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# STATE REGULATION OF INVESTMENTS IN INNOVATIVE DEVELOPMENT OF INDUSTRY TO STRENGTHEN FINANCIAL SECURITY IN THE CONTEXT OF INDUSTRY 4.0

## ABSTRACT

The main purpose of the article is the theoretical and methodological substantiation of the modern approach to the formation of a model of state regulation of investment support for innovative industrial development in the context of helping to increase the level of financial security. The object of the study is the innovative development of the industrial sector of the Ukrainian economy. At the same time, the scientific task will be to present a methodological approach to assessing the current state of trends in investment support for innovative industrial development in all regions of Ukraine as a tool for state regulation. The research methodology involves the use of modern methods of analysis and synthesis of available information on the research topic. A nonparametric statistical method was used to analyze the trends and dynamics of industrial development in Ukraine. The integral assessment method was used to form a methodological approach to assessing the level of investment support for innovative development as an effective instrument of state regulation. As a result of the study, a model of state regulation of investment support for innovative industrial development is presented. An assessment was made of the level of investment support for innovative industrial development concerning the proposed model. Based on the results obtained, measures to ensure financial security in the conditions of Industry 4.0 are proposed. The key financial obstacles to investment support for innovative industrial development are presented, ordered by the priority of the state's response to them. The study has limitations in that it does not take into account all aspects of state regulation. In this case, only the specifics of the industrial sector of the economy were taken into account.

**Keywords:** state regulation, investment support, innovative development, level of investment support, integral indicator, industry, financial security, financial performance, Industry 4.0

**JEL Classification:** L50, G18, K22, O14

## INTRODUCTION

Ensuring financial security today for any state is not inferior in importance and equality to ensuring economic or even national security. The fact is that every component of national security, including economic security, depends, on functions, and is enhanced through finance. Financial security has long gone beyond the scope of "one of the components" and occupies a full-fledged place in research at the economic level. One of the key drivers to achieving this security is investment and innovation.

Let us note that investments in innovation are closely related and have much in common. One can provide development to another, and just the opposite, successful innovations provide increased profitability. The state is not the least important on this issue. Take, for example, the formation of a regulatory framework regulating the rules of the game in the market, intellectual property, antimonopoly, etc. In addition, financial support from the state is also important. The state can also actively invest in innovative projects or simply provide finance for enterprises to stimulate the same innovations.

Practice has proven that in terms of security, the industrial sector of the economy is the most valuable. It is innovatively active enterprises in this sector that can have a significant impact on the current level of financial and economic security of both the region and the state as a whole. But for there to be a positive trend towards an increase in innovatively active enterprises in this sector, there must be appropriate state regulation that will contribute to this.

The industrial sector today, under martial law, is going through difficult times and has been forced to adapt to ensure safety and survival. But at the same time, it plays a critical role in ensuring the country's defence capability. Without industry, victory in the war that the Russian Federation unleashed is simply impossible. This is why innovation and high levels of funding are required. In such conditions, it is on the part of the state as a regulator that it is possible to direct the sector back to development precisely through financing innovation. But there are several problems and obstacles to this. First of all, financial and ineffective assessments of the current state of affairs in the industry of a particular region.

The issue of Industry 4.0 stands out, which is already almost at the peak of its development and conversations are beginning about the transition to Industry 5.0. Countries that do not take this into account cannot create the appropriate conditions for innovative industrial development. We need mass digitalization and joint projects (public-private partnerships) in the implementation of SMART programs, etc. Artificial intelligence has already brought radical changes to most industrial enterprises in the world.

Note that within the framework of this article, we will consider the features of state regulation, innovative development, and industry exclusively in Ukraine, therefore there is a possibility that the results obtained will not be consistent for other countries.

## LITERATURE REVIEW

Current research in the field of Industry 4.0 and its impact on the industrial sector is mainly focused on the integration of new technologies, sustainable development, and safety. The processes leading to Industry 4.0 include the introduction of innovative technologies and their implementation in the educational process, as reflected in the works of Laciok et al. (2020) and Marchenko et al. (2023). Particular attention is paid to environmental sustainability and exergy analysis in the context of industrial production, as shown in a study by Selicati and Cardinale (2020). A key aspect is service innovation and the use of big data analytics, as explored by Lee et al. (2014). However, of particular interest is the study of the impact of these innovations on regional development and governance, especially in the context of globalization, as noted in the studies of Kryshchanovych et al. (2022).

Also, a significant contribution to the study of the financial component is made by studies devoted to the role of state regulation in the implementation of digital technologies for sustainable development and territorial planning, as shown in the work of Borodina et al. (2023). This demonstrates the growing attention to the importance of state regulatory mechanisms in shaping the investment climate for innovation.

Regarding state regulation, studies are focused on determining the factors influencing the financial security of the state, as in the works of Dankiewicz et al. (2022), as well as on the analysis of innovation policy instruments, as in the study of Borrás and Edquist (2013). At the same time, scientists focus on the analysis of factors affecting the financial security of the state and the importance of structural analysis in this context. This indicates the need to understand the relationship between financial mechanisms and the development of the latest technologies. An important aspect is the study of methodological approaches to the planning and management of innovative activities of enterprises, as described by Panchenko et al. (2022).

Despite the significant contribution of these studies to the understanding of the impact of Industry 4.0 on the industrial sector, there are significant gaps in the literature, especially in the context of state regulation of investment support for innovative development. Among them is the lack of a methodical approach to the comprehensive assessment of the level of investment support for innovative development within the framework of the modern system of state regulation, as well as insufficient analysis of key financial obstacles to the implementation of investment support for innovative development. In addition, there is no clear vision of the very model of state regulation of investment support for innovative industrial development in the context of promoting the level of financial security.

## AIMS AND OBJECTIVES

The main aim of the article is the theoretical and methodological substantiation of the modern approach to the formation of a model of state regulation of investment support for innovative industrial development in the context of helping to

increase the level of financial security. The object of the study is the innovative development of the industrial sector of the Ukrainian economy. The key tasks are to analyze the state of industrial development in Ukraine; present the author's vision of the main model of state regulation of investment support for innovative industrial development in the context of helping to increase the level of financial security; propose a methodological approach to assessing the level of investment support for the development of innovations as an effective tool for assessing the current state; identify and streamline key financial obstacles to effective investment support for innovative industrial development in the context of helping to increase the level of financial security.

## METHODS

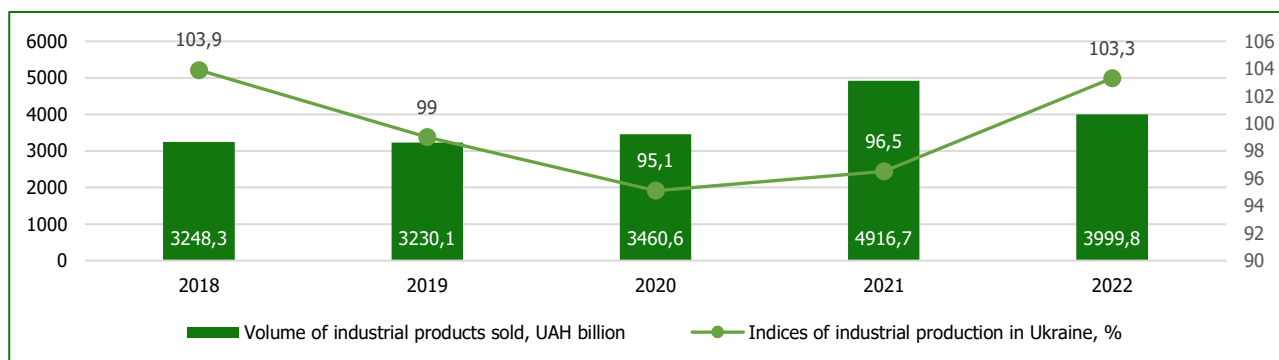
To organize financial barriers, we used the hierarchical analysis method developed by Thomas Saaty and actively based today in many leading scientific studies on various topics (Sylkin, et.al., 2019; Ogirko, et.al., 2018). Its essence is to transform subjective assessments into quantitative data that can be compared and analyzed. This method was chosen because it allows you to effectively structure a complex problem, reduce multidimensional and often heterogeneous criteria to a comparable form, and ensure objectivity in the assessment. The main part is the creation of a matrix of paired comparisons, where experts evaluate the criteria relative to each other, which allows turning subjective judgments into quantitative assessments. Therefore, the expert method was additionally used to determine the opinion of a specialist.

The method of integral assessment in the context of determining the integral index of investment support for innovative development of industry in Ukraine is an integrated approach that allows you to combine various indicators into a single quantitative indicator. This method allows us to obtain a generalized quantitative characteristic that can be used to analyze trends, as well as for planning and regulation in the field of innovative development and ensuring financial security. The Harrington ranking method was used to establish threshold values.

## RESULTS

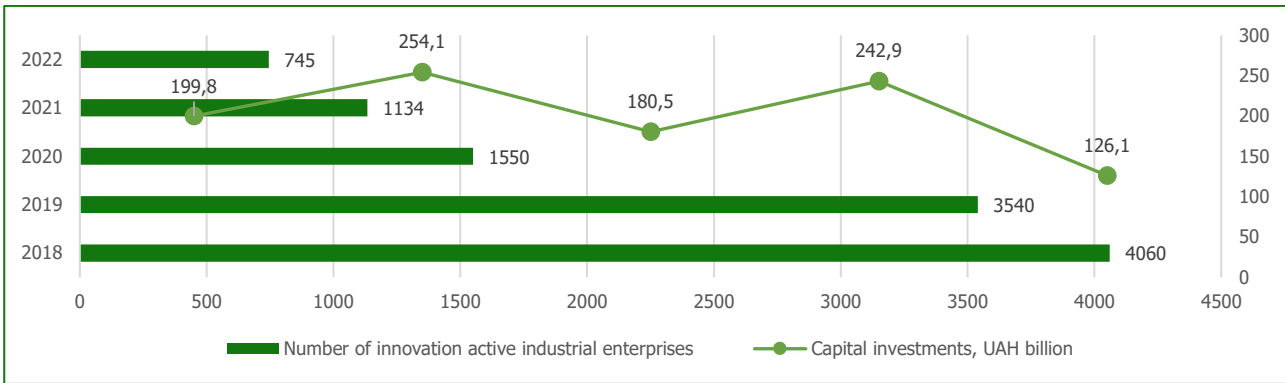
Constant changes in the national economy, characterized by a difficult-to-predict course of events due to the weakness of state policy regarding the protection of national interests under increasing pressure from external factors, including the main further struggle for the resource base, slow down the investment activity of Ukrainian industrial enterprises, depriving them of the opportunity to develop to reduce technological development lagging behind competitors from economically developed countries.

In general, the industrial sector of the economy is diverse and involves a large number of activities. At the same time, the industry itself is always highly competitive in the market. This sector has already experienced two major crises, the COVID-19 pandemic and martial law. Thus, it would be advisable to consider precisely the period of activity and development of this sector for the period 2018-2022 to determine what state it is in today (Figure 1).



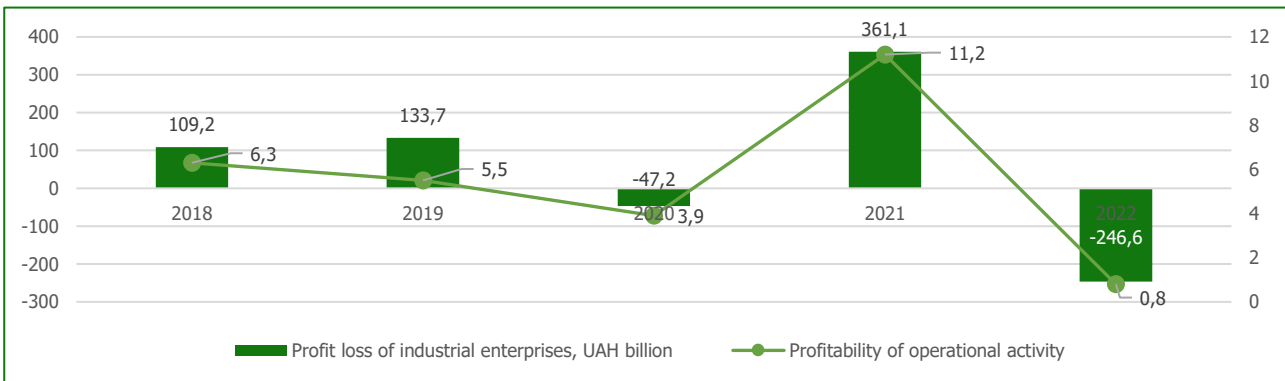
**Figure 1. Indices of industrial production in Ukraine for 2018-2022.**

In general, the volume of industrial products sold decreased in 2022 as a result of martial law and the outbreak of the February events. However, a significant reduction did not occur, but the dynamics of the decline may continue and achieve even worse results in subsequent years if martial law continues. As for the index of industrial production, we note its positive dynamics, which tells us that the industrial sector has signs of stability and investment attractiveness. An important indicator within the framework of our study is the indicator of innovation activity of industrial enterprises in Ukraine (Figure 2).



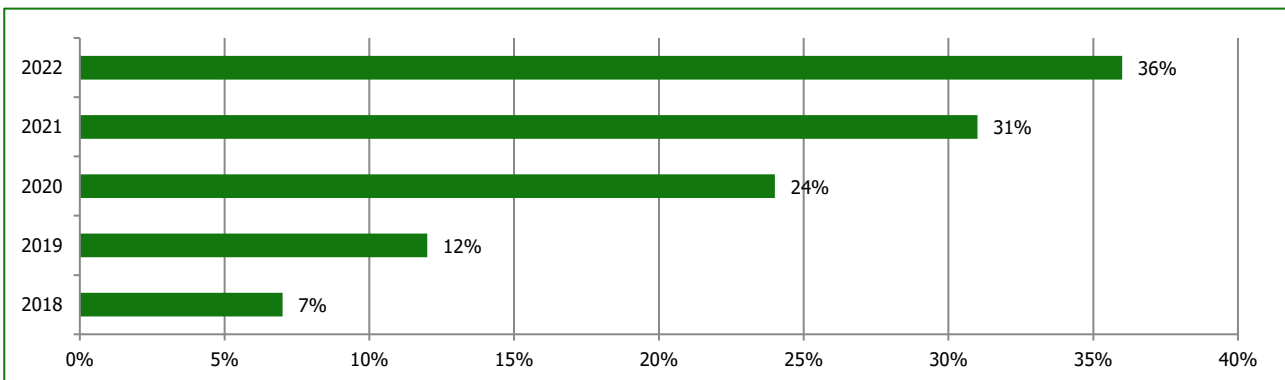
**Figure 2. Profitability of all activity of enterprises in 2018-2022, %.**

There was also a decrease in innovatively active industrial enterprises in Ukraine, which is a negative factor influencing the decrease in the level of financial security at all levels, as we can see in Figure 2. The decline in profitability and capital investment in Ukraine's industrial sector can be explained by several key factors, in particular the military situation and the low development of digital technologies of Industry 4.0. The military situation experienced by Ukraine creates numerous challenges for the economy. First of all, this leads to significant instability and uncertainty, which is a great obstacle to investment activity. At the same time, the key question remains financial results. At the same time, the dynamism of the external environment the loss of markets, and the desire to find new ones have influenced the fact that today the financial results in the industrial sector of the economy have worsened. Figure 3 very characteristically shows that it was the crisis years of 2020 and 2022 that brought more losses and damage, which significantly affected the provision of financial security. On average, losses in these periods reached growth of 10-30%.



**Figure 3. Financial results of industrial enterprises of Ukraine for 2018-2022.**

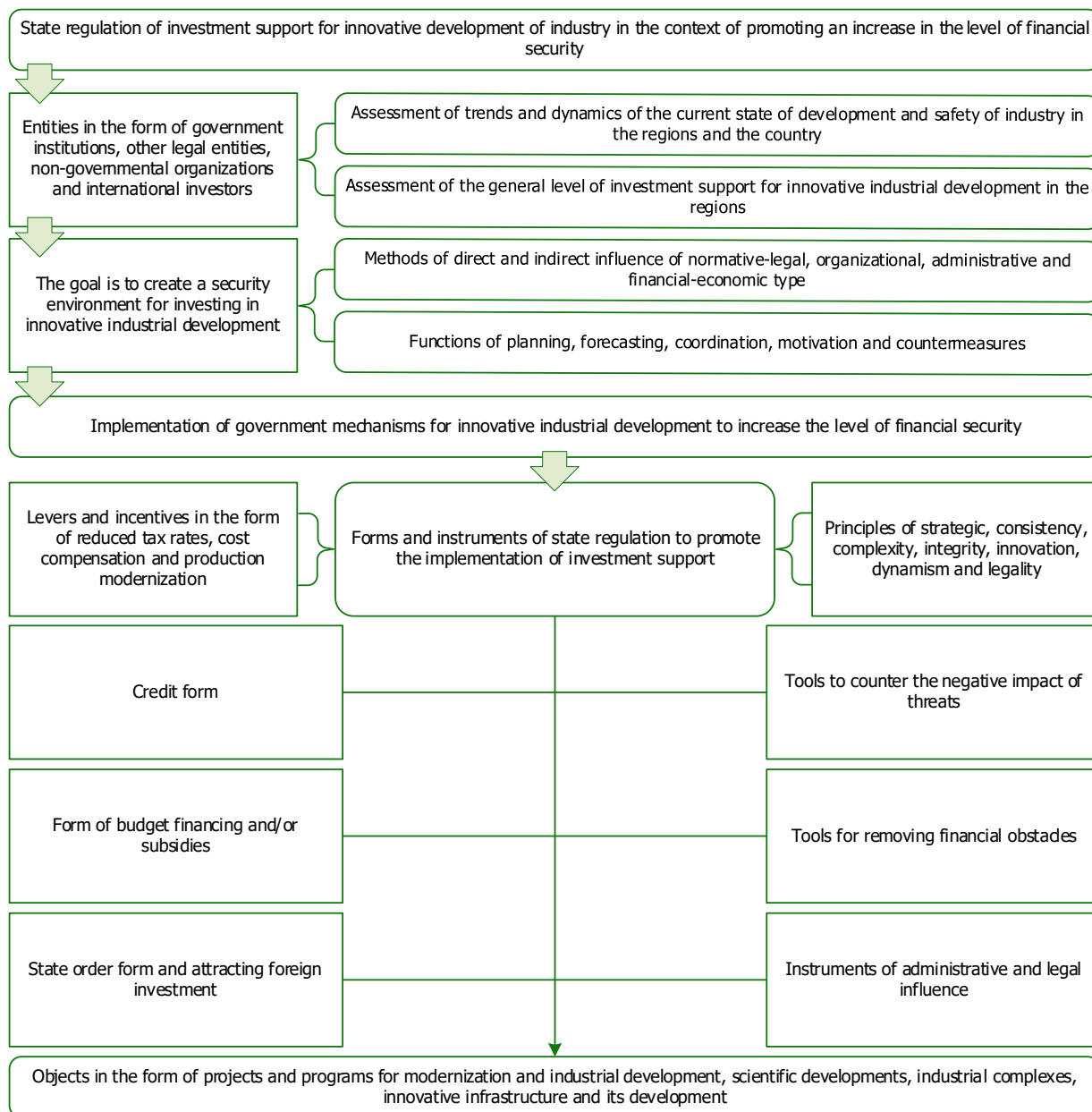
In general, the dynamics of how the industrial sector of the Ukrainian economy began to use artificial intelligence programs and technologies in work and production have increased significantly in recent years (Figure 4).



**Figure 4. Part of the technologies and artificial intelligence programs involved in the production of industrial products in dynamics for 2018-2022.**

The state should monitor and assess the risks associated with the automation of jobs and develop strategies to manage changes in the labour market, including retraining programs and support for those who may be negatively affected by automation.

The key element for facilitating assistance to the industrial sector of the Ukrainian economy today remains effective state regulation of investment support for their innovative development. In our opinion, state regulation of investment support for the development of innovation in the industrial sector of the economy is a set of measures and policies implemented by the state to stimulate, control, and direct investment in the industrial sector to support innovation and technological development. This includes measures to adapt to martial law, ensure financial security, and integrate the principles of Industry 4.0 (Figure 5).



**Figure 5. Model of state regulation of investment support for innovative industrial development in the context of helping to increase the level of financial security.**

The level of monetary safety of the country is closely related to the effectiveness of state regulation of investment support for the innovative development of industrial companies. State regulation aimed at supporting innovation and investment in the industrial sector can ensure economic stability, job growth and higher incomes, which helps strengthen the country's financial security. For example, consider a situation where the government introduces tax incentives or subsidies to support

innovative projects in industry. This may encourage businesses to invest in new technologies and modernization of production. Such investments, in turn, can lead to increased productivity and international competitiveness, leading to higher incomes and a more stable economic environment. Let us present in Table 1 the key factors of investment support for innovative industrial development, which increase the level of financial security of the state and reduce it.

**Table 1. The key factors of investment support for innovative industrial development, which increase the level of financial security of the state and reduce it.**

№	Factors for increase	Factors for reduce
1	Embracing technologies such as AI, IoT, automation, and big data analytics can significantly boost the efficiency and productivity of industrial enterprises	Ongoing war can severely disrupt industrial activities, deter foreign investment, damage infrastructure, and deplete resources
2	Investing in research and development, particularly in fields relevant to Industry 4.0, can foster innovation, leading to the development of new products and services, which can open up new markets and revenue streams	Without adequate infrastructure (like high-speed internet, energy supplies, and logistic networks), the benefits of Industry 4.0 cannot be fully realized, hindering industrial growth and innovation
3	Investing in education and training to develop a workforce skilled in Industry 4.0 technologies can enhance productivity and innovation, thereby increasing financial security	If investment in new technologies and innovative practices is insufficient, industries may lag behind in efficiency and productivity, reducing the state's competitiveness on a global scale
4	Providing tax incentives, subsidies, or grants for companies adopting innovative technologies and practices can stimulate investment in these areas, boosting the overall economic health of the country	With the increased reliance on digital technologies, vulnerabilities to cyber-attacks can pose significant risks to industrial and economic stability

We would like to dwell on the issue of assessing the overall level of investment support for innovative industrial development in the regions and eliminating financial obstacles in more detail. Therefore, to evaluate the model for calculating the integral index of investment support for innovative development of industry in Ukraine, which will serve as an information basis for subjects of ensuring financial security. The algorithm for forming and calculating the model for determining the integral indicator consists of several successive stages:

1. Taking into account the opinions and considerations of experts from the industrial sector of the economy of Ukraine, employees of the state administration apparatus and specialists from the innovative development of socio-economic systems were involved and our analysis, a set of quantitative indicators is formed, including the number of new types of products introduced; the number of new processes implemented; the number of innovatively active industrial enterprises; the number of new innovative industrial products; volumes of financing of innovation activities; volumes of financing at your own expense; volumes of costs for new technologies; volumes of innovative products sold abroad, etc. A total of 18 indicators were selected. Next, the procedure involved normalizing the obtained data for each of the indicators according to the corresponding equality (1):

$$M_{ij} = (X_{ij} - X_{\min}) / (X_{\max} - X_{\min}) \quad (1)$$

where  $M_{ij}$  - is the normalized value of the data point or indicator in the matrix at the  $i$ -th row and  $j$ -th column.

The equation is used to transform the original data point  $x_{ij}$  into a normalized value  $M_{ij}$  that lies within a new range, typically between 0 and 1.

$X_{ij}$  - is the value of the indicator for a particular region;  $\min/\max$  - maximum and minimum value for the indicator.

2. Next, the integral indicator of the investment support of the innovative development itself is calculated, but first the regional one for each region of Ukraine. It should be noted that the data also applies to 2022, therefore, our study did not take into account the Autonomous Republic of Crimea, Donetsk, and Lugansk regions due to the actions of the aggressor country. The calculation occurs through equality (2):

$$RI = \sum a_{ij} * M_{ij} \quad (2)$$

where  $RI$  - the integral indicator for regions;  $a_{ij}$  - are weighting coefficients.

3. Next, a direct calculation of the general integral index of investment support for the innovative development of industry in Ukraine is carried out (3):

$$GI = \sum b_i * RI \quad (3)$$

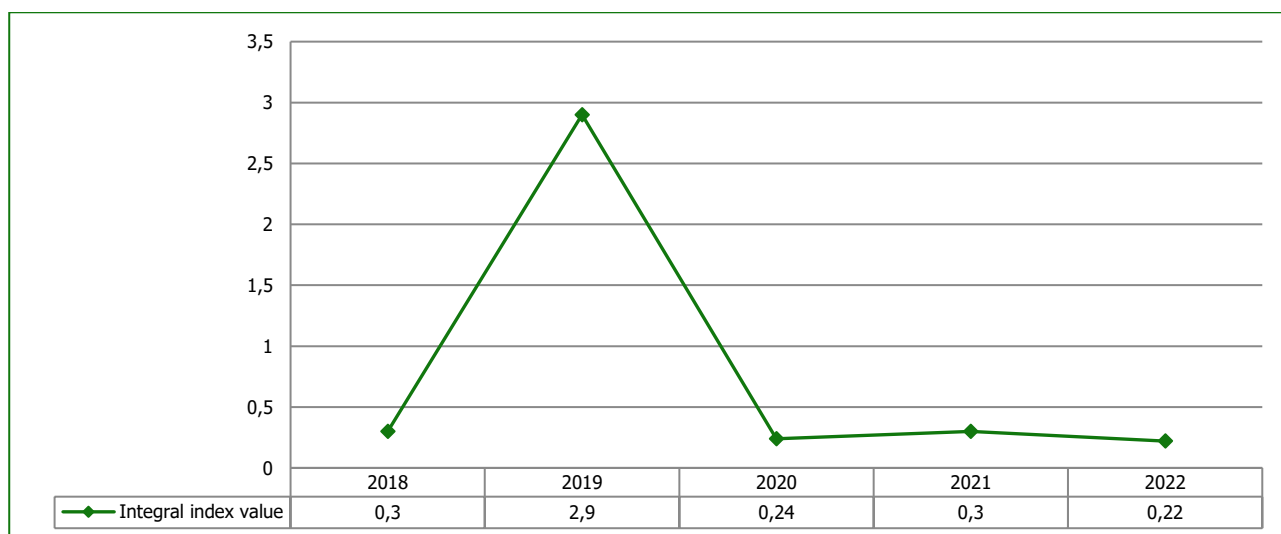
where  $G_i$  – the general integral indicator;  $b_i$  - weighting coefficients or values reflecting the importance or influence of each indicator or component included in the overall integral indicator.

The methodological approach to calculating the integral indicator is based on the Methodology for calculating integral regional indices of economic development (2003). We present the results of calculating the integral indicator of investment support for innovative industrial development by regions of Ukraine in Table 2.

**Table 2. The value of the calculated integral indicator of the investment support of the innovative development of Ukraine's industry by region.**

Region	2018	2019	2020	2021	2022
Cherkasy region	0.19	0.16	0.1	0.12	0.16
Kherson region	0.11	0.12	0.09	0.11	0.07
Ternopil region	0.08	0.06	0.08	0.08	0.05
Rivne region	0.11	0.09	0.04	0.05	0.01
Poltava region	0.19	0.2	0.16	0.18	0.1
Odessa region	0.19	0.16	0.1	0.13	0.11
Nikolaev region	0.17	0.13	0.06	0.09	0.07
Lviv region	0.29	0.28	0.26	0.32	0.3
Kirovograd region	0.11	0.12	0.078	0.08	0.09
Kyiv region	0.19	0.15	0.14	0.2	0.11
Chernivtsi region	0.05	0.06	0.02	0.03	0.02
Chernihiv region	0.09	0.16	0.06	0.07	0.4
Khmelnitsky region	0.19	0.1	0.06	0.07	0.04
Sumy region	0.2	0.22	0.21	0.21	0.16
Ivano-Frankivsk region	0.16	0.2	0.14	0.13	0.12
Zaporozhye region	0.35	0.36	0.32	0.37	0.31
Transcarpathian region	0.07	0.078	0.08	0.086	0.06
Zhytomyr region	0.14	0.1	0.09	0.1	0.09
Dnepropetrovsk region	0.4	0.6	0.5	0.8	0.45
Volyn region	0.08	0.07	0.03	0.04	0.06
Vinnitsia region	0.15	0.14	0.12	0.11	0.08

In general, this is a very convenient approach to assess how unevenly investment support for innovative development is carried out in the regions. You can see the difference with the naked eye, even under martial law. This is a good information tool for subjects of ensuring financial security in the regions and the state as a whole. The value of the general integral indicator of the investment support of the innovative development of Ukraine's industry is presented in Figure 6.



**Figure 6. The value of the general integral indicator.**

We use the Harrington scale, at which the value of our indicator is within the low level of financial security. Given this value, we propose the following state regulation measures:

1. Introduction of tax incentives for companies investing in research and development (R&D), especially in the field of Industry 4.0 (automation, robotics, Internet of things). Providing subsidies or loans on preferential terms for enterprises introducing production innovations.
2. Launch vocational training and retraining programs focusing on the skills needed for Industry 4.0. Development of insurance programs for enterprises that suffered losses due to military operations. Ensuring production and supply chain flexibility adapted to military realities.

There are several financial obstacles and problems that negatively affect both the level of security and the efficiency of investment support for innovative industrial development. We recruited and interviewed 30 experts from the industrial sector of the economy, ensuring financial security and innovative development. Their reasoning and opinion served as the basis for further hierarchical analysis and pairwise comparison. The expert survey was conducted using the Delphi method. Thus, we have identified 5 main financial obstacles to effective investment support for innovative industrial development:

1. Market instability due to martial law. Martial law leads to economic instability, fluctuations in financial markets, and increased political risk.
2. Increased financial risks. Innovative projects are already subject to high risks, but in conditions of financial danger and uncertainty, these risks intensify.
3. Limited access to financing. Conditions of martial law and financial danger may lead to limited access to credit resources.
4. Technological challenges of Industry 4.0. Investments in new technologies such as automation, robotics, and artificial intelligence require significant research and development costs, as well as adaptation of existing production lines.
5. Redistribution of resources through martial law. In times of war, especially in conflict-prone countries, there is a need to reallocate resources to immediate needs such as defence and security.

Thus, we have many financial obstacles:  $\{1,2,3,4,5\}$ .

We use the even comparison matrix to determine the relative weights of each obstacle. This is done by normalizing the matrix and calculating the average value for each row (Table 3).

**Table 3. Matrix of paired comparison of identified financial obstacles for effective investment support for innovative industrial development.**

Financial obstacles	1	2	3	4	5
1	1	2	1/3	3	1/2
2	1/2	1	1/4	2	1/3
3	3	4	1	5	2
4	1/3	1/2	1/5	1	1/4
5	2	3	1/2	4	1

The use of a pairwise comparison matrix to determine the relative weights of obstacles is based on the idea that each obstacle or criterion has a different meaning or importance in the context of decision-making. Normalizing the matrix and calculating the average for each row allows subjective assessments of relative importance (expressed through even comparisons) to be converted into quantitative values. This provides a balanced approach to measuring the importance of each obstacle, based on expert judgment, and allows for more objective and informed analysis for decision making.

Next, the matrix should be normalized (i.e., normalize each of its elements), where this is achieved through the following equality (5) (Shtangret et.al., 2016):

$$a_{ij} = a_{ij} / \sum_{k=1}^n a_{ik} \tag{5}$$

where:  $a_{ij}$  – the symbol usually denotes an element of a matrix. In a matrix,  $a_{ij}$  represents the element located at the  $i$ th row and  $j$ th column. In the context of your equation,  $a_{ij}$  on the left side of the equation is the original value of the matrix

element, and on the right side, it's being normalized;  $n$  - is the symbol that typically represents the size or dimension of the matrix, specifically the number of rows or columns;  $k$  - is an index used in the summation notation.

The weight calculation of each element is defined as the arithmetic mean of its row in the normalized matrix (6):

$$w_i = (1/n) / \sum_{j=1}^n a_{ij} \quad (6)$$

where  $w_i$  - is the weight of the  $i$ th element (or row, depending on the context).

The weight is calculated as an arithmetic mean of elements in a specific row of the normalized matrix.

As a result, we got the following weights for each of the obstacles:

- Market instability due to martial law: 0.4
- Increased financial risks: 0.1
- Limited access to finance: 0.09
- Technological challenges of Industry 4.0:2.6
- Redistribution of resources through martial law: 0.06.

In this case, the consistency index (is used in the method of analysis of hierarchies to assess the degree of consistency of experts' judgments when comparing alternatives. It measures how consistently experts' answers deviate from perfectly logically consistent answers) should be as close as possible to 0 and the following equality (7) would be satisfied:

$$CI = \lambda_{\max} - n / (n - 1) \quad (7)$$

In our case, it is 0.07, which is positive and consistent with the procedure. Thus, the most significant are two key financial obstacles that should be paid attention to in the modern system of state regulation: 1 and 4. The team of authors proposes the following measures for state regulation to eliminate and/or minimize them:

1. The government can provide tax breaks or subsidies to companies investing in emerging technologies such as automation and artificial intelligence. This can reduce the financial burden on companies and encourage innovation. The creation of specialized zones, such as technology parks or innovation hubs, can help concentrate scientific, technological, and innovation resources, simplifying access to advanced technologies and expertise.
2. The development and implementation of effective cybersecurity laws and policies can ensure the security of innovative technologies and reassure investors about the risks associated with virtual space. Promoting partnerships between government and private companies can help develop and implement emerging technologies based on market needs.

In addition, there are other factors of innovative development of the industrial sector that have a significant impact on both increasing and decreasing the level of financial security. For example, factors in the innovative development of the industrial sector that significantly affect the financial security of the state include:

- technological progress that increases production efficiency;
- innovation in management to increase productivity;
- investment in research and development to create innovative products;
- a high level of education and skills in the workforce;
- economic incentives such as tax incentives to support innovation;
- integration with global markets to increase competitiveness;
- intellectual property protection;
- development of environmentally sustainable technologies;
- digital transformation including the use of blockchain;
- development of cluster policies to promote innovation and cooperation between companies.

Each of them is unique and needs a further more detailed review, but along with this, there are a number of negative factors.

Factors that may negatively affect the financial security of the state in the context of innovative development, especially with the use of artificial intelligence, include:

- the risk of reduced employment through automation;
- the possible violations of privacy and data security;
- the ethical issues associated with autonomous artificial intelligence solutions;
- the widening digital divide between different sectors of society.

To minimize these risks, government regulation can focus on creating and implementing laws governing the use of artificial intelligence, ensuring the protection of personal data and privacy. In addition, retraining and training programs for the workforce can be developed to adapt them to new technological conditions. Increasing investment in sectors that stand to lose from automation is also important to maintaining economic growth and stability.

In order for the regulation of investment support for innovative development in the industrial sector of the economy to become the key to financial security in the conditions of Industry 4.0, the state needs to take a set of measures that take into account both technological and socio-economic aspects. First of all, it is important to create a stable and expected legislative environment that will facilitate investment in innovation and technological development. This includes the development and implementation of tax breaks, grants, subsidies and other incentives for businesses investing in the implementation of Industry 4.0 technologies. In addition, the government should focus on supporting educational and scientific programs that prepare qualified specialists capable of working with the latest technologies. Equally important is the stimulation of research projects in the field of innovation, especially those that contribute to the development of the internal technological base. To stimulate investment support for innovative development in the industrial sector of the economy, especially in the context of Industry 4.0, the state can use various tools. For example, providing tax incentives, credit rebates and subsidies for businesses investing in the latest technologies and innovations. A possible instrument to support research and development through the provision of grants and funding aimed at the development of new technologies and innovative processes.

## DISCUSSION

Our research results attempted to contribute to the understanding of the role of state regulation in providing investment for the development of innovation in the industrial sector in the context of financial security and under the conditions of Industry 4.0. The presented model reflects an integrated approach to assessing investment security, including identifying key financial obstacles. We have proposed specific measures to eliminate these obstacles, based on the method of analyzing hierarchies.

At the same time, our results resonate with the research of other scientists who also paid attention to financial aspects in the context of Industry 4.0. For example, Hajek and Henriques (2017) examined the innovation performance of European regions using neural networks, indicating the growing role of data analytics in financial innovation planning. Dilberoglu et al. (2017) explored the role of complementary manufacturing in the Industry 4.0 era, emphasizing the need for investment in new technologies. Regarding the environmental sustainability aspect, de Sousa Jabbour et.al. (2018) looked at how Industry 4.0 could impact sustainable manufacturing, which has financial implications due to critical success factors. This indicates the importance of considering environmental qualities when planning investments. A study by Dassisti et al. (2018) analyzed the challenges and opportunities for SMEs to adapt to Industry 4.0, highlighting the importance of financial support and regulation to promote innovative development. The work of Panchenko et.al. (2022) and Rushchyshyn et.al. (2021) similarly reflect the need for a methodological approach to innovation and security management, respectively. They show the importance of the legal and regulatory context in financing innovation. One of the founders of the modern school of security, Sylkin et.al. (2018) draws attention to the assessment of the financial security of engineering enterprises, which is directly related to your study, as it points to the importance of financial indicators in assessing investment potential. But at the same time, there are characteristic differences in the results we obtained. A list of the main results obtained by the authors of the article during the study is presented in Figure 7.

A modern model of state regulation of investment support for innovative industrial development is presented in the context of helping to increase the level of financial security

An approach to calculating the integral indicator for assessing the level of investment support for the development of innovation in the industrial sector as a tool for state regulation is presented

Through the method of hierarchy analysis, key financial obstacles to effective investment support for innovative industrial development were identified and analyzed; on the basis of it, state regulation measures were proposed to eliminate these obstacles

**Figure 7. A list of the main results obtained by the authors of the article during the research.**

Our study makes an important contribution to the literature by offering an embedded approach to further define investment strategies in the context of financial security and innovation development. We show new paths and horizons for research, showing the importance of an integrated approach in state regulation and investment support for innovation.

## CONCLUSIONS

It should be noted that the main component of effective government regulation is the creation of an institutional environment conducive to innovation and high-tech development. This includes the development and implementation of standards and regulations that meet the requirements of Industry 4.0, as well as the introduction of mechanisms to stimulate private and foreign investment in research and development. Government policy should be aimed at stimulating cooperation between universities, research centres and industrial enterprises. This should include the creation of innovation hubs or technology parks, where research, educational and production facilities are concentrated for joint projects. An important aspect is the development of the infrastructure needed to support the high-tech industry. This means investing in digital infrastructure such as broadband internet and developing logistics networks. Ultimately, these measures will not only ensure investment support for innovative development in the industrial sector but will also strengthen the country's financial security in the rapidly changing technological landscape of Industry 4.0, helping the industrial sector adapt and compete internationally.

In conclusion, this article has thoroughly analyzed industrial development in Ukraine, presenting a novel model for state regulation of investment support aimed at innovative industrial growth. This model is particularly focused on enhancing financial security. Additionally, a new methodological approach for assessing investment support levels for innovation development has been proposed, which serves as a robust tool for evaluating the current scenario. The article examines the problems of development of the industrial sector of the Ukrainian economy over the past five years. The problem of innovative development of industry is considered. The problems of ensuring financial and economic security are considered. The problems of assessing investment support for innovative industrial development are characterized. Finally, the study has identified and categorized the primary financial challenges hindering effective investment support in this context.

At the same time, further research should be devoted to the peculiarities of state regulation in the post-war period and artificial intelligence (Industry 5.0). In our opinion, other authors should gradually shift their focus to the new stage of the industrial revolution and how it affects financial security.

## ADDITIONAL INFORMATION

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## CONFLICT OF INTEREST

The Authors declare that there is no conflict of interest.

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## ДЕРЖАВНЕ РЕГУЛЮВАННЯ ІНВЕСТИЦІЙ В ІННОВАЦІЙНИЙ РОЗВИТОК ПРОМИСЛОВОСТІ ДЛЯ ЗМІЦНЕННЯ ФІНАНСОВОЇ БЕЗПЕКИ В УМОВАХ ІНДУСТРІЇ 4.0

Основною метою дослідження є теоретико-методичне обґрунтування сучасного підходу до формування моделі державного регулювання інвестиційного забезпечення інноваційного розвитку промисловості в контексті сприяння підвищенню рівня фінансової безпеки. Об'єктом дослідження є інноваційний розвиток промислового сектора економіки України. Науковим завданням є представлення методичного підходу до оцінювання поточного стану й тенденцій інвестиційного забезпечення інноваційного розвитку промисловості в усіх регіонах України як інструмента для вдосконалення державного регулювання. Методологія дослідження передбачає застосування сучасних методів аналізу й синтезу наявної інформації за проблематикою дослідження. Використано непараметричний статистичний метод для аналізу тенденцій і динаміки розвитку промисловості в Україні. Застосовано метод інтегральної оцінки для формування методичного підходу до оцінювання рівня інвестиційного забезпечення інноваційного розвитку як ефективного інструмента державного регулювання. У результаті проведеного дослідження представлено модель державного регулювання інвестиційного забезпечення інноваційного розвитку промисловості та здійснено оцінювання рівня такого забезпечення. На основі отриманих результатів запропоновано заходи із забезпечення фінансової безпеки в умовах Індустрії 4.0. Представлено ключові фінансові перешкоди інвестиційному забезпеченню інноваційного розвитку промисловості, які були впорядковані за пріоритетністю реагування на них зі сторони держави. Дослідження має обмеження, які полягають у врахуванні не всіх аспектів державного регулювання. Також у статті розглянута специфіка лише промислового сектора економіки.

**Ключові слова:** державне регулювання, інвестиційне забезпечення, інноваційний розвиток, рівень інвестиційного забезпечення, інтегральний показник, промисловість, фінансова безпека, фінансові результати діяльності, Індустрія 4.0

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