IBIMA Publishing
Communications of International Proceedings
https://ibimapublishing.com/p-articles/46ECO/2025/4642425/
Vol. 2025 (25), Article ID 4642425

Investment and Innovation Potential of Ukrainian Enterprises in Ensuring the Economic Security of Ukraine*

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* Presented at the 46th IBIMA International Conference, 26-27 November 2025, Ronda, Spain

Abstract

The research provides a quantitative and qualitative assessment of the investment and innovation potential of Ukrainian enterprises, identifying trends and factors affecting its development under wartime and post-war recovery conditions, and emphasizing its role as a key element of national economic security. This study addresses gaps in current literature regarding comprehensive analyses under unprecedented security challenges and the need to support post-war economic reconstruction.

Based on a combination of resource, structural-functional, and index approaches, a comprehensive methodology for assessing the investment and innovation potential of Ukrainian enterprises was developed. The study identified four key components – scientific, financial, human resources, and market – and determined normalized and standardized indicators for each to calculate an integral index for 2019–2024.

Results reveal a reduction in financial and material resources during the war, alongside relative stabilization of scientific and human resources due to adaptive strategies and structural innovation. SWOT analysis identifies internal strengths and weaknesses, as well as external opportunities and threats, which influence the growth of enterprises' investment and innovation potential as a fundamental factor in the stability and security of the national economic system at the micro and macro levels.

The study concludes that an integrated investment and innovation strategy, combining internal enterprise resources with engagement with the external environment, supported by flexible management, state assistance, and favorable institutional conditions, is essential to enhance business competitiveness, resilience, and the economic security of the state.

Keywords: investment and innovation potential; economic security; competitiveness; post-war recovery.

Introduction

The modern economy is marked by high instability and uncertainty, raising the issue of state economic security and the resilience of the national economy to internal and external threats. This largely depends on the internal capacity to protect economic sovereignty (Benson E., Mouradian C., Palazz A. L., 2024).

Cite this Article as: Mariya KHMELYARCHUK and Andrii PAVLYSHYN Vol. 2025 (25) " Investment and Innovation Potential of Ukrainian Enterprises in Ensuring the Economic Security of Ukraine " Communications of International Proceedings, Vol. 2025 (25), Article ID 4642425, https://doi.org/10.5171/2025.4642425

A key element of economic security is the investment and innovation determinant, which shapes the economy's ability to reproduce, modernise, and enhance competitiveness. Its development requires an environment that stimulates national and foreign investment in high-tech sectors and ensures integration between science and production, thereby improving resource efficiency, technological specialisation, and the share of high value-added products.

A critical prerequisite is the investment and innovation potential of enterprises, determined by their resource base (financial, material, human) and capacity to implement technologies, adapt to market dynamics, and attract investment. Strengthening this potential boosts enterprise competitiveness and resilience, supporting national economic stability (Lunina I., Nazukova N., Kvasha T., Korshun N., 2024). For Ukraine, facing military and economic instability, increasing enterprise investment and innovation potential is strategically important. Wartime conditions caused a sharp decline in activity, while post-war recovery will require significant investment, particularly in defence technologies, digital infrastructure, and other innovative sectors underpinning national economic security**.**

Analysis of recent studies and publications

The formation and development of the investment and innovation potential of enterprises and business structures is a central concern in contemporary economic science, actively studied by both Ukrainian and foreign scholars. This is evidenced by a growing number of studies on investment activity, innovation capacity, and the effectiveness of state policy, highlighting the importance of understanding how enterprises can enhance their innovation and investment capabilities.

Building on this general concern, Ukrainian researchers focus on methodological approaches to evaluating enterprise potential and its determinants at micro-, meso-, and macroeconomic levels. Yevtushenko N. (2023) and Puzyryova P. (2024) systematized approaches to structuring innovation potential, emphasizing resource, organizational, and intellectual components, while Mayorova I. (2019) proposed an integrated methodology considering investment attractiveness, innovation activity, and resource efficiency. Extending this line of inquiry, Tsimoshynska O. and Ivanova T. (2024), as well as Zalevskyi Y. and Myniv R. (2024), examined sectoral specifics of potential formation in agriculture, industry, and construction under global turbulence. Consistent with these findings, Kyrychenko O. (2023) stresses that effective management of innovation processes at the enterprise level is crucial for competitiveness and resilience.

Ukrainian research also emphasizes the strategic role of the state in enhancing the innovation and investment potential of economic entities. Demianishyn et al. (2014) highlight the necessity of coordinating fiscal and credit instruments, while Honchar M. (2024) examines institutional mechanisms designed to stimulate investment and foster a favorable business climate. Furthermore, Dubovyk A. (2024), Hrihherman Ye. (2023), and Zabarna (2024) argue that innovation potential is closely linked to regional economic development, with regional clusters and state support serving as critical drivers. In the context of wartime, Khoma I. and Vorobiy Kh. (2023) underscore strategies for attracting both national and international investments, as exemplified by the government initiative *Advantage Ukraine*.

In foreign literature, investment and innovation potential is primarily examined through concepts such as dynamic capabilities, absorptive capacity, open innovation, and the knowledge economy. Scholars emphasize that innovation is driven both by external interactions and the internal capacity of enterprises to absorb and apply new knowledge. Chesbrough (2003) highlights the role of external interactions in stimulating innovation, while Teece (2018) develops the theory of dynamic capabilities. Cohen & Levinthal (1990) and Zahra & George (2002) underscore the importance of absorptive capacity, which enables firms to recognize, assimilate, and exploit knowledge effectively. Entrepreneurship, inter-firm cooperation, and innovation clusters are further recognized as critical factors supporting innovation processes (Autio, 2017; von Hippel, 2019; Kostopoulos, 2018; Capone & Lazzaretti, 2021). At the enterprise level, effective innovation management—encompassing portfolio strategies, technological adoption, and organizational practices—plays a key role in enhancing competitiveness (Ghasemzadeh & Archer, 2022; Wang et al., 2023; Kwilinski et al., 2025; Huang, 2024; Kato, 2025; Kruglov & Shaw, 2024).

Summarizing the findings of these studies, it can be concluded that Ukrainian scholars adopt a resource-based and institutional approach to investment and innovation potential, emphasizing enterprise resources, methodological assessment, and state support, whereas foreign research highlights internal competencies, dynamic capabilities, absorptive capacity, and strategic knowledge management. Integrating these perspectives provides the foundation

for a comprehensive investment-innovation model that strengthens enterprise potential, enhances competitiveness, and ensures investment-innovation security and the resilience of the national economy.

Purpose and methodology of the study

The study aims to conduct a quantitative and qualitative assessment of the investment and innovation potential of Ukrainian enterprises, identify trends and factors influencing its development under wartime and post-war recovery conditions, and substantiate its role as a key component of the state's economic security. To achieve this, the following tasks were set:

- develop a system of analytical indicators for assessing investment and innovation potential by four components: research and development, financial, human resources, and market;
- analyse the dynamics of these components in the pre-war and war periods (2019–2024) and determine key trends;
- calculate the integral index of investment and innovation potential and perform a SWOT analysis of strengths, weaknesses, opportunities, and threats;
- outline directions for strengthening Ukraine's investment and innovation security through more effective use of enterprise potential.

The methodology combines systemic, structural-functional, resource, and index approaches, comprising four stages:

1. Developing indicators grouped into the four components.
2. Standardising and normalising indicators on a [0;1] scale for 2019–2024.
3. Quantitative assessment using the index method, calculating sub-indices and an integral index.
4. SWOT analysis for a qualitative evaluation of internal and external factors affecting investment, innovation, and economic security.

The study is based on research by Ukrainian and foreign scholars on the investment and innovation potential of enterprises, data from the State Statistics Service of Ukraine, the Ministry of Economy, Environment and Agriculture of Ukraine, the World Bank, as well as the authors' own calculations of enterprise innovation activity for 2019–2024.

This approach allowed a comprehensive assessment of the structure, dynamics, and efficiency of Ukrainian enterprises' investment and innovation potential and identified key directions for enhancing it within the national economic security framework.

Research Results

System of analytical indicators for assessing the investment and innovation potential of Ukrainian enterprises

Comparison and analysis of existing approaches to interpreting the investment and innovation potential of enterprises (as a source, as a means, as opportunities, as resources) (I. Bobukh (2010), I. Yukhnovsky (2010)) made it possible to form a system of analytical indicators of the investment and innovation potential of Ukrainian enterprises based on a resource approach (Table 1).

Table 1. System of analytical indicators of the investment and innovation potential of Ukrainian enterprises

Scientific component	Financial component
- Indices of the number of researchers in the total number of employees involved in R&D, enterprises, %; - share of employees (researchers, technicians, support staff) involved in scientific research and development, % of those employed; - indices of R&D expenditure of enterprises, %.	- Indices of total innovation costs of enterprises, %; - indices of enterprises' own expenditure on innovation from their own financial resources, % - indices of enterprises' innovation expenditure from investors' funds, %

Human resources component	Market component
- Indices of the number of employees in enterprises, %; - indices of the number of employees involved in research and development, %; - indices of labour costs, %; - indices of labour productivity of domestic enterprises, %.	- Indices of the number of types of innovative products (goods, services) introduced by enterprises in the reporting year, %; - indices of the volume of innovative industrial products (goods, services) sold by enterprises, % - share of innovative products (goods, services) sold in the total volume of products (goods, services) sold by industrial enterprises, % - share of high-tech exports, % of exports.

Source: author's own elaboration.

This approach allows a quantitative assessment of Ukrainian enterprises' scientific, financial, human, and market resources and their efficiency in commercializing innovations. Using indices enables tracking changes in investment and innovation potential before and during the war and evaluating their impact on national economic security.

A comparison of methodologies (Bobukh, 2010; Yukhnovsky, 2010) identified two main approaches: component-based assessment of enterprises' investment and innovation capacity and calculation of an integrated index using analytical indicators for scientific, financial, human, and market components. The index, with equal weighting coefficients (0.25), was standardized for comparability and to identify indicators with stimulating or disincentivizing effects, applying Zakhozhai and Koretska's (2015) range-based method.

$$n_{ij} = \frac{T_{ij} - T_{ij(min)}}{T_{ij(max)} - T_{ij(min)}} \textit{ (for stimulants)}$$

$$n_{ij} = \frac{T_{ij(max)} - T_{ij}}{T_{ij(max)} - T_{ij(min)}} \textit{ (for disincentives)}$$

where n_{ijk} is the normalized j-th indicator for the i-th year (k = 1… l); T_{ijk} is the value of the j-th indicator for the i-th year; $T_{ij(max)} - T_{ij(min)}$ are the minimum and maximum values of the j-th indicator for 2019-2024, respectively.

For statistical data processing and unification of indicators, variables were standardised to ensure that all values of each indicator for the i-th year fell within the same range for further comparison of each sub-index on a scale of [0; 1].

To calculate the sub-indices of the integral index, the normalized standardized estimates of the indicators for each component of the investment and innovation potential were aggregated by summing them up, and an integral estimate was formed as the arithmetic mean of all component. The synthetic indicators were calculated by calculating the normalized values of the analytical indicators of the innovation potential of industrial enterprises for the i-th group of indicatorsS_i (R. Kostyukevich, 2011):

$$S_i = \sum_{j=1}^{m} n_{ij} * \alpha_{ij}$$

where m is the number of indicators characterising the investment and innovation potential of enterprises;α_{ij} is the weight coefficient of the j-th indicator, which is estimated at 0.25.

The calculation of the integral indicator of investment and innovation potential based on its components is carried out using the formula (R. Kostyukevich, 2011):

$$k_{iii} = \sum_{i=1}^{q} S_{ik} * \delta_i$$

where q is the number of indicator groups;δ_i is the influence (significance) of the i-th indicator group on the integral investment and innovation potential of the enterprise.

Thus, the developed system of analytical indicators and the calculation of the integral index create a tool for quantitative measurement of the investment and innovation potential of enterprises and determination of its contribution to strengthening the economic security of the state.

Analysis and assessment of the investment and innovation potential of Ukrainian enterprises

Using the developed analytical indicators, a quantitative and qualitative assessment of Ukrainian enterprises' investment and innovation potential was conducted, tracing the dynamics of its components during wartime and post-war recovery. In particular, the indicators of the scientific component of the investment and innovation potential of Ukrainian enterprises over 2019–2024 exhibit uneven dynamics. Notably, the index reflecting the number of researchers among employees engaged in R&D increased by 21.1 points by 2024, indicating a recovery of human capital following earlier reductions (Table 2).

At the same time, the share of personnel involved in scientific research slightly decreased by 1.3 percentage points, pointing to the persistence of structural constraints in workforce composition. Nonetheless, the R&D expenditure index increased by 32 points, reflecting intensified financial support for research activities and creating conditions for enhancing enterprises' scientific and technological potential. These trends in the scientific component directly set the stage for analyzing the financial resources allocated to innovation.

Table 2: Dynamics of the scientific component indicators of the investment and innovation potential of Ukrainian enterprises in 2019-2024

Scientific component	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**Absolute deviation (2019-2024), +/-**
Indices of the number of researchers in the total number of employees involved in R&D, enterprises, %	88.7	100.6	86.8	80.9	107.7	109.8	21.1
Share of employees (researchers, technicians, support staff) involved in scientific R&D, % of total employees	6.44	6.41	5.59	4.3	4.76	5.19	-1.3
Indices of R&D expenditure of enterprises, %	99.57	113.86	121.24	79.04	108.40	131.80	32

Source: calculated by the authors based on data from the State Statistics Service of Ukraine and the World Intellectual Property Organisation

The dynamics of the financial component (Table 3) reveal corresponding fluctuations in funding for innovation activities. After a decline in 2020–2021, indices of total innovation expenditure (+99.2 points) and enterprises' own innovation spending (+73 points) demonstrate a recovery of internal financial resources.

Table 3: Dynamics of the financial component indicators of the investment and innovation potential of Ukrainian enterprises in 2019-2024

Financial component	2019	2020	20	2022	2023	2024	Absolute deviation (2019-2024), +/-
Indices of total innovation expenditure of enterprises, %	116.76	101.31	70.60	75.12	91.48	215.94	99.2
Indices of own expenditure on innovation of business structures at the expense of own financial resources, %	116.13	98.58	65.9	74.2	94.78	189.36	73

Indices of innovation costs of business structures at the expense of investors' funds, %	99.24	39.69	295.22	62.64	40.36	2 543,04	2443.8

Source: calculated by the authors based on data from the State Statistics Service of Ukraine and the World Intellectual Property Organisation

Meanwhile, innovation costs funded by investors exhibit high volatility, peaking in 2024 (+2443.8 points), which suggests one-time investment inflows and instability in external financing streams. The interaction between scientific and financial components illustrates how the availability of funding shapes the capacity of enterprises to maintain and expand their R&D activities.

Human resource indicators (Table 4) further contextualize these developments. While the total number of enterprise employees declined by 8.3 points, the number of personnel engaged in R&D increased by 19.1 points, highlighting a prioritization of human resources toward research and innovation activities.

Table 4:Dynamics of the human resource indicators component of the investment and innovation potential of Ukrainian enterprises in 2019-2024

Human resources component	2019	2020	20	2022	2023	2024	Absolute deviation (2019-2024), +/-
Indices of the number of employees at enterprises, %	107.52	99.35	100.40	84.21	93.87	99.18	-8.3
Indices of the number of employees involved in scientific research and development, %	89.9	99	87	77.3	110	109.0	19.1
Labour productivity indices of domestic enterprises, %	104.1	103.95	131.1	105.89	123.85	105.87	1.7
Labour cost indices, %	124.2	109.8	117.8	89	116	119.9	-4.3

Source: calculated by the authors based on data from the State Statistics Service of Ukraine and the World Intellectual Property Organisation

Human resource indices show fluctuations that indicate ongoing efforts to optimize resource utilization under challenging economic conditions. The alignment between human resource allocation and financial investment underscores the strategic focus on sustaining core innovation functions within enterprises.

Finally, the market component (Table 5) reflects the practical outcomes of these combined efforts. Indices of innovative product sales reached 706.2% in 2024, and the share of high-tech exports rose to 7.17%, demonstrating growing effectiveness in external market engagement. At the same time, the relatively low share of innovative products in total sales (1.7%) highlights the need to further integrate R&D results into production and commercialization processes.

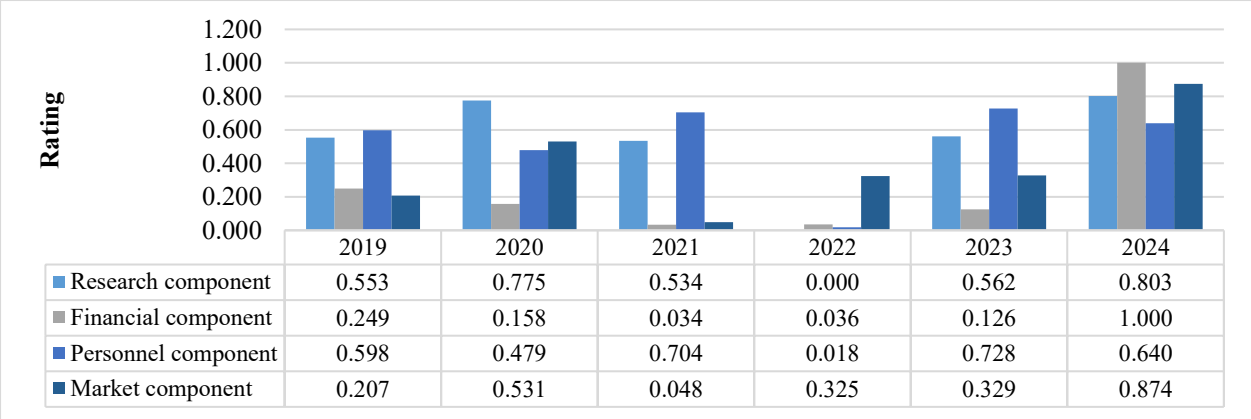
Table 5: Dynamics of market component indicators of the investment and innovation potential of Ukrainian enterprises in 2019-2024

Market component	2019	2020	2021	2022	2023	2024	Absolute deviation (2019-2024), +/-
Indices of the number of innovative products (goods, services) introduced by enterprises, %	55.89	189.29	43.19	133.66	115.68	115.68	59.8
Indices of sales volumes of innovative industrial products (goods, services) of enterprises, %	100	100.0	77.5	86	61.2	706.2	606.2

Share of innovative products sold in the total volume of products sold (goods, services) by industrial enterprises, %	1.30	1.9	0	0.9	0	3.0	1.7
Share of high-tech exports, % of exports	5.48	5.85	4.51	5.7	6.69	7.17	1.7

Source: calculated by the authors based on data from the State Statistics Service of Ukraine and the World Intellectual Property Organisation.

Thus, analyzing the scientific, financial, human resource, and market components reveals that the investment and innovation potential of Ukrainian enterprises is characterized both by recovery from crisis-induced declines and by structural imbalances. Overall, the assessment of enterprises' research and development potential using the index method remains at an average to above-average level, except for 2022, serving as a key foundation for R&D and innovation (Fig.1).



	2019	2020	2021	2022	2023	2024
Research component	0.553	0.775	0.534	0.000	0.562	0.803
Financial component	0.249	0.158	0.034	0.036	0.126	1.000
Personnel component	0.598	0.479	0.704	0.018	0.728	0.640
Market component	0.207	0.531	0.048	0.325	0.329	0.874

Fig. 1. Dynamics of sub-indices of investment and innovation potential of Ukrainian enterprises in 2019-2024

Source: calculated by the authors based on data from the State Statistics Service of Ukraine and the World Intellectual Property Organisation.

The reduction in financial resources allocated by enterprises and investors kept the financial component at a critical level throughout 2019–2024, with notable improvement in 2024 due to increased investor activity. Staffing levels remained average in 2019–2021, declined sharply in 2022, and then recovered to the average level. The market component was low in 2019 and 2022–2023, average in 2021, and rose to a high level in 2024/

In summary, the assessment of investment and innovation potential across its components highlights the need to stabilise research and human resources amid a shortage of qualified personnel, ensure sustainable innovation financing through diversified sources, and improve market mechanisms for promoting innovations in domestic and international markets. Negative trends in the reduction of research staff, workforce contraction, unstable innovation funding, and limited technological progress have contributed to a decline in the overall investment and innovation potential of Ukrainian enterprises. The integrated index is estimated at 0.402 in 2019, 0.486 in 2020, 0.333 in 2021, 0.095 in 2022, 0.436 in 2023, and 0.829 in 2024 (Fig. 2).

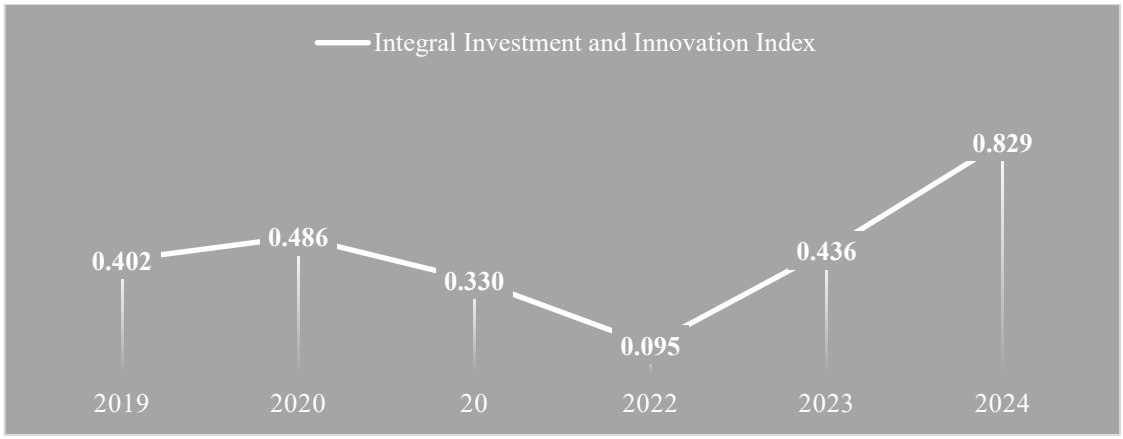


Fig. 2. Dynamics of Ukraine's integrated investment and innovation index in 2019-2024

Source: calculated by the authors based on data from the State Statistics Service of Ukraine and the World Intellectual Property Organisation

These results indicate significant fluctuations in the investment and innovation capacity of Ukrainian enterprises over the analyzed period, reflecting both internal challenges and external pressures. Addressing these issues requires coordinated strategic efforts to strengthen institutional support, foster innovation-driven growth, and enhance the resilience of the national economy.

Building on these insights and aiming to provide a comprehensive assessment of the investment and innovation potential of Ukrainian business development – while identifying promising opportunities and considering threats in the context of unprecedented security challenges – we conducted a SWOT analysis of the investment and innovation potential of Ukrainian enterprises (Table 6).

Table 6: SWOT analysis of the investment and innovation potential of Ukrainian enterprises

Component	Strengths	Weaknesses	Opportunities	Threats
Scientific component	– Restoration of research potential in 2023–2024 (growth of R&D employees by 21%); – increase in research spending (index 131.8%); – retention of qualified researchers. –participation in international programmes integrating Ukraine into the European research space.	– Instability of R&D funding in 2019–2022; –fewer enterprises conducting own research; –weak commercialisation of developments and poor science–industry interaction.	– Participation in EU research programmes (Horizon Europe, COST, Twinning); – rebuilding scientific infrastructure and innovation hubs; – rising demand for applied research in energy, security, and digitalisation.	– Migration and loss of research staff; – dependence on external funding; – damage to laboratory facilities in combat zones.
Financial component	– Growth in innovation spending (index 131.8%) and investor share (index 2543%); – activation of domestic investments and business confidence; – state focus on post-war economic modernisation.	– Decline in own innovation expenditure (to 65.98% of baseline); – fragmented financial flows and limited access to resources; – weak public-private financing mechanisms; – high production costs and energy dependence.	– Expansion of international financial support (EIB, USAID, EBRD); – development of PPPs and innovation funds; – tax incentives for investment in science and technology.	– Military uncertainty and investment risks; – currency fluctuations and inflation; – possible reduction in external financing.
Human resources component	– High qualifications and adaptability of personnel; –growth in labour productivity (index 101.7%); – presence of innovation-	– Reduction in employment (index 84.21%); – shortage of engineers and applied researchers; – limited training opportunities during the	– Development of distance learning and retraining; – return of workforce in the post-war period; – support programmes for young researchers.	– Further outflow of qualified personnel; – low motivation amid instability; – demographic imbalances.

	oriented teams in IT, energy, and engineering.	war; – ageing scientific staff.		
Market component	– Growth in sales of innovative products (index 706.2%); – increase in high-tech exports (up to 7.17%); – orientation toward domestic and defence-related markets; – digital business transformation.	– Decline in innovation-active enterprises; – limited market access due to logistics barriers; – weak marketing of innovations; – uneven regional innovation development.	– Expansion of European market integration; – demand for technologies for reconstruction; – growth of innovation clusters and cooperation platforms.	– High wartime investment risks; – rising global competition and import dependence; – declining purchasing power and market instability.

Source: Authors' own elaboration.

The SWOT analysis shows that the investment and innovation potential of Ukrainian enterprises has a pronounced adaptability and a tendency to recover after the crisis period of 2019 - 2022. Key strengths include the growth of research and development potential, an increase in the share of foreign investment, growth in labour productivity and the intensification of market innovation activity in 2023 - 2024.

Despite notable progress, persistent weaknesses include financial instability, shortages of engineering and technical personnel, limited commercialisation of research, and insufficient marketing support, all of which constrain enterprises' capacity to fully realise their innovation potential. Critical opportunities encompass the expansion of international scientific cooperation, mobilisation of financial resources to rebuild innovation infrastructure, development of public-private partnerships, and the strategic engagement of youth in research and technological initiatives. Realising these opportunities can significantly enhance enterprise competitiveness and contribute to a resilient and sustainable economic security framework. Major threats remain military risks, demographic losses, currency instability, and increasing external technological dependence, which undermine long-term innovation sustainability. Therefore, the investment and innovation potential of Ukrainian enterprises constitutes a pivotal determinant of economic recovery, technological self-sufficiency, production diversification, and sustainable national development.

Conclusions and prospects for further research

The study provides a comprehensive evaluation of the investment and innovation potential of Ukrainian enterprises across four dimensions: scientific capacity, financial sustainability, human resources, and market efficiency. Despite the socio-economic shocks generated by the ongoing conflict, enterprises demonstrate notable adaptability and a gradual revitalisation of innovation activities.

The scientific dimension exhibits stabilisation, reflected in an increased number of researchers, heightened interest in commercialisation, and expanding collaboration with academic institutions, although persistent funding constraints and damaged infrastructure remain significant challenges. Financial capacity continues to be the most vulnerable, constrained by limited resources and high operational risks; nonetheless, international partnerships and state-supported programmes offer pathways for recovery. Human resources, affected by migration, retain a high level of education and innovative capacity, forming a foundation for the restoration of scientific and technological potential. The market dimension is undergoing transformation, with enterprises adopting digitalisation, adjusting to new conditions, and enhancing export activities, despite logistical disruptions and subdued domestic demand.

Collectively, the investment and innovation potential of enterprises constitutes a critical determinant of national economic security. Implementation of an integrated strategy at both micro- and macroeconomic levels, combining internal resources, external interactions, and supportive state policy, will strengthen innovation, competitiveness, and national resilience. Further research should focus on refining assessment methodologies, state regulation, financing mechanisms, and frameworks for state-business-science cooperation within the context of Ukraine's European integration.

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