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FINANCIAL AND ECONOMIC MECHANISM OF PUBLIC ADMINISTRATION IN THE CONTEXT OF DIGITAL TRANSFORMATION OF PUBLIC SERVICES

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ABSTRACT

The article is devoted to the substantiation of the financial and economic mechanism of public administration that can link budget resources with the actual effectiveness of the digital transformation of public services. The relevance of the study is determined by the fact that an increase in spending on general government services does not in itself guarantee accessibility, transparency, interoperability, and convenience of electronic interaction between citizens and enterprises with government authorities. The aim of this article is to theoretically substantiate the structure and instruments of the financial and economic mechanism for public administration of the digital transformation of public services and to assess the alignment of the budget burden with the results of digital public service delivery in a sample of European Union countries. The information base consists of Eurostat data on general government expenditure for 2023 and the results of the eGovernment Benchmark 2026 obtained from the assessment of public services. The sample covers 12 countries of the European Union, namely Austria, Bulgaria, Croatia, Latvia, Lithuania, Poland, Romania, Slovakia, and Slovenia. The proposed methodology combines Saaty hierarchy analysis, entropy determination of objective weights, TOPSIS method, input-oriented DEA-BCC model, synergistic aggregation of results, standardized regression testing and scenario modeling. A system of 8 criteria has been formed, covering fiscal resource intensity, administrative and debt costs, the level of digitalization of services, transparency, interoperability, user support, and the basic quality of government portals. The most hybrid scales received basic portal quality, transparency, and interoperability. According to the synergy index, Estonia, Austria and Lithuania took the highest positions, while Hungary and Romania received the lowest results. The regression test showed the statistically significant impact of interoperability on the overall assessment of public services. The target scenario of resource redistribution and increased digital maturity increases the overall result, while the stress scenario reduces it. The practical significance of the results lies in the formation of tools for program-targeted budgeting, performance-based financing, management of the full cost of public services, and prioritization of investments in general digital infrastructure.

Keywords: public administration, public services, digital transformation, budget expenditures, performance-based financing, interoperability, DEA-BCC, TOPSIS, Saaty hierarchy analysis, scenario modeling

JEL Classification: H11, H50, H83, O33, C61

INTRODUCTION

The financial and economic mechanism occupies a central place in the public administration system, as it ensures the formation, distribution, redistribution, and use of public financial resources in accordance with defined public policy objectives. Its functioning must align budget allocations with specific socially significant results, create economic incentives for the rational use of funds, and ensure control over the ratio of expenditures to the achieved results. Under these conditions, the volume of funding cannot be considered an independent indicator of public administration effectiveness, as the areas of resource use, expenditure structure, financing methods, and the ability of public authorities to achieve established results are decisive.

The digital transformation of public services creates additional demands on the financial and economic mechanism. Funding for the corresponding processes includes expenses for the development and modernization of information systems, registry integration, data migration, cybersecurity, technical support, employee training, ensuring service availability, backup storage of information, and the decommissioning of obsolete components. A one-time allocation of funds for the creation of a software product does not ensure the stable provision of a public service throughout its entire lifecycle. Consequently, financial planning must take into account the full cost of creating, operating, updating, and protecting the relevant service.

The financial component of such a mechanism determines the sources, volumes, timing, methods, and conditions for generating and using resources. The economic component includes methods for evaluating alternatives, economic incentives, performance standards, cost indicators, and tools for selecting the most justified method of using funds. Organizational, regulatory, and information-analytical support create the conditions for the mechanism's functioning, but should not be equated with its financial methods and economic levers. This distinction prevents the unjustified transfer of organizational mechanism functions to the financial and economic mechanism. Particular attention is required to the relationship between the budgetary burden and the results of the digital transformation of public services. Significant expenditures in the general government sector can be combined with high service quality, but can also reflect a complex administrative structure, significant debt repayments, duplication of information systems, or poorly justified resource allocation. Low expenditures also do not automatically confirm high performance, as they may be the result of underfunding. Therefore, the assessment must simultaneously consider the financial characteristics and actual results of public service delivery. International experience with program-based and performance-based budgeting confirms the need to use performance data when planning and adjusting expenditures. However, a direct mechanical link between funding volumes and a single indicator is insufficiently justified due to the complex and not always linear relationship between public expenditures and social outcomes. A financial and economic mechanism should combine medium-term budget planning, funding the full cost of public services, performance assessment, analysis of alternatives, and ongoing monitoring of resource use (OECD, 2019; Douglas & Overmans, 2020).

The scientific problem lies in the insufficient development of a financial and economic mechanism that would ensure the alignment of budgetary burdens with the results of the digital transformation of public services. Existing research primarily focuses separately on digital governance, the quality of e-services, budgetary performance, or the technological maturity of public authorities. However, the issue of combining financial methods, economic levers, and performance indicators within a unified public administration mechanism remains understudied. The practical relevance of this study in our country is determined by limited financial resources, the need to maintain the continuity of public services during martial law, stricter data protection requirements, and the gradual alignment of the public administration system with European Union standards. Under these circumstances, funding common components, assessing the full cost of public services, eliminating duplication of expenditure, and using performance indicators in budget allocation are priorities.

LITERATURE REVIEW

Scientific study of the financial and economic mechanism of public administration presupposes a distinction between its financial and economic components. The financial mechanism is associated with the mobilization, distribution, redistribution, and use of public financial resources, while the economic mechanism encompasses the methods, incentives, standards, and instruments that guide the behavior of participants in relevant relationships and ensure the achievement of specific results. The combination of these components allows for a transition from simply funding the activities of government agencies to the justified allocation of resources based on results and public benefit.

Garafonova et al. (2021) examined the stages of developing a financial mechanism for public administration of anti-corruption processes in the context of digitalization and noted the need to align its goals, instruments, and implementation sequence. The value of this approach lies in its interpretation of the financial mechanism as an orderly system of interconnected actions, rather than as an arbitrary list of management functions. However, the authors' proposed approach focuses on the specialized field of anti-corruption policy and does not address the specifics of financing the life cycle of digital public services.

The economic component of public administration mechanisms was examined by Piatnychuk (2024), who defined the economic mechanism as a set of relationships, methods, tools, and measures aimed at ensuring the functioning and development of the relevant sphere. The author highlighted financing, standardization, management instruments, control, and support for innovation. This approach confirms the multicomponent nature of the economic mechanism but requires a clear distinction between its main financial and economic instruments and supporting conditions.

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Zhuk et al. (2023) examined the mechanisms of digitalization of public finance and found that the use of information technology can increase the speed of financial transactions, data compatibility, transparency, accountability, and the economic return on resource management. The researchers focused on the architecture of information systems in public finance and the European experience with their application. At the same time, in this work, digitalization is considered primarily as a tool for modernizing financial management, while the issue of financing the digital transformation of public services requires a separate study.

Hrytsenko and Burlai (2020) substantiated the relationship between technological change and the transformation of socio-economic relations and drew attention to the risks of unequal access to the benefits of digitalization.

Vasyneva (2022) and Kryshtanovych (2022) examined the digitalization of public administration as a necessary condition for interaction between government agencies, citizens, and enterprises. These studies expand our understanding of the societal consequences of digital transformation, but do not directly explore ways to align budget expenditures with the performance of public services.

In the international financial literature, this area is represented by studies of program-based and performance-based budgeting. OECD (2019) defines performance budgeting as the systematic use of performance information to justify budget decisions, enhance transparency, and strengthen accountability. At the same time, the OECD cautions against automatically linking budget allocations to individual indicators due to the complex nature of the relationship between resources and results. The concept of a financial and economic mechanism is interpreted in contemporary research as an integrated system rather than as a set of isolated financing procedures.

Derhaliuk et al. (2022) consider an organizational and economic mechanism through the interaction of its components, functions, forms, methods, and regulatory levers, emphasizing that the effectiveness of the mechanism depends on the consistency of these elements within a common system.

Hrytsyshen et al. (2025), examining financial and economic mechanisms in public governance, additionally emphasize the role of subjects, financial resources, fiscal autonomy, economic incentives, and institutional conditions in transforming available resources into socially significant results. These approaches are important for the present study because they support the interpretation of the financial and economic mechanism as a structured relationship between subjects, objects, resources, methods, levers, instruments, and expected outcomes rather than as an equivalent of budgeting or general public administration.

Purnamasari et al. (2025), using evidence from Indonesia, demonstrate that financial resource availability generates improvements in public services only through interaction with technological infrastructure, digital innovation, and management capacity.

Chen et al. (2026), using data from Chinese cities, identify two fiscal-economic channels of government digital transformation: correction of the expenditure structure and enhancement of the capacity to use existing financial resources.

Thus, the financial and economic mechanism of digital transformation should encompass both the formation and allocation of financial resources and the economic instruments through which these resources are transformed into service outcomes. For the digital transformation of public services, this means integrating financing methods, financial levers, cost assessment, incentives, resource reallocation, and performance feedback within one functional mechanism.

Douglas and Overmans (2020) developed the concept of public value budgeting, according to which the allocation of funds should align financial resources, stakeholder interests, and socially significant outcomes. The theoretical framework for evaluating public services is complemented by studies devoted to the public value of digital governance.

Cordella and Bonina (2012) demonstrated the limitations of evaluating technological reforms solely based on cost savings, as the outcome must encompass accessibility, equity, accountability, and public utility.

Twizeyimana and Andersson (2019) systematized e-governance outcomes by improving public services, streamlining administration, and creating public value.

Mergel et al. (2019) emphasized that digital transformation of the public sector involves changes in processes, structures, and user interactions, and is not limited to the implementation of individual information systems.

Methodological approaches to comparative public administration assessment are developing through the use of multicriteria methods. Ardielli (2019) used TOPSIS to assess good governance in European Union countries and demonstrated the feasibility of forming a comparative ranking based on a set of divergent indicators.

Yang (2021) combined entropy-based weighting and TOPSIS to assess the quality of public services and further analyze its relationship with fiscal transparency.

Łukomska-Szarek et al. (2024) applied TOPSIS and other linear ordering methods to assess the development of information and communication technologies in public administration in Poland. These studies confirm the feasibility of TOPSIS for comparing entities based on financial and performance indicators; however, the resulting coefficient should be interpreted as a relative proximity to the best state in the sample, rather than as absolute effectiveness.

The conducted review revealed several insufficiently developed provisions. The scientific literature lacks a consistent distinction between the financial, economic, and organizational components of the digital transformation of public services. Existing methodologies generally assess the level of digital governance without properly accounting for budgetary burdens or examining public expenditures without comparing them with the characteristics of public services. Furthermore, a methodological approach that combines objective weighting of financial and performance criteria, comparative assessment of countries, and interpretation of the results within a financial and economic framework requires further development.

AIMS AND OBJECTIVES

The aim of this article is to theoretically substantiate the structure and instruments of the financial and economic mechanism for public administration of the digital transformation of public services and to assess the alignment of the budget burden with the results of digital public service delivery in a sample of European Union countries. Achieving this goal requires completing the following tasks:

1. To clarify the economic essence of the financial and economic mechanism of public administration of the digital transformation of public services and to distinguish its financial, economic, security, and provisioning components.
2. To determine the financial methods, financial levers, and economic instruments that ensure the financing of the full life cycle of digital public services.
3. To substantiate the system of criteria for the budget burden and the results of the provision of digital public services, as well as to establish their connection with the studied tools of the mechanism.
4. To form hybrid weights of criteria by combining the Saati hierarchy analysis method and the entropy method, to conduct a comparative assessment of countries using the TOPSIS and DEA-BCC methods, and to calculate a generalized index of financial and digital coherence.
5. To check the stability of the obtained ranking, to assess the change in results under the target and stress scenarios, and to conduct an additional regression test of the relationship between the budget burden and the results of digital transformation.
6. To form differentiated recommendations on the application of financial methods, financial levers and economic instruments depending on the identified type of consistency of the budget burden with the results of the provision of digital public services.

METHODS

The methodological basis of the study comprises a combination of general scientific and special methods. Analysis and synthesis were applied to systematise scholarly approaches to the nature of financial and economic mechanisms. The systems method was used to establish relationships among funding sources, financial methods, economic instruments, and the results of public service delivery. The structural-functional method enabled the financial, economic, and supporting components of the mechanism to be distinguished. Comparative analysis was employed to compare the budgetary burden and performance indicators across 12 countries of the European Union. The entropy method was used to determine objective criterion weights. The Technique for Order Preference by Similarity to an Ideal Solution (TOPSIS) was selected as the principal empirical method for determining the relative proximity of each country to the best combination of financial and performance characteristics within the analysed sample. Sensitivity analysis was used to test the stability of the resulting ranking under changes in criterion weights.

The TOPSIS method was chosen because it ensures simultaneous consideration of the criteria of fiscal and administrative burden and the criteria of the results of the provision of digital public services. The corresponding criteria have different units of assessment and opposite directions of desirability. For criteria K1–K3, lower values characterize a smaller budgetary

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burden, while for criteria K4–K8, higher values reflect better results of the provision of digital public services. This division does not oppose financial criteria to performance criteria, but distinguishes resource characteristics of public administration and socially significant results obtained.

The information base comprises two groups of data. The first group includes Eurostat indicators of general government expenditure on general public services in 2023, expressed as a percentage of GDP. The second group contains the results of the eGovernment Benchmark 2026 obtained from the assessment of public services. The sample includes Austria, Bulgaria, Croatia, Czechia, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and Slovenia.

Criteria K_1-K_3 were treated as cost criteria. With equal public service outcomes, lower values of these indicators represent a lower budgetary burden. Criteria K_4-K_8 were treated as benefit criteria because higher values indicate better characteristics of digital public services. The overall eGovernment Benchmark score was not included among the TOPSIS criteria in order to avoid double counting the dimensions already represented by K_4-K_8.

Criteria K1-K3 are disincentives, since, given the same digital output, lower resource intensity indicates better economic returns. Criteria K4-K8 are incentives. The overall eGovernment Benchmark score was used for regression testing and is not included in TOPSIS, preventing double counting of its components (Table 1).

Table 1. Criteria for assessing financial and digital performance. *(Source: developed by the author based on Eurostat and eGovernment Benchmark 2026 data)*

Code	Criterion	Economic meaning
K1	Expenditure on general public services, % of GDP	Fiscal resource intensity
K2	Expenditure on executive and legislative bodies, % of GDP	Administrative resource intensity
K3	Expenditure on public debt transactions, % of GDP	Fiscal rigidity
K4	Digital public services, points	Completeness of online service delivery
K5	Transparency of service delivery, points	Openness of processes and outcomes
K6	Interoperability features, points	Data exchange and reuse
K7	User support, points	Availability of assistance and guidance
K8	Basic portal quality, points	Accessibility, speed, security, and search functionality

To eliminate subjective expert influence, criterion weights were determined using the entropy method. At the first stage, the initial values were transformed into comparable dimensionless values. For benefit criteria, normalisation was performed as follows.

$$z_{ij} = \frac{x_{ij} - \min\limits_{1 \le i \le n} x_{ij}}{\max\limits_{1 \le i \le n} x_{ij} - \min\limits_{1 \le i \le n} x_{ij}}, \quad (1)$$

In Equation (1), z_{ij} is the normalised value of benefit criterion j for country i; x_{ij} is the initial observed value of criterion j for country i; i is the country index, where i = 1, ..., n; j is the criterion index, where j = 1, ..., m; n is the number of countries in the sample; m is the total number of criteria; $\min_{(1<=i<=n)} x_{ij}$ and $\max_{(1<=i<=n)} x\_{ij}$ are, respectively, the minimum and maximum observed values of criterion j across all countries.

The numerator measures the distance of xij from the sample minimum, whereas the denominator represents the observed range of criterion j. For a benefit criterion, a larger zij denotes a more desirable result, and zij belongs to the interval [0, 1], provided that the denominator is non-zero.

For cost criteria, the following transformation was applied.

$$z_{ij} = \frac{\max\limits_{1 \le i \le n} x_{ij} - x_{ij}}{\max\limits_{1 \le i \le n} x_{ij} - \min\limits_{1 \le i \le n} x_{ij}} \quad (2)$$

Here, x_{ij} denotes the initial value of criterion j for country i; z_{ij} denotes its normalised value; $i = 1, \dots, n$ identifies countries; and $j = 1, \dots, m$ identifies criteria.

The proportion of each observation within the corresponding criterion was calculated using Equation (3).

$$p_{ij} = \frac{z_{ij}}{\sum_{i=1}^{n} z_{ij}}. \quad (3)$$

In Equation (3), pij is the proportional contribution of country i to criterion j after normalisation; zij is the normalised value of criterion j for country i; i is the country index, where i = 1, ..., n; j is the criterion index, where j = 1, ..., m; n is the number of countries; m is the total number of criteria; and the summation sum(i=1)n zij is the total of the normalised values for criterion j across all countries.

Dividing zij by this total converts the observations into proportions, so that sum(i=1)n pij = 1 for each criterion j, provided that the denominator is non-zero.

The entropy of criterion j was determined using Equation (4).

$$e_j = -\frac{1}{\ln n}\sum_{i=1}^{n} p_{ij} \ln p_{ij} \quad (4)$$

In Equation (4), ej is the entropy value of criterion j; pij is the proportional contribution of country i to criterion j calculated using Equation (3); ln denotes the natural logarithm; i is the country index, where i = 1, ..., n; j is the criterion index, where j = 1, ..., m; n is the number of countries.

When $p_{ij} = 0$, the expression $p_{ij} \ln p_{ij}$ was treated as equal to zero. The degree of information differentiation was calculated as follows.

$$d_j = 1 - e_j. \quad (5)$$

In Equation (5), dj is the degree of information differentiation, also referred to as the divergence coefficient, for criterion j; ej is the entropy value of criterion j obtained from Equation (4); j is the criterion index, where j = 1, ..., m; m is the total number of criteria; and the constant 1 represents the upper bound of normalised entropy.

A larger dj means that criterion j contains more information for distinguishing the countries in the analysed sample.

The objective weight of each criterion was then determined using Equation (6).

$$w_j = \frac{d_j}{\sum_{j=1}^{m} d_j}. \quad (6)$$

In Equation (6), wj is the objective entropy weight assigned to criterion j; dj is the degree of information differentiation of criterion j; j is the criterion index, where j = 1, ..., m; m is the total number of criteria.

Accordingly, a larger weight is assigned to a criterion with greater variability within the sample because that criterion provides more information for differentiating the analysed countries.

The subsequent assessment was conducted using TOPSIS. The decision matrix was normalised by vector normalisation.

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{n} x_{ij}^2}}. \quad (7)$$

In Equation (7), rij is the vector-normalised value of criterion j for country i; xij is the initial observed value of criterion j for country i; xij2 is the squared observed value; i is the country index, where i = 1, ..., n; j is the criterion index, where j = 1, ..., m; n is the number of countries; m is the total number of criteria.

The weighted normalised values were calculated as follows.

$$v_{ij} = w_j r_{ij}. \quad (8)$$

In Equation (8), vij is the weighted normalised value of criterion j for country i; wj is the weight assigned to criterion j; rij is the vector-normalised value calculated using Equation (7); i is the country index, where i = 1, ..., n; j is the criterion index, where j = 1, ..., m; n is the number of countries; and m is the total number of criteria.

Multiplication by w_j incorporates the relative importance of criterion j into the normalised decision matrix.

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The best empirical state A^{best} was constructed from the minimum weighted normalised values of the cost criteria and the maximum weighted normalised values of the benefit criteria.

$$A^{best} = \left\{\min_i v_{ij}\ (j \in J_c);\ \max_i v_{ij}\ (j \in J_b)\right\}. \quad (9)$$

The worst empirical state A^{worst} was constructed according to the opposite principle.

$$A^{worst} = \left\{\max_i v_{ij}\ (j \in J_c);\ \min_i v_{ij}\ (j \in J_b)\right\}. \quad (10)$$

In Equations (9) and (10), J_c denotes the set of cost criteria, and J_b denotes the set of benefit criteria. The best and worst states are empirical reference vectors formed within the analysed sample. They do not represent an absolute normative standard or an actually existing country.

The Euclidean distance of each country from the best empirical state was calculated using Equation (11).

$$D_i^{best} = \sqrt{\sum_{j=1}^{m}\left(v_{ij} - v_j^{best}\right)^2}. \quad (11)$$

The distance from the worst empirical state was calculated using Equation (12).

$$D_i^{worst} = \sqrt{\sum_{j=1}^{m}\left(v_{ij} - v_j^{worst}\right)^2}. \quad (12)$$

The coefficient of relative closeness to the best empirical state was determined as follows.

$$C_i = \frac{D_i^{worst}}{D_i^{best} + D_i^{worst}}. \quad (13)$$

The value of C_i lies within the interval $[0,1]$. A higher value indicates a better combination of budgetary burden and digital public service outcomes relative to the other countries in the sample. The coefficient is not interpreted as an absolute measure of financial efficiency and does not provide a basis for causal inference.

The stability of the results was examined through sensitivity analysis. The weight of each criterion was alternately increased and decreased by 10%, while the remaining initial weights were kept unchanged before the complete weight vector was renormalised. For criterion k, the preliminary adjusted weight was defined as follows.

$$w_k^{raw} = w_k(1+\delta), \quad w_j^{raw} = w_j\ (j \neq k), \quad \delta \in \{-0.10, 0.10\}. \quad (14)$$

The adjusted weights were renormalised to ensure that their sum remained equal to one.

$$\tilde{w}_j = \frac{w_j^{raw}}{\sum_{h=1}^{m} w_h^{raw}}. \quad (15)$$

For each adjustment, the TOPSIS coefficients and country positions were recalculated. Rank stability was assessed using Spearman's rank correlation coefficient between the baseline ranking and each adjusted ranking.

$$\rho_s = 1 - \frac{6\sum_{i=1}^{n} q_i^2}{n(n^2-1)}. \quad (16)$$

Here, q_i denotes the difference between the baseline rank and the adjusted rank of country i. Values of ρ_s close to one indicate that the ranking is stable under moderate changes in criterion weights.

The sensitivity analysis is used as a robustness test and is not interpreted as a forecast of future changes. To further test the relationship between budget burden, interoperability, and overall digital transformation outcomes, a standardized linear regression model was applied.

RESULTS

Within the framework of the study, the financial and economic mechanism of public administration of the digital transformation of public services is considered through a set of interconnected financial methods, financial levers, and economic instruments. The studied instruments include medium-term program-target budgeting, formation of the full cost of the life cycle of a public service, portfolio financing by life events, financing by results, targeted financing of a common interoperability infrastructure, formation of continuity reserves, analysis of transaction costs, comparison of alternatives, and open control of results. The choice of appropriate instruments is determined by the nature of the digital transformation of public services. The provision of such a service requires financing for the development and updating of information systems,

integration of registers, data exchange, cyber protection, technical support, employee training, backup recovery and decommissioning of obsolete components. Therefore, the amount of allocated funds does not provide sufficient information about the effectiveness of the mechanism without comparison with accessibility, transparency, interoperability, quality of portals and user support. Criteria K1–K3 are not direct indicators of digital transformation expenditures. They characterize the overall fiscal and administrative burden within which public authorities make decisions on financing digital public services. Criteria K4–K8 characterize the results of the functioning of such services. Their joint use allows us to determine whether the existing budgetary burden is combined with appropriate results, as well as to justify which tools of the mechanism are appropriate to apply for each type of discrepancy identified.

The financial and economic mechanism for public administration of the digital transformation of public services is defined as a unified functional system through which the subjects of public administration influence the objects of financing and digital transformation by applying financial methods, financial levers and economic instruments under appropriate regulatory, organizational, information-analytical and security support. Its purpose is to ensure economically justified formation, allocation and use of public financial resources throughout the life cycle of digital public services and to transform these resources into accessible, transparent, interoperable, secure and sustainable public-service outcomes. The mechanism includes several interrelated functional elements. Its subjects comprise central and local public authorities, financial authorities, bodies responsible for digital transformation, administrators of budget programmes and operators of common digital infrastructure. Its objects comprise public financial resources, digital public services, information systems, registers, shared digital infrastructure and the costs associated with their life cycle. Financial methods determine the forms and procedures for resource formation and allocation, whereas financial levers regulate the volumes, proportions, priorities and conditions of financing. Economic instruments provide the analytical justification for alternative uses of resources, assessment of costs and expected effects, incentives for the reuse of common components and subsequent adjustment of financial decisions. The functioning of these elements is supported by financial and regulatory, organizational, information-analytical, and security arrangements. The complete functional structure of the mechanism is presented in Figure 1.

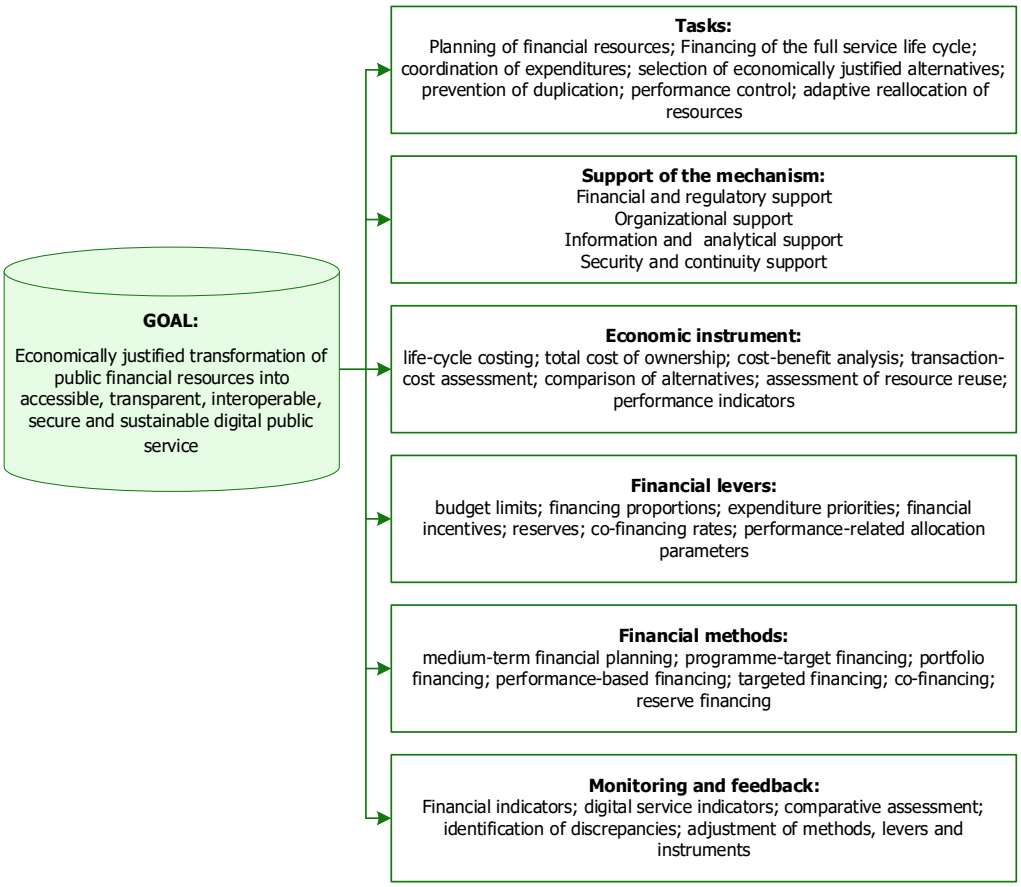

Figure 1. Functional structure of the financial and economic mechanism for public administration of the digital transformation of public services.

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Figure 1 demonstrates that the financial and economic mechanism encompasses considerably more than the individual instruments examined empirically in this study. The empirical part of the study deliberately concentrates on those instruments whose application can be substantiated through comparable financial and digital public-service indicators. In particular, medium-term and programme-target financing, life-cycle costing, performance-based financing, financing of shared interoperability infrastructure, continuity reserves, transaction-cost assessment and comparison of alternatives directly respond to the types of mismatches between the budget burden and digital-service outcomes identified in the comparative analysis. Selected areas of their practical application and corresponding monitoring indicators are systematised in Table 2.

Table 2. Components of the financial and economic mechanism for the digital transformation of public services.

Component	Instruments	Monitoring indicators	Expected outcome
Budget and portfolio	Medium-term programming; service portfolio; total lifecycle cost	Volume and structure of expenditure	Transition away from isolated funding of individual systems
Performance-based	Performance-based funding; service-level monitoring	Accessibility, time, transparency, satisfaction	Alignment of budget resources with outcomes
Infrastructure	Shared registry services; digital identification; data exchange	Share of reused components	Reduced duplication and technical debt
Economic	Transaction cost assessment; analysis of alternatives; reuse	Cost per completed transaction	Selection of the option with the highest overall return
Risk	Continuity reserves; cyber insurance; supplier oversight	Recovery time; share of critical dependencies	Acceptable level of security and resilience
Analytical	DEA, TOPSIS, scenario assessment; open monitoring	Si index and its components	Adaptive reallocation of funding

Fiscal characteristics show significant heterogeneity. Bulgaria has the lowest K1 burden in the sample, while Hungary has the highest. Low total expenditure values should not be automatically interpreted as efficiency, as they may reflect underfunding. Therefore, financial inputs are compared with digital outputs. The K2+K3 indicator characterizes the portion of resources associated with the maintenance of the central administrative apparatus and debt management, meaning it has limited direct ability to improve the user experience of public services (Table 3).

Table 3. Fiscal indicators for the sample, 2023, % of GDP. *(Source: calculated by the author based on the Eurostat dataset)*

Country	K1	K2	K3	K2+K3
Austria	5.664	2.085	1.404	3.488
Bulgaria	3.180	2.290	0.495	2.785
Croatia	4.839	2.504	1.735	4.239
Czechia	4.560	2.206	1.342	3.548
Estonia	4.156	1.911	0.391	2.303
Hungary	10.256	3.514	4.981	8.495
Latvia	3.881	2.458	0.807	3.265
Lithuania	3.430	1.810	0.670	2.480
Poland	4.893	2.327	2.244	4.571
Romania	5.355	2.886	2.016	4.902
Slovakia	5.509	3.008	1.164	4.172
Slovenia	4.572	2.002	1.234	3.236

Digital results do not reflect the order of countries' budget expenditures. Estonia combines high scores for digital services, transparency, interoperability, and user support with a moderate fiscal burden. Austria has high digital results with higher overall expenditures. Bulgaria achieves acceptable digital results with the lowest K1, but the basic quality of its portals remains weak. Romania has the lowest scores for transparency and interoperability, while Hungary combines the highest fiscal resource intensity with average scores. These differences justify the use of multi-criteria and marginal assessments (Table 4).

Table 4. Digital maturity indicators for public services, 2023, points. *(Source: calculated by the author based on eGovernment Benchmark 2026, Results per Dimension and Indicator)*

Country	K4	K5	K6	K7	K8	Overall
Austria	85.50	68.01	86.68	93.65	77.21	85.52
Bulgaria	75.22	57.67	62.03	89.68	41.20	67.77
Croatia	74.17	74.88	60.32	96.30	25.93	68.54
Czechia	89.48	64.17	71.42	95.50	39.03	79.25
Estonia	96.72	95.68	86.58	100.00	59.40	90.37
Hungary	84.52	61.86	68.12	63.49	62.58	71.19
Latvia	93.89	88.27	83.77	96.30	36.08	87.11
Lithuania	88.30	61.51	87.92	91.01	64.19	84.75
Poland	85.07	60.81	70.64	85.19	71.07	78.39
Romania	64.13	35.44	29.56	75.66	27.25	47.85
Slovakia	73.66	28.29	46.47	85.19	40.16	61.38
Slovenia	84.46	78.66	70.15	89.68	45.10	76.05

The obtained CR value confirms the internal consistency of the pairwise comparison matrix. The higher analytical priority of transparency and interoperability has a direct financial and economic meaning. Transparency provides control over the structure of expenditures, the results of budget programs, and the full cost of public services. Interoperability creates conditions for data reuse, joint use of registers, and reduction of duplication of information systems, which reduces transaction costs and the need for parallel financing of identical components. The higher entropy weight of the basic quality of portals means that it is by this criterion that the sample countries have the greatest differences. The obtained value does not indicate the automatic superiority of the technical quality of portals over financial criteria. It confirms the high diagnostic ability of the corresponding indicator when comparing countries. The low CR value confirms the matrix's high internal consistency. The expert component prioritizes transparency and interoperability, as they reduce duplication, ensure data reuse, and create the prerequisites for proactive services. The entropy component increased the weight of the basic quality of portals, where the greatest information variability is observed across countries (Table 5).

Table 5. Saaty pairwise comparison matrix for the criteria. *(Source: developed by the author. λmax=8.0568; CI=0.0081; CR=0.0058)*

Criterion	K1	K2	K3	K4	K5	K6	K7	K8
K1	1	2	2	1/2	1/3	1/3	1/2	1/2
K2	1/2	1	1	1/3	1/4	1/4	1/3	1/3
K3	1/2	1	1	1/3	1/4	1/4	1/3	1/3
K4	2	3	3	1	1/2	1/2	1	1
K5	3	4	4	2	1	1	2	2
K6	3	4	4	2	1	1	2	2
K7	2	3	3	1	1/2	1/2	1	1
K8	2	3	3	1	1/2	1/2	1	1

K8 received the highest hybrid weighting at 0.1867, followed by K5 at 0.1842, and K6 at 0.1675. The combined weighting of transparency, interoperability, and basic portal quality is 53.83%. Fiscal criteria K1-K3 together account for 22.05% of the final score. This distribution does not diminish the importance of budget sustainability, but reflects the position that resource savings are only feasible if the quality of public services is maintained or improved (Table 6).

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Table 6. Subjective, objective, and hybrid weights of the criteria.

Code	Criterion	AHP	Entropy	Hybrid	Share, %
K1	Expenditure on general public services	0.0745	0.0795	0.0770	7.70
K2	Expenditure on executive and legislative bodies	0.0459	0.1135	0.0797	7.97
K3	Public debt transactions	0.0459	0.0818	0.0638	6.38
K4	Digital public services	0.1283	0.1277	0.1280	12.80
K5	Transparency	0.2245	0.1438	0.1842	18.42
K6	Interoperability	0.2245	0.1105	0.1675	16.75
K7	User support	0.1283	0.0981	0.1132	11.32
K8	Basic portal quality	0.1283	0.2450	0.1867	18.67

Estonia ranked first with a Si value of 0.912. This result is explained by a combination of high digital outputs and relatively low fiscal inputs. Austria and Lithuania also rank high. Austria compensates for its high resource intensity with consistently high service quality, while Lithuania demonstrates an effective combination of low costs, strong interoperability, and acceptable portal quality. Latvia completes the high-level group thanks to high K4, K5, and K6, although a weaker K8 value limits its overall performance.

Bulgaria ranks fifth. Its DEA-BCC score is 1, indicating relative efficiency with a low volume of inputs within the sample. Meanwhile, its TOPSIS score is only 0.554 due to insufficient basic portal quality and average interoperability. Slovenia, Poland, and the Czech Republic form the sufficient-level group. Poland has a relatively high TOPSIS score, but its technical efficiency is reduced by higher K1 and K3. The Czech Republic demonstrates strong digital services and user support, but weak basic portal quality and average transparency limit its ranking.

Croatia and Slovakia are ranked as moderate. For Croatia, the weak component is the basic quality of portals, while for Slovakia, it is transparency and interoperability. Romania and Hungary are ranked as low for different reasons. Romania has the lowest digital outputs, particularly in K5 and K6. Hungary is characterized by high K1-K3 expenditures that do not translate into proportionally high digital outcomes. Thus, the method distinguishes between underfunded digital weaknesses and low returns on significant resources, which is important for the selection of a financing mechanism (Figure 2).

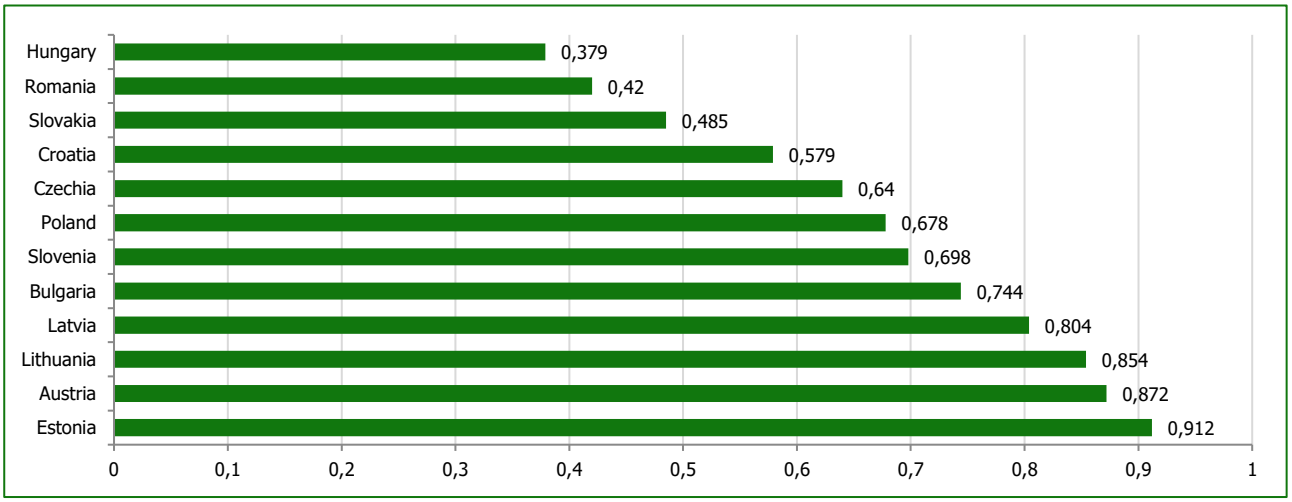

Figure 2. Ranking of countries by the synergistic index of financial-digital performance.

The baseline scenario represents the actual combination of fiscal and digital performance indicators observed for the analysed countries and therefore uses the original values of K1–K8 without adjustment. It serves as the reference state against which all subsequent scenario changes are assessed. The target scenario includes directional changes that improve the alignment between the budget burden and the results of digital public service delivery. A change is classified as belonging to the target scenario when it reduces the cost criteria K1–K3, which represent fiscal resource intensity, administrative resource intensity, and fiscal rigidity, and/or increases the benefit criteria K4–K8, which represent digital public services, transparency, interoperability, user support, and basic portal quality. The stress scenario reflects the opposite combination of changes and includes an increase in K1–K3 and/or a decrease in K4–K8, indicating a higher fiscal and

administrative burden accompanied by deterioration in the characteristics of digital public service delivery. Thus, the allocation of changes to the baseline, target, or stress scenario is determined by their direction relative to the baseline values and by the economic meaning of each criterion rather than by an arbitrary classification of events. In all three scenarios, the ranking criteria remain identical. K1–K3 are treated as cost criteria for which lower values are preferable, whereas K4–K8 are treated as benefit criteria for which higher values are preferable. TOPSIS, DEA-BCC, and the synergy index (S_i) are recalculated for each scenario using the same hybrid criterion weights as in the baseline assessment, which makes it possible to isolate the effect of changes in fiscal burden and digital public service outcomes without simultaneously changing the analytical importance of the criteria.

The hybrid weights remain at the baseline level, which ensures the assessment of the impact of changing the criteria without changing their analytical significance. The target scenario increases the index by an average of 3.35%. Hungary achieves the largest relative gain, as reducing resource intensity produces a significant effect despite low initial DEA efficiency. Poland, the Czech Republic, Croatia, and Slovenia also demonstrate significant improvements. Estonia's gain is the smallest, due to its proximity to the efficiency frontier and high initial digital maturity. In this state, further improvement requires more complex innovations, not just cost optimization.

The stress scenario reduces the result by an average of 3.69%. Hungary is the most sensitive, where increasing inputs and decreasing outputs exacerbate the existing mismatch. Poland, the Czech Republic, Croatia, and Slovenia also lose approximately 4% of their integrated result. The scenario assessment confirms that the financial and economic mechanism must have continuity reserves, rules for priority funding of critical services, and predefined minimum acceptable quality indicators (Figure 3).

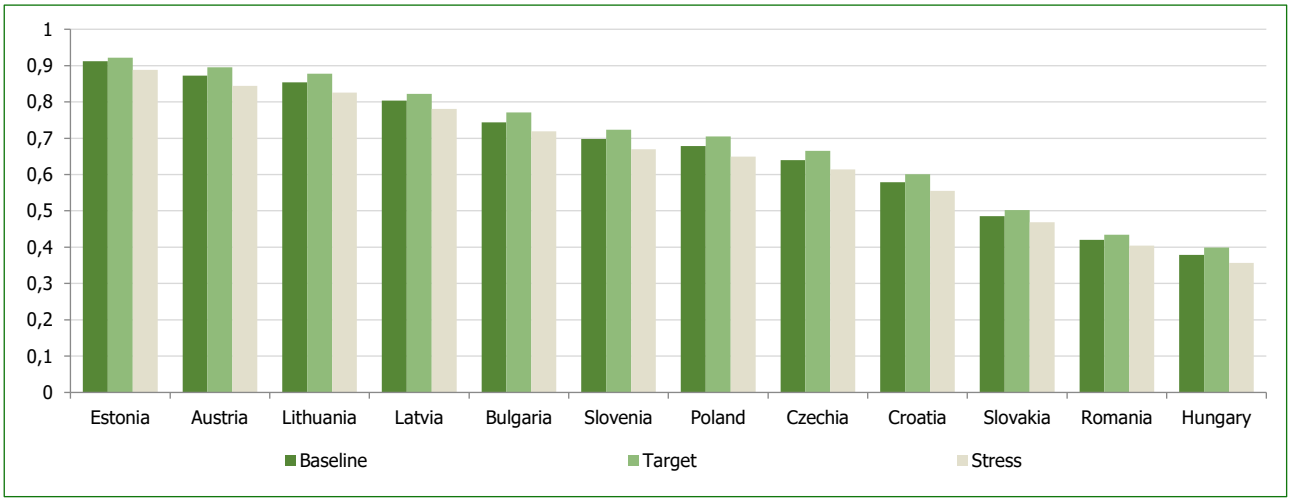

Figure 3. Comparison of the baseline, target, and stress scenarios.

The regression model explains 96.8% of the variance in the overall score, but this result should be interpreted with caution due to the small sample size and the substantive proximity of K6 to the final eGovernment Benchmark index. The standardized interoperability coefficient is 0.954 and is statistically significant. Fiscal variables do not independently demonstrate statistical significance after including K6. This result does not prove the absence of a funding impact, but rather indicates that expenditure alone does not determine digital performance without a mechanism for transforming resources into collaborative data exchange and seamless user journeys (Table 7).

Table 7. Results of standardised regression validation. *(Source: calculated by the author. Number of observations: 12)*

Variable / indicator	Coefficient	Std. error	t	p
Constant	0.000	0.063	0.000	1.000
K1, total expenditure	0.016	0.214	0.073	0.944
K2+K3, fiscal-administrative rigidity	-0.083	0.226	-0.367	0.723
K6, interoperability	0.954	0.078	12.174	0.000002
R^2 / adjusted R^2	0.968 / 0.956			
F / Prob(F)	80.19 / 0.00000261			

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The aggregate fiscal and administrative burden in the study refers to the sum of expenditures on the activities of executive and legislative bodies and operations with the public debt, expressed as a percentage of GDP. The indicator does not characterize direct expenditures on digital transformation. It reflects the part of the total budget burden that limits the possibilities of reallocating resources for the development of digital public services. Figure 4 shows the overall negative trend but also highlights some exceptions. Austria has relatively high rigidity and a high digital score, indicating the importance of resource management quality. Hungary has high stiffness without a corresponding numerical result, while Estonia provides a high result with a low load (Figure 4).

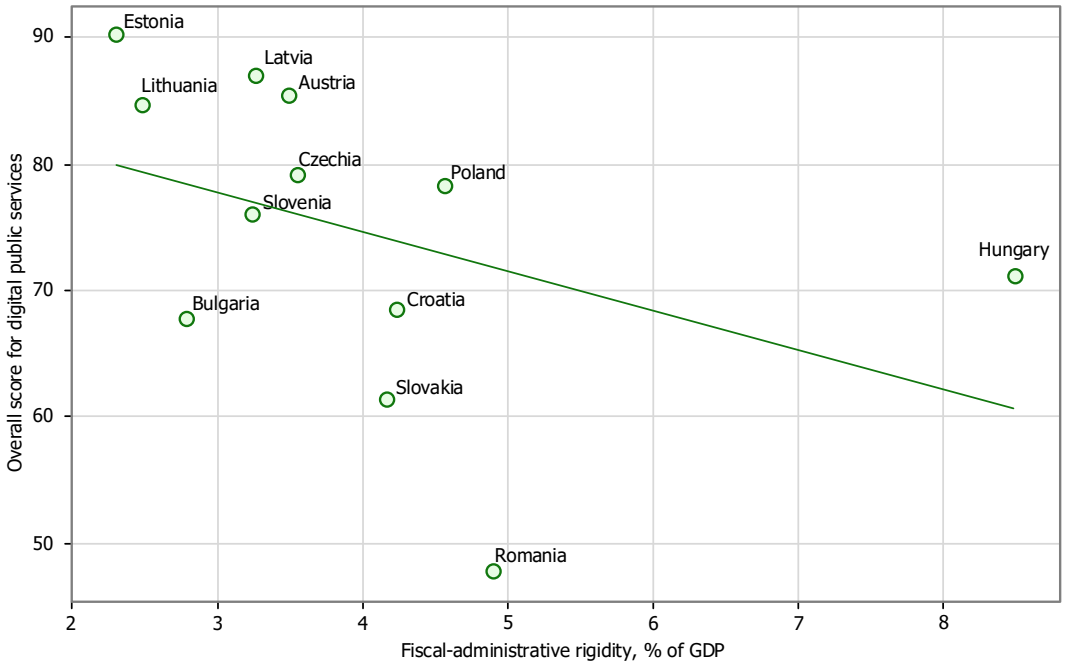

Figure 4. Relationship between fiscal-administrative rigidity and the overall score for digital public services.

The full cost of a public service should become the foundation of budget planning. It includes not only software development but also integration with registers, data migration, support, cybersecurity, staff training, backups, accessibility for people with disabilities, and the decommissioning of obsolete components.

Portfolio budgeting by events changes the departmental focus of funding. For example, the birth of a child, the start of a business, or a change of residence cover the services of several government agencies. Funding the entire route creates incentives for data sharing, while departmental funding often encourages duplication. The Interoperability Fund should finance components of an interdepartmental nature, in particular electronic identification, basic registers, exchange gateways, data catalogs, and common electronic payment tools (Table 8).

Table 8. Instruments for implementing the financial and economic mechanism. *(Source: developed by the author based on the study results)*

Implementation area	Content	Key indicators	Expected effect
1. Full service cost profile	CAPEX, OPEX, integration, cybersecurity, training, archiving	cost per completed transaction; 5-year TCO	elimination of hidden costs
2. Portfolio budgeting	allocation by life events rather than departmental systems	share of common components; registry duplication	coordination across public authorities
3. Performance-based funding	fixed component and variable component based on KPIs	accessibility, transparency, processing time, online completion rate	incentives for substantive improvement
4. Interoperability Fund	earmarked funding for APIs, registry exchange, and identification	K6; volume of reused data	scaling without duplication
5. Continuity reserve	backup environments, recovery, and testing of critical dependencies	RTO, RPO, share of critical systems with redundancy	acceptable level of security
6. Open performance oversight	public performance dashboard and independent audit	S_i, DEA, TOPSIS, scenario deviations	accountability and adaptive adjustment

Performance-based funding should be introduced gradually. The base component ensures continuity, while the variable component depends on the achievement of agreed-upon indicators. Metrics should measure online transaction completion, not portal visits. Without such clarification, a government agency may demonstrate high activity without actually reducing its administrative burden. It's also important to use quality metrics to ensure savings don't lead to decreased accessibility or a reduction in the acceptable level of security.

The general result of the assessment is that the consistency of the budget burden with the results of digital transformation is determined not by the volume of expenditures as such, but by the ability of the financial and economic mechanism to transform available resources into transparent, interoperable, accessible, and continuous public services. The combination of an increased budget burden with high digital results indicates the possibility of maintaining performance, provided that the full cost of services is further controlled. A low or moderate burden together with insufficient quality of services indicates the need for targeted funding for interoperability, user support and basic quality of portals. An increased burden without proportional digital results confirms the need to review the structure of expenditures, eliminate duplication, develop common components, and transition to result-based financing.

DISCUSSION

The scientific novelty of the obtained results lies in the deepening of theoretical provisions on the financial and economic mechanism of public administration of the digital transformation of public services. The proposed approach clearly distinguishes the financial, economic, security, and provisioning components of the mechanism and defines specific instruments for financing the full life cycle of public services. The methodological provision, which has been further developed, consists of combining the author's AHP weights, objective entropy weights, TOPSIS, DEA-BCC, and synergistic aggregation. This combination ensures simultaneous consideration of the structure of the budget burden, digital results, and the relative ability of public authorities to convert resources into the appropriate quality of services. Unlike studies focused mainly on assessing digital maturity or the quality of public administration, the proposed approach links the obtained ranking with the choice of specific instruments of the financial and economic mechanism. The identified type of discrepancy determines various management actions. Insufficient digital results with moderate workload require targeted funding for quality and interoperability, while significant workload without adequate results requires a review of the cost structure, full cost of services, and duplication of components. The proposed aspects are consistent with the position of Garafonova et al. (2021) regarding the systemic and consistent nature of the formation of a financial mechanism. However, in this study, the financial mechanism is not equated with the entire set of organizational and information processes. Its content is limited to the methods and levers for the formation, distribution, and use of public financial resources. This approach ensures a clearer distinction between the main mechanism and its regulatory, organizational, and informational-analytical support.

The results are also consistent with the position of Piatnychuk (2024), according to which the economic mechanism encompasses methods, tools, and measures aimed at ensuring the functioning of the relevant sphere. The distinctive feature of the proposed approach lies in the specification of economic instruments for the digital transformation of public services, which include an assessment of the full life cycle cost, cost-benefit analysis, an assessment of transaction costs, a comparison of alternatives, and incentives for the use of common components.

The observed lack of a direct correlation between total public expenditure and the performance of digital public services is consistent with OECD recommendations (2019). Performance information should be used in budgeting decisions; however, the complex nature of the relationship between expenditure and performance limits the ability to automatically adjust funding.

The results also support the position of Douglas and Overmans (2020), according to which budgeting decisions should align public resources with public value and take into account the interests of different user groups.

The application of TOPSIS is consistent with the approach of Ardielli (2019), who used this method to comparatively assess good governance in European Union countries. Similar to the results of Yang (2021), the combination of entropy weights and TOPSIS reduced the subjectivity of weight determination while simultaneously taking into account financial and performance characteristics.

The study by Łukomska-Szarek et al. (2024) also confirms the suitability of linear ranking methods for assessing technological development in public administration.

This study differs in the inclusion of budget and debt burden indicators and the subsequent interpretation of the ranking through financial and economic framework instruments. Based on the recalculation results, Austria, Estonia, and Lithuania achieved the highest combination of financial and performance indicators. Austria compensates for its relatively high

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budget burden with high public service performance. Estonia combines high performance indicators with more moderate financial values. Lithuania demonstrates a favorable balance between interoperability and fiscal burden. These results indicate the existence of a universal financing model. They demonstrate different ways to achieve relatively high results and confirm the need to consider the national structure of expenditure. The low positions of Romania and Hungary are due to different reasons. Romania is characterized by low values on several performance indicators, while Hungary has a significant general, administrative, and debt burden without a proportionally high result.

This distinction has practical implications for the selection of instruments. In the case of insufficient performance indicators, the priority is to finance the availability, integration, and support of services. In the case of a high budget burden, an assessment of full costing, a review of the cost structure, the elimination of duplication, and the expansion of common components are advisable. The application of the results has a number of limitations. First, the indicators of expenditure on general public services characterize the overall fiscal and administrative burden and are not direct indicators of capital and current spending on digital transformation. Second, the study covers 12 countries and one time period, so the results are comparative in nature and do not provide for the establishment of cause-and-effect relationships. Third, the TOPSIS ranking and the DEA-BCC boundary depend on the sample composition, the system of criteria, and the weights used.

CONCLUSIONS

The first objective of the study made it possible to clarify the economic essence and functional structure of the financial and economic mechanism for public administration of the digital transformation of public services. The mechanism is interpreted as a unified system rather than as two autonomous financial and economic mechanisms. Its structure integrates a purpose, tasks, subjects, objects, financial methods, financial levers and economic instruments, while financial-regulatory, organizational, information-analytical and security arrangements provide the conditions for their functioning. This functional relationship is systematised in Figure 1.

The second objective resulted in the identification of the principal methods, levers and instruments through which the full life cycle of digital public services can be financed. The most relevant include medium-term and programme-target financing, portfolio financing, performance-based financing, targeted financing of common interoperability infrastructure, continuity reserves, life-cycle costing, total cost of ownership, transaction-cost assessment and comparison of alternative resource-allocation options. Their application should be coordinated because isolated financing of individual information systems does not ensure the continuity or economic justification of a digital public service.

The solution of the third objective made it possible to substantiate the system of financial and digital criteria used to determine the correspondence between the budget burden and the results of public service. Criteria K1–K3 characterise the fiscal and administrative environment within which financing decisions are made, whereas K4–K8 characterise the achieved properties of digital public services. Importantly, K1–K3 are not interpreted as direct expenditure on digital transformation. Their joint analysis with digital-service indicators makes it possible to distinguish cases where increased resource intensity is accompanied by strong results from cases where a comparable or higher burden does not generate proportional service outcomes.

The fourth objective was to carry out a comparative assessment based on hybrid AHP and entropy weights, TOPSIS, DEA-BCC, and a generalized index of financial-digital coherence. The highest positions were obtained by Estonia, Austria and Lithuania, although their combinations of fiscal burden and digital outcomes differ. The hybrid weighting also showed that basic portal quality, transparency, and interoperability have the greatest analytical contribution to differentiation within the sample. This confirms that a single universal financing configuration cannot be identified and that the mechanism should account for the initial financial and digital position of each country.

The solution of the fifth objective confirmed the overall stability of the comparative assessment and demonstrated its response to alternative scenarios. The target scenario increases the generalized result by an average of 3.35%, whereas the stress scenario reduces it by 3.69%. The additional regression test identified interoperability as the strongest statistically significant variable associated with the overall digital public-service score, while the fiscal variables did not demonstrate an independent statistically significant relationship after interoperability was included. This result should not be interpreted causally, but it confirms that the amount of resources alone does not explain differences in digital public-service outcomes.

The solution of the sixth objective made it possible to formulate differentiated recommendations in accordance with the identified type of discrepancy between the load of resources and digital results. Countries combining moderate resource intensity with insufficient digital outcomes should prioritise targeted financing of interoperability, user support and basic

service quality. A high fiscal and administrative burden combined with weak outcomes requires revision of the cost structure, elimination of duplicated systems, wider reuse of common components and stronger application of performance-based financing. Countries combining high digital performance with a relatively high burden should concentrate on life-cycle cost control and prevention of future duplication, whereas countries with strong outcomes and moderate resource intensity should prioritise continuity, resilience and the scaling of common digital components.

Further research should develop a specialised database of direct capital and current expenditure on the digital transformation of public services, extend the analysis to panel data, incorporate the actual volume of completed digital transactions and compare the cost of individual public services. Such data would make it possible to move from comparative financial-digital coherence toward a more complete assessment of the economic effectiveness of individual instruments of the financial and economic mechanism.

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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ФІНАНСОВО-ЕКОНОМІЧНИЙ МЕХАНІЗМ ПУБЛІЧНОГО АДМІНІСТРУВАННЯ В УМОВАХ ЦИФРОВОЇ ТРАНСФОРМАЦІЇ ДЕРЖАВНИХ ПОСЛУГ

Статтю присвячено обґрунтуванню фінансово-економічного механізму публічного адміністрування, спроможного пов'язати бюджетні ресурси з фактичною результативністю цифрової трансформації державних послуг. Актуальність дослідження визначається тим, що збільшення видатків на загальні державні послуги саме собою не гарантує доступності, прозорості, інтероперабельності й зручності електронної взаємодії громадян і підприємств із держав-

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ними органами влади. Метою дослідження є формування та апробація комбінованого методичного підходу до оцінювання фінансово-цифрової результативності публічного адміністрування. Інформаційну основу становлять дані Eurostat щодо видатків сектора загального державного управління за 2023 р. і результати eGovernment Benchmark 2026, отримані під час оцінювання державних послуг 2025 р. Вибірка охоплює 12 країн Європейського Союзу, а саме Австрію, Болгарію, Хорватію, Чехію, Естонію, Угорщину, Латвію, Литву, Польщу, Румунію, Словаччину та Словенію. Запропонована методологія поєднує аналіз ієрархій Сааті, ентропійне визначення об'єктивних ваг, метод TOPSIS, орієнтовану на входи модель DEA-BCC, синергетичне агрегування результатів, стандартизовану регресійну перевірку та сценарне моделювання. Сформовано систему з 8 критеріїв, яка охоплює фіскальну ресурсомісткість, адміністративні та боргові видатки, рівень цифровізації послуг, прозорість, інтероперабельність, підтримку користувачів і базову якість державних порталів. Найбільші гібридні ваги отримали базова якість порталів, прозорість та інтероперабельність. За синергетичним індексом найвищі позиції посіли Естонія, Австрія та Литва, а найнижчі результати отримали Угорщина й Румунія. Регресійна перевірка показала визначальне статистичне значення інтероперабельності для загальної оцінки державних послуг. Цільовий сценарій перерозподілу ресурсів і підвищення цифрової зрілості збільшує інтегральний результат, а стресовий сценарій знижує його. Практичне значення результатів полягає у формуванні інструментарію для програмно-цільового бюджетування, фінансування за результатом, управління повною вартістю державної послуги та визначення пріоритетів інвестицій у спільну цифрову інфраструктуру.

Ключові слова: публічне адміністрування, державні послуги, цифрова трансформація, бюджетні видатки, фінансування за результатом, інтероперабельність, DEA-BCC, TOPSIS, аналіз ієрархій Сааті, сценарне моделювання

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