УДК 338.24:338.22
DOI: 10.60022/3(1)-18S

Ostroverkh Petro
Candidate of Economic Sciences, Professor
Head of the Department of Economic Theory
Ivan Franko National University of Lviv, Ukraine
Островерх Петро Іванович
кандидат економічних наук, професор
завідувач кафедри економічної теорії
Львівський національний університет імені Івана Франка, Україна
ORCID: 0000-0003-1909-8338

Moryak Tetyana
Candidate of Economic Sciences
Associate Professor of the Department of Economic Theory
Ivan Franko National University of Lviv, Ukraine
Моряк Тетяна Петрівна
кандидат економічних наук
доцент кафедри економічної теорії
Львівський національний університет імені Івана Франка, Україна
ORCID: 0000-0001-9337-982X

Popovych Taras
PhD student
Ivan Franko National University of Lviv, Ukraine
Попович Тарас Андрійович
здобувач третього (освітньо-наукового) рівня вищої освіти
Львівський національний університет імені Івана Франка, Україна
ORCID: 0009-0006-7479-6664

CRITERIA AND INDICATORS FOR ASSESSING THE SOCIO-ECONOMIC EFFECTIVENESS OF STATE REGULATION OF NATURAL MONOPOLIES

Abstract*. This article examines the criteria and indicators used to assess the socio-economic effectiveness of state regulation of natural monopolies, emphasizing the multidimensional nature of regulatory outcomes in modern economic conditions. Natural monopolies operate in strategically important sectors where the absence of competition necessitates effective state intervention to balance consumer interests, ensure infrastructural sustainability, and promote long-term development.*

The study highlights that regulatory effectiveness is reflected not only in tariff dynamics and investment activity but also in productivity, quality and accessibility of services, social fairness, and institutional capacity of the regulatory environment. To provide a structured analytical framework, key economic, social, and institutional criteria of evaluation are systematized, accompanied by relevant quantitative, qualitative, and composite indicators. Special attention is given to the methodological integration of these indicators into a unified assessment system.

The article outlines the logic of combining criteria and indicators, describes normalization procedures, and examines methods of aggregating results–including scoring, integral indices, and the Analytic Hierarchy Process (AHP). These tools enable the transformation of heterogeneous data into comprehensive, comparable assessments of regulatory performance. Practical applications of the proposed system are considered in the context of regulatory monitoring, strategic planning, evaluation of tariff and investment policies, and cross-sectoral comparison of natural monopolies. The findings demonstrate that a comprehensive indicator-based approach enhances the transparency, accountability, and effectiveness of state regulation while supporting evidence-based decision-making and the identification of priority areas for regulatory improvement.

Keywords*: natural monopolies, state regulation, efficiency criteria, evaluation indicators, integral index, analytic hierarchy process, regulatory monitoring.*

КРИТЕРІЇ ТА ІНДИКАТОРИ ОЦІНКИ СОЦІАЛЬНО-ЕКОНОМІЧНОЇ ЕФЕКТИВНОСТІ ДЕРЖАВНОГО РЕГУЛЮВАННЯ ПРИРОДНИХ МОНОПОЛІЙ

Анотація. *Статтю присвячено комплексному дослідженню критеріїв, індикаторів і методичних підходів до оцінювання соціально-економічної ефективності державного регулювання природних монополій у сучасних умовах розвитку національної економіки. Обґрунтовано, що природні монополії функціонують у стратегічно важливих секторах, де обмеженість конкуренції зумовлює необхідність активного та збалансованого державного впливу, спрямованого на узгодження інтересів споживачів, суб'єктів господарювання та суспільства в цілому.*

У роботі розкрито нормативно-інституційні засади регулювання природних монополій та визначено ключові економічні, соціальні й інституційні наслідки регуляторної політики. Показано, що ефективність державного регулювання не зводиться виключно до контролю тарифів або інвестиційних програм, а проявляється також у рівні продуктивності, якості та доступності послуг, соціальної справедливості, прозорості процедур і спроможності регуляторних органів. Систематизовано групи економічних, соціальних та інституційних критеріїв оцінювання, а також відповідні кількісні, якісні та інтегральні індикатори, які забезпечують можливість багатовимірного аналізу результативності регуляторного впливу.

Особливу увагу приділено методологічним аспектам інтеграції показників у єдину систему оцінювання, зокрема процедурам нормалізації та агрегування даних. Розглянуто застосування бальної оцінки, інтегрального індексу та методу аналізу ієрархій як інструментів формування узагальнених і порівнюваних оцінок ефективності регулювання. Обґрунтовано практичну значущість запропонованого підходу для регуляторного моніторингу, стратегічного планування, оцінювання тарифної й інвестиційної політики та міжгалузевого порівняльного аналізу природних монополій. Зроблено висновок, що використання комплексної системи критеріїв і індикаторів сприяє підвищенню прозорості, підзвітності та обґрунтованості державного регулювання, а також підтримує ухвалення управлінських рішень на основі доказів.

Ключові слова: *природні монополії, державне регулювання, критерії ефективності, індикатори оцінювання, інтегральний індекс, метод аналізу ієрархій, регуляторний моніторинг.*

Formulation of the problem. Natural monopolies play a critical role in the provision of socially significant services, and the results of their activities have a substantial impact on economic development and public welfare. At the same time, the monopolistic nature of these markets creates risks of inefficient pricing, low service quality, and insufficient investment activity, which determines the necessity of state regulation.

However, in both academic research and practical regulatory practice, there is still no agreed system of criteria and indicators that would allow for a comprehensive and objective assessment of the socio-economic effectiveness of such regulation. Existing approaches remain fragmented and do not take into account the multidimensional and long-term nature of the effects of state intervention.

In this regard, the problem of developing a methodologically grounded system of criteria and indicators for assessing the effectiveness of state regulation of natural monopolies remains relevant. Such a system would contribute to improving the effectiveness of regulatory policy and ensuring its alignment with contemporary economic challenges.

Analysis of recent research and publications. In domestic and international scholarly traditions, research on the nature, functioning, and regulation of natural monopolies is focused on identifying their economic, social, and institutional characteristics, as well as on assessing the effectiveness of state intervention. In the study by O. Shramenko and O. Poliakova [2], the authors emphasise the dependence of regulatory effectiveness on dynamic changes in the technological and institutional environment, which leads to an expansion of the role of the state in ensuring infrastructure resilience and addressing market failures.

In the existing literature, a substantial body of research is devoted to the analysis of economic mechanisms used in the regulation of natural monopolies. In the research by N. Rudkovska and T. Popovych [3], particular emphasis is placed on the interconnection between tariff policy, investment activity, and enterprise productivity, with the authors showing that regulatory effectiveness is closely linked to the balance between tariff-based incentives and innovation processes. The social dimension of regulation is explored in the study by V. Hornyk and V. Shpachuk [4], where particular attention is paid to the accessibility, quality, and reliability of natural monopoly services as key factors of public welfare. The authors also point to the risk of social tensions that may arise when state intervention proves ineffective.

Institutional aspects of regulatory policy are examined in a separate strand of research. In this context, Shaohua Z. et al. [5] emphasise the role of transparency and antimonopoly instruments in strengthening the predictability and stability of the regulatory environment, which, in turn, influences investor confidence and the long-term social sustainability of markets. In the study by A. Gerasymenko and V. Hanovskyi [7], the evolution of institutional models of regulation is analysed, with emphasis placed on the need for a systematic evaluation of regulatory activity through a comprehensive set of criteria and indicators.

The methodological foundations for assessing regulatory systems are presented in the seminal work by A. Brown, J. Stern, B. Tenenbaum, and D. Gencer [8], which substantiates the principles for constructing performance indicators and the tools used for comparative analysis of regulators in infrastructure sectors. Issues related to the interaction between the knowledge economy, digitalisation, and structural changes in the regulation of natural monopolies are examined in the studies by V. Bolhov and I. Akhnovska [9], which emphasise the influence of the knowledge economy on the transformation of regulatory practices. T. Artemchuk [10] examines monopolistic markets in the domestic context, focusing on the key problems of their functioning and possible mechanisms of state intervention.

The analysed literature covers economic, social, and institutional features of natural monopolies and includes various methods used to evaluate regulatory effectiveness. At the same time, further development is required of an integrated approach capable of combining criteria and indicators of different nature, enabling a systematic assessment of regulatory performance and supporting the scientifically grounded improvement of state regulation of natural monopolies. Addressing this issue forms the scientific focus of the present study.

The purposes of the article. The purpose of the article is to substantiate and develop a system of criteria and indicators for a comprehensive assessment of the socio-economic effectiveness of state regulation of natural monopolies, which will make it possible to enhance the effectiveness of regulatory policy and ensure its compliance with contemporary requirements of economic development.

The objectives of the article are as follows:

1. To systematise theoretical approaches to identifying the economic, social, and institutional effects of state regulation of natural monopolies, by generalising current academic research and the regulatory and legal framework governing the functioning of monopoly sectors.

2. To identify and classify key criteria and indicators for assessing the socio-economic effectiveness of regulatory policy, substantiating their substantive content and analytical purpose while taking into account the specific features of natural monopolies.

3. To develop a methodological approach to the formation of an integrated assessment system that combines criteria, indicators, and aggregation methods (normalisation, integral index, and the analytic hierarchy process) for practical application in regulatory monitoring and decision-making support.

The main material presentation. According to the Law of Ukraine *"On Natural Monopolies"*, a natural monopoly is defined as a state of the commodity market in which the satisfaction of demand is more efficient in the absence of competition due to technological characteristics of production, and where goods cannot be substituted by other goods in consumption. The Law establishes the legal, economic, and organisational foundations of state regulation of the activities of natural monopoly entities, aimed at ensuring a balance of interests among consumers, business entities, and the state. Regulation is carried out through tariff setting, licensing, supervision of the activities of natural monopoly entities, and the application of other instruments provided for by law. The sphere of natural monopolies includes services in the areas of transportation, distribution, and supply of energy resources, as well as communal infrastructure, which determines the specific nature of regulatory approaches applied in these sectors [1].

Alongside the legislative consolidation of the objectives and principles of state regulation of natural monopolies, academic research emphasises that the effectiveness of such regulation largely depends on the dynamic nature of the monopoly sectors themselves and on changes in the technological and economic environment. Rapid scientific and technological progress alters the conditions under which natural monopolies operate, affecting resource uniqueness, the scale of required investment, and the potential emergence of competition, which necessitates the adaptation of regulatory mechanisms to new economic realities. Under these conditions, the role of the state extends beyond traditional functions such as price regulation, control over access to infrastructure, and antimonopoly supervision. It also includes ensuring infrastructure security, supporting strategic sectors, and addressing market failures [2, p. 228]. Changes in the institutional environment of this kind have a direct impact on the economic, social, and institutional outcomes of regulatory policy and make it necessary to analyse the socio-economic effects of state intervention in a comprehensive manner.

Taking into account the evolution of the institutional environment and changes in the operating conditions of natural monopolies, these transformations are directly reflected in the economic parameters of their activities, primarily tariffs, investment activity, and productivity. In this regard, the economic consequences of state regulation of natural monopolies are manifested above all in the areas of tariffs, investment, and productivity. Inefficient tariff setting and weak regulatory influence lead to inflated tariffs and restrain the development of competitive incentives, thereby reducing enterprises' interest in improving efficiency. Tariffs play a key role in shaping investment potential: in the absence of a clearly defined investment component, monopolies are unable to modernise infrastructure and ensure technological development. The introduction of incentive-based regulatory methods contributes to cost optimisation and productivity growth, whereas excessively rigid price constraints may weaken enterprises' innovative activity [3, pp. 168–169].

At the same time, the social consequences of the activities of natural monopolies and the mechanisms of their state regulation are primarily associated with their impact on the standard of living of the population, since the products and services of these sectors are of critically high social importance and are consumed in both productive and non-productive spheres. As noted by researchers, natural monopolies ensure the creation of vital conditions for the functioning of the economy, but at the same time may generate a number of negative social effects—from inflated tariffs and the shifting of costs onto consumers to a deterioration in service quality—which directly affects public welfare [4, p. 41]. For this reason, the effectiveness of public administration in these sectors determines not only economic stability, but also the level of accessibility, reliability, and quality of basic services that shape the everyday living conditions of citizens.

The coherence and effectiveness of the social parameters of natural monopoly functioning largely depend on the institutional capacity of the regulatory environment, primarily on its level of transparency, predictability, and efficiency. The institutional effects of state regulation of natural monopolies are manifested through the degree of transparency and the effectiveness of antimonopoly policy, which determine the predictability and overall quality of the regulatory environment. As empirical studies show, increased transparency of regulatory decisions reduces information asymmetry and corruption risks, while effective antimonopoly policy restrains excessive market power and creates conditions for innovative development, thereby strengthening institutional trust and the stability of market processes [5, pp. 5–6].

Taken together, the economic, social, and institutional effects reflect the systemic nature of the impact of state regulation of natural monopolies, as they determine not only the financial sustainability and technological dynamics of these sectors, but also the level of public welfare and the quality of institutional interaction within the market. The interdependence of these effects forms a complex environment in which the effectiveness of regulatory policy is expressed through the balance of tariff discipline, service accessibility, and transparency of managerial decisions.

It is precisely this multidimensionality of effects that necessitates the use of clearly defined criteria and objective indicators for evaluating the effectiveness of state regulation of natural monopolies, enabling a comprehensive analysis of regulatory outcomes and the identification of directions for further improvement.

The comprehensive nature of the impact of state regulation of natural monopolies necessitates the application of a multidimensional system of criteria, which makes it possible to assess both the economic performance of natural monopoly entities and the social effects for consumers, as well as the institutional capacity of the regulatory environment. In this regard, it is appropriate to systematise the key groups of criteria for assessing the socio-economic effectiveness of regulatory policy, which are summarised in Table 1.

Table 1

Criteria for Assessing the Socio-Economic Effectiveness of Regulatory Policy in Natural Monopoly Sectors

Criterion	Substantive Characteristics	Applied Indicators / Outcomes
Economic Criteria		
Effectiveness of tariff regulation	Limitation of monopolies' market power, prevention of inflated tariffs, orientation toward public welfare	Tariff dynamics; absence of unjustified price increases
Investment activity	Stimulation of long-term investment and infrastructure modernisation	Volume of capital investment; renewal of fixed assets
Productivity and cost efficiency	Assessment of cost levels and performance efficiency of enterprises	Productivity indicators; operating costs; profitability
Financial sustainability	Ability of an entity to ensure operational and investment activity	Solvency; stability of cash flows
Social Criteria		
Service accessibility	Ensuring sufficient consumer coverage and access to basic services	Share of population covered by services; accessibility for vulnerable groups
Quality and reliability of services	Continuity of supply, compliance with technical standards, stability of service provision	Frequency and duration of service interruptions; compliance with quality standards

Continuation of Table 1

Social equity	Minimisation of excessive financial burden on households	Share of household expenditure on services; level of social complaints
Consumer rights protection	Availability of complaint mechanisms, feedback channels, and consumer participation	Number of complaints; effectiveness of their resolution
Institutional Criteria		
Regulatory transparency	Openness of procedures, disclosure of decisions, access to information	Public availability of decisions; conduct of consultations
Policy predictability	Stability of regulatory rules and consistency of decisions	Regulatory stability; absence of abrupt rule changes
Independence and capacity of the regulator	Autonomy, authority, and professional capacity of staff	Organisational independence; staff capacity
Accountability and stakeholder participation	Public consultations, reporting, and quality of interaction with stakeholders	Frequency of consultations; public reports; quality of feedback

Source: compiled on the basis of a synthesis of domestic and international academic sources [6], [7], [8]

The proposed table summarises the key groups of criteria used to assess the socio-economic effectiveness of regulatory policy in the field of natural monopolies. The systematisation of economic, social, and institutional criteria makes it possible to comprehensively reflect the impact of state regulation both on the financial and operational activities of natural monopoly entities and on the quality, accessibility, and stability of services, as well as on the level of transparency and capacity of the regulatory environment.

In the process of state regulation of natural monopolies, it is important not only to define evaluation criteria, but also to identify the instruments through which such assessment is carried out. Indicators play a key role in this process, as they ensure the measurability and substantive content of each criterion, allowing a transition from general characteristics of regulatory policy to its specific results defined in quantitative and qualitative terms. For the purpose of systematising such indicators, it is appropriate to distinguish their main groups, which is reflected in Table 2.

Table 2

Indicators for Assessing the Effectiveness of State Regulation of Natural Monopolies

Indicator Group	Substantive Characteristics	Typical Indicators (Examples)	Analytical Purpose
General principles for indicator formation	Indicators should be based on the principles of relevance, measurability, objectivity, stability, data availability, and methodological transparency. These requirements ensure the scientific validity of assessment and its comparability over time	Consistency of indicators with regulatory objectives; availability of official data sources; possibility of cross-sectoral comparison; reproducibility of calculation methods; minimisation of subjective interpretation	Ensure the quality of the assessment system and enable correct comparison of results across time periods and different natural monopoly sectors
Quantitative indicators	Reflect the economic outcomes of regulatory policy, including changes in tariffs, cost structures, investment activity, and enterprise productivity. Based on objective financial and technical-economic data	Tariff dynamics; tariff structure (share of the investment component); volume of capital investment; operating costs; return on assets; costs per unit of output; degree of renewal of fixed assets	Make it possible to assess economic sustainability and investment activity of enterprises, the effectiveness of tariff policy, and the presence of incentives for modernisation and productivity growth
Qualitative indicators	Characterise perceptions of regulatory effectiveness and the quality of interaction with stakeholders, including levels of trust, transparency of processes, service quality, and compliance of management procedures with good governance standards	Level of consumer satisfaction with service quality and accessibility; assessment of transparency of regulatory procedures; quality of stakeholder consultations; level of trust in the regulator; expert assessment of regulatory decision effectiveness	Allow assessment of the institutional quality of regulatory activity and its social impact, and determination of the extent to which the regulator complies with contemporary public governance principles
Integral indicators	Represent aggregated composite measures combining quantitative and qualitative data. Used for comprehensive effectiveness assessment, cross-sectoral comparisons, and strategic analysis of regulatory policy performance	Regulatory environment index; index of institutional capacity of the regulator; integrated assessment of tariff policy effectiveness; composite index of regulatory transparency; aggregated index of socio-economic outcomes of regulation	Enable a comprehensive understanding of the state and dynamics of regulatory policy, identification of problem areas, and determination of priorities for state intervention

Source: compiled based on the generalisation of domestic and international scholarly sources [6], [9], [10], [11

The presented table summarises the main groups of indicators used for a comprehensive assessment of the effectiveness of state regulation of natural monopolies.

It reflects the interrelationship between the principles underlying indicator formation, their quantitative and qualitative characteristics, and integral indicators that make it possible to obtain a generalised assessment of regulatory policy performance.

Such structuring allows for a holistic coverage of the economic, social, and institutional aspects of natural monopoly functioning and ensures methodological consistency in further analysis.

The logic of combining criteria and indicators into a unified assessment system is based on the need for a coordinated reflection of both the strategic objectives of state regulation of natural monopolies and the specific results of its implementation.

Criteria define the substantive framework of assessment by outlining the key dimensions of socio-economic effectiveness, while indicators provide their operationalisation through quantitatively and qualitatively measurable variables.

This structure makes it possible to establish clear cause-and-effect relationships between regulatory instruments, their impact on the economic and social parameters of natural monopoly functioning, and changes in the institutional environment.

As a result, a coherent and methodologically consistent system is formed, which is capable not only of reflecting the current state of regulatory policy but also of ensuring comparability over time and suitability for strategic planning.

To generalise assessment results, it is advisable to apply methods that allow heterogeneous indicators to be combined into a single integral outcome.

Score-based assessment enables the transition from individual indicators to a unified scale through their normalisation, which increases comparability and allows indicators of different nature to be processed.

At this stage, normalisation functions are applied to bring values into a common range and to avoid the influence of differing measurement scales [12, p. 7].

A more advanced tool is the integral index, which is constructed as a weighted sum of normalised indicators.

The weights of criteria may be determined using the Analytic Hierarchy Process (AHP), which involves building a hierarchy of criteria, constructing pairwise comparison matrices, and calculating priorities through eigenvalues or geometric means.

A specific feature of AHP is the possibility of verifying the consistency of expert judgments and aggregating the opinions of multiple experts, which ensures the reliability of the obtained weights and the stability of the integral indicator [12, p. 8].

The application of aggregation methods provides not only a technical means of generalising heterogeneous indicators, but also creates a foundation for forming a coherent and analytically applicable assessment of regulatory policy effectiveness.

In this context, integral approaches become a practical analytical tool suitable both for strategic planning and for ongoing regulatory activity.

The proposed system of criteria and indicators, in combination with aggregation methods, opens broad opportunities for practical application in assessing the effectiveness of state regulation of natural monopolies.

It can be used as a regulatory monitoring tool that makes it possible to track the dynamics of enterprise performance, assess the alignment of actual results with state policy objectives, and timely identify imbalances.

The use of an integral index and the Analytic Hierarchy Process allows for objective ranking of natural monopoly entities, identification of strengths and weaknesses in their functioning, and the formation of a basis for adjusting tariff and investment policy.

In addition, such a system may serve as an effective decision-support tool for regulators, particularly in the approval of investment programmes, justification of tariff structures, and analysis of the effectiveness of incentive-based mechanisms. It also has significant value for comparative analysis across different natural monopoly sectors, ensuring unified approaches and comparability of results.

As a result, the system becomes useful for strategic planning, regulatory audits, independent expert assessment, and contributes to enhancing the transparency and accountability of regulatory authorities to society.

Conclusions. The study has shown that the effectiveness of state regulation of natural monopolies cannot be reduced to a single dimension, as it simultaneously involves economic, social, and institutional aspects of monopoly sector functioning. The findings indicate that ongoing technological and economic changes require regulatory mechanisms to remain adaptive, while the overall outcomes of state policy depend on the regulator's capacity to balance the interests of consumers, market operators, and the state.

The classification of criteria used to assess the socio-economic effectiveness of regulatory policy made it possible to distinguish three interrelated groups: economic, social, and institutional. Each group captures a particular dimension of regulatory impact, ranging from tariff discipline and investment incentives to service accessibility, service quality, decision-making transparency, and policy stability. Presenting these criteria in a structured form provides a methodological basis for organising the assessment process.

The separation of indicators into quantitative, qualitative, and integral categories allowed for a more detailed assessment framework. Quantitative indicators make it possible to measure economic outcomes in an objective manner, whereas qualitative indicators reflect social perceptions and institutional features of regulatory practice. Integral indicators combine these dimensions and offer a general view of the condition of the regulatory environment and the direction of its change.

The combination of criteria, indicators, and aggregation methods—such as normalisation, the integral index, and the Analytic Hierarchy Process—forms an assessment framework that makes it possible to analyse both the current situation and longer-term changes in the regulation of natural monopolies. The application of these tools contributes to greater consistency and comparability of results and enables their use in regulatory monitoring, strategic planning, tariff-related decisions, and the assessment of investment programmes.

The analysis highlights the relevance of an assessment system that accounts for the interaction between economic, social, and institutional dimensions. Such an approach supports a more balanced view of regulatory outcomes and contributes to greater transparency, accountability, and policy effectiveness.

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Отримано: 31.12.2025
Прийнято до публікації: 13.01.2026
Опубліковано: 15.01.2026