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Assessing the impact of intersectoral integration and digitalization on the economic performance of EU service economy sectors

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Purpose. The purpose of the study is to assess the impact of intersectoral integration and digitalization on the economic performance of service economy sectors in the European Union and to identify intersectoral differences in the combination of integration, digital, and performance characteristics.

Methodology. The methodological framework is based on the theory of intersectoral linkages, concepts of digital transformation, and systemic and ecosystem approaches. Statistical, structural, and comparative analyses were applied. The empirical database was compiled using Eurostat and OECD data for NACE Rev. 2 sectors H, I, J, M, and N across EU countries.

Results. The study reveals substantial sectoral differentiation in development dynamics, the nature of intersectoral linkages, the level of digitalization, and economic performance. The highest labour productivity was recorded in the information and communication sector; while professional, scientific and technical activities generated the largest volume of value added; the lowest labour productivity was observed in accommodation and food service activities. Transport and storage were found to exhibit pronounced two-way linkages, whereas accommodation and food services are characterized predominantly by backward linkages. Information and communication, professional, and administrative and support service activities act as important suppliers of resources and services to other economic activities. It is demonstrated that technological digitalization is more strongly associated with productivity than the digitalization of sales channels, while the performance effects of intersectoral integration depend not only on the intensity of linkages but also on their functional orientation.

Scientific novelty. The scientific novelty lies in the integrated comparison of the direction of intersectoral linkages, the level of technological and market digitalization, and the performance indicators of EU service economy sectors.

Practical value. The practical value of the results lies in their potential use for identifying sectors with insufficient digital maturity and a limited capacity to translate intersectoral linkages into productivity and value-added growth.

Keywords: intersectoral integration, digitalization, service economy, European Union, economic performance, labor productivity, intersectoral linkages, cloud technologies, e-sales, value added.

Introduction

The contemporary development of the service economy is accompanied by the deepening of intersectoral linkages, the diffusion of digital technologies, and the transformation of models of economic activity organization. Business entities increasingly operate through interactions with other sectors involving the exchange of resources, services, information, and technologies. This makes it relevant to examine the service economy not only at the level of individual economic activities, but also from the perspective of how they are embedded in the system of intersectoral linkages.

These processes are particularly important for service economy sectors, which differ substantially in labour intensity, technological sophistication, reliance on external resources, and the level of digitalization. Accordingly, their economic performance may be associated not only with the scale of activity and internal resource endowment, but also with the nature of forward and backward intersectoral linkages, the sector's position within the value-added creation system, and the extent to which digital technologies are embedded in business processes.

Alongside the development of intersectoral interaction, the digital transformation of service sectors is intensifying. The use of cloud technologies, electronic sales channels, analytical tools, and integrated information systems is reshaping business processes and forms of interaction among economic actors. At the same time, the relationship between the level of digitalization and economic performance is not necessarily

uniform and may vary depending on sector-specific functional characteristics, the structure of intersectoral linkages, and the ways in which digital tools are applied.

In this context, it is appropriate to examine integration and ecosystem capacity as an aggregate characteristic of actors within a given sector, reflecting their participation in intersectoral interactions, their ability to attract external resources and competencies, and their use of digital technologies in value-added creation processes. At the same time, the extent to which the intensity and direction of intersectoral linkages and the level of digitalization are associated with productivity, value added, and operating performance requires separate empirical verification.

The substantial differentiation of EU service economy sectors in terms of structural, digital, and performance characteristics necessitates their comparative analysis. Combining intersectoral, digital, and performance dimensions makes it possible to identify the nature of the relevant relationships, reveal intersectoral differences, and determine the structural configurations under which digitalization and intersectoral interaction are associated with higher levels of economic performance.

Literature Review

The issues of intersectoral integration, digital transformation, and ecosystem-based organization of economic interaction occupy an important place in contemporary research on the development of the service economy. The theoretical foundations of business ecosystem functioning, resource complementarity, and the coordination of interdependent actors are explored in the works of M. Jacobides, C. Cennamo, and A. Gawer (2024), M. Krome and U. Pidun (2023), and R. Ferlito and R. Faraci (2024). These authors emphasize the transition from autonomous business models to network-based configurations, in which the performance of an individual firm or sector increasingly depends on the nature of its relationships with suppliers, customers, and other participants in the value creation system. G. Dai, L. Zhang, Q. Zhang, and M. Mao (2024) further develop this perspective by examining the relationship between value creation and value appropriation, highlighting the role of coordination mechanisms, complementarity, and the alignment of ecosystem participants' interests.

An important strand of the academic discourse concerns digitalization as a factor of structural transformation and economic performance. D. Buhalis, P. O'Connor, and R. Leung (2023) consider digital technologies as a foundation for the transition towards flexible network-based ecosystems in the service economy, where the integration of data, resources, and actors creates new opportunities for coordination and value creation. O. Troisi, A. Visvizi, and M. Grimaldi (2023) argue that digitalization transforms business models through the integration of information, technologies, and resources into the processes of value formation, creation, and capture. A. Coskun-Setirek et al. (2024) emphasize the interdependence between digital architecture and business ecosystem governance mechanisms.

The empirical dimension of the relationship between digitalization and performance is further developed by F. Nucci, C. Puccioni, and O. Ricchi (2023), who identify a positive association between the adoption of digital technologies and firm productivity. Z. Fan, R. Bian, and S. Anwar (2024) examine the digital transformation of services as a factor contributing to deeper intersectoral linkages and the integration of economic actors into global value chains. At the same time, B. Johansson and J. Klaesson (2024) substantiate the co-evolutionary nature of the development of business services and the sectors that use them: growing demand for specialized service inputs stimulates the expansion of the corresponding service sectors, while their development, in turn, contributes to productivity growth in other economic activities. These findings are particularly relevant for substantiating the relationship between intersectoral integration and economic performance.

In Ukrainian academic literature, the ecosystem and digital dimensions of business development are addressed in the works of L. Blahodyr (2022), K. Boichenko and M. Sierhieiev (2024), O. Levkovets (2024; 2025), and V. Stadnyk and S. Naskalny (2025). L. Blahodyr interprets digital business ecosystems as

a specific form of coordination of economic activity based on network effects, modularity, and multilateral interaction. K. Boichenko and M. Sierhieiev associate the ecosystem approach with resource complementarity, innovation, and value generation. O. Levkovets examines strategic models of ecosystem interaction and the roles performed by its participants, whereas V. Stadnyk and S. Naskalny focus on the relationship between digitalization, the deepening of integration processes, and the competitiveness of business structures.

A synthesis of recent studies indicates that intersectoral integration, digitalization, and economic performance are predominantly examined as separate or only partially interconnected research areas. Considerably less attention has been paid to their simultaneous comparison at the sectoral level, particularly to identifying how forward and backward intersectoral linkages and different forms of digitalization are associated with labour productivity, value-added creation, and operating performance across service economy sectors. Insufficient attention has also been devoted to the possibility that technological digitalization of business processes and the digitalization of sales channels may be associated differently with performance, while the economic effects of intersectoral integration may depend not only on the intensity of linkages but also on the functional position of a sector within the value creation system.

Thus, the existing academic debate provides a sufficient theoretical foundation for the present study while also revealing the need for a comprehensive structural and comparative assessment of the relationship between intersectoral integration, digitalization, and the economic performance of service economy sectors based on comparable open statistical data. The subsequent analysis is aimed at addressing this research gap.

Research Aim

The aim of the study is to assess the nature of the impact of intersectoral integration and digitalization on the economic performance of service economy sectors and to identify intersectoral differences in the combination of integration, digital, and performance characteristics.

To achieve this aim, the study seeks to: analyse the dynamics and intersectoral differentiation of economic performance; identify the nature of forward and backward intersectoral linkages and the level of digitalization across the sectors under study; compare integration and digital characteristics with labour productivity and operating performance indicators; and generalize the patterns underlying their interrelationships.

Methodology

To achieve the research aim, a combination of general scientific and specialized methods was employed to ensure a consistent assessment of economic performance, intersectoral linkages, and digitalization across EU service economy sectors. Statistical analysis was used to assess the dynamics and levels of key indicators of economic performance and digitalization; comparative analysis was applied to identify intersectoral differentiation; and structural analysis was used to determine the nature of forward and backward intersectoral linkages and the position of individual sectors within the value creation system. Methods of generalization and synthesis were employed to identify patterns in the relationships among integration, digital, and performance characteristics.

The empirical sample comprised five NACE Rev. 2 sectors: H – transportation and storage; I – accommodation and food service activities; J – information and communication; M – professional, scientific and technical activities; and N – administrative and support service activities. These sectors were selected because

of their differences in labour intensity, technological sophistication, the nature of intersectoral linkages, and the level of digitalization, as well as the availability of comparable open statistical data. The information base of the study consists of Eurostat and OECD data. Sectoral development dynamics were analysed using Eurostat services production indices for 2019–2023; economic performance was assessed using Eurostat Structural Business Statistics for 2023, including value added, labour productivity, employment, and gross operating rate; digitalization was evaluated using indicators of cloud service use and e-sales for 2023; and the nature of intersectoral linkages was examined on the basis of OECD input–output tables for 2022, the closest available period suitable for comparison.

The relationship among the factors under study was assessed through a structural and comparative matching of integration and digital characteristics with indicators of labour productivity and operating performance. This approach makes it possible to identify persistent intersectoral patterns and differences in the combination of intersectoral integration, digitalization, and economic performance without unnecessarily complicating the analytical framework. Given the aggregated sector-level nature of the data, the findings are interpreted as analytically established associations rather than strictly proven causal effects.

Presentation of the Main Research Findings

The contemporary service economy is developing amid a gradual blurring of traditional boundaries between different types of economic activity. Transport, information and communication, financial, professional, trade, tourism, and other services increasingly function not only as final products in their own right but also as intermediate inputs that support the operation of other sectors. As a result, the economic performance of an individual sector is determined not only by the volume of resources, capital, and labour available within it, but also by the nature of its integration into intersectoral flows. Recent studies confirm the growing role of service activities as intermediate inputs and as important components of intersectoral interaction and value chains (Johansson & Klaesson, 2024; Fan et al., 2024).

In the broadest sense, intersectoral integration refers to the process of deepening economic, technological, informational, and resource linkages among different types of economic activity, whereby the functioning of one sector becomes increasingly dependent on the resources, services, competencies, and outputs of other sectors. Unlike the simple coexistence of industries within a national economy, integration implies their sustained incorporation into common value chains, production networks, and systems for the exchange of intermediate goods and services. From the perspective of intersectoral analysis, its material basis is represented by intermediate consumption flows, while the intensity of integration can be assessed through the strength of forward and backward linkages between sectors. Recent research indicates that the structure of such linkages affects the diffusion of technological change, productivity, and economic effects across the system of intersectoral interaction (Johansson & Klaesson, 2024; OECD, 2025).

For service economy sectors, intersectoral integration has a specific significance. A substantial share of modern services – information technologies, transport, logistics, consulting, financial, marketing, professional, and digital services – simultaneously serves as an input into the activities of numerous other sectors. B. Johansson and J. Klaesson (2024) show that the development of business services is co-evolutionary: growing demand from other sectors stimulates the expansion of specialized service provision, while the development of these services, in turn, creates conditions for productivity growth among their users. Similarly, studies

of intersectoral linkages indicate a positive relationship between the increasing integration of market services into production systems and productivity growth.

Thus, intersectoral integration may affect economic performance through several interconnected mechanisms. First, it provides access to specialized resources and competencies that would be economically inefficient to develop internally within each sector. Second, the expansion of intersectoral exchange facilitates the diffusion of innovation and technological knowledge. Third, stronger linkages with suppliers and users of intermediate services can improve resource-use efficiency and generate multiplier effects. Fourth, integration enables the formation of more complex value chains in which service sectors perform not only supporting but also coordinating and technological functions. At the same time, excessive dependence on a limited number of sectors or suppliers may increase vulnerability to external shocks; therefore, a high intensity of linkages should not automatically be interpreted as evidence of high performance.

Within the framework of this study, intersectoral integration is understood as the degree to which a particular service economy sector is embedded in a system of stable forward and backward economic linkages with other activities, realized through flows of intermediate goods and services and enabling the use of complementary resources in the process of value-added creation. This interpretation is also methodologically important because it allows the concept of integration to be operationalized through indicators derived from publicly available input-output tables, including the structure of intermediate consumption, the share of inputs originating from other sectors, and measures of forward and backward intersectoral linkages.

A second key factor in the contemporary transformation of the service economy is digitalization. Its economic content should not be reduced merely to converting information into digital form or to the use of individual information technologies. Digitalization involves the systematic incorporation of digital technologies into business processes, organizational arrangements, information exchange, interaction with suppliers and customers, and value creation mechanisms. Digital technologies reduce the costs of search, information processing, communication, and coordination, thereby changing both the internal organization of firms and the nature of interaction among them. Empirical studies demonstrate a positive association between the adoption of digital technologies and firm productivity, while in the service economy digitalization additionally contributes to business model transformation, resource integration, and the development of network-based forms of value creation (Nucci et al., 2023; Buhalis et al., 2023; Troisi et al., 2023).

For the service economy, digitalization has a dual effect. On the one hand, it directly affects sectoral productivity through automation, data analytics, cloud solutions, e-commerce, artificial intelligence, and integrated information systems. On the other hand, digitalization strengthens intersectoral integration by providing the technological infrastructure required for the rapid exchange of information and resources among economically autonomous actors. Studies of the digital transformation of services indicate that its effects extend beyond individual sectors: digital services can reduce transaction and coordination costs, improve the efficiency of related economic activities, and facilitate their deeper integration into global value chains (Fan et al., 2024; Nucci et al., 2023).

This nature of digitalization directly links it to the ecosystem logic of the contemporary economy. M. Jacobides, C. Cennamo, and A. Gawer (2024) view platforms and ecosystems as organizational structures in which value creation is based on resource complementarity and the coordination of multiple economic actors. D. Buhalis, P. O'Connor, and R. Leung (2023) identify digital technologies as a foundation for the development of flexible service business ecosystems, while O. Troisi, A. Visvizi, and M. Grimaldi (2023) show that digitalization transforms

value creation and value capture mechanisms through the integration of data, technologies, and resources. A similar perspective is advanced by L. Blahodyr (2022), who conceptualizes digital business ecosystems as a specific form of coordination of economic activity shaped by intersectoral convergence and the development of information and communication technologies (Jacobides et al., 2024; Buhalis et al., 2023; Troisi et al., 2023; Blahodyr, 2022).

Accordingly, within the framework of this study, digitalization of service economy sectors is understood as the extent to which digital technologies are systematically embedded in economic activities and intersectoral interactions, thereby enabling faster information exchange, lower transaction costs, process automation, broader interaction channels, and new modes of value creation. This definition also has practical relevance, as it allows digitalization to be assessed using statistically available indicators, including digital intensity, the use of cloud technologies, e-commerce, data analytics, and other digital tools.

Importantly, intersectoral integration and digitalization should not be treated as independent processes. Digital technologies reduce the cost and increase the speed of intersectoral interaction, while well-developed intersectoral linkages, in turn, create a broader environment for the diffusion of digital solutions. Therefore, the economic performance of a service sector should be considered not as the outcome of the isolated effects of each of these factors, but rather as a result of their complementarity. Research on the digital transformation of services indicates that the effects of digitalization are strengthened under conditions of active intersectoral interaction and the integration of service inputs into broader value chains. At the same time, studies of business ecosystems emphasize the complementarity of resources, technologies, and competencies as an important source of joint value creation (Fan et al., 2024; Jacobides et al., 2024; Troisi et al., 2023).

In this context, the economic performance of a sector reflects its ability to transform the resources employed and the economic linkages established into the creation of economic value. For sectoral analysis, it is appropriate to assess economic performance not through a single indicator, but through a set of characteristics reflecting both the scale and efficiency of economic activity. Within Eurostat Structural Business Statistics, the performance of economic activities is characterized, *inter alia*, by indicators of value added, employment, labour productivity, and operating performance. Accordingly, in this study, labour productivity and the gross operating rate are used as the principal performance indicators, while value added and the number of persons employed serve as additional measures of sectoral scale and structural importance (Eurostat – Structural Business Statistics (SBS): Final data for 2023, 2025).

Accordingly, the analysis proceeds to the development of a system of indicators integrating three interrelated dimensions: the nature of intersectoral linkages, the level of digitalization, and the economic performance of service economy sectors. The indicators were selected on the basis of their economic relevance, intersectoral comparability, and availability in the open statistical databases of Eurostat and the OECD.

Intersectoral integration is assessed through the direction of a sector's participation in intersectoral flows. Backward linkages characterize a sector's dependence on intermediate inputs, goods, and services supplied by other economic activities, whereas forward linkages reflect the use of a sector's outputs as intermediate inputs by other sectors. Considering both dimensions makes it possible to identify whether intersectoral interaction is predominantly backward-oriented, forward-oriented, or bidirectional.

The level of digitalization is characterized by two indicators reflecting different dimensions of digital transformation: the share of enterprises using cloud services and the share of enterprises engaged in e-sales. The first indicator captures the

technological digitalization of business processes, while the second reflects the digitalization of market interaction and sales channels.

Table 1
Indicators of Intersectoral Integration, Digitalization, and Economic Performance of EU Service Economy Sectors

Assessment Component	Indicator / Characteristic	Description
Intersectoral Integration	Backward Linkages	Sector Dependence on Inputs and Services from Other Sectors
	Forward Linkages	The Sector's Role as a Supplier of Intermediate Services to Other Economic Activities
	Predominant Type of Linkages	Backward, Forward, or Bidirectional Type of Intersectoral Interaction
Digitalization	Enterprises Using Cloud Services, %	Technological Digitalization of Business Processes
	Enterprises Engaged in E-sales, %	Digitalization of Sales Channels
Economic Performance	Labour Productivity, EUR Thousand per Person Employed	Efficiency of Value-Added Creation
	Gross Operating Rate, %	Operating Performance
	Value Added, EUR Billion	Scale of the Sector's Contribution to Value Added in the Economy
	Number of Persons Employed, Million	Scale of Labour Resource Engagement in the Sector

Note:

*backward linkages reflect a sector's dependence on inputs from other sectors, whereas forward linkages indicate its role as a supplier of intermediate services. Digitalization is assessed using the adoption of cloud services and e-sales, while economic performance is evaluated in terms of labour productivity and the gross operating rate.

Source: compiled by the authors based on data from Eurostat (Cloud computing services by economic activity, 2023; E-commerce sales by economic activity, 2023; ICT usage in enterprises, 2023; Structural Business Statistics (SBS): Final data for 2023, 2025) and OECD (Input-Output Tables, 2025).

Economic performance is assessed using labour productivity and the gross operating rate. Value added and the number of persons employed are used as supplementary structural indicators that make it possible to account for the scale of economic activity across sectors.

The developed system of indicators provides a consistent framework for examining three interrelated dimensions of service economy sector development: the nature of intersectoral interaction, the level of digitalization, and economic performance. Performance indicators provide the basis for the initial comparison of sectors, while integration and digital characteristics are subsequently used to explain the observed differences. This approach makes it possible to first establish the actual dynamics and extent of intersectoral differentiation in economic performance and then relate these differences to the nature of intersectoral linkages and the level of digitalization.

Accordingly, the next stage of the study focuses on analysing the dynamics and intersectoral differentiation of economic performance across EU service economy sectors.

Sectoral dynamics are assessed using Eurostat's Index of Services Production (ISP), which measures changes in the volume of services provided at constant prices

and, unlike nominal turnover, minimizes the influence of price effects. The indicator covers sectors H, I, J, M, and N and therefore provides an appropriate basis for comparing their development trajectories (Eurostat. Production in services: Index of Services Production (ISP). Eurostat Database, 2023).

Sectoral dynamics over 2019–2023 were heterogeneous. The most pronounced structural changes occurred in 2020, when the pandemic shock sharply reduced activity across the service economy: between February and April, services turnover in the EU fell by approximately 21%, while accommodation and food service activities declined by nearly 80%. A substantial contraction was also observed in transportation and storage, whereas information and communication and professional services proved relatively more resilient. Recovery began across most sectors in 2021–2022, although the pace varied considerably. Sector I was characterized by a particularly large amplitude of decline and subsequent recovery; sector H, after strong growth in 2021 and the first half of 2022, weakened again, while sectors J and M maintained a more stable upward trajectory.

At the end of the period under review, sectoral differentiation remained pronounced. In December 2023 compared with December 2022, services production increased by 1.0% in sector H, 1.4% in sector I, 4.8% in sector J, 0.9% in sector M, and 1.2% in sector N. Thus, the information and communication sector demonstrated the strongest growth dynamics at the end of the period, whereas the other activities under study recorded more moderate rates of expansion (Eurostat. Key figures on European business, 2024).

To assess intersectoral differentiation in economic performance, Eurostat Structural Business Statistics data for 2023 were used. This year was selected because it provides a complete and methodologically consistent dataset across all sectors included in the analysis. In addition, since 2021, SBS statistics have been compiled under the harmonized European Business Statistics framework, which enhances the comparability of structural indicators.

The intersectoral comparison confirms substantial differences in performance. Sector J – information and communication – records the highest labour productivity, at approximately EUR 93.6 thousand of value added per person employed. Sectors H

Table 2

Economic Performance of Selected EU Service Economy Sectors in 2023

Sector	Number of Persons Employed, Million	Value Added, EUR Billion	Labour Productivity, EUR Thousand per Person Employed	Gross Operating Rate, %
H – Transportation and Storage	10,313	≈ 675,0	≈ 65,5	12,8
I – Accommodation and Food Service Activities	11,318	≈ 293,0	≈ 25,9	14,3
J – Information and Communication	7,370	≈ 690,0	≈ 93,6	16,5
M – Professional, Scientific and Technical Activities	12,382	779,3	≈ 62,9	17,0
N – Administrative and Support Service Activities	14,084	≈ 617,0	≈ 43,8	12,7

Note:

Labour productivity is calculated as the ratio of value added to the number of persons employed; values marked with “≈” are rounded. The gross operating rate is calculated as the ratio of gross operating surplus to turnover.

Source: compiled and calculated by the authors based on Eurostat Structural Business Statistics data (Eurostat. Structural Business Statistics (SBS): Final data for 2023, 2025).

and M occupy intermediate positions, at around EUR 65.5 thousand and EUR 62.9 thousand, respectively. At the same time, sector M generates the largest absolute volume of value added within the sample, amounting to EUR 779.3 billion. The lowest labour productivity is observed in sector I, at approximately EUR 25.9 thousand per person employed, which is largely associated with its labour-intensive nature and the prevalence of part-time and seasonal employment. Eurostat also classifies sectors I and N among the activities with relatively low apparent labour productivity (Eurostat, 2025).

Thus, the analysis of sectoral dynamics and structural characteristics reveals persistent intersectoral differentiation. The information and communication sector combines the most favourable development dynamics with the highest labour productivity, whereas labour-intensive service activities are characterized by lower levels of value added per person employed. These differences provide the empirical basis for the next stage of the study – assessing the degree of intersectoral integration and subsequently examining its relationship with sectoral economic performance.

The observed differentiation in economic performance requires further examination of the structural characteristics that may help explain it. In this study, such characteristics are defined as the nature of intersectoral linkages and the level of digitalization across sectors H, I, J, M, and N.

To analyse intersectoral interaction, Eurostat FIGARO input-output tables are used, as they capture flows of intermediate goods and services across economic activities. FIGARO tables are compiled according to NACE Rev. 2 and make it possible to trace, on the one hand, the extent to which a sector relies on inputs from other activities and, on the other hand, the extent to which its own outputs are used as intermediate inputs by other sectors. This distinction makes it possible to differentiate sectors that primarily depend on external inputs from those whose outputs support a broad range of other economic activities.

The structural characteristics of the sectors under study indicate different patterns of participation in intersectoral linkages. Transportation and storage (H) exhibit a pronounced bidirectional pattern: the sector relies on fuel, energy, technical, information, financial, and professional services while simultaneously supporting the transport and logistics needs of virtually all other economic activities. Accommodation and food service activities (I) are characterized predominantly by backward linkages, as their operation requires substantial inputs from food manufacturing, agriculture, energy, transport, trade, and business services, whereas a large share of their output is directed towards final demand. By contrast, sectors J, M, and N play an important role as suppliers of information, professional, scientific and technical, and support services to other sectors, which strengthens the importance of forward linkages. This structural interpretation is consistent with the logic of input-output analysis, according to which services may simultaneously constitute final outputs and intermediate inputs in the value-creation processes of other sectors.

The digital dimension is assessed using indicators that are simultaneously available for all selected sectors and directly reflect the use of digital technologies in business activity. For this purpose, two Eurostat indicators for 2023 were used: the share of enterprises using cloud computing services of medium or high sophistication and the share of enterprises whose e-sales accounted for at least 1% of total turnover. The statistics cover enterprises with 10 or more persons employed.

The results reveal substantial intersectoral differentiation in digitalization. The highest level of technological digitalization is observed in sector J – information and communication, where 74% of enterprises used cloud computing services of medium or high sophistication. Sector M – professional, scientific and technical activities – ranks second, at approximately 55%. By contrast, the corresponding share in transportation and storage was only 33%. Eurostat likewise identifies information

Table 3
Nature of Intersectoral Interaction and Digitalization Indicators of EU Service Economy Sectors

Sector	Predominant Type of Intersectoral Linkages	Use of Medium-/High-Sophistication Cloud Services, %, 2023*	Enterprises with E-sales Accounting for $\geq 1\%$ of Turnover, %, 2023	Overall Digitalization Profile
H – Transportation and Storage	Bidirectional	33	14,8	Moderate
I – Accommodation and Food Service Activities	Predominantly Backward	≈ 41	35,5	Moderate, with a High Degree of Sales Channel Digitalization
J – Information and Communication	Pronounced Forward / Bidirectional	74	24,0	High
M – Professional, Scientific and Technical Activities	Predominantly Forward	55	8,8	High Technological Digitalization
N – Administrative and Support Service Activities	Predominantly Forward	≈ 39	11,4	Moderate

Note:

Values for the use of cloud services are rounded; the predominant type of intersectoral linkages was determined by the authors based on the direction of sectors' forward and backward linkages.

Source: compiled by the authors based on Eurostat data (Cloud computing services by economic activity; E-commerce sales by economic activity) and OECD Input-Output Tables.

and communication as the sector with the highest penetration of advanced cloud technologies (Eurostat. Cloud computing services by economic activity, 2023).

A different pattern emerges for e-sales. Sector I – accommodation and food service activities – ranks first, with 35.5% of enterprises generating e-sales equivalent to at least 1% of turnover. The corresponding figures were 24.0% in sector J, 14.8% in sector H, 11.4% in sector N, and only 8.8% in sector M. This difference confirms that digitalization should not be equated solely with e-commerce. In sector I, digital technologies are used primarily to support interaction with final consumers and digital sales channels, whereas in sectors J and M they are more extensively embedded in internal business processes and B2B interaction.

A synthesis of the findings makes it possible to distinguish several patterns in the combination of intersectoral and digital interaction. Sector J is characterized by high digital maturity and a significant role in supplying other economic activities with information and digital resources; sector M combines a high level of technological digitalization with the function of providing knowledge-intensive and professional services; sector I exhibits a high degree of digitalization in market interaction while remaining strongly dependent on inputs from related sectors. Sectors H and N are characterized by a more moderate level of digitalization alongside substantial involvement in intersectoral processes.

Thus, the preliminary analysis confirms that the intensity of intersectoral interaction and the level of digitalization are distinct sectoral characteristics. Their combination gives rise to different structural models within the service economy and provides the basis for the next stage of the study – comparing these characteristics with labour productivity and operating performance indicators in order to identify the nature of the relationship among integration, digital, and economic development parameters across sectors.

The synthesis of the assessment results indicates that the service economy sectors under study differ substantially both in the nature of their intersectoral linkages and in their level of digitalization. Sector H is characterized by pronounced bidirectional intersectoral interaction, as it simultaneously depends on a substantial volume of external inputs and provides transport and logistics services to other economic activities. Sector I exhibits predominantly backward linkages due to its high dependence on inputs from related sectors, while also standing out for a relatively high degree of sales channel digitalization. Sectors J and M primarily function as suppliers of information, technological, professional, and knowledge-intensive services to other sectors and demonstrate the highest levels of technological digitalization. Sector N is also actively involved in intersectoral interaction, although its digital characteristics are more moderate.

The next stage of the study involves comparing the characteristics of intersectoral integration and digitalization with indicators of economic performance. Given the limited number of sectors examined and the aggregated nature of the data, a structural and comparative analysis is appropriate at this stage, without interpreting the observed relationships as statistically proven causal effects. The OECD identifies input–output tables as an analytical tool for examining intersectoral linkages, while Eurostat provides comparable sector-level data on digitalization and business performance.

Table 4
Relationship between Integration, Digital, and Performance Characteristics of EU Service Economy Sectors

Sector	Nature of Intersectoral Linkages	Cloud Technologies*, %	E–sales, %	Labour Productivity, EUR Thousand per Person Employed	Gross Operating Rate, %	Overall Assessment
H	Bidirectional	33	14,8	65,5	12,8	High Integration with Moderate Digitalization
I	Predominantly Backward	≈41	35,5	25,9	14,3	High Sales Digitalization with Low Productivity
J	Pronounced Forward and Bidirectional	74	24,0	93,6	16,5	Combination of High Digitalization and the Highest Productivity
M	Predominantly Forward	55	8,8	62,9	17,0	High Technological Digitalization and High Economic Performance
N	Predominantly Forward	≈39	11,4	43,8	12,7	Moderate Digitalization and Relatively Lower Productivity

Note:

*The “Cloud technologies” indicator reflects the share of enterprises using cloud computing services of medium or high sophistication; E-sales denotes the share of enterprises whose electronic sales account for at least 1% of turnover. The nature of intersectoral linkages was determined by the authors based on the relationship between forward and backward linkages; values marked with “≈” are rounded.

Source: summarized by the authors based on Eurostat and OECD data (Eurostat. *Cloud computing services by economic activity*, 2023; Eurostat. *E-commerce sales by economic activity*, 2023; Eurostat. *Structural Business Statistics (SBS): Final data for 2023*, 2025; OECD. *Input-Output Tables*, 2025).

The comparison reveals the clearest correspondence between technological digitalization and labour productivity. Sector J, where the use of medium- and high-sophistication cloud services is most widespread, also records the highest labour productivity, at EUR 93.6 thousand per person employed. The strong digital characteristics of sector M are likewise associated with relatively high labour productivity and the highest gross operating rate among the sectors examined. Eurostat confirms the particularly high penetration of advanced cloud technologies in information and communication activities (Eurostat – Cloud computing services by economic activity, 2023; Eurostat – Structural Business Statistics (SBS): Final data for 2023, 2025).

By contrast, the e-sales indicator does not show a comparable relationship with economic performance. Sector I has the highest share of enterprises engaged in e-sales, yet it also records the lowest labour productivity. This provides grounds for distinguishing between the digitalization of sales channels and deeper technological digitalization of business processes. The former broadens access to customers but does not, by itself, ensure more efficient resource use. Eurostat likewise treats e-sales primarily as a distinct channel for the sale of goods and services (Eurostat – E-commerce sales by economic activity, 2023; Eurostat – Structural Business Statistics (SBS): Final data for 2023, 2025).

Comparison with the nature of intersectoral linkages shows that higher performance characteristics are observed primarily in sectors that are not only embedded in intersectoral flows but also act as suppliers of resources, knowledge, and technologies to other economic activities. Sectors J and M are particularly illustrative, as strong forward linkages are combined with a high level of technological digitalization. This is consistent with the logic of the input–output approach, according to which intersectoral linkages reflect the roles of sectors as users and suppliers of intermediate inputs, while the structure of these linkages shapes the transmission of economic and technological effects across activities (OECD, 2025; Johansson & Klaesson, 2024).

At the same time, the examples of sectors H and I indicate that a high degree of intersectoral integration does not automatically translate into strong economic performance. Sector H exhibits well-developed bidirectional linkages and relatively high labour productivity despite a moderate level of digitalization. Sector I, by contrast, is strongly dependent on inputs from other sectors and makes extensive use of digital sales channels, yet remains the most labour-intensive and least productive sector in the sample. Thus, performance depends not merely on the existence of integration linkages, but on their functional orientation and their combination with the sector's technological capabilities.

The comparative analysis makes it possible to identify three main patterns. First, technological digitalization shows a more evident positive association with labour productivity and operating performance than the digitalization of sales channels. Second, the economic effects of intersectoral integration depend on a sector's position within the value creation system: the provision of information, knowledge-intensive, and professional inputs to other sectors is associated with higher performance than predominant dependence on external inputs. Third, the most favourable combination of performance characteristics is observed where developed intersectoral linkages coexist with a high level of technological digitalization.

Overall, the findings suggest that intersectoral integration and digitalization should be viewed as complementary rather than interchangeable determinants of the economic performance of service economy sectors. Their effects operate through different mechanisms: integration broadens access to complementary resources and expands the scope of intersectoral value creation, whereas digitalization enhances technological capacity for coordination, information processing, and the effective utilization of such linkages.

The analysis provides grounds for concluding that intersectoral integration, digitalization, and the economic performance of service economy sectors form an interconnected but heterogeneous system of relationships. The strongest performance characteristics are observed in sectors where developed intersectoral linkages are combined with a high level of technological digitalization. This pattern is particularly evident in information and communication and in professional, scientific and technical activities, which simultaneously act as suppliers of knowledge-intensive, information, and professional inputs to other economic activities and demonstrate high levels of labour productivity and operating performance.

At the same time, the comparison shows that a high degree of intersectoral embeddedness alone does not guarantee strong economic performance. The functional nature of linkages is of decisive importance: sectors primarily oriented towards supplying information, technological, and professional services to other activities exhibit greater potential for value-added creation than sectors whose interaction is dominated by dependence on inputs from related industries. Similarly, the digitalization of sales channels is not equivalent to the technological digitalization of business processes. The high share of e-sales in accommodation and food service activities is not accompanied by high labour productivity, whereas the extensive use of cloud technologies in sectors J and M is associated with stronger performance indicators.

Accordingly, the most substantiated conclusion is that intersectoral integration and digitalization exert complementary effects. Integration broadens access to complementary resources and facilitates a sector's participation in value-creation networks, while digitalization improves the efficiency of coordination, information exchange, and the use of these linkages. Their combination therefore creates more favourable conditions for productivity growth and improved economic performance across service economy sectors.

The synthesis of the results makes it possible to identify several persistent patterns characterizing the relationship between intersectoral integration, digitalization, and economic performance in the service economy. First, the most favourable performance characteristics emerge where developed intersectoral linkages are combined with a high level of technological digitalization. This pattern is most clearly observed in information and communication and in professional, scientific and technical activities, which simultaneously exhibit active interaction with other economic activities, extensive use of digital technologies, and high levels of labour productivity and operating performance.

At the same time, what matters is not only the scale of intersectoral linkages but also their functional orientation. Sectors that supply information, technological, professional, and other highly complementary services to a broad range of economic activities have greater potential for value-added creation than sectors whose interaction is dominated by dependence on inputs and services from related industries. Thus, the economic effect of intersectoral integration is determined not simply by a sector's participation in the system of economic linkages, but by its position within intersectoral value chains and its capacity to generate inputs that enhance the efficiency of other economic activities.

A further pattern concerns the differentiated effects of various forms of digitalization. The analysis shows that the technological digitalization of business processes – including the use of cloud technologies, digital information systems, and data-processing tools – is more closely associated with high productivity than the digitalization of sales channels. A high share of e-sales alone does not ensure a corresponding level of economic performance, as illustrated by the accommodation and food service sector. Accordingly, the effectiveness of digital transformation depends less on the mere use of digital channels than on the depth

of digital technology integration into value creation, resource management, and interorganizational interaction.

An important pattern is the sectoral heterogeneity of the effects of integration and digitalization. Labour-intensive service activities may exhibit a high degree of intersectoral embeddedness and extensive use of digital channels while still maintaining lower productivity due to structural characteristics of service provision and the substantial role of human labour. By contrast, knowledge- and technology-intensive sectors are better able to convert intersectoral and digital opportunities into value-added growth. This implies that the effects of integration and digitalization should be assessed with due regard to sector-specific characteristics, resource models, and the nature of service value creation.

The study also confirms that sectoral scale is not a direct equivalent of economic performance. A large number of persons employed or a substantial volume of activity may coexist with relatively low productivity, whereas smaller but more technologically intensive and highly integrated sectors can demonstrate considerably greater resource-use efficiency. Therefore, performance assessment should primarily rely on relative indicators, including labour productivity, gross operating rate, and value added per person employed.

In summary, intersectoral integration and digitalization can be regarded as complementary determinants of the economic performance of service economy sectors. Integration broadens access to complementary resources, knowledge, technologies, and markets, while digitalization increases the speed, flexibility, and efficiency with which these linkages are utilized. The strongest outcomes are achieved not through the maximum level of each factor in isolation, but through their systemic combination, whereby intersectoral linkages are supported by advanced digital infrastructure and embedded in value-added creation processes.

Thus, the findings support a shift from the isolated assessment of digitalization or intersectoral integration towards their integrated consideration as interrelated factors shaping economic performance. At the same time, given the use of aggregated sector-level data, the identified patterns should be interpreted as persistent analytical relationships rather than as conclusively established causal effects. Such an approach ensures the methodological robustness of the conclusions and provides a basis for further in-depth assessment of the integration and digital factors underpinning the development of the service economy.

Conclusions and Prospects for Further Research

The study made it possible to clarify the nature of the relationship between intersectoral integration, digitalization, and the economic performance of service economy sectors. Based on open Eurostat and OECD data, a system of indicators was developed that integrates three analytical dimensions: characteristics of intersectoral interaction, the level of digitalization, and indicators of economic performance. This framework enabled a shift from the separate analysis of digital and structural transformations towards their integrated examination in the context of value-added creation, labour productivity, and operating performance.

The comparative analysis of sectors H, I, J, M, and N revealed substantial intersectoral differentiation in both development dynamics and performance characteristics. The information and communication sector records the highest labour productivity, while professional, scientific and technical activities are characterized by a substantial volume of value added and high operating performance. By contrast, labour-intensive service activities, particularly accommodation and food service activities, display lower productivity levels. This confirms that the scale of employment or the volume of activity alone does not determine a sector's level of economic performance.

The assessment of intersectoral linkages showed that the sectors under study occupy different functional positions within the value creation system. Transportation and storage are characterized by pronounced bidirectional interaction; accommodation and food service activities are more dependent on inputs from related economic activities; while information and communication, professional, and support services perform an important function in supplying knowledge, information, technologies, and business services to other sectors. It was established that the economic significance of intersectoral integration is determined not only by the intensity of linkages but, above all, by their functional orientation and by the sector's position within the system of intersectoral value creation.

The analysis of digitalization demonstrated that its relationship with economic performance is likewise heterogeneous. The clearest positive association with productivity is observed for technological digitalization, particularly the use of cloud services and digital tools embedded in internal business processes. At the same time, a high level of e-sales is not necessarily accompanied by high productivity, confirming the need to distinguish between the digitalization of sales channels and the depth of digital transformation in operational activities. Thus, the economic effects of digitalization are determined not merely by the adoption of digital technologies, but by the extent to which they are integrated into management, coordination, and value creation processes.

The synthesis of the results provides grounds for considering intersectoral integration and digitalization as complementary determinants of the economic performance of service economy sectors. Intersectoral integration provides access to complementary resources, knowledge, technologies, and markets, whereas digitalization increases the speed, accuracy, and efficiency of coordinating these linkages. The most favourable configuration emerges in sectors where developed intersectoral linkages are combined with a high level of technological digitalization and the capacity to transform external resources and competencies into value added.

At the same time, the findings should be interpreted in light of the study's limitations. The use of aggregated sector-level data and comparative analysis makes it possible to identify persistent patterns and directions of relationships, but does not allow the causal effect of each factor to be established unequivocally. In addition, different types of service activities differ in their resource, technological, and labour characteristics, which requires sector-specific features to be taken into account when interpreting the results.

Prospects for further research should focus on deepening the quantitative assessment of the interaction between integration and digital factors. Relevant directions include expanding the sample of countries and sectors, constructing a multi-year panel dataset, refining backward and forward linkage indicators based on input-output tables, and applying cluster and regression analysis to test the robustness of the identified patterns. Another promising avenue is the development of an integrated indicator of sectoral integration and digital capacity and the assessment of its relationship with productivity, value added, profitability, and structural resilience. This would enable a transition from identifying individual relationships to developing a comprehensive analytical framework for assessing the integration and ecosystem-based development of service economy sectors.

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Зайченко В. В., Бугасва М. В., Юрченко О. В. Оцінювання впливу міжгалузевої інтеграції та цифровізації на економічну результативність секторів сервісної економіки ЄС

Мета. Метою дослідження є оцінювання впливу міжгалузевої інтеграції та цифровізації на економічну результативність секторів сервісної економіки Європейського Союзу та виявлення міжсекторальних відмінностей у поєднанні інтеграційних, цифрових і результативних характеристик.

Методологія. Методологічну основу становлять теорія міжгалузових взаємозв'язків, концепції цифрової трансформації, системний та екосистемний підходи. Застосовано статистичний, структурний і

компаративний аналіз; інформаційну базу сформовано за даними Eurostat та OECD для секторів H, I, J, M, N NACE Rev. 2 у країнах-членах ЄС.

Результати. Установлено суттєву диференціацію секторів за динамікою розвитку, характером міжгалузевих зв'язків, рівнем цифровізації та економічною результативністю. Найвищу продуктивність праці продемонстрував сектор інформації та комунікацій, найбільший обсяг доданої вартості – професійна, наукова та технічна діяльність, а найнижчу продуктивність – тимчасове розміщування та організація харчування. Виявлено, що транспорт і складське господарство мають виражені двосторонні зв'язки, сектор розміщування та харчування – переважно зворотні, тоді як інформаційно-комунікаційні, професійні та допоміжні послуги є важливими постачальниками ресурсів і послуг для інших видів діяльності. Обґрунтовано, що технологічна цифровізація має виразніший зв'язок із продуктивністю, ніж цифровізація каналів збуту, а результативність міжгалузевої інтеграції залежить не лише від інтенсивності, а й від функціональної спрямованості зв'язків.

Наукова новизна. Наукова новизна полягає в комплексному зіставленні спрямованості міжгалузевих зв'язків, рівня технологічної та ринкової цифровізації та результативних показників секторів сервісної економіки ЄС.

Практична цінність. Практична цінність результатів полягає в можливості використання їх для виявлення секторів з недостатньою цифровою зрілістю та слабкою здатністю трансформувати міжгалузеві зв'язки у зростання продуктивності й доданої вартості.

Ключові слова: міжгалузева інтеграція, цифровізація, сервісна економіка, Європейський Союз, економічна результативність, продуктивність праці, міжгалузеві зв'язки, хмарні технології, електронні продажі, додана вартість.

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