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THE ANTI-CORRUPTION ECOSYSTEM IN ENSURING THE STATE'S ECONOMIC SECURITY: THE EVOLUTION OF THE CONCEPT AND NEW INSTITUTIONAL MECHANISMS

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ABSTRACT

In the current climate of intensifying global economic challenges and the need for digital transformation and sustainable state development, establishing effective anti-corruption mechanisms is becoming increasingly important. Consequently, the concept of an anti-corruption ecosystem — an integrated environment that facilitates interaction between all anti-corruption stakeholders and fosters transparency and security in the economy — is of particular significance. This article examines the economic significance of the anti-corruption ecosystem concept as a vital mechanism for ensuring a state's economic security, and explores the evolution of anti-corruption strategies.

The article aims to elucidate the concept of an "anti-corruption ecosystem" and examine its evolution in the context of the development of anti-corruption theory and practice to ensure state economic security.

This article sets out the rationale behind the need to transition from a piecemeal approach to an ecosystem-based one in the implementation of the state's anti-corruption policy. It provides a critical analysis of the term's "ecosystem" and "anti-corruption ecosystem". The origins of the "anti-corruption ecosystem" as an economic phenomenon are examined, as is its significance in the modern business environment. The author has formulated a definition of this term as an open, adaptive, multi-level socio-economic system that aims to minimise and eliminate corruption risks and strengthen the state's economic security. The use of an ecosystemic approach in anti-corruption activities is established as a natural stage in the development of modern economic science and public administration practice. The structural elements of the anti-corruption ecosystem have been identified and are comprised of institutional, regulatory, legal, informational and analytical, digital and technological, social, educational, and international components. The functional purposes of these elements are explained, as are the interrelationships between them, ensuring the integrity of the ecosystem's functioning and its ability to adapt to new challenges. Particular attention is paid to the role of digital technologies, open data, and the synergy between human and artificial intelligence in creating an effective anti-corruption system.

Keywords: anti-corruption ecosystem, public administration, audit, corruption, digitalization, human capital, artificial intelligence, economic security, resilience, risks

JEL Classification: M19, M41, H10, H56, H79

INTRODUCTION

Corruption poses a significant threat to the effective functioning of the state, its sustainable economic development, and public trust in the authorities. It is a key factor hindering socio-economic development, reducing the effectiveness of public administration and undermining public trust. Corruption leads to the stratification of society along material lines, resulting in the complete destruction of the moral and legal foundations and principles that underpin the state's existence. Against a backdrop of global and regional instability and insecurity in all areas of life, and intensifying conflict and confrontation between countries, formulating and implementing a country's anti-corruption legal policy is becoming increasingly difficult. This problem is particularly acute in

Ukraine, where corruption has permeated virtually all spheres of public life and has become a serious threat to national security. Many academic publications have noted that corruption in Ukraine is systemic. Experience has shown that traditional approaches to combating corruption, based on repressive measures by individual bodies, are insufficiently effective and efficient. Current economic conditions in Ukraine, linked to European integration processes and the transformation of public administration, necessitate shifting from these traditional approaches towards a comprehensive anti-corruption strategy implemented through the creation of a holistic "anti-corruption ecosystem".

Consequently, there is an increasing need to examine the economic nature and evolution of this concept as a vital instrument for tackling corruption at a national level. This research is particularly relevant in the context of Ukraine's progress towards European integration, an important component of which is eradicating corruption through effective anti-corruption policies.

LITERATURE REVIEW

In the current context of the country's economic development, the study of the essence of the concept of "ecosystem" is attracting increasing attention from researchers. Among foreign scholars who have researched this issue and made significant contributions to its resolution, the following stand out: Tansley A.G. (1935), who first used this concept in biology; Rothschild M. (1995), who pioneered the introduction of this term into economic research; Jacobides M.G., Cennamo C., Gawer A. (2018), Munro T. (2012), Steenkamp, I. (2024), and Chessell M. (2008), who extended the use of the "ecosystem" category to the field of research into innovative enterprise development and demonstrated the relevance of applying an ecosystem approach in this area.

Domestic scholars have also addressed the issue of ecosystem development in various fields of economic research. In particular, Kolot A.M. (2024) examines the ecosystem approach in his works as an imperative for sustainable human-centred development. Scholars such as Kotko O.K. (2016), I. Ivakhnenko (2019), Lanovska H.I. (2017), and Shatilo O. (2025) have proposed implementing an ecosystem approach to the innovative development of enterprises with the aim of improving the efficiency of their operations and enhancing their competitiveness.

The issue of combating corruption has been examined in the works of many domestic and foreign scholars. Specific aspects of this issue in the context of the development of anti-corruption legal policy have been examined in the works of P.I. Haman (2018), Kalugina I.O. (2024), Kornyakova T.V. (2016), Kostohryz, Ya.O. (2024), Prykhodko A.A. (2019) and others. For example, Kalugina I.O. (2024) set out the fundamental principles for combating corruption in the public and private sectors and identified the most important directions for the development of anti-corruption policy, including: the formulation of interlinked anti-corruption programmes at national and regional levels; ensuring a unified approach to the understanding and interpretation of anti-corruption standards; analysing the state of corruption, corruption risks and the factors influencing it; taking into account the historical experience of the development of the state"s legal and political systems and legislation, as well as the cultural characteristics of society.

Due attention has been paid to the issues of establishing and developing anti-corruption auditing in the works of scholars such as Bezverkhyi, K., Parasii-Verhunenko et al. (2024) and Maistrenko, A. et al. (2024).

However, contemporary research into the mechanisms and methods of combating corruption is increasingly focusing on more than just institutions; it is also considering the interactions between institutions, the role of civil society, digital technologies, and a culture of integrity. This necessitates the creation of an anti-corruption ecosystem involving the integration and interaction of state, private, and civil society institutions through innovative technology. This approach enables anti-corruption activities to be viewed as a dynamic system of interaction between various elements, resulting in a synergistic effect. Nevertheless, an analysis of the literature reveals that the concept of an anti-corruption ecosystem has only recently begun to attract the attention of researchers and has not yet been adequately reflected in academic works.

Over the past decade, the ecosystem approach has been widely adopted in research on strategic management, institutional economics, digital transformation, public administration, and innovative development. The concept of an ecosystem has evolved from a biological interpretation to become a universal model for analysing complex socio-economic systems in which value is created through the interaction of many autonomous yet interconnected participants. Despite the significant development of ecosystem theory, its application to issues such as preventing corruption and ensuring a state's economic security remains under-researched.

The first area of contemporary research is devoted to establishing the theoretical foundations of the ecosystem approach. Cobben et al. (2022) systematised existing types of ecosystems, defining their conceptual boundaries, functional characteristics and development objectives. Further development of the theory is presented in the works of Wurth, Stam and

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Spigel (2022; 2023), who substantiated the mechanisms underlying the functioning of entrepreneurial ecosystems and demonstrated that their effectiveness is determined primarily by the quality of interaction between participants, rather than the efficiency of individual organisations. Cho et al. (2022) proposed an evolutionary approach to the development of ecosystems, emphasising their ability to adapt to changes in the external environment. At the same time, these studies mainly concern innovation and entrepreneurial activity, with virtually no consideration given to institutional mechanisms for combating corruption.

The second research area covers the study of ecosystem governance mechanisms. Foss, Schmidt and Teece (2023) define ecosystem leadership as the dynamic capacity to coordinate the interaction of independent participants. Daymond et al. (2023), Shen et al. (2024), Neto et al. (2024) and Fischer et al. (2026) develop the concept of ecosystem orchestration, emphasising the coordination of resources, collective decision-making and adaptive management. At the same time, most of the proposed models focus on the business environment and innovation networks, whilst the issue of interaction between government bodies, law enforcement agencies, civil society and international organisations remains outside the scope of research.

A significant body of contemporary literature is devoted to digital and platform ecosystems. Gawer (2022), Kretschmer et al. (2022), Bejjani et al. (2023), Zahra et al. (2023), Secundo et al. (2024) and Barile et al. (2026) demonstrate that digital technologies are fundamentally transforming the mechanisms of interaction between ecosystem actors, ensuring transparency, speed of information exchange and a reduction in transaction costs. Artificial intelligence, big data, digital platforms and integrated information systems play a particular role, forming the basis of modern governance. At the same time, these studies are largely focused on enhancing the innovativeness and competitiveness of enterprises, whilst the potential of digital technologies for the development of anti-corruption infrastructure remains largely untapped.

A separate area of research focuses on the institutional aspects of ecosystem development. Hazenberg et al. (2016), Osborne et al. (2022), Thomas and Ritala (2022), Vargo et al. (2023), and Wirtz et al. (2023) emphasise that the effectiveness of ecosystems is determined by the level of institutional trust, legitimacy, the quality of interaction between stakeholders, and the ability of institutions to collectively create social value. Despite these authors' significant contribution to the development of institutional ecosystem theory, they do not analyse the relationship between the quality of the institutional environment and the functioning of the anti-corruption system.

Research into sustainable, responsible and circular ecosystems has also seen significant development. Falcke et al. (2024), Kanda et al. (2025), Tabas et al. (2025) and Geissdoerfer et al. (2026) argue that achieving sustainable development goals requires comprehensive collaboration between the state, business, academia, civil society and international organisations. The principles of integrated governance, coordination of interests and multi-level interaction proposed by the authors can be used as a methodological basis for shaping a modern anti-corruption ecosystem. At the same time, the issue of combating corruption is not, in fact, addressed in these works.

In recent years, there has been a growing body of research focusing on the institutional nature of corruption and the mechanisms for combating it. Contemporary systematic literature reviews indicate that the majority of academic works are based on the "principal–agent" theory, institutional theory, or the concept of collective action. At the same time, researchers are increasingly emphasising the need to move away from analysing individual anti-corruption tools towards studying the complex networked interrelationships between state institutions, business, civil society and international organisations. This approach opens up opportunities for applying the ecosystem paradigm in the field of anti-corruption policy.

Historically, the concept of an "ecosystem" was borrowed from biology and has since been adapted to socio-economic research. The term "ecosystem" was first used by the British ecologist Tansley (1935), who employed it to explain the interaction of living organisms with one another and with their environment, whilst emphasising that these living organisms exhibit complex interactions, develop collectively and respond adaptively to changes in their internal and external environments.

In an economic context, the term "ecosystem" is a relatively recent addition to the vocabulary. While the term has a well-established definition in the field of biology, economic research communities are still actively developing approaches to its interpretation. In the 1990s, several publications emerged that viewed ecosystems as interactions between various organisations and other market participants (Kolot, 2024).

The term "ecosystem" was first used in economic research in 1996 by the American economist Rothschild M. (1995), who focused on the nature of interactions between economic agents, models of their business activity, and their relationships with the external environment. Chessell (2008) developed this approach and proposed interpreting the concept of an "ecosystem" as a networked community whose members pool their resources on a mutually beneficial basis in order to

achieve shared outcomes. Munro T. (2012) proposes viewing an ecosystem as a dynamic and adaptive organism that creates, consumes, and transforms knowledge into innovative products. Jacobides, Cennamo & Gawer (2018) interpret an ecosystem as a relevant system formed as a set of elements that contribute to value creation.

In the 1990s, the concept of an "ecosystem" began to attract significant attention from academics. For the most part, the term came to be interpreted not only as the interaction between organisations themselves, but also as their interaction with other market participants (Kolot, 2024).

Later (over time), many domestic researchers developed their own approaches to interpreting this concept, emphasising its specific variations depending on the characteristics and areas of its application. The different approaches to understanding this concept are determined, first and foremost, by the context of the research, including the aim, the objective of the analysis, the type of enterprise, the types of economic activity undertaken by economic agents, and the specific features of their interaction with other agents. For example, Lanovska (2017) interprets the "innovation ecosystem" as a combination of the state, the business and research environments, utilising organisational, regulatory, educational and methodological, and financial resources, and the introduction of a mechanism for knowledge transfer with the aim of transforming it into innovative products. In effect, her understanding of the essence of an innovation ecosystem boils down to the organic interaction of many components, in particular the state, business, science, law, education and finance. Kotko (2016) emphasises that the most important feature of the ecosystem is an innovative approach, which facilitates the integration of information infrastructure, an innovative culture and the digital environment.

In a broad sense, an ecosystem is regarded as a set of interrelated elements functioning as a single entity. In the context of economic research, an ecosystem represents a set of services through which users are able to satisfy a variety of cross-sectoral needs within a single integrated experience (Niharika, Hamza & Istvan, 2021).

The interpretations of the concept of "ecosystem" provided by various scholars are set out in Table 1.

Table 1. The economic essence of the concept of «ecosystem».

Author, source	Economic essence
Tsyhanenko, Zubko & Samus (2022)	The ecosystem is a business model that brings together various services and technologies on a single cloud platform under a single brand. It is designed to enable full and effective interaction with consumers
Steenkamp (2024)	An ecosystem is an economic community of interacting entities that considers all participants, not just those within a single sector. This can help boost a company's productivity
Ivakhnenko (2019)	The following perspectives are used to view an ecosystem: ▪ as a collection of participants who interact and take part in the "value chain"; ▪ as a marketplace for goods and services, where various products are offered to meet a wide range of similar needs; ▪ as a self-developing organization.
Munro (2012)	An ecosystem is a dynamic and adaptive entity that generates, utilises and transforms knowledge into innovative products
Shatilo (2025)	An ecosystem is a network of interconnected systems that create added value for consumers and improve business efficiency by introducing innovations and facilitating interaction between staff, customers, suppliers, competitors, financial institutions and regulators
Kolot (2024).	An ecosystem is a dynamic, open and voluntary network of economic agents who come together around a value proposition and interact based on the principles of competitive cooperation, consolidation and co-evolution
Kotko (2016)	In economics, an "ecosystem" is defined as an environment characterised by innovative activity and active, productive collaboration between its participants

The literature review conducted here identifies a number of research gaps.

Firstly, ecosystem theory and anti-corruption theory have developed largely independently of one another. Whilst research on ecosystems focuses on innovation, digital transformation, entrepreneurship and sustainable development, anti-corruption research is largely centred on the legal, economic or institutional aspects of combating corruption without employing an ecosystem approach.

Secondly, contemporary literature largely lacks a comprehensive concept of the anti-corruption ecosystem as an integrated system of interaction between state bodies, law enforcement agencies, the judiciary, the business sector, civil society, international partners, and digital infrastructure.

Thirdly, the relationship between the functioning of the anti-corruption ecosystem and the safeguarding of a state's economic security is not well understood. Most academic works treat corruption as a separate issue of public administration or institutional effectiveness without analysing its impact on factors such as investment attractiveness, financial stability, economic competitiveness and national security.

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AIMS AND OBJECTIVES

This article aims to explore the essence of the concept of an "anti-corruption ecosystem" and examine its evolution within Ukraine's economic security system in the context of the development of anti-corruption theory and practice.

To achieve the set objective, the following tasks needed to be addressed:

1. To conduct a critical analysis of academic approaches to interpreting the concept of "ecosystem" and examine its conceptual landscape in journal articles indexed in Scopus's scientometric databases.
2. To investigate how this term has evolved from the natural sciences to economics, management, the digital economy, and public administration.
3. To substantiate the author's vision of an anti-corruption ecosystem as an open, adaptive, multi-level socio-economic system that aims to minimise and eliminate corruption risks and strengthen the state's economic security.
4. To identify the structural elements of an anti-corruption ecosystem and explain their functional purpose.
5. To justify the role of digital technologies in developing the anti-corruption ecosystem.

METHODS

The following general qualitative research methods were employed in this study: systems analysis – to construct the architectonic framework of the anti-corruption module within the national security system; the abstract-logical method, analysis and synthesis – to identify the constituent elements of the country's anti-corruption ecosystem; the dogmatic (formal-legal) and comparative-legal methods – to examine the legal and institutional framework underpinning the functioning of Ukraine's anti-corruption ecosystem; the historical method – in examining the evolution of approaches to the formulation of measures aimed at preventing corruption; heuristic techniques, in particular the method of associations and analogies – in the process of adapting behavioural economics theory to ensure the effectiveness and emergence of Ukraine's anti-corruption ecosystem.

The development of methodological approaches to achieving the set objective was based on the use of the following quantitative analytical techniques: time series analysis – to study trends in corruption levels in Ukraine and forecast the direction of anti-corruption policy; trend analysis – to identify trends in the research priorities of scholars working on this issue; cluster analysis using the VOSviewer programme – to examine the conceptual landscape of the "ecosystem" category in journal articles indexed in the Scopus scientometric databases; and graphical techniques – to visualise the research findings.

RESULTS

Traditionally, corruption is defined as the abuse of power by individuals for private gain. It is multifaceted in nature, manifesting itself in various forms including bribery, lobbying on behalf of specific parties in return for remuneration, misuse of resources, abuse of official position and conflicts of interest. From an economic theory perspective, corruption arises from imperfect control mechanisms and low moral standards among individuals with significant authority due to information asymmetry.

In the context of modern socio-economic challenges associated with the digital transformation of the economy, martial law and large-scale international financing of Ukraine's recovery and integration into the European Union processes, strengthening state control over corruption offences is especially relevant. Corruption leads to the inefficient use of state resources and undermines the institutional capacity of the state. It also reduces the country's investment attractiveness, worsens the quality of public administration, weakens public trust in the authorities and threatens economic security. The strengthening of state control should not only involve increasing the number of control measures or strengthening sanctions, but also, and more importantly, increasing their effectiveness. This can be achieved by integrating the activities of anti-corruption institutions, digitising control procedures, developing interdepartmental information exchange, ensuring the transparency of accounting processes and introducing modern analytical tools.

An analysis of the data in Table 2 and Figure 1 indicates an increase in the detection, investigation and prosecution of corruption offences in Ukraine between 2023 and 2025, although certain financial indicators show uneven trends.

Table 2. Key indicators characterising the level of corruption in Ukraine for 2023–2025. *(Source: Key indicators, 2023, 2024, 2025)*

№	Indicators	Years		
		2023	2024	2025
1	Number of registered corruption criminal offenses and criminal offenses related to corruption, units	13495	14049	14351
2	Number of criminal offenses investigated, units	25791	29257	31008
3	Amount of material damages in criminal proceedings, UAH thousand	24265772	31914083	23630244
4	Amount of property seized in criminal proceedings, UAH thousand	9983555	7636645	7885537
5	The number of cases on administrative offenses related to corruption, units	2871	5661	8769
6	Number of persons against whom cases of administrative offenses related to corruption were considered, persons	1909	4618	7747

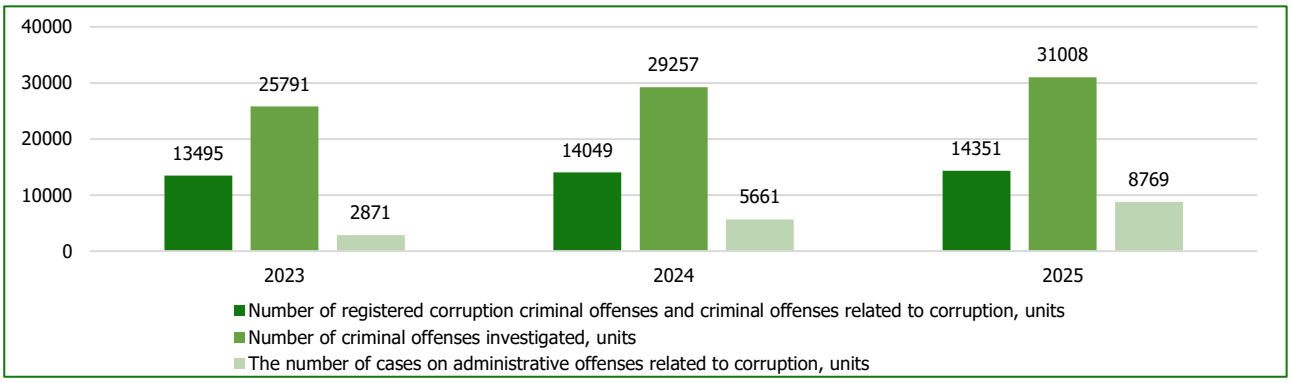

Figure 1. Key indicators of the level of corruption in Ukraine for 2023-2025. *(Source: constructed with the data from the Table 1)*

Research has shown that the number of recorded corruption-related criminal offences has gradually increased from 13,495 in 2023 to 14,351 in 2025. The total increase over this period was 856 offences (6.3%), indicating a consistently high level of corruption-related crime and improved detection rates.

A more significant increase was seen in the number of criminal offences under investigation by pre-trial investigation authorities. Over three years, this figure rose from 25,791 to 31,008 cases (a 20.2 per cent increase), suggesting an expansion in the scope of law enforcement agencies' work and an increase in criminal proceedings in the fight against corruption.

The negative consequences of corruption offences primarily manifest as increased material losses, which significantly impact macroeconomic indicators.

The trend in financial losses has been volatile (Figure 2). In 2024, total losses increased to UAH 31.9 billion, a rise of 31.6 per cent compared to 2023. However, in 2025, this figure fell to UAH 23.6 billion (26.0 per cent less than in 2024 and 2.6 per cent below the 2023 level). This may indicate either a reduction in the scale of individual corruption schemes or differences in the structure of the criminal offences detected.

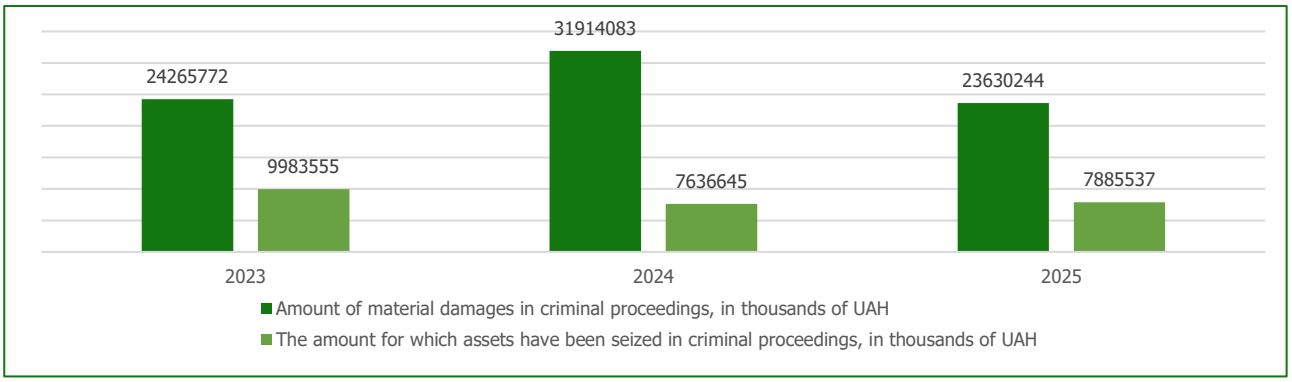

Figure 2. Trends in financial losses resulting from corruption offences for 2023–2025. *(Source: compiled with the data from the Table 1)*

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At the same time, the total value of assets subject to seizure has shown an overall downward trend. While it stood at almost UAH 10.0 billion in 2023, by 2024 it had fallen to UAH 7.6 billion (a 23.5 per cent decrease), rising slightly to UAH 7.9 billion in 2025, though remaining 21.0 per cent below the 2023 level. This may indicate a change in the composition of assets subject to seizure or difficulty in securing compensation for state losses.

The most significant growth has been observed in administrative liability for corruption offences. The number of administrative cases increased from 2,871 in 2023 to 8,769 in 2025, representing a more than threefold increase (+205.4%). A similar trend is evident in the number of individuals against whom administrative proceedings were brought, rising from 1,909 to 7,747 (an increase of 305.8%). This significant increase may be linked to both improved efficiency in the work of authorised bodies in the field of corruption prevention and stricter monitoring of compliance with anti-corruption legislation, particularly with regard to financial control, conflicts of interest, and restrictions on public officials.

Overall, the results of the analysis indicate a trend towards stronger anti-corruption measures in Ukraine between 2023 and 2025. This is evidenced by an increase in the number of criminal and administrative offences detected, an expansion in the scope of pre-trial investigations, and greater activity by law enforcement and anti-corruption agencies. However, the reduction in financial losses and the decrease in the volume of seized assets in 2025 suggest the need for improvements in financial investigation mechanisms, the identification of illegally acquired assets, and the effective seizure and subsequent confiscation of these assets. Thus, whilst these indicators confirm the positive trend in Ukraine's anti-corruption system's institutional capacity, they also highlight the need to improve compensation for losses and the recovery of assets obtained through corruption offences.

The evolution of approaches to developing measures aimed at preventing corruption has taken place in a series of stages:

1. The repressive approach is based on establishing a system of punitive measures for corruption offences.
2. The institutional approach involves creating specialised bodies responsible for drafting anti-corruption legislation and monitoring its implementation. It emphasises the role of formal and informal rules governing the behaviour of economic agents.
3. The administrative approach is aimed at monitoring and regulating anti-corruption measures. Implementation of anti-corruption measures is the responsibility of the system of internal control and external anti-corruption audit.
4. The preventive approach aims to prevent corruption by establishing appropriate preventive procedures that make it impossible to carry out corrupt acts.
5. The repressive approach is based on establishing a system of punitive measures for the commission of corruption offences.
6. The institutional approach involves creating specialised bodies responsible for drafting anti-corruption legislation and monitoring its implementation. This approach emphasises the role of formal and informal rules that govern the behaviour of economic agents.
7. The administrative approach is aimed at monitoring and regulating anti-corruption measures. In this context, responsibility for implementing these measures rests with the internal control system and external anti-corruption audit.
8. The preventive approach is aimed at preventing corruption by establishing appropriate procedures that make corrupt acts impossible.

Despite the importance of all these approaches, their lack of effectiveness was linked to a certain degree of isolation, which prevented them from delivering the desired results. The development of a theoretical framework for the effective functioning of an anti-corruption ecosystem is based on an understanding of the economic essence of this concept.

The first stage of investigating the role of the ecosystem approach in fighting corruption is to examine how academic views on the concepts of "ecosystem" and "anti-corruption ecosystem" have changed over time. This can be done by analysing Google Trends data from 1 January 2004 to 1 July 2026 (Figure 3).

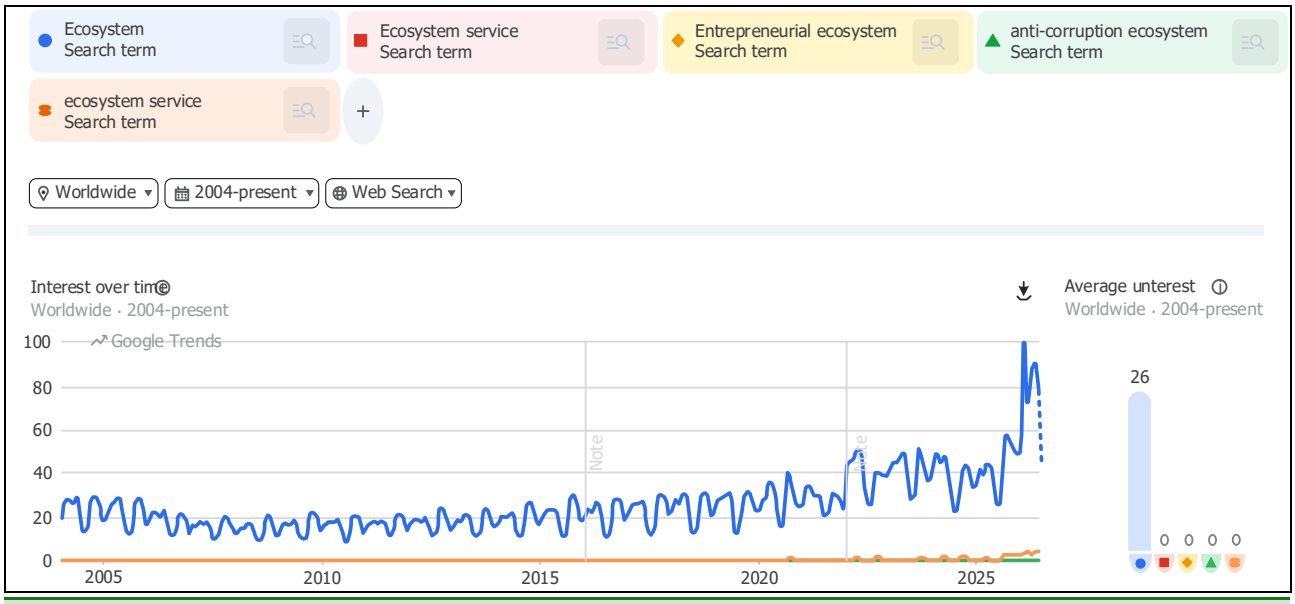

Figure 3. Dynamics of changes in search frequency by ecosystem categories (for the period January 1, 2004 – July 1, 2026). *(Source: built by the authors using Google Trends tools)*

As the study shows, researchers' interest in the concept of "ecosystem" began to rise significantly from 2020 onwards, remaining fairly stable ever since. At the same time, the nature of this type of trend analysis remains relatively stable. When creating graphical representations, the peak level of search activity for the selected concept is taken into account to reflect the content sought by internet users. Until 2008, this concept attracted virtually no attention from researchers. It should also be noted that the concept of an "anti-corruption ecosystem" was scarcely considered in academic works and was not in demand among internet users.

As part of our research, we conducted a bibliometric analysis of academic publications devoted to the study of ecosystem development. To this end, we utilised the Scopus scientometric database, widely regarded as one of the most authoritative in the world, as well as the VOSviewer software to construct bibliographic maps. During the analysis, we applied several key criteria that enabled us to carry out a detailed assessment and visualisation of trends in this field:

1. The search was conducted using the term "ecosystem".
2. The timeframe covered the period from 1982 to 2026.

Our entire sample (4,761 articles) was imported into the VOSviewer software. The search carried out within this software was designed to identify the frequency with which authors used the term "ecosystem" in article titles. We also set a threshold requiring the phrase "ecosystem" to appear at least 82 times. The bibliometric map provides information on the frequency of use of the term "ecosystem" as indicated by the size of the circles, and also allows one to trace the variations in categories within and between clusters. The results of the study are shown visually in Figure 4.

This analytical approach makes it possible to assess not only trends in ecosystem development, but also which subcategories and related concepts are important to the scientific community.

The graph (Figure 4) illustrates several significant clusters representing the primary research themes associated with the concept of "ecosystem". Each cluster consists of terms that frequently appear in scientific publications, and their size indicates how often they are used.

During the process of grouping articles devoted to ecosystems, 21 keywords were identified based on the frequency with which the concepts were mentioned (frequency of mention >82).

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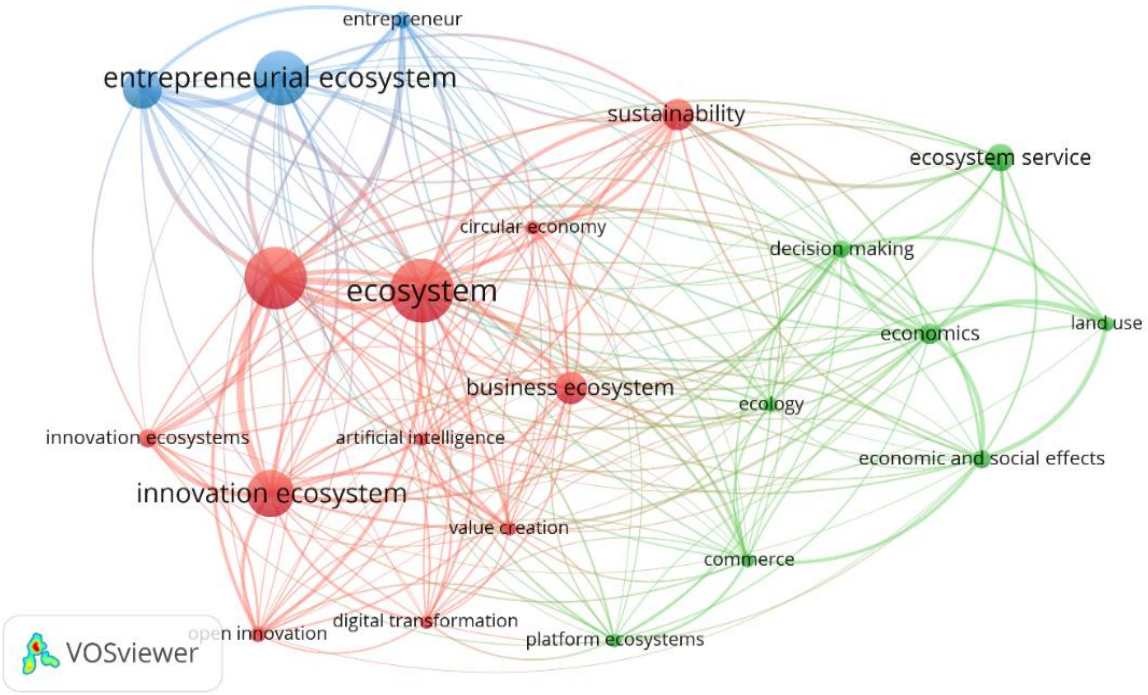

Figure 4. Visualization of the most used categories in articles devoted to the use of the term "ecosystem". *(Source: developed by the authors using the VOSviewer program based on the Scopus article database)*

The clustering of research in the field of ecosystems based on the Scopus article database is presented in Table 3.

Table 3. Clustering of research in the field of ecosystems, based on the Scopus article database. *(Source: the authors compiled this based on Scopus data obtained using the VOSviewer software)*

No	Cluster color	The most used term	Number of keywords	Related primary keywords
1	Red	Ecosystem	10	Innovation, innovation ecosystem, business ecosystem, sustainable development, open innovation, value creation, circular economy, artificial intelligence, digital transformation
2	Green	Ecosystem service	8	Economics, economic and social impact, decision-making, land use, ecology, commerce, platform ecosystems
3	Blue	Entrepreneurial ecosystem	3	Entrepreneurship, entrepreneur

The research has identified three clusters in the conceptual landscape of the ecosystem, which have been analysed in this subject area. The largest of these clusters is the "red" cluster, encompassing research into ecosystems, innovation, innovation ecosystems, business ecosystems, sustainable development, open innovation, value creation, the circular economy, artificial intelligence, and digital transformation.

The "green" cluster brings together terms relating to ecosystem services. This cluster is closely intertwined with the "red" cluster, demonstrating the inseparable nature of these concepts in relation to the topic under investigation.

The "blue" cluster focuses on terms such as the entrepreneurial ecosystem, entrepreneurship, and entrepreneurs.

Consequently, the concept of an anti-corruption ecosystem is relatively new and has not yet become widely established in academic research. We believe that it should be viewed as a holistic, dynamic, multi-level, open system of interaction between institutions, processes, mechanisms, tools and actors. This system is aimed at preventing, detecting and combating corruption based on the principles of transparency, accountability and mutual responsibility.

The key characteristics of a modern anti-corruption ecosystem are:

- openness and transparency;
- the digitalisation of all processes and the use of analytics and artificial intelligence;
- a focus on preventive measures rather than combatting offences that have already been committed;

- the extensive involvement of citizens and internal control bodies in identifying corruption offences.

The anti-corruption ecosystem has evolved through the following stages (Figure 5):

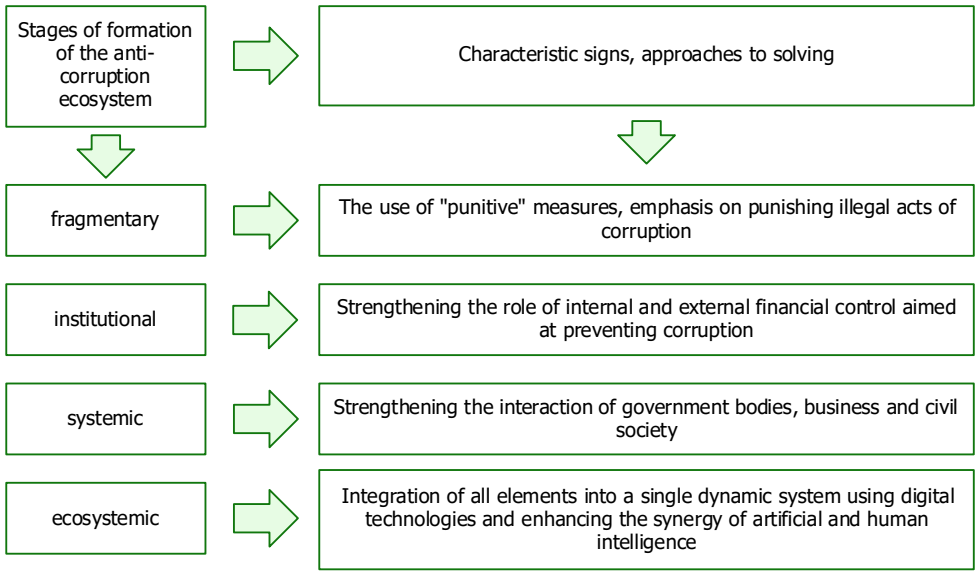

Figure 5. Stages of formation of the anti-corruption ecosystem.

1. *The fragmented (traditional) stage*. This stage is characterised by the dominance of a "punitive" approach, whereby the fight against the consequences of corruption was carried out by law enforcement agencies. The links and interaction between the components of this ecosystem were weak or non-existent at this stage.
2. *The institutional stage.* This stage is characterised by the establishment of internal and external financial control systems, the development of a regulatory framework, and the creation of specialised anti-corruption bodies. These factors contribute to improvements in legislation in this field. While undoubtedly more progressive than the fragmented stage, it is characterised by a lack of integration and a certain degree of hierarchy that prevents a systematic approach to tackling corruption at all levels.
3. *The systemic stage.* This stage is characterised by a more comprehensive approach to tackling corruption, involving close cooperation between government bodies, the business sector, and civil society. The main aim is to create preventive conditions that render corrupt schemes impossible.
4. *The ecosystem stages.* This stage is characterised by the integration of all elements into a single dynamic system and the widespread use of digital technologies, open data, and analytics. The synergy between human and artificial intelligence is strengthened at this stage, enabling potential corruption schemes to be proactively identified and the risks of unlawful actions to be detected more effectively.

We propose that a modern anti-corruption ecosystem should comprise the following structural elements: institutional, legal, economic, social, and technological components.

The most important of these is the institutional component, comprising state bodies, anti-corruption bureaus, the judiciary, anti-corruption agencies, and financial control bodies. These bodies constitute Ukraine's anti-corruption infrastructure and include the following: the National Anti-Corruption Bureau of Ukraine (NABU); the Specialised Anti-Corruption Prosecutor's Office (SAPO); the High Anti-Corruption Court (HACC); the National Agency for Asset Recovery and Management (ARMA); the National Agency for the Prevention of Corruption (NAPC); other investigative bodies, such as the National Police of Ukraine, the Security Service of Ukraine and the State Bureau of Investigations; and the public prosecution service.

The legal component covers the legal environment, particularly the development of anti-corruption legislation and regulatory mechanisms to combat corruption.

The economic component encompasses the relevant business environment and includes the creation of effective compliance systems, the establishment of internal control and audit systems, the conduct of forensic audits and the implementation of codes of corporate ethics.

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The social component engages civil society, including the media, civil society organisations, activists, and concerned citizens, in identifying instances of corrupt practices. It also addresses the human factor, including moral principles, human values, behaviour, and integrity.

The technological component includes digital technologies such as electronic declarations, e-audits, open data and risk analysis systems, as well as the development of open data systems and the creation of analytical tools and artificial intelligence technologies. Digitalisation is a key factor in enhancing the effectiveness of anti-corruption efforts, ensuring transparency of processes, reducing subjectivity, providing access to open data, and enabling the automation of controls. Positive examples include electronic declarations, the public procurement system, and open registers.

The defining feature of an ecosystem is not just the presence of its constituent parts, but also their interaction and interdependence, which creates a synergistic effect in the fight against corruption. An anti-corruption ecosystem is a logical development of a systemic approach, involving the integration of various actors and mechanisms into a single structure.

For an anti-corruption ecosystem to function effectively, artificial and human intelligence must complement one another. Human intelligence provides the foundation for analytical thinking and ethical evaluation of corruption schemes. In turn, artificial intelligence enables large datasets to be processed and specific patterns and discrepancies arising from corrupt activities to be identified automatically. This synergy improves the accuracy with which corruption risks can be identified and neutralises the subjective element in assessments; optimises management decisions; and ensures rapid information processing.

The main obstacles to creating an effective anti-corruption ecosystem in Ukraine are:

- a lack of coordination between the various institutions that form part of the ecosystem;
- a lack of transparency and limited availability of information regarding corrupt activities;
- low moral and ethical standards among certain officials who stand to gain financially from corruption;
- insufficient public trust in state bodies;
- risks associated with digital technology;
- ethical issues surrounding artificial intelligence;
- management's reluctance to disclose illegal activities within the organisation that negatively impact its image and reputation.

DISCUSSION

Our analysis of the literature has allowed us to identify several controversial positions and scientific gaps.

Firstly, although the ecosystem approach is becoming increasingly popular in economic research, its scope remains quite limited. For instance, the ecosystem approach is widely used in studies of ways to enhance enterprises' innovative activity by researchers such as Kotko (2016), Ivakhnenko (2019), Lanovska (2017), Munro (2012) and Shatilo (2025). The functioning mechanisms of various entrepreneurial ecosystems have been examined in the work of Cobben et al. (2022), Wurth, Stam and Spigel (2022; 2023), while the benefits of the ecosystem approach in studying sustainable human capital development have been explored by Kolot (2024).

Secondly, while there are certain advantages to this approach in economic research, it should be noted that the ecosystem approach has not yet become widespread in the field of anti-corruption, as our studies of the conceptual landscape in Scopus-indexed journal publications have shown. Modern literature offers little by way of a holistic concept of the anti-corruption ecosystem as an integrated system of interaction between state bodies, law enforcement institutions, the judiciary, businesses, civil society, international partners, and digital infrastructure. An analysis of recent publications on this topic reveals that ecosystem theory and anti-corruption theory are evolving independently of each other. While ecosystem research focuses on innovation, digital transformation, entrepreneurship, and sustainable development, anti-corruption research mostly focuses on the legal, economic, or institutional aspects of corruption without using the ecosystem approach.

We agree with the scientific views of Hazenberg et al. (2016), Osborne et al. (2022), Thomas and Ritala (2022), Vargo et al. (2023) and Wirtz et al. (2023). These scientists argue that the effectiveness of ecosystems (including anti-corruption ones) is primarily determined by the quality of interaction between stakeholders, and by the ability of institutions to create a collective, synergistic effect from such interaction. Supporting this concept, we believe that special attention should be

paid to the relationship between the quality of the institutional environment and the effectiveness of the corruption prevention system. We also support the view of scientists such as Gawer (2022), Kretschmer et al. (2022), Bejjani et al. (2023), Zahra et al. (2023), Secundo et al. (2024) and Barile et al. (2026), who argue that digital technologies play a special role in improving the implementation of the ecosystem approach in strategic management practices and enhancing business entity competitiveness. These technologies radically change the interaction mechanisms between ecosystem entities, ensuring transparency and the speed of information exchange.

Thirdly, the relationship between the functioning of the anti-corruption ecosystem and the economic security of the state is a topic that has not been sufficiently explored in scientific literature. Most scientists, including P. Gaman (2018), I. Kalugina (2024), T. Kornyakova (2016) and Ya. Kostogryz (2024), A. Maistrenko (2024), K. Nazarova (2024) and A. Prikhodko (2019), consider corruption to be a distinct issue within public administration or institutional efficiency. However, they fail to analyse its impact on investment attractiveness, financial stability, the competitiveness of the economy, and national security.

The authors of this article have made a scientific contribution by substantiating the need to change the conceptual principles of the anti-corruption ecosystem's functioning as an effective tool for ensuring the state's economic security. To this end, the authors present their vision of the anti-corruption ecosystem as an open, adaptive, multi-level socio-economic system uniting state bodies, businesses, civil society, international institutions, information resources, digital technologies, and artificial intelligence tools. The interaction between these elements is aimed at preventing, identifying, minimising, and eliminating corruption risks while ensuring transparency and accountability, and strengthening the state's economic security. The authors have identified the structural elements of the anti-corruption ecosystem, including institutional, regulatory, informational, analytical, digital, technological, social, educational, and international components. The functional purpose of these elements is revealed, as are the relationships between them, ensuring the integrity of the ecosystem's functioning and its ability to adapt to new challenges.

The anti-corruption ecosystem in Ukraine is subject to a number of constraints, including legal, institutional, technological, organisational and socio-psychological ones.

Legal constraints include limited access to information due to requirements regarding the protection of personal data, state secrets and official information, as well as inconsistencies in legislation between various anti-corruption and sector-specific regulations. Other constraints include the existence of discretionary powers within state bodies, which may lead to the inconsistent application of rules and regulations, and the difficulty of proving corruption offences, particularly in cases involving covert schemes and conflicts of interest.

Institutional constraints may include conflicts of jurisdiction between the NACP, NABU, SAPO and the State Bureau of Investigation, political influence on certain anti-corruption institutions, management instability and frequent staff changes, and limited financial, human and technical resources.

Technological constraints are largely linked to insufficient integration of government information systems, risks posed by cyber threats and leakage of confidential data, limited scope for utilising artificial intelligence due to data quality and completeness, and the need for significant financial resources to modernise digital platforms.

The effectiveness of the anti-corruption ecosystem is also significantly affected by financial constraints, essentially resulting from the high cost of developing and maintaining digital anti-corruption tools, dependence on international technical assistance for certain projects, and limited budgetary funding under martial law.

In addition to the above, social constraints play a significant role. These include an insufficient level of anti-corruption culture among the population, citizens' low willingness to report corruption, fears of possible persecution among whistleblowers, and insufficient awareness of whistle-blower protection mechanisms.

For Ukraine, martial law-related restrictions are particularly relevant. These include the prioritisation of defence needs, which sometimes reduces the transparency of certain procedures, and restrictions on access to public information and certain state registers for security reasons. There are also heightened corruption risks in the areas of procurement, humanitarian aid and infrastructure reconstruction, and it is difficult to exercise full public oversight during wartime.

CONCLUSIONS

The study yielded a number of theoretical and practical conclusions.

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In particular, a critical analysis of scientific approaches to interpreting the concept of "ecosystem" revealed that the modern understanding of this category's economic essence has expanded beyond the natural sciences to become interdisciplinary. In economic and management science, the ecosystem is considered to be a set of interconnected subjects, institutions, resources, and mechanisms whose interaction ensures the achievement of common goals, the creation of value, and sustainable development.

Research into the transformational evolution of the concept of "ecosystem" has revealed a natural progression from its biological origins to its adoption in economics, management, the digital economy, and public administration. Under current conditions, the ecosystem approach is increasingly being used to explain complex socio-economic phenomena and processes characterised by high dynamism, network interaction among participants, increased digitalisation, and the need for rapid adaptation to changes in the external environment.

The author proposes the concept of an anti-corruption ecosystem as an open, adaptable, multi-level socio-economic system that unites state institutions, business entities, civil society, international organisations, digital platforms, regulatory and legal support, and information and analytical mechanisms. The interaction between these entities is aimed at preventing, identifying, and minimising corruption risks, forming a culture of integrity, and ensuring the economic security of the state.

The concept of the "anti-corruption ecosystem" has evolved from a narrow understanding of fighting corruption to a comprehensive model of interaction between various entities (institutions, technologies, and society). The modern ecosystem approach increases the efficiency of anti-corruption activities by creating a synergy between institutions, technologies, and people. Further development of this approach is associated with the introduction of innovative digital technologies, the development of analytical platforms, increased social responsibility, and the formation of a culture of integrity. Applying an ecosystem approach increases the effectiveness of anti-corruption policy and ensures the state's sustainable development.

The structure of the anti-corruption ecosystem has been substantiated, as has the functional purpose of its main elements. It is evident that the effectiveness of the ecosystem hinges not only on the efficacy of individual institutions' activities, but also on the quality of their interaction, the degree of information integration, the coordination of management processes, the transparency of procedures, accountability, public oversight, and the existence of effective feedback mechanisms. It is proven that digital technologies are one of the key drivers of the development of the modern anti-corruption ecosystem. Using artificial intelligence technologies, big data, blockchain technologies, e-government, open state registers, digital platforms, and analytical tools significantly increases the ability to monitor corruption risks, automate control procedures, ensure transparency in public administration, and make informed management decisions. However, digitalisation requires proper regulatory and legal frameworks, cybersecurity and data protection, as well as the development of digital competencies among all ecosystem participants.

The results obtained have practical value in that they can be used to develop state anti-corruption policy, improve mechanisms for ensuring economic security and develop digital public administration. They can also be used in further scientific research devoted to integrating digital technologies and artificial intelligence tools into systems for preventing and combating corruption. Further scientific research could focus on deepening the theoretical and methodological foundations of forming an anti-corruption ecosystem and developing practical tools for assessing its effectiveness in the context of the digital transformation of the economy. Particular focus should be given to developing a system of indicators and criteria to assess the maturity level of the anti-corruption ecosystem, as well as a methodology to comprehensively diagnose its effectiveness and determine the impact of individual components on ensuring the economic security of the state. The institutional resilience of the anti-corruption ecosystem to external and internal challenges must also be studied, particularly in the context of martial law, post-war recovery, and Ukraine's integration into Europe.

ADDITIONAL INFORMATION

AUTHOR CONTRIBUTIONS

All authors have contributed equally.

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CONFLICT OF INTEREST

The Authors declare that there is no conflict of interest.

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АНТИКОРУПЦІЙНА ЕКОСИСТЕМА В ЗАБЕЗПЕЧЕННІ ЕКОНОМІЧНОЇ БЕЗПЕКИ ДЕРЖАВИ: ЕВОЛЮЦІЯ КОНЦЕПЦІЇ ТА НОВІ ІНСТИТУЦІЙНІ МЕХАНІЗМИ

У сучасних умовах посилення глобальних економічних викликів, цифрової трансформації та необхідності сталого розвитку держави особливої актуальності набуває формування ефективних механізмів протидії корупції. Відтак особливого значення набуває концепція антикорупційної екосистеми як інтегрованого середовища, що забезпечує взаємодію всіх суб'єктів антикорупційної діяльності й створює умови для формування прозорого та безпечного економічного простору. У роботі досліджено економічну сутність поняття «антикорупційна екосистема» як найважливішого механізму забезпечення економічної безпеки держави та еволюцію підходів до протидії корупції.

Метою дослідження є розкриття сутності поняття «антикорупційна екосистема» та дослідження еволюції цього поняття в контексті розвитку теорії й практики протидії корупції для забезпечення економічної безпеки держави.

У статті обґрунтовано необхідність переходу від фрагментарного до екосистемного підходу в реалізації державної антикорупційної політики. Здійснено критичний аналіз термінів «екосистема» та «антикорупційна екосистема». Проаналізовано витоки формування такого економічного явища як «антикорупційна екосистема» та визначено її значення в сучасному бізнес-середовищі. Сформовано авторське бачення сутності цього терміна як відкритої, адаптивної, багаторівневої соціально-економічної системи, спрямованої на мінімізацію та усунення корупційних ризиків і зміцнення економічної безпеки держави. Установлено, що використання екосистемного підходу в царині антикорупційної діяльності є закономірним етапом розвитку сучасної економічної науки та практики публічного управління. Виокремлено структурні елементи антикорупційної екосистеми, до яких віднесено інституційну, нормативно-правову, інформаційно-аналітичну, цифрово-технологічну, соціальну, освітню та міжнародні складові. Розкрито їхнє функціональне призначення та визначено взаємозв'язки між окремими елементами, що забезпечують цілісність функціонування екосистеми та її здатність адаптуватися до нових викликів. Особливу увагу приділено ролі цифрових технологій, відкритих даних і синергії людського та штучного інтелекту у формуванні ефективної системи запобігання корупції.

Ключові слова: антикорупційна екосистема, екосистема, державне управління, аудит, корупція, цифровізація, людський капітал, штучний інтелект, економічна безпека, резильєнтність, ризики

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