; Nitsenko, V. (2022) Talent management in the hospitality sector: Predicting discretionary work behaviour. *Administrative Sciences*, 12(4), 122.

Ferjanić Hodak, D. (2017) Impact of labour mobility on selected business performance indicators in the hospitality industry in Croatia. *Acta Turistica*, 29(1), 75-102.

Getzner, M. (2021) Socio-economic and spatial determinants of municipal cultural spending. *Journal of Cultural Economics*, 46(4), 699-722.

Giannoukou, I. (2024) Revolutionizing hospitality: Strategic integration of innovation management embracing technological innovation for enhanced customer experiences. *Technium Business and Management*, 7, 24-39.

Jamalova, M.; Milán, C. (2019) The comparative study of the relationship between smartphone choice and socio-economic indicators. *International Journal of Marketing Studies*, 11(3), 11-25.

Kairišs, A.; Geipele, I.; Oļevska, I. (2023) Sustainability of cultural heritage-related projects: Use of socio-economic indicators in Latvia. *Sustainability*, 15(13), 10109.

Khatter, A. (2023) Challenges and solutions for environmental sustainability in the hospitality sector. *Sustainability*, 15(15), 11491.

Khaustova, K.; Hoblyk, V.; Chernychko, T. (2020) Evaluation of economic stable development of hospitality enterprises in the region. *Scientific Bulletin of the Moscow State University*. Series of Economics, 1(13), 168-174.

Kim, Y. H.; Spears, D. L. (2021) Differing career expectations in the hospitality industry: A cross-cultural study. *International Hospitality Review*, 36(2), 304-321.

Kvach, Y.; Koval, V.; Hrymaliuk, A. (2018) Tourism and hospitality industry in the context of global economic development. *Ekonomìka*, Ekologìâ, Socìum, 2(4), 11-21.

López-Gamero, M. D.; Molina-Azorín, J. F.; Pereira-Moliner, J.; Pertusa-Ortega, E. M. (2023) Agility, innovation, environmental management and competitiveness in the hotel industry. *Corporate Social Responsibility and Environmental Management*, 30(2), 548-562.

Matijević, J.; Zielinski, S.; Ahn, Y. J. (2025) Exploring the Impact of COVID-19 Recovery Strategies in the Hospitality and Tourism Industry. *Administrative Sciences*, 15(4), 142.

Mizyuk, V.; Melnyk, I. (2021) Paradigmatic approach to system management in the hospitality industry. *Bulletin of Khmelnytsky National University*. Economic sciences, 294(3), 148-153.

Monteiro, J.; Martins, B.; Pires, J. M. (2017) A hybrid approach for the spatial disaggregation of socio-economic indicators. *International Journal of Data Science and Analytics*, 5, 189-211.

Naherniuk, D.; Kovalenko, L. (2021) Characteristics of the hospitality sector: Definition of the concept of hospitality. *Market Infrastructure*, 59, 50-54.

Niziaieva, V.; Liganenko, M.; Muntyan, I.; Ohiienko, M.; Goncharenko, M.; Nazarenko, O. (2022) Balancing interests in the field of tourism based on digital marketing tools. *Journal of Information Technology Management*, 14, 59-77.

Ostovskaya, A.; Smirnova, E. A.; Shendrikova, S. P. (2020) Socio-economic development of tourism infrastructure. IOP Conference Series: Earth and Environmental Science, 459(5), 52064-52064.

Pereira, V.; Silva, G. M.; Dias, Á. (2021) Sustainability practices in hospitality: Case study of a luxury hotel in Arrábida Natural Park. *Sustainability*, 13(6), 3164.

Premović, Đ.; Arsić, J. (2020) Socio-economic aspects of tourism in the modern society. *Proceedings of the Faculty of Arts in Pristina*, 50(3), 125-154.

Romanovska, Y.; Makarenko, M.; Khmaruk, V. (2021) Socio-economic indicators of territorial region. *Black Sea Economic Studies*, 66, 108-115.

Sanabria-Díaz, J. M.; Aguiar-Quintana, T.; Araujo-Cabrera, Y. (2021) Public strategies to rescue the hospitality industry following the impact of COVID-19: A case study of the European Union. *International Journal of Hospitality Management*, 97, 102988.

Sarkisian, G. O.; Tymomir, L. A. (2019) Development of innovative comprehensive hospitality programme for improving international Ukrainian-French relations. *Geography and Tourism*, 50, 160-167.

Tanveer, M. I.; Yusliza, M. Y.; Fawehinmi, O. (2024) Green HRM and hospitality industry: challenges and barriers in adopting environmentally friendly practices. *Journal of Hospitality and Tourism Insights*, 7(1), 121-141.

Yakushev, O.; Zakharova, O.; Zachosova, N.; Yakusheva, O.; Chernyshov, O.; Naboka, R. (2023) Assessment of financial and economic security of business innovation enterprises in hospitality and tourism. *Financial and Credit Activity Problems of Theory and Practice*, 2, 135-147.

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Contemporary Paradigms of Security Within Industry: Digital Landscape Toolkit, Performance-based Vision, and Legal Frameworks

Paradigmas Contemporâneos de Segurança no Contexto Industrial: Ferramentas para o Panorama Digital, Abordagem Baseada no Desempenho e Enquadramentos Jurídicos

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ABSTRACT
In the technocentric paradigm marked by rapid digital progress, digital transformation becomes a key condition for the effective functioning of industrial enterprises. It reshapes traditional business models, introducing new standards of productivity, resilience, and competitiveness. Autonomous systems, IoT, and AI enhance efficiency, reduce costs, and strengthen cybersecurity, yet demand a comprehensive analysis of economic and legal security. This study evaluates the use of digital tools in managing industrial security, identifies development vectors, and justifies the need for formalised cyber defence mechanisms. The methodology combines theoretical, empirical, and legal approaches to examine how digital technologies optimise production, management, and decision-making. International indices on digital development, communication, services, and cybersecurity are analysed. The challenges of

digital integration are outlined, highlighting managerial barriers, cybersecurity concerns, and conceptual approaches to legal support for transformation.
Keywords: Digital transformation; Information and communication technologies; Big data analytics; Cybersecurity; Industrial enterprises.

JEL Classifications: O33; L60; K23; D80; G32.

RESUMO

No paradigma tecnocêntrico marcado pelo rápido progresso digital, a transformação digital torna-se uma condição essencial para o funcionamento eficaz das empresas industriais. Esta transformação reformula os modelos de negócio tradicionais, introduzindo novos padrões de produtividade, resiliência e competitividade. Sistemas autónomos, IoT e IA aumentam a eficiência, reduzem custos e reforçam a cibersegurança, exigindo, contudo, uma análise abrangente da segurança económica e jurídica. Este estudo avalia a utilização de ferramentas digitais na gestão da segurança industrial, identifica vetores de desenvolvimento e justifica a necessidade de mecanismos formalizados de ciberdefesa. A metodologia combina abordagens teóricas, empíricas e jurídicas para examinar como as tecnologias digitais otimizam a produção, a gestão e a tomada de decisões. São analisados índices internacionais sobre desenvolvimento digital, comunicação, serviços e cibersegurança. Os desafios da integração digital são delineados, destacando barreiras de gestão, preocupações com a cibersegurança e abordagens conceptuais ao apoio jurídico da transformação.

1. Introduction

The accelerating pace of scientific and technological advancement constitutes a pivotal driver of modernization within the economic landscape at the microeconomic level, particularly in the operational domains of industrial enterprises. The intensification of digital transformation processes unveils novel horizons for institutional growth and innovative progress, while simultaneously necessitating substantial capital investment, paradigmatic shifts in organizational culture, and a systemic reconfiguration of human capital development. Economic entities that exhibit a high degree of adaptability to digital innovation secure significant strategic advantages and foster the prerequisites for long-term sustainable development.

The implementation of the Industry 4.0 paradigm is concomitant with the emergence of qualitatively new threats that stem from the deployment of high-tech digital solutions and are conditioned by the sectoral idiosyncrasies of specific economic segments. This has resulted in a considerable complication of risk matrices, particularly within the industrial sector. Industry 4.0 represents a technologically driven stage of evolution characterized by the predominance of autonomous production systems embedded within intelligent management frameworks that engage in continuous interaction with both endogenous and exogenous environments, thereby shaping globalized industrial ecosystems with a high degree of interconnectedness.

In the current context, numerous economic actors are undergoing profound transformational shifts in their production domains, aimed at optimizing operational efficiency, minimizing transaction costs, and adapting to volatile market dynamics through the implementation of cutting-edge digital mechanisms. These include the institutionalization of modular production architectures, the establishment of collaborative platforms, the customization of product offerings, and the integration of environmentally conscious technologies, including energy-saving and energy-efficient systems. However, despite the presence of these favorable dynamics, the digital transformation of industrial processes is accompanied by a spectrum of challenges that jeopardize enterprises' capacity to safeguard their economic interests and adhere to regulatory requirements. Among such challenges are the escalation of cyber threat intensity and complexity, the increasing technological dependency of production workflows on digital infrastructure, and the criticality of safeguarding intellectual property and data confidentiality – factors that collectively necessitate the adoption of comprehensive and interdisciplinary security strategies.

Given the exponential acceleration of digitalization across all sectors of economic activity, there arises an urgent imperative for legislative bodies to engage in continuous regulatory monitoring in order to ensure the timely adaptation of legal frameworks in alignment with the imperatives of the digital economy. Consequently, ensuring legal and informational security within the digital paradigm emerges as one of the paramount challenges confronting the contemporary socio-economic order.

2. State-of-art

The issue of the impact of digital transmutation on business entities remains a focal point of sustained heuristic inquiry within scholarly discourse, given its conceptual multidimensionality and epistemological significance in the context of continuous technogenic evolution. Over the past decades, researchers such as Boulton (2020), Buhrimenko and Smirnova (2024) have conducted purposeful theoretical and methodological investigations into the mechanisms through which digital innovations affect the paradigms of economic, political, and cultural development, with an analytical emphasis on institutionalised phenomena such as algorithmic intelligence, cyber-physical systems, and large-scale data analytics.

According to Goldfarb and Tucker (2019), digital transformation transcends mere superficial technological upgrades, constituting instead a profound revision of traditional business archetypes, consumer practices, and socio-economic interactions, in which value orientations and institutional priorities are undergoing radical realignments. The polyvectorial aspects of societal digital reprogramming are increasingly becoming the object of interdisciplinary interpretation, as evidenced in the works of Khan et al. (2023), who underscore the necessity of synergistic integration between blockchain architectures, cognitive algorithms, and the industrial Internet of Things to form a multifunctional technological environment where innovation is actualised not in isolation but through interaction.

Digital metamorphosis of the business environment within the framework of globalisation trends undeniably emerges as a determinant axis of strategic organisational reconfiguration, generating both challenges and opportunities for enterprises. Thus, Ozdogan et al. (2017) articulate a dichotomy between the vector of productivity and the paradigm of total digitalisation, which in the future is expected to induce an ontological transformation of entrepreneurial entities. Even within the digital economy of the European Union, as noted by Mihus and Gupta (2023), there is an escalating reliance on data analytics and process algorithmisation as catalysts for economic growth and innovative breakthroughs.

The impulses of digital transformation determine the intensification of production processes, cost reduction, and profit multiplication, as documented by Moghrabi et al. (2023). In particular, digital technologies facilitate rapid adaptation to shifting market conditions, enhance energy efficiency, optimise logistical routes, and enable the creation of personalised customer propositions, thereby implicitly influencing customer loyalty and sales volumes. Blockchain technology, in turn, actualises the vector of data transparency and trust, serving as a foundational pillar for the construction of sustainable long-term partnerships.

Peter et al. (2023) contend that technological advancements – manifested in augmented intelligence, voice interfaces, autonomous transport systems, robotics, and predictive analytics – have led to a qualitative shift in digital tools from mere communication instruments to powerful analytical and managerial mechanisms. In this context, blockchain ensures data integrity and verifiability within business intelligence frameworks, while its convergence with cognitive technologies, as demonstrated by Rakibul (2024), engenders innovative solutions across domains such as logistics, finance, and the operational architecture of enterprises.

Nevertheless, these processes, notwithstanding their positive correlation with economic advancement, engender a spectrum of security dilemmas, including cyberattacks, phishing, malware infiltration, informational manipulation, and socio-digital fragmentation – as

emphasised by Kyrylenko (2024). Therefore, contemporary academic paradigms are increasingly directed towards constructing theoretical and applicative frameworks for a resilient economic security system under conditions of digital turbulence. Baddam et al. (2023), for instance, advocate for the analytical exploration of shifting consumer behaviour, evolving regulatory landscapes, and technological proliferation through the prism of secondary data.

Digitalisation simultaneously functions as a vector for financial inclusion, economic emancipation, and innovation, while also generating normative ambiguity, cyber threats, and infrastructural constraints. As noted by Shostak et al. (2024), the priorities for forming a secure digital environment must include regulatory clarity, risk-oriented governance, cyber-resilience, and consumer awareness. The interdisciplinary nature of the digital economy necessitates integrative collaboration between legal and economic thought to design adequate regulatory models.

According to Khaustova (2022), regulation of the digital sector requires a synthesis of institutional, legal, economic, organisational, socio-psychological, and technological mechanisms, with the application of multilayered methodological tools. However, as Orlova (2023) observes, despite the phenomenal intensification of digital transformations, academic discourse has yet to crystallise a comprehensive methodological paradigm for their integration into socio-economic praxis. The systematic attention of economists and practitioners to the digital economy entails the need to develop novel legal constructions for regulating digital interactions. Overcoming existing normative lacunae requires the engagement of multidisciplinary consortia of experts — from legal scholars to software engineers. Nevertheless, despite significant progress, the impact of digital innovation on the economic security of entrepreneurial structures remains an area of interpretive incompleteness and scholarly inquiry.

The present study is devoted to a thorough analysis of the current state and conceptual trajectories of the institutionalisation of digital technologies within the framework of integrated security management systems of industrial business entities, with an emphasis on the synergetic interaction of economic and legal paradigms. The author's specific objective is to provide a substantiated rationale for the potential advancement of mechanisms ensuring the efficacious application of digital transformation instruments, particularly in the realm of cybersecurity, amidst a turbulent socio-economic environment.

3. Research Methodology

The research methodology encompasses a comprehensive array of general scientific and specialised methods, prominently featuring generalisation, synthesis, scientific abstraction, analytical diagnostics, and both regulatory and statistical analysis, thus enabling a multidisciplinary approach to the explored issues. To ensure a dialectical interpretation of the socio-economic metamorphoses induced by the digital transformation of the industrial sector, the study employed dialectical reasoning, formal logical tools, and elements of systems analysis, facilitating extrapolation of findings across macro- and meso-levels.

The application of regulatory and legal analytical tools enabled the identification of the fundamental structural components of the legal environment that condition the effective implementation of digital technologies in industrial governance practices.

Information and communication technologies function as a foundational driver of high-level comparative analytics, ensuring access to vast repositories of relevant data. The analytical diagnostics method facilitated the stratification of key indicators reflecting the degree of digitalisation of the European Union's economy in general and the industrial complex in particular. The interpretation of empirical data was based on open-access sources, including the Digital Decade DESI visualisation tool (composite index), the ICT Development Index (a comprehensive indicator of information and communication technology advancement), the NCSI (National Cyber Security Index, reflecting the overall status of cybersecurity) (NCSI: Ranking, 2023), and Open Data in Europe (specifically the percentage of open data in the business sector) for the year 2023.

The utilisation of methodological synthesis and heuristic generalisation enabled the consolidation of the entire corpus of obtained scholarly outcomes into a coherent paradigmatic construct, fully reflecting the pertinence of the issue regarding the deployment of digital instruments to ensure the economic and legal security of industrial enterprises. The conducted systematic literature review, encompassing scholarly discourse from leading international academics and other authoritative sources, facilitated the reconstruction of the current theoretical and empirical landscape of digital transformation, the identification of systemic vulnerabilities within economic and legal security management – particularly cyber threats – and the formulation of the author's conceptual perspective on the problem in question.

4. **Results**

The contemporary economic landscape is characterized by rapid development, fundamentally driven by the integration of digital technologies that serve as pivotal catalysts for progress across all sectors of economic activity. Digital transformation, in turn, emerges as an indispensable facet of industrial advancement, delineating the forefront of modern production system evolution. The deployment of digital instruments significantly enhances productivity, fosters the creation of innovative products and services, and facilitates the agile adaptation of enterprises to fluctuating market conditions. Companies that effectively incorporate digital transformation into their operational frameworks consolidate competitive advantages and establish the foundation for sustainable and resilient development.

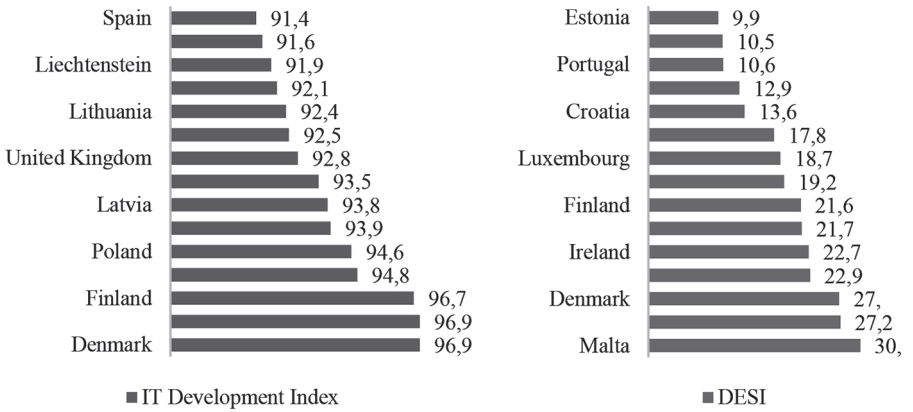
The proliferative augmentation in data volumes engendered by mercantile entities exacerbates the obsolescence of conventional data-processing paradigms and mandates the conceptualization and enactment of avant-garde epistemological frameworks. By capitalizing on the burgeoning of datasets and sophistications in heuristic instrumentation, enterprises are capacitated to execute perspicacious analyses of market vicissitudes, discern nascent prospects, and refine endogenous operational modalities. This faculty markedly ameliorates the exactitude and celerity of executive deliberations, thereby enhancing competitive ascendance (Buhrimenko and Smirnova, 2024). To effectuate an exhaustive interrogation of the cybernetic maturation of economic architectures, sundry barometers are deployed, inter alia the ICT Development Index, DESI, the e-Government Development Index, the Global Cybersecurity Index, and the Open Data Maturity rating. The deployment of

information and communication technologies constitutes an irreplaceable armamentarium for comparative epistemological inquiries across variegated geopolitical expanses, enabling the demarcation of vanguards and stragglers in the trajectory of digital transfiguration. It likewise facilitates the cartography of overarching teleological schemas on the global politico-economic proscenium and assists in the diagnostic delineation of infrastructural lacunae in cyberspatial architecture, Internet permeation, and populational techno-literacy.

The ICT Development Index (Figure 1) elucidates that notwithstanding the tenacity of the cyber schism among European polities vis-à-vis informatization, an incipient trajectory toward its dissipation appears tenable. This vector is predominantly correlated with prodigious pan-European endowments in digital apparatuses, encompassing the propagation of broadband conduits, mobile telecommunication matrices, and ancillary pivotal elements of digital substratum, conjoined with regulatory stratagems fostering inclusive digitization. An elevated ordinal status in the digital echelon operates as a formidable magnetizer of extraterritorial capital, emblematic of a propitious entrepreneurial milieu and catalytic of transnational synergies in the metamorphosis of digital ecosystems (Hubarieva et al., 2023).

Augmented DESI valuations connote a resilient and propitious fiscal biosphere that beckons patrimonial influx from both endogenous and exogenous loci. Commercial entities domiciled within jurisdictions of august DESI stratification (Figure 1) manifest heightened salience in the global mercantile arena, owing to their superior aptitude in exploiting digital apparatuses for procedural streamlining, amelioration of deliverables, and penetration into unexplored commercial interstices (Mihus and Gupta, 2023). This metric constitutes a fulcrum for the corporate sphere, as it encapsulates the aggregate quotient of a nation's cybernetic evolution and exerts significant sway over pivotal vectors such as capital magnetism, innovative fecundity, competitive robustness, and cross-border collaborative enterprise.

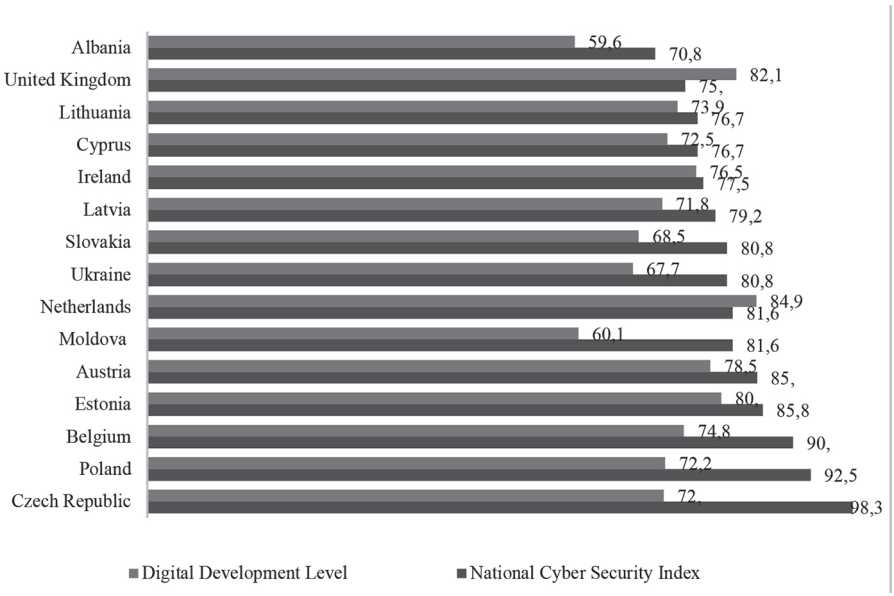
Figure 1 – Preeminent European Nations as ranked by the ICT development index and DESI, 2023



Source: Based on data from Measuring digital development ICT Development Index 2023 (2023); Digital Decade DESI visualisation tool (2023).

The systematic implementation of comprehensive monitoring of cybersecurity conditions constitutes a foundational component within the architecture of national security paradigms, serving as a guarantor for the preemptive identification and subsequent neutralization of latent vulnerabilities. This, in turn, facilitates the consolidation of stability within the information and communication continuum and enables the realization of an integrated digital transformation, particularly within the industrial sector (Kyrylenko, 2024). In response to the escalating cyber threats, European states are intensifying financial allocations towards the institutional infrastructure of cyber defence, enhancing the educational and professional training of domain-specific specialists, and amplifying transnational cooperation in the field of information security through the systematic exchange of threat intelligence and the codification of integrated protection protocols. Furthermore, a thorough revision of the regulatory-legal framework is being undertaken, with a particular emphasis on the jurisdictional codification of liability for malicious cyber activity and the implementation of norms safeguarding individualized digital identifiers. These measures enable such states to consistently maintain leading positions in the global Cybersecurity Index rankings (Figure 2).

Figure 2 – Comparative overview of leading European states by national cyber security index in correlation with digital development levels, as of August 2023

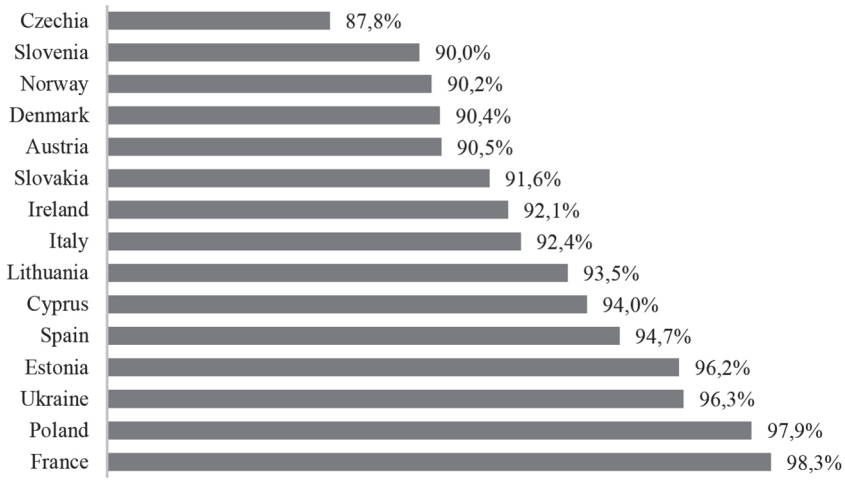


Source: Based on data from Digital Decade DESI visualisation tool (2023).

The Open Data Maturity ranking constitutes a highly effective analytical instrument for the verification of national jurisdictions' digital competence and the evaluation of their capacity for innovative transformation. This metric acquires particular significance within the

industrial sector, as open data operates as a powerful catalyst for structural reconfiguration and economic expansion. Consequently, its systematic development emerges as an imperative for states striving to ensure long-term economic stability. According to the empirical data presented in Figure 3, as of August 2024, the French Republic exemplifies the highest degree of methodological maturity in the domain of open data, ensuring comprehensive access to official information and fostering an innovation-driven ecosystem for its utilization. Poland, which occupies the second position, demonstrates a dynamic strategy aimed at intensifying the accessibility of open data sets and their targeted application in societal and economic development processes. Ukraine, ranking third, reflects an extraordinary level of institutional effort toward transparency and data openness, despite the constraints imposed by the ongoing martial law, thereby affirming its commitment to digital emancipation amidst crisis conditions.

Figure 3 – Consolidated ranking of leading European nations according to the open data maturity indicator for 2023



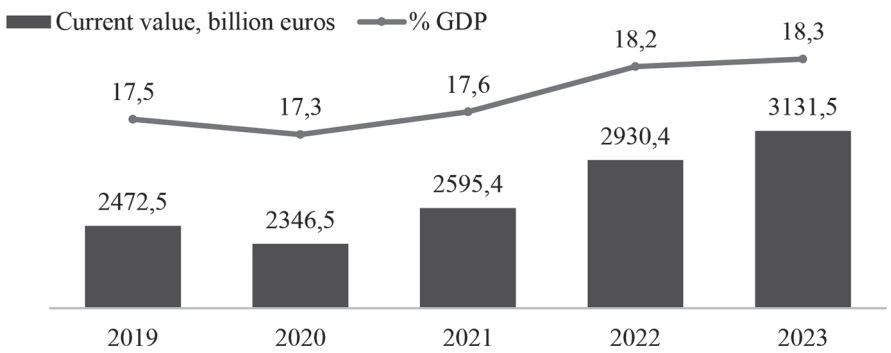
Source: Based on Open Data in Europe 2023 (2023).

The industrial sector of the European continent is undergoing profound and multifaceted transformations driven by both macro-global trends and purely local exogenous and endogenous determinants, among which intensified digitalization of the social structure, growing environmental awareness, demographic challenges such as population aging and a shortage of skilled labor resources, as well as shifts in international trade paradigms stand out. Collectively, these factors stimulate increased competition, primarily from Asian regions, imposing an imperative on European industry to adapt to new conjunctural conditions. Several member states of the continent have encountered the phenomenon of deindustrialization, particularly pronounced in traditional sectors such as metallurgy and the textile

industry; simultaneously, a parallel restructuring process oriented toward the development of high-tech sectors and innovative platforms is underway. The incorporation of advanced technological solutions, including the Internet of Things, artificial cognitive systems, and big data analytics, radically transforms production algorithms, fostering significant growth in operational efficiency and adaptive flexibility of manufacturing.

At first glance, the assertion of universal industrial development growth across all European countries appears discordant within the context of globalization processes, deindustrialization, and digital reorganization; it should be noted that traditional sectors such as steelmaking and textiles face significant structural challenges. Competitive pressure from Asian economies remains intense, and geopolitical instability creates additional risks for European industry. Nonetheless, overall, positive trends are emerging related to technological modernization, a concentration of efforts on high-tech segments, and state subsidiarity support (Figure 4).

Figure 4 – Progression of the European industrial sector (excluding construction) from 2019 to 2023



Source: Based on data from (Decision – 2011/833 – EN – EUR-Lex (2011).

Digital transformation fundamentally reconfigures the vectors of industrial evolution, unveiling unprecedented prospects for economic growth and technological advancement. The proliferation of technologies, particularly automation, robotic systems, and artificial intelligence, drives exponential increases in productivity and significantly reduces production costs while simultaneously catalyzing the emergence of innovative entrepreneurial structures (Arroyabe et al., 2024). Despite the evident potential benefits digital transformation offers to industrial entities, its implementation is often impeded by numerous barriers, as elaborated in Table 1. Impulsive adoption of digital innovations can provoke destabilization of the existing managerial architecture of industrial enterprises, which, in turn, may induce highly unpredictable consequences.

Table 1 – Common challenges in managing industrial enterprises during digital transformation implementation

Obstacles	Causes	Resistance Content
Transformation of Corporate Paradigms	Low adaptability to transformations	The inherent inertia of corporate entities significantly impedes the implementation of advanced technological innovations.
	Deficiency of an innovation culture	A substantial segment of organizations exhibits retrogressive tendencies, rendering them incapable of engaging actively in digital convergence processes.
Human Capital	Institutional insufficiency of funding	Substantial investment requirements in infrastructure, educational programs, and cutting-edge technologies constitute a formidable financial barrier.
	Shortage of competent professionals	The limited availability of highly skilled personnel critically hampers the advancement of digital evolution within enterprises.
Cybersecurity Domains	Escalation of cyber threats	The progressive increase in the volume of digital content and intensification of cyberattacks present significant risks to information security.
	Breaches of data confidentiality	The potential compromise of confidential data considerably demotivates organizations from pursuing radical digital experiments.
Lack of Unified Regulations	Regulatory pluralism	The multiplicity of normative standards substantially complicates system integration processes.
Resistance to Transformation	Personnel resistance	In the absence of collective cooperation, any digital initiatives are a priori unproductive.
Legacy Information Artifacts	Obsolete technological systems	Legacy systems create significant obstacles to the seamless integration of contemporary digital platforms.
	Uncorrelated information systems	The fragmentation and isolation of information systems severely hinder data exchange and inter-system collaboration.
Legal Restrictions	Issues of informational compliance	Regulatory norms in the realm of personal data protection may constitute barriers to the scaling of digital technological solutions.
Suboptimal Strategy	Suboptimal selection of the technology stack	The selection of technologies must be underpinned by meticulous analysis and aligned with the specific requirements of the organization to avoid strategic missteps.

Source: Compiled by the author based on Buhrimenko and Smirnova (2024).

The systematic implementation of advanced information technology innovations and algorithmic frameworks constitutes a fundamental determinant of enterprises' digital transformation, as it facilitates the creation of an integrated digital environment characterized by high levels of interaction and dynamism. The technological foundation of contemporary innovations is grounded in the achievements of the Fourth Industrial Revolution, including intelligent systems, robotic complexes, large-scale data analytics, digital platforms, and additive manufacturing technologies (3D and 4D printing) (Vereskun et al., 2021; Hrosul et al., 2021).

Technological support for the digital transformation of industry encompasses three interrelated components: data processing tools, methodologies for optimizing production processes, and instruments for integration with the external environment. The critical digital technologies today include artificial intelligence systems, machine learning methods, big data technologies, cloud computing, blockchain, the Internet of Things (IoT), as well as augmented reality (AR) and virtual reality (VR) technologies, accompanied by comprehensive cybersecurity measures. Notably, cognitive technologies represent an integral element of the Big Data ecosystem, functioning as a tool for processing vast information arrays (Table 2).

Table 2 – Key application areas and digital technologies in industrial enterprise operations

Area of Activity	Technologies and Tools (Simplified)
Material Flow Management	Internet-connected devices; drones; robots; large-scale data analysis platforms
Production Process	Smart technologies; brain-related technologies; intelligent machines; blockchain; advanced physical tech; Internet-connected devices; cloud computing; facial or fingerprint recognition; unmanned machines; 3D printing; automated control systems
Product Promotion and Sales	Data analysis; smart technologies; intelligent machines; blockchain; Internet-connected devices; cloud services
Service and Maintenance	Data analysis; smart technologies; intelligent machines; blockchain; Internet-connected devices; cloud computing; biometric scanning; unmanned machines; automated systems; robots
Resource Provision	Smart technologies; blockchain; advanced physical technologies; Internet-connected devices; 3D printing; robots
Technological Innovations	Data analysis; smart technologies; brain-related technologies; intelligent machines; blockchain; cloud services; 3D printing
Personnel Management	Data analysis; smart technologies; brain-related technologies; intelligent machines; blockchain; cloud services
Infrastructure Business Model	Data analysis; blockchain; cloud services; intelligent machines; Internet-connected devices

Source: Based on Chmeruk (2020).

The determination of optimal digital instrumentation is contingent upon, inter alia, the scale of the enterprise, the idiosyncratic attributes of its production processes, and the elasticity of its fiscal resources. A holistic and multilevel paradigm – encompassing the synergistic deployment of heterogeneous technological modalities alongside the perpetual capacitation of human capital – constitutes the cornerstone of efficacious resilience against cybernetic incursions. Table 3 delineates an array of digitized apparatuses systematically integrated to obviate cyber hostilities and mitigate the manifold vulnerabilities inherent in the operational infrastructure of industrial entities.

Table 3 – Security solutions in the digital enterprise environment

Category	Description
Intrusion Detection and Prevention Systems (IDS/IPS)	Continuous surveillance of telecommunication environments is conducted to discern anomalous behaviors that may be indicative of malicious intent, utilizing automated mechanisms for real-time network traffic analysis.
Identity and Access Management Systems (IAM)	The allocation of differentiated access rights to informational assets is implemented through multi-tiered authentication and authorization protocols, ensuring the secure interaction of entities within computational ecosystems.
Network Firewalls	The regulation of network communication is achieved via the deployment of packet filtering policies, which enforce selective transmission permissions based on predefined authorization criteria.
Anomaly Detection Mechanisms (ADM)	The systematic examination of aggregated data within computational infrastructures aims to identify statistically significant deviations that could be construed as indicators of latent security threats.
DDoS Mitigation Systems	Architectural countermeasures for safeguarding information and telecommunication infrastructures involve the proactive suppression of excessive network flows that exhibit characteristics of distributed, coordinated overload attacks.
Data Encryption Systems	The confidentiality and integrity of data are assured through the application of robust cryptographic transformations, both during transmission across communication channels and in storage on physical or virtual media.
Backup and Recovery Systems	Automated replication and preservation of mission-critical data—structured in accordance with fault-tolerant design principles—facilitate rapid restoration of operational capabilities in the aftermath of deleterious incidents.
Integrated Security Solutions (SIEM/SOAR/EDR)	The convergence of heterogeneous telemetry sources enables comprehensive cyber event analysis, fostering the identification of latent threats, correlation of incidents, and the initiation of automated response protocols.

Source: Compiled and supplemented by the author based on Khan et al. (2023).

The automation of production processes through the deployment of the aforementioned technological instruments effectively mitigates numerous inaccuracies inherent to manual labour, thereby ensuring an elevated degree of precision and operational reliability in task execution. Furthermore, these tools facilitate integrative interaction among all participants within the production environment, engendering synergistic growth in labour productivity and a substantial reduction in workforce expenditures. It is essential to underscore that the sector-specific characteristics of economic entities predetermine divergent levels of adaptive capacity to digital transformation, as well as variable efficacy in the application of digital technologies across distinct industrial domains. Manufacturing enterprises, owing to the protracted nature of their industrial cycles, encounter extended capital return periods; nevertheless, they employ a significantly broader arsenal of digital instruments aimed at the optimisation and automation of technological processes than do service-oriented entities (Yaqub and Alsabban, 2023).

The global digital transformation is accompanied by the emergence of novel juridical phenomena, notably digital assets, which necessitate the elaboration of appropriate legal constructs for the normative regulation of this dynamically evolving sphere (Table 4). Digital technologies precipitate the formation of new legal relations that demand meticulous codification, with a precise articulation of the rights, obligations, and legal liabilities of the involved parties. This task becomes particularly intricate in scenarios devoid of direct intersubjective engagement, thereby implicitly complicating the institutional definition of legal status among stakeholders. Accordingly, the development of coherent jurisprudential mechanisms constitutes a multidimensional challenge that requires the concerted engagement of legal scholars, information technology experts, business sector representatives, and civil society actors.

The integration of big data analytics enables the identification of latent patterns and trend dynamics within data structures that were previously impervious to systematic analysis. Raw, fragmented enterprise data dispersed across multiple sources lacks intrinsic informative value; however, through intelligent interpretation grounded in pre-established parameters, such data is transformed into cognitively significant material suitable for the formulation of rationalised managerial decisions. The pertinence of these technological paradigms is evident across a multitude of sectoral contexts, wherein they are employed to facilitate procedural automation, data analytics, trend extrapolation, and the personalisation of user-oriented services.

Table 4 – Proposals for implementing legal mechanisms for digital transformation

Regulatory Domain	Conceptual Foundation	Implementation Proposal
Substantive transformation of the normative matrix under digital reality	Renovation of the positivist legal paradigm through the implementation of a composite, multi-source methodology that fuses axiological plasticity with structural rigidity.	Initiate the formulation of an integrative digital code that accumulates heterogeneous normative sources via technological unification and juridical interoperability.
Algorithmization of procedural legitimacy in justice	Jurisdictional evolution acknowledging the epistemic recalibration of adjudicative reasoning under the influence of neural architectures and statistical teleology.	Introduce experimental frameworks for AI-assisted adjudication, contingent on embedded legal reflection, real-time precedent-based monitoring, and strict adherence to justice principles.
Transnational cybersovereignty and digital autonomy	The emerging hypersubjectivity of nation-states within cyberspace necessitates the reconceptualization of sovereignty as a dynamic construct amid asymmetric transjurisdictional data flows.	Enact a legislative regime ensuring sovereign control over critical information infrastructures while imposing normative constraints on transcontinental digital interventionism.
Redefinition of individual rights in the digital environment	Post-anthropocentric legal theory reconceptualizes personhood as a multi-agent, holographic construct that is intrinsically shaped by algorithmic ontologies and mediated informational structures.	Draft a comprehensive Digital Corporeality Act that establishes virtual identity as a legally protected attribute and codifies emergent subjective rights, including the right to algorithmic self-expression and cognitive privacy.
Institutionalization of public-private cognitive symbiosis in e-governance	A neo-systemic regulatory framework grounded in cognitive-legal complementarity, facilitating co-evolutionary governance between the interventionist state and techno-entrepreneurial private actors.	Develop a dual-governance doctrine for digital public services, wherein the state assumes a facilitatory, meta-regulatory role, while private entities provide innovative, adaptive infrastructure within a bounded legal architecture.

The General Data Protection Regulation (GDPR) constitutes an intricate and far-reaching legislative framework promulgated by the European Union, meticulously devised to uphold the inviolable prerogatives of individuals in relation to the intricate modalities of personal data processing. Its overarching objective resides in the fortification of informational autonomy through the imposition of unequivocal juridical strictures governing the acquisition, archiving, and manipulation of such data, concomitantly delineating stringent prerequisites for its transnational dissemination. In light of the inexorable ascendancy of computational paradigms such as cloud infrastructures and machine intelligence, these emergent technological vectors necessitate the imposition of rigorous and anticipatory normative oversight. Consequently, for industrial entities to harness digital informational resources with maximal efficacy, it is imperative that they incessantly recalibrate and augment their technological substratum.

Such strategic modernization engenders not only heightened operational efficaciousness but also fortifies the enterprise's structural resilience and market-oriented dynamism amidst volatile economic vicissitudes. Albeit beset by inherent impediments, the gravitation toward advanced technological ecosystems emerges as an axiologically superior trajectory, given its propensity to consolidate both productive output and systemic security.

5. **Discussion**

The digital economy, embodying a synthesis of neo-industrial segments and traditional industries reconfigured through the prism of digital innovations, functions as an intensifier of economic advancement while simultaneously serving as an instrument of profound socio-cultural mutation (Hapieieva et al., 2023). The concept of the Fourth Industrial Revolution accurately reflects the current stage of socio-economic development, characterized by hyperactive synergy between production paradigms and digital technologies, accompanied by the total cognitive reconfiguration of labor processes (Mironova et al., 2022; Sukrat et al., 2023).

The digital revolution subverts the foundational matrices of social communication, generating unprecedented opportunities for interactive collaboration and informational interconnection. As a result of digital transformation processes, economic agents acquire a precedent-setting toolkit for proactively forecasting market deviations and strategically adapting to volatile externalities (Zghurska et al., 2022). Globalized digital transformation is not confined to purely technoscientific innovations – namely, the deployment of artificial intelligence, the Internet of Things, cloud-based computational infrastructures, blockchain architectures, augmented and virtual reality, and biometric mechanisms – but also presupposes a comprehensive organizational and structural inversion encompassing the entire managerial continuum of the enterprise: from the formulation of metastragetic imperatives to their pragmatic implementation through institutionalized business mechanisms (Boulton, 2020).

The success of digital transformation is, a priori, contingent upon organizational plasticity, reflexive responsiveness to external impulses, and the integrated utilization of contemporary digital instruments as means of addressing multi-layered problem clusters (Iastremska et al., 2024). Simultaneously, despite numerous benefits, the transformational paradigm engenders a range of novel risks, including the imperative for constant technological adaptation,

cybersecurity resilience, and the governance of colossal volumes of data (Likarchuk et al., 2022; Purnomo et al., 2022).

The integration of digital technologies with the natural ontological domain facilitates the construction of simulacral environments capable of adequately replicating real-world conditions, thereby opening pathways for a priori modeling, empirical testing, and product refinement during the prototypical stages, substantially reducing expenditures (Bukht and Neeks, 2017). The accelerated accumulation of technocratic knowledge, the dominance of innovation as a guiding vector, and the adaptiveness of organizational structures enable industrial actors to effectively neutralize market threats, optimize resource utilization, refine managerial practices, and consolidate economic and legal security. The contemporary configuration of industrial production demands a heightened degree of operational elasticity, the capacity for immediate responsiveness to market mutations, and the maintenance of sustainable business processes. High-tech innovations cumulatively enhance productivity, rationalize resource use, and contribute to the extensive growth of an enterprise's economic output. Within the manufacturing sector, leading industrial entities actively apply digital algorithms for comprehensive automation and the enhancement of product quality (Peter et al., 2023; Ogborigbo et al., 2024).

An enterprise's economic resilience is determined by its interaction with other components of the macroeconomic system and by its strategic positioning within the overarching network of economic interrelations (Telukdarie et al., 2023; Tymoshenko et al., 2023). At this level, the objectives of economic security transcend profit-seeking and encompass countermeasures against deviant forms of economic behavior – such as unfair competition, corrupt practices, and corporate raiding. The sustainable assurance of economic security is attainable only through the epistemological comprehension of its phenomenology and the axiological assessment of risks emerging within the professional environment. A critical determinant in this context is the consolidated preservation of corporate integrity, necessitating the responsibility of each functional unit – from security services to IT infrastructure (Rakibul, 2024).

Given the intensifying role of digital paradigms within the societal fabric, there arises an urgent necessity to transform the normative-legal doctrine in order to harmonize it with emerging technosocial determinants. The conceptualization of the Big Data phenomenon entails the use of specialized analytical tools for the deconstruction of massive informational flows and the identification of latent correlations (Zamora Iribarren et al., 2024). Novel technologies, while serving as sources of entrepreneurial innovation, simultaneously pose risks to data confidentiality and may be instrumentalized for the implementation of unethical competitive strategies. Hence, it is imperative to construct a flexible legal system that ensures a favorable investment climate while simultaneously stimulating innovative activity among all market participants (Orlova, 2023; Redko et al., 2023).

6. **Conclusion**

The conducted research has demonstrated that the current paradigm of European industrial development is characterised by deeply integrated and highly complex transformational processes, which, on the one hand, generate a multitude of systemic challenges, and on the other, unveil a spectrum of new existential opportunities for progressive advancement. Within this context, a consolidated synergy between governmental institutions, entrepreneurial entities, and civil society structures is imperative for equitably addressing structural complications and maximising the realisation of latent potential. The implementation of mechanisms aimed at reinforcing Europe's industrial capacity – particularly the institutionalisation of joint research centres and the subsidisation of innovation-oriented projects – constitutes a strategic necessity in preserving the continent's leadership in the industrial domain.

The analytical interpretation of empirical data, obtained through scholarly reflection on digital transformation in the industrial sector, has enabled a multivalent assessment of the current level of integration of digital tools into the comprehensive management of economic and legal security of industrial entities. It has also facilitated the identification of prospective trajectories for the evolution of digital security infrastructure within this sphere and substantiated the urgent need for systematic implementation of cyber-defence paradigms in the context of globalised economic activity.

Digital transgression, in its essence, engenders novel vectors of development while simultaneously accumulating high-density risks associated with breaches of confidentiality, acts of digital fraud, and other offences within the information and communication domain. Industrial digitalisation emerges as a polyaspectual and polyphonic process, necessitating a profound reinterpretation of technogenic management paradigms, corporate cultural mindsets, and the transformation of technological regulations. Nevertheless, this civilisational metamorphosis lays the foundation for innovative breakthroughs, growth extrapolation, and the articulation of new ontological objectives.

By virtue of their capacity to configure multidimensional digital environments, innovative IT architectures serve as the ontological bedrock for the full-scale digital reorganisation of industrial structures, thereby facilitating the intensification of interactivity and the expansion of economic actors' mobility.

In the process of identifying the transformational impact of digitalisation on industrial entities, analytical focus must be directed toward the modification of each phase of the production cycle and the degree of added value induced by technological innovation. Digital platforms open new horizons for the total optimisation of internal corporate processes, the institutionalisation of operational transparency, and the acceleration of procedures related to the market introduction of novel products and services.

The successful implementation of digital transformation is inextricably linked to the parallel and coordinated resolution of economic and legal security dilemmas. A comprehensive synergistic approach – encompassing the integration of technical, organisational, and regulatory-legal vectors of influence – enables the reduction of risks and stabilises the functioning of industrial entities within the digital economy. However, considering the susceptibility to fraudulent manipulations, cyberattacks, and other threats – including

those of a jurisdictional nature – digitalisation constitutes a new dimension of threats that necessitates the development of a holistic system for safeguarding the informational assets of enterprises.

Thus, the process of integrating digital technologies into the industrial sphere should be perceived not merely as inevitable but as a civilisationally determined phenomenon that unlocks new business prospects and necessitates the continual revision of the regulatory-legal matrix. Particular relevance is assumed by issues pertaining to information security, cybercrime prevention, digital taxation, and consumer protection in the digital environment. The security discourse, especially in the context of pervasive digitalisation, becomes universally pertinent to all business entities, regardless of their sectoral affiliation, and requires further fundamental and applied scholarly investigation.

References

Arroyabe, M. F.; Arranz, C. F. A.; Arroyabe, I. F. d.; Arroyabe, J. C. F. d. (2024) The effect of IT security issues on the implementation of industry 4.0 in SMEs: Barriers and challenges. *Technological Forecasting and Social Change*, 199, 123051.

Baddam, P.; Yerram, S.; Varghese, A.; Janaki R.; Goda, D.; Mallipeddi, S. (2023) From Cashless Transactions to Cryptocurrencies: Assessing the Impact of Digitalisation on Financial Security. *Asian Accounting and Auditing Advancement*, 14, 31-42.

Boulton, C. (2020) What is digital transformation? A necessary disruption.

Buhrimenko, R.; Smirnova, P. (2024) The impact of the development of digital transformation on the activity of the enterprise. *Economy and Society*, 59.

Bukht, R.; Neeks, R. (2017) Defining, Conceptualising and Measuring the Digital Economy. Development Implications of Digital Economies (DIODE) Strategic Research Network.

Chmeruk, H. (2020) Tools for digital transformation of business entities. State and regions. Series: *Economics and Business*, 2(113), 170-177.

Decision – 2011/833 – EN – EUR-Lex (2011) The official portal for European data | data.europa.eu.

Digital Decade DESI visualisation tool. (2023) Digital Decade DESI visualisation tool.

Goldfarb, A.; Tucker, C. (2019) Digital Economics. *Journal of Economic Literature*, 57(1), 3-43.

Hapieieva, O.; Holovko, R.; Vitiutin, V. (2023) Economic security of the enterprise in conditions of digitalisation. Scientific perspectives, 9(39), 322-333.

Hrosul, V.; Kovalenko, S.; Saienko, V.; Skomorovskyi, A.; Kalienik, K.; Balatska, N. (2021) Research of logical contradictions in the conditions of cluster management of the enterprise. *Journal of Management Information and Decision Sciences*, 24(1), 1-4.

Hubarieva, I. O.; Buka, S. A.; Bielikova, N. V. (2023) Assessing the Level of Digitalisation of the Economy of Ukraine and the EU Member States. *The problems of economy*, 4(58), 14-21.

Iastremska, O.; Rudych, A.; Bumane, I.; Hazukin, A.; Zdolnyk, V.; Kukhta, P. (2024) Management of innovative development of enterprises in the conditions of digitalisation: strategy modelling. *Scientific Bulletin of the National Agricultural University*, 2, 194-200.

Khan, A. A.; Laghari, A. A.; Li, P.; Dootio, M. A.; Karim, S. (2023) The collaborative role of blockchain, artificial intelligence, and industrial Internet of Things in the digitalisation of small and medium-sized enterprises. *Scientific Reports*, 13(1), 1656.

Khaustova, M. (2022) The concept of digitalisation: national and international approaches. *Law and Innovations*, 2(38), 7-18.

Kyrylenko, S. V. (2024) System of economic security in the conditions of the digital economy. *Journal of Strategic Economic Research*, 1, 40-47.

Likarchuk, N.; Andrieieva, O.; Likarchuk, D.; Bernatskyi, A. (2022) Impression marketing as a tool for building emotional connections in the public administration sphere. *Studies in Media and Communication*, 10(1), 9-16.

Measuring digital development ICT Development Index 2023 (2023) ITU: Committed to connecting the world.

Mihus, I.; Gupta, S. K. (2023) The main trends of the development of the digital economy in the EU countries. In The development of innovations and financial technology in the digital economy: monograph, OÜ Scientific Center of Innovative Research, pp. 23-41.

Mironova, N.; Koptieva, H.; Liganenko, I.; Sakun, A.; Chernyak, D. (2022) Modelling the Selection of Innovative Strategy for Development of Industrial Enterprises. *WSEAS Transactions on Business and Economics*, 19, 278-291.

Moghrabi, I. A. R., Bhat, S. A.; Szczuko, P.; AlKhaled, R. A.; Dar, M. A. (2023) Digital Transformation and Its Impact on Sustainable Manufacturing and Business Practices. *Sustainability*, 15(4), 3010.

NCSI: Ranking (2023) Index.

Ogborigbo, J. C.; Sobowale, O. S.; Amienwalen, E. I.; Owoade, Y.; Samson, A. T.; Egerson, J. (2024) Strategic integration of cyber security in business intelligence systems for data protection and competitive advantage. *World Journal of Advanced Research and Reviews*, 23(1), 81-96.

Open Data in Europe 2023. data.europa.eu (2023) The official portal for European data. Retrieved from data.europa.eu.

Orlova, O. S. (2023) Legal regulation of economic activity in conditions of digitalisation. Bulletin of the Uzhhorod National University. *Series: Law*, 1(77), 195-201.

Ozdogan, B.; Gacar, A.; Aktas, H. (2017) Digital agriculture practices in the context of agriculture 4.0. *Pressacademia*, 4(2), 184-191.

Peter, O.; Pradhan, A.; Mbohwa, C. (2023) Industrial Internet of Things (IIoT): Opportunities, challenges, and requirements in manufacturing businesses in emerging economies. *Procedia Computer Science*, 217, 856-865.

Purnomo, A.; Susanti, T.; Rosyidah, E.; Firdausi, N.; Idhom, M. (2022) Digital economy research: Thirty-five years insights of retrospective review. *Procedia Computer Science*, 197, 68-75.

Rakibul, H. (2024) Blockchain and AI: Driving the future of data security and business intelligence. *World Journal of Advanced Research and Reviews*, 23(1), 2559-2570.

Redko, K.; Borychenko, O.; Cherniavskyi, A.; Saienko, V.; Dudnikov, S. (2023) Comparative analysis of innovative development strategies of fuel and energy complex of Ukraine and the EU countries: international experience. *International Journal of Energy Economics and Policy*, 13(2), 301-308.

Shostak, L.; Fedoniuk, A.; Pomazun, O. (2024) Cyber security in the system of forming the business model of the enterprise in the conditions of the digital economy. *Economy and society*, 64.

Sukrat, S.; Leeraphong, A. (2023) A digital business transformation maturity model for micro enterprises in developing countries. *Global Business and Organizational Excellence*, 43(2), 149-175.

Telukdarie, A.; Dube, T.; Matjuta, P.; Philbin, S. (2023) The opportunities and challenges of digitalisation for SME's. *Procedia Computer Science*, 217, 689-698.

Tymoshenko, M.; Saienko, V.; Serbov, M.; Shashyna, M.; Slavkova, O. (2023) The impact of industry 4.0 on modelling energy scenarios of the developing economies. *Financial and credit activity-problems of theory and practice*, 1(48), 336-350.

Vereskun, M. V.; Kolosok, V. M.; Kolosok, E. V. (2021) The impact of digital transformation on the management of industrial enterprises. *Entrepreneurship and trade*, 30, 11-16.

Yaqub, M. Z.; Alsabban, A. (2023) Industry-4.0-Enabled Digital Transformation: Prospects, Instruments, Challenges, and Implications for Business Strategies. *Sustainability*, 15(11), 8553.

Zamora Iribarren, M.; Garay-Rondero, C. L.; Lemus-Aguilar, I.; Peimbert-García, R. E. (2024) A Review of Industry 4.0 Assessment Instruments for Digital Transformation. *Applied Sciences*, 14(5), 1693.

Zghurska, O.; Korchynska, O.; Rubel, K.; Kubiv, S.; Tarasiuk, A.; Holovchenko, O. (2022) Digitalisation of the national agro-industrial complex: new challenges, realities and prospects. *Financial and credit activity problems of theory and practice*, 6(47), 388-399.

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The Evolution of Accounting Practices in the Context of Sustainability and Social Impact, Considering Trends in Financial Analysis

A Evolução das Práticas de Contabilidade no Contexto da Sustentabilidade e do Impacto Social, Considerando as Tendências na Análise Financeira

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ABSTRACT
With the entry into force of the EU Directive on corporate sustainability reporting, public companies must disclose non-financial information, integrating ESG (environmental, social, governance) indicators into accounting and reporting. This requires adapting systems to ESG principles, classifying related costs, and ensuring transparency. The study analyzes EU directives, ESRS, and the NFRD (2014–2024), using comparative and structural methods. Results show the emergence of sustainable accounting, combining financial and non-financial reporting. ESG costs are grouped into environmental, social, and governance categories, enabling measurement of contributions to sustainability goals. Findings highlight the link between CSR and accounting trends, as well as the practical impact of EU regulations on sustainable reporting.
Keywords: Sustainable accounting and development; ESG reporting and costs; Corporate social responsibility; Innovation; Artificial intelligence.

JEL classification: M41; Q56; M14.

RESUMO
Com a entrada em vigor da Diretiva da UE sobre relatórios de sustentabilidade empresarial, as empresas públicas devem divulgar informações não financeiras, integrando indicadores ESG (ambientais, sociais e de governação) na contabilidade e nos relatórios. Isto exige a adaptação dos sistemas aos princípios ESG, a classificação dos custos associados e a garantia de transparência. O estudo analisa as diretivas da UE, os ESRS e a NFRD (2014-2024), utilizando métodos comparativos e estruturais. Os resultados evidenciam o surgimento da contabilidade sustentável, que combina relatórios financeiros e não financeiros. Os custos ESG são agrupados em categorias ambientais, sociais e de governação, permitindo medir os contributos para os objetivos de sustentabilidade. As conclusões destacam a ligação entre a responsabilidade social das empresas (RSE) e as tendências contabilísticas, bem como o impacto prático das regulamentações da UE nos relatórios sustentáveis.

1. Introduction

In today's world of globalization and rapid development of the digital economy, accounting is undergoing significant changes. Traditional financial reporting models are increasingly being supplemented by non-financial indicators that reflect sustainable development, corporate social responsibility, and environmental and social principles of business conduct. Under the influence of international initiatives such as the UN Sustainable Development Goals (SDGs) and the EU Non-Financial Reporting Directive, companies are forced to adapt their accounting systems to new stakeholder demands.

The relevance of the study is determined by the need to rethink the role of accounting information in the context of sustainable development, as well as the growing demand for integrated, transparent, and technologically adapted financial reporting. In addition, the rapid digitization of accounting processes and the introduction of artificial intelligence for processing accounting data and analytical platforms are shaping new approaches to the organization of accounting activities.

Despite significant scientific interest in CSR, non-financial reporting, and digital innovation, questions remain about how to reconcile these trends with factors such as regulatory and legal frameworks, institutional regulation, sustainable development and CSR policies, innovation, and their impact on accounting.

The purpose of this study is to systematize current trends in accounting related to the obligation of public companies to disclose non-financial information in accordance with new EU regulatory requirements during 2014–2024.

2. Literature Review

In academic discourse, several main areas of research have emerged on contemporary trends in accounting related to the growing role of sustainable development, CSR, and innovation in financial reporting. Among the priority areas for 2010-2020, researchers highlight: sustainability reporting, corporate social responsibility, and disclosure (Vysochan et al., 2021). In contrast, Diwan and Sreeraman (2024), based on a bibliometric analysis, identify the following scientific thematic discourses: non-financial reporting standards; the impact of ESG on financial performance; the role of digital technologies in financial reporting and accounting; institutional interaction in the formation of global reporting standards. Botchway and Bradley (2023) point to a significant increase in scientific interest in the social component of the concept of sustainable development: impact on communities, inclusiveness, ethical management, etc. The works of Scarpellini (2022), Sisaye (2021), and Abeysekera (2022) deserve special attention, as they contain proposals for methods of assessing the social and environmental impact of business on social justice, sustainable development, and human rights.

The main thematic areas of work identified in the critical review of the literature relate to: concepts, evolution, and the regulatory framework for ESG reporting or non-financial reporting (Erin et al., 2022; Efunniyi et al., 2024); the strategic role of CSR in reporting (Nwachukwu, 2022; Chopra et al., 2024); digitalization, artificial intelligence, and analytics

as innovations in accounting (Bielialov et al., 2023); implementation of sustainable development goals in reporting and related processes to measure companies' impact on their achievement (Sumets et al., 2022); and the role of EU directives, the UN, and professional organizations in institutional support for sustainable accounting (Gavkalova et al., 2022).

2.1. Sustainable development and non-financial reporting

Research by Diwan and Sreeraman (2024) and Pasko et al. (2021) demonstrates the growing importance of non-financial and ESG (ecological, social, governance) reporting as a means of demonstrating business commitments to sustainable development. This can be attributed to the fact that in developed countries, CSR is established as a business obligation to adhere to social standards of entrepreneurship. The study by Turzo et al. (2022) asserts that there has been a significant increase in interest in integrated financial reporting and transparency in measuring non-financial performance indicators of companies. An integrated approach to financial reporting involves harmonizing it with management reporting and summarizing the results of the financial, social, and environmental performance of enterprises. The publications by Abeysekera (2022), Levytska et al. (2022) and Vysochan et al. (2021) systematize approaches to sustainable accounting and highlight the main concepts of sustainable financial reporting. The authors point to the need to introduce ESG indicators into financial reporting to enable their analysis.

2.2. Corporate social responsibility and financial reporting

The studies by Cuomo et al. (2024) and Mohammadi and Saeidi (2022) examine the impact of the adoption of EU Directive 2014/95/EU on non-financial reporting and CSR practices and financial reporting. The establishment of mandatory regulatory requirements for companies to disclose information about their activities in the areas of the environment, social initiatives, human rights, and anti-corruption has had a significant impact on management and, accordingly, reporting. The implementation of the Directive is driven by the need to increase the transparency and accountability of companies and to meet the needs of investors and stakeholders for information on non-financial aspects of companies' operations and results in terms of sustainable practices. This work highlights the importance of accounting for transactions related to the social and environmental activities of firms as an element of the control system.

Research by Manes-Rossi and Nicolo' (2022) shows a shift from formal to substantive disclosure of information and reporting by companies on their achievement of sustainable development goals (SDGs). As a result of analyzing companies' perceptions of SDGs, Botchway and Bradley (2023) found a low level of disclosure of relevant information in companies' reports. Although accounting for relevant data on sustainable practices is beneficial for a number of reasons, the complexity and incomparability of accounting for such transactions limits companies in their rapid transition to sustainable accounting. Other studies, including Akpan and Oluwagbade (2023) and Le et al. (2024), focus on highlighting companies'

reporting practices on sustainable development, corporate social responsibility, the integration of non-financial indicators into reporting, and the management decision-making process. Ethical aspects of business conduct have become an integral part of accounting, as they enhance the reputation and trust of stakeholders in enterprises. The integration of non-financial indicators into the accounting system ensures the adoption of holistic and sustainable business decisions.

2.3. Innovations in accounting and financial reporting

Academic literature also covers the topic of introducing innovations, including artificial intelligence and cloud technologies, into accounting practice. For example, Odonkor et al. (2024) demonstrate the impact of artificial intelligence on accounting and the preparation of high-quality financial statements (relevance, reliability, understandability, comparability, credibility, and timeliness of presentation). Another study by De Silva et al. (2025) highlights the importance of digital knowledge in the processes of integration and sustainable accounting, the growing attention to digital technologies as a factor in ensuring sustainable accounting, and the importance of artificial intelligence, blockchain technology, and big data. These works demonstrate that the transition to new integrated sustainable accounting practices requires the use of innovation, technology, and digital knowledge.

3. **Methodology**

The research methodology is based on an analysis of EU legislation on corporate social reporting on sustainable development, which came into force in 2024, and relevant standards. A detailed comparative analysis of the provisions of the EU Directive on corporate reporting on sustainable development and the relevant European Sustainability Reporting Standards (ESRS) was conducted, taking into account the previous requirements of EU Directive 2014/95/EU on non-financial reporting (Non-Financial Reporting Directive, NFRD) to identify changes and innovations in the financial and non-financial reporting of large EU companies and, accordingly, to identify new trends in sustainable accounting.

The article uses structural and logical analysis and grouping methods to systematize, generalize, and classify ESG costs of enterprises within the framework of sustainable accounting. The grouping of costs made it possible to form classes of costs according to their environmental, social, and managerial nature and their economic essence. When forming expense classes, the peculiarities of the national (Ukrainian) chart of accounts (in particular, accounts of classes 1, 2, 4, 6, and 9) were taken into account, which ensures the practical application of this classification for the needs of the enterprise.

4. Results and discussion

4.1. The transformation of accounting under the influence of the concept of sustainable development

The inclusion of environmental, social, and ethical aspects in corporate reporting has become a new requirement for large companies, especially in developed countries. In today's business environment, the concept of sustainable development has become crucial for strategic management and has accordingly influenced the development of sustainable accounting and reporting concepts for companies. Accounting is no longer limited to financial indicators. Non-financial metrics, including environmental, social, and management parameters, have been integrated into the accounting system of companies in connection with the obligation to report on the social and environmental performance of large public companies. Table 1 shows the classification of expenses according to their economic nature, analytical accounting accounts, and types of expenses.

Environmental expenses are related to the accounting of companies' expenses for reducing the negative impact of their operations on the environment, including: expenses for disposal, recycling of waste using innovative methods, wastewater treatment, and environmental certification. The structure of environmental costs also includes investments in green technologies, including the purchase of energy-efficient equipment and solar power stations.

The structure of social costs includes transactions related to the company's social initiatives, compliance with social standards of business conduct, staff development and training, and occupational safety. Expenditures on anti-corruption measures and related management actions are related to the needs of public companies to ensure transparency, ethical behavior of personnel, and the development of corporate ethics.

As a result of stricter requirements for mandatory disclosure of information on social, environmental, and management activities, there is a need to move towards comprehensive, integrated sustainable accounting and integrated financial and non-financial reporting. At the national and international levels, this provides an understanding of the contribution of large businesses to the achievement of the SDGs.

Accounting for new types of expenses for social, environmental, and management activities (initiatives, projects, programs, strategies) allows for the formation of integrated financial and non-financial reporting that fully discloses information about companies' achievements within the concepts of sustainable development and CSR. However, adapting the accounting system to the needs of enterprises in measuring the effectiveness of sustainable development and CSR implementation remains a problem. Adaptation requires the use of new accounting tools, technologies for integrated reporting, and the introduction of analytical sub-accounts for transaction accounting. The investment, time, and human costs of these innovations in practice serve as a barrier to the rapid transition to sustainable accounting. At the same time, accounting for ESG costs facilitates the measurement of the effectiveness of social, environmental, and management measures, projects, and programs, including quantitative assessments of companies' contributions and roles in achieving sustainable development.

Given the growth in national spending on environmental protection by residents in EU countries during 2018–2023, accounting for these costs is extremely important for firms.

These expenditures also include investments in environmental protection activities, which are estimated at €354.68 billion in 2023 in all EU member states, or 2.1% of EU GDP. For comparison, in 2020, the amount of expenditure was €294.9 billion (Eurostat, n.d. b). The largest amounts of expenditure were recorded in Germany (€80.3 billion), France (€50.0 billion), and Italy (€47.0 billion). Estimates of the corporate sector's contribution to environmental protection expenditure amounted to 52% of total expenditure by various institutional sectors (Eurostat, n.d. a).

Sustainable accounting costs affect the financial results of large companies. Current profits decrease due to the classification of ESG expenses as current period expenses, which leads to a decrease in accounting profits, especially during the implementation phase of the CSRD (Corporate Sustainability Reporting Directive), adopted in 2022 by the EU Directive on corporate reporting on sustainable development. The document will gradually come into force from 2024 and was adopted with the aim of standardizing, expanding, and making mandatory reporting on environmental, social, and governance aspects of business. Large EU companies and foreign companies operating in the European market with a turnover of more than €150 million must report on sustainable development in accordance with the ESRS and conduct audits of their reporting with digital submission.

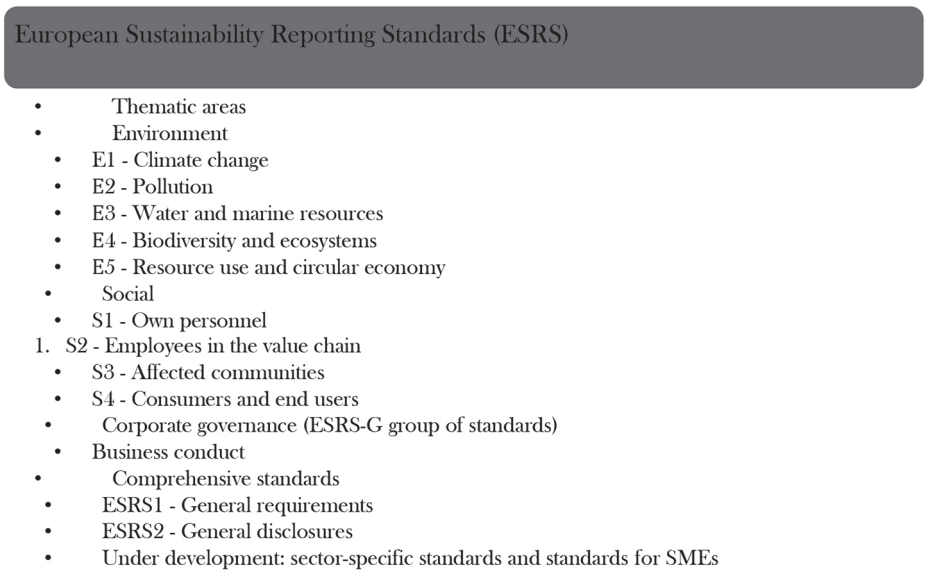
Table 1 – Classification of ESG expenses in sustainable accounting

Classification of expenses	The essence of expenses	Analytical accounting	Types of expenses
Environmental costs (E)	Related to accounting for expenses incurred to reduce the negative impact of enterprises' activities on the environment	91, 92, 949, 47, 23	Waste disposal, wastewater treatment, purchase of carbon credits, environmental certification
Social expenditure (S)	Expenses for ensuring compliance with social standards of business conduct, occupational safety, personnel development, and community relations	92, 94, 949	ESG employee training, equality support, health programs, social initiatives, and projects
Management and anti-corruption expenses (G)	Ensuring transparency, corporate ethics, internal compliance, and control	92, 92.ESG, 94, 949	Conducting audits, creating a code of ethics and internal ethical conduct rules for staff, ESG department expenses
Investments in fixed assets	Capital investments in green technologies	10, 15, 11	Purchase of energy-efficient equipment, installation of solar panels, reconstruction of production facilities
Information and analytical expenses	Costs for collecting, processing, auditing, and publishing ESG data	92, 949, 949. ESG, 66	Outsourcing of non-financial audits, subscription to ESG systems, report development
Reserves and provisions for ESG risks	Creation of provisions for expenses related to future environmental or social obligations	47, 38	Reserves for reclamation, environmental fines, compensation to those affected by negative impacts, damage to production

Source: Authors' own elaboration.

The requirements for disclosure of information on corporate sustainability reporting are set out in the European Sustainability Reporting Standards (ESRS). These are the principles of corporate sustainability reporting in the EU, covering a number of areas: environment, social sphere, corporate governance (ESG) (Figure 1). The main purpose of these standards is to provide users with clear, simple, and logical information on sustainable development. At the same time, the new requirements will provide companies with competitive advantages at the international level: strengthening their reputation among partners, investors, and consumers; attracting investment and other forms of long-term financing; and timely implementation of strategies to reduce negative environmental impact and improve working conditions.

Figure 1 – Directions of European Sustainability Reporting Standards (ESRS)



Unlike the previous EU Directive NFRD (Non-Financial Reporting Directive), the document covers a larger number of companies (about 50,000 companies) in regulated EU markets that are required to conduct audits and implement sustainability reporting standards. Therefore, companies are required to invest in all types of sustainable accounting costs, their accounting, staff training, and other areas of work related to the new requirements.

In addition, sustainable accounting costs also affect financial results by improving reputational capital, which contributes to increased trust from investors, banks, and counterparties. In recent years, CSR practices have become important for companies in terms of reputational risks, and relevant activities allow attracting the most qualified personnel, for whom social aspects are an important criterion for employment.

Improved access to capital through the recording of sustainability accounting costs allows ESG-reporting companies to gain advantages in attracting financing, including green bonds

for investment in green technologies, obtaining preferential loans to cover the costs of green technologies, and creating ESG funds (Skulysh and Fathutdinov, 2022; Riski et al., 2025).

Reduced risk of penalties is another advantage of ESG cost accounting, as compliance with legal requirements minimizes losses due to violations. Increased operational efficiency through energy conservation, recycling, and resource optimization leads to lower production costs in the medium term.

According to empirical research by Manes-Rossi and Nicolo' (2022), companies in the energy sector are transitioning from formal to substantive financial reporting. This indicates the practical implementation of reporting principles in accordance with new requirements for disclosing information on ESG practices.

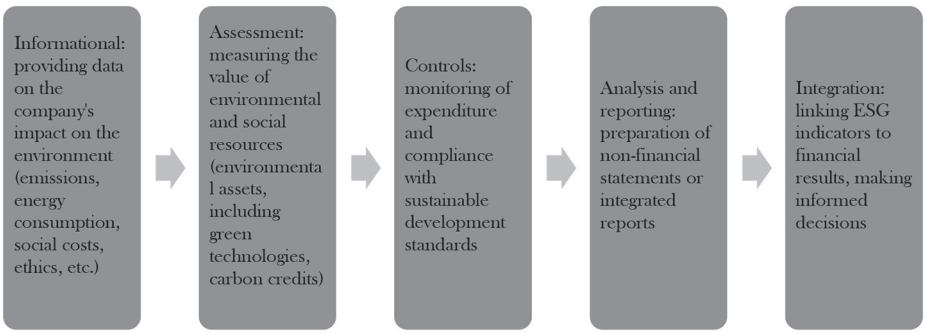
In addition, Cuomo et al. (2024) point to the significant impact of the EU Non-Financial Reporting Directive on the accounting practices of large companies. This directive encourages the disclosure of information on the impact of companies on the environment, human rights, the fight against corruption, etc., necessitating the adaptation of accounting systems and approaches to sustainability requirements.

In the context of increasing regulatory pressure and growing expectations from investors and consumers, sustainable development is increasingly becoming an integral part of companies' accounting policies, which in turn is transforming the functional purpose of accounting from a control tool to a strategic development tool.

4.2. Development of corporate social responsibility and its reflection in accounting

Corporate social responsibility has gradually become not only an ethical obligation, but also a strategic tool for companies to influence stakeholder trust, society, reputation, and long-term business sustainability. Therefore, large corporations are integrating relevant concepts into their corporate strategies in conjunction with sustainable development strategies. Its active integration into the accounting system responds to society's demand for transparency, accountability, and ethical business conduct. Mohammadi and Saeidi (2022) note the increasingly close link between CSR and key accounting concepts, particularly in the context of disclosure of information on social expenditure, charity, inclusiveness, and the protection of workers' rights. The accounting system must adapt to the recording of non-financial assets related to social initiatives, which requires a review of both methodological approaches and reporting tools. Le et al. (2024) emphasize that the combination of CSR, environmental innovation, and sustainable development strategies ensures the integration of non-financial elements into management decisions. This confirms the trend towards multifunctional accounting, which covers not only economic but also environmental and social parameters of companies' performance (Figure 2).

Figure 2 – Key functions of accounting in sustainable company development



Source: Authors' own elaboration.

The implementation of EU Directive 2014/95/EU as a regulatory framework for mandatory disclosure of information on CSR policies, their implementation results, and related risks has been a decisive factor influencing the emergence of new trends in accounting. Cuomo et al. (2024) proved that the provisions of EU Directive 2014/95/EU have significantly influenced the improvement of corporate standards and transparency of companies in the EU and contributed to an increase in the amount of non-financial information in company reports.

In summary, the development of CSR is transforming the accounting paradigm from a narrow financial perspective to a comprehensive view of a data collection system that takes into account a wide range of stakeholders and is focused on achieving long-term social value. The EU Directive on Corporate Sustainability Reporting (previously mentioned CSRD), published in December 2022, goes beyond simple CSR requirements, asking companies to consider the value of their business to a society that prioritizes sustainable development. This requires business owners to set sustainable development goals related to decarbonization, carbon emission reduction, the development of environmentally friendly products, the development of circular economy projects, etc. (Koval et al., 2023). Accordingly, companies will need a new, innovative accounting system in which accounting is not just a cost control tool, but a mechanism for reflecting the financial, environmental, and social results of their activities.

CSRD is not just about reporting, it stimulates business and influences a large number of business processes, promoting a more rigorous strategic approach to planning and implementing sustainable practices.

4.3. Innovative approaches to reporting: digitization, artificial intelligence, and big data

Innovations in the financial sector are radically changing accounting processes, in particular approaches to financial reporting and the processing of accounting data. Among the main trends are the active introduction of artificial intelligence, cloud technologies, big data, and automated accounting systems. Thus, innovations have created numerous opportunities for automating accounting processes using artificial intelligence and have enabled financial analysis through the use of big data. According to Odonkor et al. (2024), the use of artificial intelligence in accounting not only automates routine processes (such as account processing or audit testing), but also provides real-time analytics, improves forecasting accuracy, and enhances risk management. These changes are transforming the role of the accountant from a technical performer to an analyst and strategic business partner. A study by Peng et al. (2023) examines the impact of digitalization on the achievement of sustainable development goals through the improvement of ESG accounting mechanisms. Artificial intelligence technologies enable the processing of complex non-financial information and the identification of environmental and social risks based on data analytics from open sources. De Silva et al. (2025) empirically demonstrate the positive impact of digital technology integration on transparency, business accountability, reliability of reported information, and analytical data. On the other hand, researchers point to risks associated with cyber threats, personal data protection, and reduced personal responsibility of staff in an automated environment. Thus, innovation has not only changed accounting technologies, but also the philosophy of reporting, which should ensure the disclosure of meaningful, accurate, and transparent data based on the principles of reliability, relevance, timeliness, and credibility.

4.4. The state and prospects of non-financial reporting (ESG reporting)

In response to global challenges such as climate change, social inequality, corruption, and loss of trust in business, non-financial reporting has become an important component of modern corporate communication. It provides transparency regarding companies' impact on the environment, society, and governance, which is becoming critically important for investors and society as a whole.

According to the results of a study by Diwan and Sreeraman (2024) and a bibliometric analysis of literature from 2000 to 2020, the authors note a rapid increase in publications on ESG reporting, especially since 2015. This coincides with the adoption of the Sustainable Development Goals within the 2030 Agenda for Sustainable Development. Researchers are focusing most of their attention on integrated reporting, the impact of ESG factors on financial performance, and disclosure standards.

Regulatory policy plays an important role in this process. EU Directive 2014/95/EU introduced mandatory reporting for large companies on CSR and ESG issues. New initiatives, such as CSRD, have not only introduced new requirements for the structure and quality of information, but have also given impetus to the development of new accounting concepts. Cuomo et al. (2024) argue that these changes have forced companies not only to formally

disclose information, but also to integrate non-financial indicators into their reporting and use new data for strategic management purposes. These findings correlate with the results of Pasko et al. (2021) and Vysochan et al. (2021), who, based on a bibliometric analysis, demonstrate a growing scientific interest in non-financial reporting in connection with sustainable development.

Despite significant achievements in the development of sustainable accounting and ESG reporting, there are challenges in this area, such as the lack of global unified standards, insufficient data comparability, and the risks of greenwashing. At the same time, given the active participation of international organizations in the development of standards and the strengthening of ESG reporting requirements, there is a trend towards the gradual formation of an integrated reporting system, which in the coming years will contribute to the creation of global standards for reporting on companies' contributions to the achievement of the SDGs.

Thus, the systematization of accounting trends in connection with the improvement and introduction of new requirements for the disclosure of non-financial reporting demonstrates: a trend towards the need to implement an integrated model of sustainable accounting and integrated reporting that contains financial and non-financial information; a transition from formal disclosure of information on sustainable practices to a more meaningful presentation of social and environmental performance; the need for public companies to classify ESG costs in order to measure their contribution to the achievement of sustainable development goals at the enterprise and national levels.

Based on a review of current trends in accounting, the following promising areas for further research can be identified: development of unified ESG reporting standards; adaptation of accounting and models to the conditions of digital transformation; research on the impact of the new regulatory framework on the sustainable development of companies and their investment attractiveness; integration of machine learning and big data into enterprise audit procedures.

5. Conclusions

Current trends and changes in accounting demonstrate a clear shift towards integrated sustainable accounting, where financial and non-financial reporting comprehensively reflects the environmental, social, and governance aspects of business operations. The mandatory introduction of ESG reporting reinforces the trend towards more meaningful and standardized disclosure, helping stakeholders better understand the long-term sustainability of companies. This transition requires not only new methodologies for classifying and measuring ESG-related costs, but also the incorporation of sustainability goals into traditional accounting systems.

Such developments drive the transformation of accounting into a more flexible and transparent system. Innovation and artificial intelligence are increasingly seen as essential tools for building adaptive accounting models capable of processing large amounts of financial and non-financial data, detecting risks, and providing real-time analytical insights. In this way, accounting evolves from a purely technical function into a strategic instrument for forming sustainable reports, evaluating corporate responsibility, and supporting

decision-making processes. It becomes central to the assessment, measurement, analysis, and control of environmental and social costs, which play a crucial role for businesses in identifying and demonstrating their contribution to the achievement of the UN Sustainable Development Goals (SDGs).

Looking ahead, the development of unified international reporting standards will become increasingly significant for ensuring comparability and transparency across markets. At the same time, the digital adaptation of accounting systems to the requirements of both financial and non-financial reporting will intensify. This process will involve greater harmonization of ESG reporting practices, the integration of digital platforms, and the use of innovative technologies to simplify disclosure and verification. As a result, sustainable accounting will not only support compliance with regulatory requirements but also enhance the strategic value of corporate reporting in fostering trust, innovation, and long-term competitiveness.

References

Abeysekera, I. (2022) A framework for sustainability reporting. Sustainability Accounting, *Management and Policy Journal*, 13(6), 1386-1409.

Akpan, J. U.; Oluwagbade, O. (2023) Social and environmental responsibility in accounting: Beyond financial metrics. *International Journal of Social Sciences and Management Research*, 9(9), 163-188.

Bielialov, T.; Kalina, I.; Goi, V.; Kravchenko, O.; Shyshpanova, N.; Negoda, A. (2023) Global experience of digitalization of economic processes in the context of transformation. *Journal of Law and Sustainable Development*, 11(3), e814.

Botchway, G. O.; Bradley, O. J. (2023) The diffusion of the sustainable development goals (SDGs): an examination of preparer perceptions. *Sustainability Accounting, Management and Policy Journal*, 14(2), 289-312.

Chopra, S. S.; Senadheera, S. S.; Dissanayake, P. D.; Withana, P. A.; Chib, R.; Rhee, J. H.; Ok, Y. S. (2024) Navigating the challenges of environmental, social, and governance (ESG) reporting: The path to broader sustainable development. *Sustainability*, 16(2), 606.

Cuomo, F.; Gaia, S.; Girardone, C.; Piserà, S. (2024) The effects of the EU non-financial reporting directive on corporate social responsibility. *The European Journal of Finance*, 30(7), 726-752.

De Silva, P.; Gunarathne, N.; Kumar, S. (2025) Exploring the impact of digital knowledge, integration and performance on sustainable accounting, reporting and assurance. *Meditari Accountancy Research*, 33(2), 497-552.

Directive 2014/95/EU of the European Parliament and of the Council of 22 October 2014 amending Directive 2013/34/EU as regards disclosure of non-financial and diversity information by certain large undertakings and groups.

Diwan, H.; Sreeraman, A. B. (2024) From financial reporting to ESG reporting: a bibliometric analysis of the evolution in corporate sustainability disclosures. *Environment, Development and Sustainability*, 26(6), 13769-13805.

Efunniyi, C. P.; Abhulimen, A. O.; Obiki-Osafiele, A. N.; Osundare,O. S.n, Agu, E. E.; Adeniran, I. A. (2024) Strengthening corporate governance and financial compliance: Enhancing accountability and transparency. *Finance Accounting Research Journal*, 6(8), 1597-1616.

Erin, O. A.; Bamigboye, O. A.; Oyewo, B. (2022) Sustainable development goals (SDG) reporting: an analysis of disclosure. *Journal of Accounting in Emerging Economies*, 12(5), 761-789.

Eurostat (n.d., a). Environmental protection expenditure accounts. European Commission.

Eurostat (n.d., b). National expenditure on environmental protection by institutional sector. European Commission.

Gavkalova, N.; Akimova, L.; Zilinska, A.; Lukashev, S.; Avedyan, L., Akimov, O. (2022) Functioning of united territorial communities and identification of main problems of organizational support of local budget management. *Financial and Credit Activity: Problems of Theory and Practice*, 2(43), 107-117.

Koval, V.; Mikhno, I.; Tamosiuniene, R.; Kryshtal, H.; Kovalenko-Marchenkova, Ye., Huazhi G. (2023). Ensuring sustainable consumption behaviours in circular economy engagement. *Transformations in Business and Economics*, 22(2), 161-177.

Le, T. T.; Tran, P. Q.; Lam, N. P.; Tra, M. N. L.; Uyen, P. H. P. (2024). Corporate social responsibility, green innovation, environment strategy and corporate sustainable development. *Operations Management Research*, 17(1), 114-134.

Levytska, S.; Pershko, L.; Akimova, L.; Akimov, O.; Havrilenko, K.; Kucherovskii, O. (2022) A risk-oriented approach in the system of internal auditing of the subjects of financial monitoring. *International Journal of Applied Economics, Finance and Accounting*, 14(2), 194-206.

Manes-Rossi, F.; Nicolo', G. (2022). Exploring sustainable development goals reporting practices: From symbolic to substantive approaches – Evidence from the energy sector. *Corporate Social Responsibility and Environmental Management*, 29(5), 1799-1815.

Mohammadi, S.; Saeidi, H. (2022) Corporate social responsibility and financial accounting concepts: evidence from an emerging market. *Sustainability Accounting, Management and Policy Journal*, 13(3), 740-764.

Nwachukwu, C. (2022) Systematic review of integrated reporting: recent trend and future research agenda. *Journal of Financial Reporting and Accounting*, 20(3/4), 580-598.

Odonkor, B.; Kaggwa, S.; Uwaoma, P. U.; Hassan, A. O.; Farayola, O. A. (2024) The impact of AI on accounting practices: A review: Exploring how artificial intelligence is transforming traditional accounting methods and financial reporting. *World Journal of Advanced Research and Reviews*, 21(1), 172-188.

Pasko, O.; Chen, F.; Oriekhova, A.; Brychko, A.; Shalyhina, I. (2021) Mapping the literature on sustainability reporting: A Bibliometric analysis grounded in Scopus and Web of science core collection. *European Journal of Sustainable Development*, 10(1), 303-303.

Peng, Y.; Ahmad, S. F.; Ahmad, A. Y. B.; Al Shaikh, M. S.; Daoud, M. K.; Alhamdi, F. M. H. (2023). Riding the waves of artificial intelligence in advancing accounting and its implications for sustainable development goals. *Sustainability*, 15(19), 14165.

Riski, M.; Husnatarina, F.; Umbing, G. B.; Christmas, A. F.; Nasir, D.; Yeremi, R.N. H.; Ludang, R. F. A. (2025). The Effect of Green Accounting, Green Intellectual Capital Corporate Social Responsibility on Financial Performance: Empirical Study of Energy Sector Companies Listed on the Indonesian Stock Exchange for the 2021-2023 Period. *Golden Ratio of Finance Management*, 5(1), 123-136.

Scarpellini, S. (2022) Social impacts of a circular business model: An approach from a sustainability accounting and reporting perspective. *Corporate Social Responsibility and Environmental Management*, 29(3), 646-656.

Sisaye, S. (2021) The influence of non-governmental organizations (NGOs) on the development of voluntary sustainability accounting reporting rules. *Journal of Business and Socio-economic Development*, 1(1), 5-23.

Skulysh, I.; Fathutdinov, V. (2022) Analysis of the dynamics of income and expenses of the pension fund of Ukraine. *Financial and Credit Activity: Problems of Theory and Practice*, 3(44), 72-81.

Sumets, A.; Tyrkalo, Y.; Popovych, N.; Poliakova, J.; Krupin, V. (2022) Modeling of the environmental risk management system of agroholdings considering the sustainable development values. *Agricultural and Resource Economics*, 8(4), 244-265.

Turzo, T.; Marzi, G.; Favino, C.; Terzani, S. (2022) Non-financial reporting research and practice: Lessons from the last decade. *Journal of Cleaner Production*, 345, 131154.

Vysochan, O.; Hyk, V.; Vysochan, O.; Olshanska, M. (2021) Sustainability accounting: A systematic literature review and bibliometric analysis. *Calitatea*, 22(185), 95-102.

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