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ORIGINAL PAPER

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DIGITALIZATION AND THE ENTREPRENEURIAL ECOSYSTEM IN VISEGRAD GROUP (V4) COHESION REGIONS: A COMPARATIVE DESK ANALYSIS OF COHESION POLICY AND NON-INFRASTRUCTURAL BARRIERS

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ABSTRACT

Aim: A thematic synthesis enabling a qualitative comparison of cohesion policy and identifying non-infrastructural barriers affecting the development of digital entrepreneurial ecosystems (EEs) within Visegrad Group (V4) less-developed regions according to EU Cohesion Fund classification (called in the study "cohesion regions"). The aim was also to assess the effectiveness of national strategies in addressing significant shortfalls regarding human capital and e-government. **Methods:** The study relies on comparative desk research, employing thematic synthesis of qualitative research of the official EU and national reports from 2021 to 2025. The Digital Economy and Society Index (DESI) reports, national reports from 2001–2025 published in the EU series Digital Decade Country Report, and V4 national digital strategies have been analyzed to identify policy intentions and various performance gaps between policy goals and actual outcomes. **Results:** Findings suggest primary infrastructure access does not hinder V4 digital transformation, but ongoing systemic non-infrastructural barriers do. These include a skills mismatch, especially in Industry 4.0; border friction in e-government affecting digital services (scores below 40 in Poland and Hungary); and organizational conservatism, leading to low tech adoption among regional SMEs. This diminishes the likelihood of achieving the targeted convergence under the EU cohesion policy. **Conclusions:** The paper emphasizes a vital policy synchronization gap that hampers the V4's efforts to build robust digital EE. Future policies from the country and the EU should go beyond just offering external infrastructure subsidies. Instead, they need to focus on systemic reforms, such as developing Industry 4.0 human capital and streamlining entrepreneurial e-governance. These measures will help break through institutional and organizational inertia in cohesion regions.

Key words: digitalization, entrepreneurial ecosystem, Visegrad Group, cohesion policy, digital skill, e-government, Industry 4.0

JEL codes: O33, R58, F50

INTRODUCTION

The cohesion policy strategic imperative of enhancing socio-economic convergence within the European Union has remained in line with the aims of the comprehensive framework called Digital Decade Policy Programme 2030 [Konomi 2025]. The requirement to achieve sustainable regional development and to empower the entrepreneurial ecosystem (EE) in less-developed regions is digitalization, characterized

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by infrastructure expansion, skills development, and e-governance.

An important case in this convergence dilemma is the Visegrad Group (V4), which includes Poland, Czechia, Slovakia, and Hungary. These countries have a history of economic transition, meaning that their developmental shortcomings are similar, especially in the areas where they are united [Gyimesi 2021]. Although the V4 records high fixed broadband coverage, key performance indicators vital to a successful digital EE, such as the digital skills and the digital transformation of businesses, are consistently below the EU average [EC 2025a, EC 2025b]. It is reported that SMEs' adoption of innovative technologies is low, and identified gaps in policies hinder the scalability of start-ups across borders [EC 2021, EC 2022]. To summarize on this research work, the term "cohesion regions" is used to denote the less-developed regions as well as transition regions that can be classified according to the NUTS 2 classification by the EU, as the cohesion policy can be granted to regions whose GDP per capita levels are below the average of the EU. Additionally, national strategy documents, including those in Slovakia, are explicitly focused on overcoming the acute skills gap emerging from rapid fourth industrial revolution development, which presents a considerable qualitative bottleneck to entrepreneurial capacity [MIRRI SR 2023, Țurcan and Pojar 2024].

AIM AND METHOD

Existing literature provides quantitative benchmarks and broad policy outlines for the V4. However, a structured comparative desk analysis that synthesizes policy mechanisms and qualitative, non-infrastructural barriers impacting the digital EE, specifically within the cohesion regions, is currently lacking.

This paper aims to conduct a comparative synthesis of V4 national and EU-supported strategies, and of non-infrastructural barriers, influencing the development of the digital entrepreneurial ecosystem in their respective cohesion regions.

The study addresses the following questions:

1. What is the comparative effectiveness of V4 national strategies in addressing the digital skills deficit within their entrepreneurial ecosystems?
2. How do the levels of digital public services (e-governance) compare across the V4, and how do policy shortcomings affect the ease of start-up creation?
3. What key non-infrastructural barriers (e.g., policy implementation gaps, cultural factors) are identified in official reports as hindering the digital entrepreneurial capacity of V4 cohesion regions?

This study utilizes a comparative desk research methodology combined with thematic qualitative synthesis, consistent with scholarly practice for policy-focused economic analysis in transitional economies [Konomi 2025]. This approach involves systematically reviewing and synthesizing official documents, policy reports, and secondary academic sources to address the defined research questions.

The analysis is based on a structured sample of European Union (EU) and Visegrad Group (V4) national policy documents and data reports, selected for their direct relevance to the digital entrepreneurial ecosystem in cohesion regions:

1. EU benchmarks (digitalization status): The Digital Economy and Society Index (DESI) reports provide critical quantitative benchmarks on connectivity, human capital (skills), and the digitalization of public services (e-governance) for all V4 countries [EC 2021, EC 2022]. The annual reports for Czechia and Poland called Digital Decade Country Report offer the most recent policy goals and performance evaluations [EC 2025a, EC 2025b].
2. National strategy (policy mechanisms): Documents such as National Digital Skills Strategy of the Slovak Republic for 2023–2026 detail specific national action plans to address digital skills deficits, a critical component of policy synthesis [MIRRI SR 2023].
3. Academic comparative analysis (barriers): Secondary academic sources, including comparative studies on Industry 4.0 platforms in the V4 [Gyimesi 2021] and the impact of technology on skill requirements [Țurcan and Pojar 2024], provide the qualitative framework for identifying common non-infrastructural barriers and policy implementation deficits.

The selection of documents was done according to four directions: (i) official authorship by institutions on the EU or national level, (ii) directly related to the sphere of digitalization, entrepreneurial ecosystems, or cohesion policy, (iii) similarity of indicators included across V4 countries, and (iv) the latest publication in the policy cycle.

The analysis proceeds in three steps: data charting, thematic coding, and comparative synthesis. Firstly, relevant indicators and policy objectives from the DESI [EC 2021, EC 2022] and the Digital Decade Country Report series [EC 2025a, EC 2025b] are charted across the V4. Secondly, the thematic coding process is applied to all policy documents to isolate specific actions and qualitative statements related to human capital, e-government, and business adoption. Finally, comparative policy synthesis is employed to identify commonalities, divergences, and best practices in addressing digital barriers across the V4 cohesion regions, directly answering the research questions.

Being a desk-based study, this study uses policy documents and aggregate indicators, which limit the capture of informal practices, regional administrative diversity, and firms' experiences.

CONCEPTUAL FRAMEWORK AND LITERATURE REVIEW

This paper analyzes the digital entrepreneurial ecosystem within the V4 cohesion regions, necessitating a clear definition of the core concepts and a review of the theoretical and empirical links between digitalization and regional entrepreneurial vitality.

The entrepreneurial ecosystem concept

The entrepreneurial ecosystem (EE) shifts the focus from individual firms or entrepreneurs to the holistic environment that fosters and sustains new venture creation and growth [Volkmann et al. 2021]. It is defined as a set of interconnected actors (e.g., universities, venture capitalists, support organizations), institutions (e.g., government, legal framework), and factors (e.g., culture, human capital, finance) that combine to create a regional environment conducive to entrepreneurship [Stam 2015]. A fundamental characteristic of the EE is that its performance is determined not by the strength of any single component, but by the quality of the interactions and flows between them. For instance, substantial financial capital is ineffective without skilled human capital and a supportive regulatory culture.

Digitalization as a cross-cutting entrepreneurial ecosystem factor

Digitalization is the transformative process that affects every component of the EE, serving as a 'meta-driver' rather than just a single factor [Autio et al. 2018]. Its impact is felt across three primary dimensions relevant to the V4 cohesion regions:

1. Digital infrastructure: provides the foundational connectivity (broadband, 5G), reducing the geographical friction that historically disadvantaged cohesion regions [EC 2022].
2. Digital public service: digital public services (e-governance) involve modernizing policy and administrative processes, which could directly affect the policy component of the EE by potentially lowering bureaucratic barriers to entry and operation [EC 2021].
3. Digital capabilities: This dimension encompasses the necessary human capital (skills) and business culture to adopt and integrate digital technologies [Gyimesi 2021]. It is particularly critical in transitional economies where legacy systems and traditional business practices are prevalent.

The challenge of Industry 4.0 and skills in transitional economies

The digital challenge of the V4 is best perceived through the shift to Industry 4.0, the integration of physical and digital in production and services. Nations within the V4 recognize the need for digitalization to achieve economic success. However, they lack specific skills, education, and incorporation of such new technologies into companies [Gyimesi 2021].

As mentioned in the literature, the change to Industry 4.0 results from a severe skills mismatch, a critical qualitative obstacle in the human capital aspect of the EE. Țurcan and Pojar [2024] confirm that Industry 4.0 requires transforming specific occupational skills into sophisticated transversal, data analytics, cybersecurity, problem-solving, and traditional technical skills. In underdeveloped regions, the inability

to quickly produce or retain this specialized human capital directly kills the creation and development of new digital start-ups. In addition, the Slovak Digital Skills Strategy for 2023–2026 acknowledges that this deficit is not only an issue of availability but also one of retention and institutional flexibility in the education system [MIRRI SR 2023].

Industry 4.0 is conceptualized in this paper as: (i) a structural technological shift, transforming the skills requirements and business models, (ii) a policy goal, which is included in the digitalization strategies of nation states and the EU. This role of duality is especially applicable to transitional economies, where policy ambition is usually ahead of institutional capacity and human capital.

Accordingly, this analysis presents the problem of the entrepreneurial ecosystem in V4 cohesion regions as one that is grappling with both the challenges of the requirements of Industry 4.0 and legacy systems to be adapted to and the challenges of systemic, non-infrastructural barriers (such as policy fragmentation and skills mismatches) to hinder the required convergence that cohesion policy facilitates. This conceptual model will be applied in the following policy synthesis to classify the desk research findings.

POLICY ANALYSIS AND COMPARATIVE RESULTS

The comparative analysis of the V4 cohesion regions reveals a pattern of strong infrastructural commitment juxtaposed with significant systemic weaknesses in human capital and public service delivery, hindering the full potential of their digital EEs. The synthesis is organized around the key components of the EE.

Digital infrastructure and connectivity (base layer)

The foundational layer of the digital EE – connectivity – shows relative strength across the V4, primarily due to targeted cohesion policy funding [EC 2023]. However, disparities exist between national policy aims and regional rollout, which affect entrepreneurial access (Table 1).

The V4 countries have made significant progress in national connectivity, with Poland and Hungary in particular demonstrating ambitious targets for fixed broadband take-up (full fiber connection delivery services – FITP) and nationwide 5G coverage, often surpassing or narrowing the gap with the EU average [EC 2025b]. This level of infrastructure generally provides a sufficient foundation for basic digital start-up operations. However, the major challenge lies in the uneven quality of rollout across cohesion regions, especially in non-capital NUTS 2 and NUTS 3 areas. Despite high national 5G coverage, the widespread deployment of very high-capacity networks (VHCNs) – a key prerequisite for Industry 4.0 and advanced business services – remains insufficient. Czechia, for example, lags behind in VHCN rollout, which limits the ability of innovative enterprises in its regions to adopt data-intensive technologies such as advanced cloud computing and real-time data analytics [EC 2025a]. Although national Industry 4.0 platforms correctly identify digitalization as a central economic priority [Gyimesi 2021], implementation tends to focus on urban-industrial centers, leaving smaller and rural cohesion regions affected by persistent last-mile infrastructure deficits that hinder the development of geographically dispersed digital

Table 1. Comparative digital performance of V4: key digital entrepreneurial ecosystem indicators

Indicator	Poland (PL)	Czechia (CZ)	Slovakia (SK)	Hungary (HU)	EU average
Basic digital skills [% of individuals]	low/below average	near/below average	below average	below average	~54
ICT specialists [% of employment]	below average	near/at average	below average	below average	~4.5
SMEs with at least basic digital intensity [%]	lagging	progressing	lagging	lagging	~69
Cloud computing take-up [% of enterprises]	below average	below average	below average	below average	~42
VHCN coverage [% of households]	progressing	lagging	progressing	progressing	~70

Source: EC [2022], EC [2025a], EC [2025b].

enterprises [EC 2024]. Although Czechia performs comparatively better in terms of specialists in the field of information and communication technology (ICT), availability is concentrated structurally in metropolitan areas, thus restricting the spillover of these effects to cohesion areas. This implies that the performance in a country conceals the presence of inequalities at a sub-regional level, which is vital in the development of the entrepreneurial ecosystem.

Human capital and digital skills (the critical barrier)

The most pronounced qualitative barrier identified across the V4 is the deficit in human capital, which directly threatens the sustainability of their digital EEs. This analysis answers Research Question 1.

Despite sustained national efforts, the proportion of individuals possessing at least basic digital skills remains insufficient in several V4 countries. Although Czechia and Poland are making notable progress in this area, a substantial shortage of ICT specialists persists, representing a critical constraint for any start-up ecosystem [EC 2022, EC 2025c]. This quantitative deficit is particularly acute in cohesion regions, where brain drain toward capital cities and Western Europe further weakens local labor markets. In response, some countries have introduced targeted policy measures, with Slovakia providing a clear example through its National Digital Skills Strategy for 2023–2026, which explicitly prioritizes the development of ICT specialists, youth digital skills, and active labor market interventions, including actions aligned with the European Recovery Plan [MIRRI SR 2023]. Nevertheless, academic literature emphasizes that the challenge extends beyond the sheer number of skilled workers. The rapid transition toward Industry 4.0 requires a qualitative shift toward transversal competencies – such as data literacy, critical thinking, and complex problem-solving – which traditional education systems in the V4, particularly within regional vocational education, have been slow to deliver [Țurcan and Pojar 2024]. This mismatch between skills supply and technological demand creates a structural bottleneck: even where financial support is available, enterprises in cohesion regions often cannot recruit the talent necessary to implement advanced digital business models. While policy intent across the V4 is broadly aligned, implementation effectiveness varies, with Czechia's relatively stronger performance in ICT specialists likely reflecting a more mature educational base than that of Hungary or Poland. Overall, the qualitative synthesis indicates that the skills gap constitutes the most restrictive non-infrastructural barrier to scaling digital entrepreneurship in V4 cohesion regions.

Digital public services (e-governance)

The efficiency of digital public services (DPS) is a key determinant of the policy component of the EE, directly impacting the ease and cost of launching and operating a business. This analysis answers Research Question 2 (Table 2).

The V4 countries, particularly Poland and Hungary, have historically lagged behind in the provision of cross-border digital public services, a key indicator of digital state capacity [EC 2021]. Although national e-government services for citizens have shown gradual improvement, the specific services

Table 2. Performance of the e-governance and policy friction: digital public services for businesses in V4

Indicator	Poland (PL)	Czechia (CZ)	Slovakia (SK)	Hungary (HU)	EU average
Digital public services for businesses (overall score)	below average	progressing	below average	below average	~75
Cross-border services (score 0–100)	<40	~45–60	~45–60	<40	~65
Availability of eID (key enabler)	lagging	progressing	progressing	lagging	~50
User support for e-services (score 0–100)	<40	~70+	~70+	<40	~70.7

Note: In scale 0–100 means the best.

Source: EC [2021].

required by digital entrepreneurs – such as remote company registration, cross-border VAT compliance, and secure digital identification (eID) for international transactions – remain underdeveloped. This policy gap generates significant friction for emerging digital start-ups, which are inherently oriented toward regional and international markets. In the absence of seamless cross-border e-government services, entrepreneurs face higher administrative burdens, slower scaling trajectories, and increased operational costs, placing them at a competitive disadvantage relative to firms operating in Western EU countries [EC 2021]. While policy emphasis within the V4 differs, with Czechia demonstrating stronger overall performance in citizen-oriented e-government usage and Poland focusing more intensively on cybersecurity measures across different levels of government – an essential prerequisite for secure digital public services [EC 2025c] – a common structural weakness persists. National digital strategies continue to prioritize general citizen services, rather than systematically addressing the specific needs of digital entrepreneurs, thereby reinforcing cross-border digital public services as a policy-induced barrier to the development of the digital entrepreneurial ecosystem.

Business digital adoption and Industry 4.0 barriers

The final thematic area focuses on the EE's business adoption component, which is the ultimate test of digitalization policies. This addresses Research Question 3.

Official reports consistently identify the slow adoption of advanced digital technologies – such as artificial intelligence, cloud computing, and big data – by small and medium-sized enterprises as a major systemic weakness across the V4 countries, including Czechia and Poland [EC 2025a, EC 2025b]. This pattern reflects not only technological inertia but also deeper organizational conservatism and limited managerial capacity within regional SMEs. Although national strategies, including the V4 Industry 4.0 platforms, explicitly aim to stimulate the uptake of advanced technologies [Gyimesi 2021], qualitative evidence indicates a substantial gap between policy intent and regional implementation. In cohesion regions, SMEs frequently lack the organizational capital and strategic capabilities required to undertake high-risk technological investments [Ţurcan and Pojar 2024]. This reluctance is further reinforced by persistent skills shortages, creating a self-reinforcing cycle in which firms are unable to adopt Industry 4.0 technologies due to insufficient human capital, while skilled workers migrate toward metropolitan centers in search of more advanced career opportunities. Beyond organizational and human capital constraints, the desk research also aligns with findings from the literature on transitional economies, which highlight limited access to diversified financing – particularly risk capital and venture funding – as an additional, though secondary, barrier to digital start-up growth [Konomi 2025]. As a result, many early-stage digital firms in cohesion regions remain dependent on traditional debt-based financing instruments that are poorly suited to high-risk, high-growth digital business models. The absence of robust regional venture capital ecosystems, therefore, constitutes a critical non-infrastructural financial constraint. Taken together, the synthesis of the evidence indicates that digital entrepreneurship in V4 cohesion regions is primarily hindered by a triad of interrelated non-infrastructural barriers: a persistent mismatch between Industry 4.0 skill requirements and available human capital, structural friction arising from gaps in cross-border digital public services, and entrenched organizational conservatism combined with low managerial risk appetite for advanced technology adoption among regional SMEs.

DISCUSSION AND POLICY IMPLICATIONS

Interpretation of persistent barriers

The synthesis demonstrates that the digital entrepreneurial gap in V4 cohesion regions is not primarily an issue of hardware access but systemic, non-infrastructural inertia [Gyimesi 2021]. The persistence of the identified barriers can be interpreted through three lenses standard to transitional economies [Konomi 2025]:

1. Policy fragmentation versus systemic integration: National and EU policies often address digitalization as separate components – for instance, funding infrastructure (cohesion policy) versus training skills (ESF+). However, the entrepreneurial eco-

system requires systemic integration. Funding high-capacity networks is ineffective if the simultaneous policy to generate Industry 4.0 specialists [Țurcan and Pojar 2024] is too slow or misdirected. The core challenge is the lack of policy synchronicity: the supply of digital infrastructure outpaces the supply of digital human capital and the demand created by modernized e-governance.

2. Institutional path dependence (e-governance): The slow progress in cross-border DPS indicates institutional path dependence. Modernizing public administration requires deep, often politically challenging, reforms to legacy bureaucratic systems. Since e-government services for citizens often receive priority for political visibility, the less visible but economically critical services for digital businesses (e.g., eID for entrepreneurs, remote legal entity formation) are consistently deprioritized [EC 2021]. This creates a structural barrier to scaling digital ventures beyond national borders.
3. Organizational conservatism and risk aversion: Regional SMEs' low adoption rates of advanced technologies (AI, cloud computing services) stem from deep-seated organizational conservatism. Many regional firms prefer incremental efficiency gains over radical digital transformation due to perceived risk, cost, and the unavailability of skilled internal management and IT staff [EC 2025a]. This risk aversion in the business culture of cohesion regions is a significant non-infrastructural drag on the entire digital EE.

According to recent research on the role of digital entrepreneurial ecosystems, skills, the ability to govern, and institutional trust are increasingly more important than infrastructure for resource in the regional performance of entrepreneurship, as in Audretsch et al. [2019], Spigel and Harrison [2022]. The results align with the literature in EE, which highlights the role of interaction quality as a prerequisite for ecosystem performance rather than the individual strength of factors [Stam 2015]. These interactions are deterred in the V4 cohesion regions by broken policy enactment and curbed self-reinforcement of ecosystems.

Policy implications and recommendations

To effectively address the digital EE gap in V4 cohesion regions, policy interventions must shift focus from broad infrastructure spending to targeted, synergistic support for human and organizational capital.

Recommendations for national governments (V4):

- Integrated Industry 4.0 skill retooling: National policies (like the Slovak one) must explicitly integrate educational pathways with regional industrial demands. This requires prioritizing transversal digital skills for existing SMEs workforces, focusing on data literacy and cloud management, delivered through regional training hubs [Țurcan and Pojar 2024].
- Prioritize entrepreneurial e-governance: Governments must urgently prioritize and ring-fence funding for the "business layer" of digital public services. Specifically, accelerate the rollout of mandatory, cross-border eID solutions and digitized business registration processes to reduce friction for start-ups aiming for the single market [EC 2021].

Recommendations for the European Commission (cohesion policy):

- Conditional cohesion funding on systemic change: Future cohesion policy (post-2027) should more rigorously tie digital funding to evidence of systemic policy synchronicity. Infrastructure funding should be conditional on simultaneous, measurable progress in regional digital skills attainment and improved DPS for businesses in the target cohesion region, rather than relying solely on national average figures.
- Targeted SMEs digital vouchers: To overcome organizational conservatism, the European Commission should promote regional schemes that offer highly subsidized, risk-mitigated digital adoption vouchers specifically for advanced technologies (AI/cloud computing services) [EC 2025a]. These vouchers must include human capital training alongside technology adoption, effectively subsidizing both the software and the necessary skills acquisition to drive fundamental transformation at the micro-level.

- Encourage regional risk capital: According to the financial barriers analysis, the latter ought to be used by the European Commission and European Investment Fund (EIF) to launch special digital seed funds for V4 cohesion regions [Konomi 2025]. This would add much-needed risk capital and venture experience in the regional markets, breaking the current reliance on traditional debt funding, which is not conducive to the growth of digital start-ups.

CONCLUSIONS

This paper aimed to compare policy summaries of national and EU-based policies supported by V4, and to examine non-infrastructural barriers to the digital entrepreneurial ecosystem (EE) within their respective cohesion regions. In the focus, through comparative desk research and thematic qualitative synthesis, the research may substantiate the acute split between good intentions and the low implementation efficacy of infrastructural policy regarding human and organizational capital.

The most significant conclusions are that connectivity ceases to be the force worth being pulled by the V4 digital EE, but becomes a chronic systemic, tripartite and non-infrastructural drag:

1. Skills mismatch: A shortage of specialized ICT labor combined with the slow adoption of transversal Industry 4.0 skills by regional vocational systems [Țurcan and Pojar 2024].
2. Friction of e-governance: A distinct policy deficit in developing seamless cross-border digital public services for businesses [EC 2021] directly increases operational costs for digital start-ups.
3. Organizational conservatism: A low managerial risk appetite among regional SMEs creates a low demand for advanced technologies and skilled labor, which defines a dynamic digital EE [EC 2025a].

This paper's unique aspect and value lie in its explicit focus on discussing the V4 cohesion regions as the unit of analysis, beyond national averages, to integrate policy intent with the qualitative barriers to its implementation. Organizing the analysis using the EE framework, the research gives an in-depth, comparative view of the systemic character of the digital transformation challenge, where the national strategies – such as the Slovak Digital Skills Strategy for 2023–2026 [MIRRI SR 2023] – are successful in diagnosing the problem, yet are unable to accomplish the synchronicity of all the EE components.

The main weakness of this research is that it relies on secondary research (desk research) that provides policy intent and aggregate performance scores but does not provide detailed, real-time information on day-to-day interactions between entrepreneurs and local public administrations.

Future studies must work on quantitative validation. Namely, empirical quantification of the relationship between the convenience of international digital business services and the survival frequency of start-ups in V4 cohesion areas should be carried out to test the mechanisms of interaction policy assumed in this paper, not only by DESI scores. It would provide necessary evidence to help plan the strategic implementation of future cohesion policy funding.

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CYFRYZACJA ORAZ EKOSYSTEM PRZEDSIĘBIORCZOŚCI W REGIONACH SPÓJNOŚCI GRUPY WYSZEHRADZKIEJ (V4): ANALIZA PORÓWNAWCZA POLITYKI PUBLICZNEJ I BARIER POZAINFRASTRUKTURALNYCH

STRESZCZENIE

Cel: Synteza tematyczna umożliwiająca porównanie jakościowe polityki publicznej oraz identyfikację barier pozainfrastrukturalnych wpływających na kształtowanie cyfrowych ekosystemów przedsiębiorczości (EE) w regionach Grupy Wyszehradzkiej (V4), które zgodnie z klasyfikacją Funduszu Spójności UE mają status słabiej rozwiniętych (w badaniu określono je jako regiony spójności). Celem była także ocena skuteczności strategii krajowych w niwelowaniu istotnych niedoborów w obszarze kapitału ludzkiego oraz administracji elektronicznej (*e-government*). **Metody:** Analizę porównawczą *desk research* oficjalnych raportów Unii Europejskiej oraz krajowych dokumentów strategicznych państw Grupy Wyszehradzkiej (V4) z lat 2021–2025 przeprowadzono z wykorzystaniem syntezy tematycznej danych jakościowych. Analizie poddano w szczególności raporty Digital Economy and Society Index (DESI), raporty krajowe z lat 2001–2025 w ramach sprawozdań publikowanych w serii Digital Decade Country Report, a także krajowe strategie cyfrowe państw V4 w celu identyfikacji intencji politycznych oraz określenia luk pomiędzy deklarowanymi

założeniami strategii publicznych a ich faktycznymi rezultatami wdrożeniowymi. **Wyniki:** Uzyskane wyniki wskazują, że podstawowy dostęp do infrastruktury nie stanowi istotnej bariery dla transformacji cyfrowej w krajach V4, zaś systemowe bariery pozainfrastrukturalne nadal się utrzymują. Obejmują one niedopasowanie kompetencji w szczególności w obszarze przemysłu 4.0, tarcia transgraniczne w *e-government* wpływające na usługi cyfrowe (wyniki poniżej 40 punktów w Polsce i na Węgrzech) oraz konserwatyzm organizacyjny prowadzący do niskiego poziomu adopcji technologii przez regionalne MŚP. Czynniki te ograniczają prawdopodobieństwo konwergencji zakładanej w ramach polityki spójności. **Wnioski:** Artykuł podkreśla istnienie istotnej luki w synchronizacji strategii publicznych, która osłabia wysiłki państw V4 na rzecz budowy trwałych cyfrowych ekosystemów przedsiębiorczości. Przyszłe działania strategiczne na poziomach krajowym i unijnym powinny wykraczać poza subsydiowanie infrastruktury zewnętrznej i koncentrować się na reformach systemowych, takich jak rozwój kapitału ludzkiego dla przemysłu 4.0 oraz usprawnienie elektronicznej administracji zorientowanej na przedsiębiorców. Działania te mogą przyczynić się do przełamania inercji instytucjonalnej i organizacyjnej w regionach objętych polityki spójności.

Słowa kluczowe: cyfryzacja, ekosystem przedsiębiorczości, Grupa Wyszehradzka, polityka spójności, kompetencja cyfrowa, e-administracja, przemysł 4.0

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INVESTING IN AGRICULTURE: STRUCTURAL AND FINANCIAL DETERMINANTS OF FARM INVESTMENT ACTIVITY IN POLAND

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ABSTRACT

Aim: This study investigates the structural and financial determinants of investment activity among Polish farms, focusing on investment propensity, planned investments, and innovative investment initiatives. **Methods:** The study draws on data collected through a nationally representative CATI survey of 800 farm owners or co-owners and was conducted between the end of 2024 and the beginning of 2025. Using logistic regression models, we identify key predictors of past investments, future investment plans, and the innovativeness of recent investments. **Results:** Results highlight the significant role of farm size, financial condition, prior investment activity, and usage of external funding in shaping investment decisions. Regional disparities and production type (plant vs. animal) also affect investment propensity and innovation adoption. Farms that applied for funding, regardless of the outcome of the process, were more likely to invest, suggesting that strategic planning itself correlates with investment activity. **Conclusions:** The research findings contribute to the literature on agricultural modernization and provide practical recommendations for policymakers seeking to promote the development of rural areas through targeted investment support. The agricultural sector in Poland is undergoing a significant transformation driven by the implementation of environmental regulations, ESG frameworks, and the shift toward sustainable production. These changes require not only financial capital but also adaptability, strategic planning, and institutional support to ensure balanced and inclusive development. Targeted policies dedicated to small and medium-sized farms, particularly those operating in disadvantaged regions and with limited access to capital, are essential to strengthen their productivity and competitiveness. Enhancing education and advisory services could help farmers develop more effective investment strategies and better access funding opportunities, especially in areas with lower levels of investment activity.

Key words: agricultural investment, farm size, innovation, public funding, Poland, logistic regression

JEL codes: Q12, Q14, C25

INTRODUCTION

Agricultural investments play a key role in driving sectoral development. They influence, among other things, the level of technological advancement of farms, their productivity, income levels, and competitiveness [Sunding and Zilberman 2001, Kusz et al. 2015, Koloszko-Chomentowska and Sieczko 2017, Zmyślona and Barczak 2025, Zmyślona et al. 2025]. Investments are made for modernization, development of durable

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assets, and their impact goes beyond individual farms, contributing to broader structural objectives and national food security [Kusz et al. 2015, Koloszko-Chomentowska and Sieczko 2017, Dziwulski and Szymańska 2020, MRiRW 2023, Kulawik and Soliwoda 2025].

Institutionally, EU regulations classify farms as economic entities; in Poland, due to the structure of the agricultural sector, agricultural farms are treated as important microeconomic entities of the national economy [Wielechowski et al. 2023], which means that their investment activity has significant importance in implementing structural changes in agriculture and increasing its productivity.

In the context of dynamic technological changes and growing market requirements, increasing importance is attributed to investments in modern and innovative solutions. Modern agriculture requires the implementation of solutions that enhance production efficiency and competitiveness, such as digital technologies, precision farming, and knowledge-based solutions [Piwowar 2018, Kokotek and Korencki 2020, Yarashynskaya and Prus 2022, Kramarz and Runowski 2025].

The need to support agricultural investments is also reflected in strategic documents. The Strategy for Sustainable Development of Rural Areas, Agriculture and Fisheries 2030 emphasizes the key role of investments in increasing the competitiveness of agricultural farms, improving living conditions in rural areas, and protecting natural resources. The strategy indicates the need to strengthen modernization of the agricultural sector, taking into account economic, climate, and social challenges [MRiRW 2023].

INVESTMENT ACTIVITY AND INNOVATION IN AGRICULTURE

Agricultural investment has been widely studied in the literature, which emphasizes its complex and multifaceted nature. Investments in this sector form the foundation for enhancing farm competitiveness, improving production efficiency, and adapting to evolving market and environmental conditions [Zmyślona et al. 2025]. Empirical studies on the implementation of financial instruments under the Rural Development Program 2014–2020 for Poland indicate that Polish farmers' investments – mainly aimed at the modernization of farms (data from 2016) – resulted in higher labor productivity compared to farms that did not use such support [Pawłowska et al. 2018]. Productivity growth, however, required a rational investment approach. Analyses from 2010 to 2019 showed that farms that invested excessively in relation to their production potential demonstrated the weakest economic outcomes, including production declines [Zmyślona et al. 2025]. Investments that were too low were also associated with production drops, stemming from a lack of competitiveness of these farms. Only optimal investment levels were linked to increased productivity and better production results [Zmyślona et al. 2025]. Similarly, overinvestment has been observed in other EU countries – data from 2004 to 2015 indicated that the highest share of farms with absolute overinvestment[1] was recorded in Estonia, and the lowest in Latvia [Pawłowski et al. 2021b].

Further studies indicate that farms implementing comprehensive investments – those exceeding 50% of the average annual value of fixed assets – improved their technical efficiency, and pro-investment public policy mechanisms contributed to proportional increases in asset values and farm growth [Czubak et al. 2021]. Additionally, direct payments play a significant role in financing agricultural investments. As Zielonka et al. [2021] demonstrate, farms could not have achieved comparable investment levels without these payments, which accounted for over one-third of farm profits in 2021, confirming their critical role in sustaining investment activity.

In addition to traditional modernization, investments in innovative solutions, such as digital and precision farming, climate-smart practices, and environmental, social, and governance- compatible (ESG) technolo-

[1] The authors developed a proprietary typology of farms, comprising the following categories: (1) Optimum investment level – where the growth rate of labor productivity exceeds the growth in the assets-to-land ratio; (2) Relative overinvestment – where labor productivity increases, but at a slower pace than the assets-to-land ratio; (3) Absolute overinvestment – where labor productivity declines while the assets-to-land ratio continues to grow [Pawłowski et al. 2021b, p. 1].

gies, play a pivotal role in increasing farm productivity, resilience, and environmental performance. Agricultural innovation is defined by the Food and Agriculture Organization (FAO) as "the process whereby individuals or organizations bring new or existing products, processes, or ways of organization into use for the first time in a specific context in order to increase effectiveness, competitiveness, resilience to shocks or environmental sustainability and thereby contribute to food security and nutrition, economic development or sustainable natural resource management" [FAO 2019].

Studies by Yarashynskaya and Prus [2022] showed that well-developed metropolitan areas have the highest potential for implementing precision agriculture, while poorly developed peripheral regions have the lowest. The adoption of advanced digital tools associated with precision farming and crop production automation in Poland remains limited. Empirical evidence [Kramarz and Runowski 2025] indicates that farm size, the age of the farm manager, and the scope of farm activities significantly increase the likelihood of implementing such technologies, whereas insufficient knowledge and lack of trust constitute major barriers, underscoring the need for targeted educational and advisory interventions, particularly for small-scale farms. Piwowar [2018] argues that Agriculture 4.0, which combines information and communication technologies (ICT) and automation, can support low-carbon farming, yet its deployment requires universal access to ICT devices and the appropriate competences and knowledge to use them.

DETERMINANTS OF INVESTMENT ACTIVITY

Farm investment activity is shaped by a complex set of interrelated factors, which can be grouped into two categories: exogenous (external, macroeconomic) and endogenous (internal, microeconomic) [Kusz and Gędek, 2015, Kusz et al. 2015, Miłaszewicz and Nermend 2017]. The exogenous factors refer to conditions external to the farm that influence investment decisions and may include (to name a few): demand conditions, current and expected price levels, supply conditions, income, availability of preferential credit, commercial interest rates, the accessibility of EU funding, and current and future economic outlook (conditions). Additionally, they can also include geographic and socio-demographic conditions, government economic policies, inflation, the degree of openness of the economy to international connections, trade barriers and regulations, particularly those related to environmental protection and animal welfare, as well as pressures from environmental groups.

The endogenous factors are linked to the internal potential and characteristics of the agricultural farm, e.g., availability of production resources, the level of fixed assets consumption, economic and financial situation of the farm, adoption of modern manufacturing techniques, knowledge and skills in farm management, as well as the farmer's age.

In this article, we focus on the structural and financial determinants of investment activity, as these two groups of factors – capturing the specialization of farms and regional differences on the one hand, and access to investment capital, liquidity, and credit conditions on the other – are consistently identified in the literature cited below as important drivers of investment decisions. Both groups of determinants were incorporated into our analysis.

FINANCIAL DETERMINANTS OF INVESTMENT ACTIVITY

Among the key financial factors, the most crucial are farm income, access to external capital, opportunities to use preferential loans, and the structure of public support – especially investment subsidies. Investment subsidies remain one of the most important conditions for investment development. After Poland's accession to the EU, the value of investment co-financed from public funds increased from 2.4 billion PLN in 2005 to 6.1 billion PLN in 2015. Over 90% of these investments were self-financed [Koloszko-Chomentowska and Sieczko 2017].

Different studies indicate that various support instruments can effectively promote investment in agriculture. Some research indicates that direct payments significantly increase farmers' investment capacity [Zielonka et al. 2021]. On the other hand, preferential loans appear to be among the most significant factors influencing investment decisions, often outweighing even income levels [Szymańska et al. 2021]. Other studies indicate that EU support programs, which

include various financial support instruments, are "an equally important source of investment financing in Polish agricultural holdings" [Szymańska et al. 2021, p. 90]. Recent analyses emphasize that financial instruments, e.g., preferential loans, tend to complement public subsidies as a source of financing for agriculture in the EU [Kulawik and Soliwoda 2025].

Research by Bereźnicka [2024] shows that investment activity in Polish family farms increases with their financial flexibility. Positive cash flows, cash reserves, and financial leverage support higher investment levels, but mainly when farms simultaneously make use of credit. Therefore, the author concludes that credit is the primary driving force behind investment activity. What's interesting is that investment activity is closely linked to the financial security of farms [Szafraniec-Siluta et al. 2024]. Similarly, as equity capital and debt levels increase, so does the likelihood of an agricultural holding making investments. This means that the possibility of greater use of financial leverage has a significant impact on farmers' investment decisions [Wieliczko et al. 2019].

STRUCTURAL DETERMINANTS OF INVESTMENT ACTIVITY

Farm size and investment activity

Research findings indicate that farm size plays a significant role in determining both the scale and direction of investments. For instance, large farms tend to invest more in fixed assets [Wieliczko et al. 2019], and innovation, as they generate income that facilitates co-financing of investments and more frequently make use of investment support instruments [Kusz 2008, Wicki and Pietrzykowski 2018, Sass 2019 as cited in Wicki 2019].

Findings by Lorencowicz and Cupiał [2013] revealed that larger farms in Poland with an average area of over 40 ha implemented investments of greater value. This was due both to their greater capital potential and to the need to modernize production technologies or to purchase larger and more expensive machinery. Moreover, studies from 2004–2015 showed that larger farms were more likely to implement complex investments, including those co-financed with pro-investment CAP mechanisms [Czubak et al. 2021].

Region's agricultural differences

Various studies show differences between macro-regions. These differences result not only from the different years covered by the studies but also from the indicators used by researchers, such as investment activity or interest in investment programs. According to data from 2007 to 2018, the level of investment determinants correlated with the geographical location and socio-economic status of municipalities [Kozera et al. 2021]. The highest investment activity was observed in rural municipalities located in the southern and eastern macroregions of Poland. Research by Bórawski et al. [2020] covering the period 2000–2018 showed that the level of investment in Polish agriculture varied from region to region. The highest investment expenditure was recorded in provinces with favorable conditions for animal production, especially dairy and beef production, i.e., in the voivodeships of Wielkopolskie, Mazowieckie, Warmińsko-Mazurskie, and Podlaskie, while the lowest were in the southern and eastern macroregions, characterized by poorer natural and production conditions. The study of Sadowski et al. [2021] examined the relationships between socio-economic, natural, and structural characteristics of Polish communes and the scale of EU-supported investments, showing that local agricultural development processes are partly autonomous. The highest socio-economic development was observed mainly in western Poland and near major cities, while the highest agricultural production space index occurred in selected communes in the north, southeast, and south of the country. The activity of farmers in obtaining EU funds for investment purposes also shows strong regional differentiation. Between 2004 and 2013, the majority of funds were located in central and northern voivodeships, where agriculture is more developed [Grzelak and Kiełbasa 2014].

Similarly, interest in pro-investment programs (according to a study from 2007–2013), measured by the number of submitted applications rather than the number of signed contracts, also reveals regional differences. Interest was higher in regions with more advanced agricultural development and better agrarian structure, that is, in western and northeastern Poland, whereas the lowest interest was observed in southeastern Poland [Kiryluk-Dryjska et al. 2021].

Investment differentiation according to farm profile

The studies also examined the type of agricultural production as a factor differentiating investment behavior. In cereal and livestock farms (as opposed to dairy farms), changes in investment behavior were strongly correlated with income from the previous year, indicating greater sensitivity to market conditions [Szymańska and Dziwulski 2021]. Analysis of data from 2009 to 2014 [Koloszko-Chomentowska and Sieczko 2017] suggests that investment processes were related to the production profile. Although investments were implemented across all farm groups, the growth effect was most pronounced in livestock farms, while farms with no clear specialization were in the most disadvantaged position. According to research by Kusz [2008], there are differences in investment patterns – animal farms invest more often in buildings, while plant and mixed farms invest more in machinery and transportation. In turn, research by Wieliczko et al. [2019] on investment behavior indicated that mixed farms most often invested in fixed assets, while the lowest percentage was recorded in horticultural farms. The study of Zmyślona and Barczak [2025] indicated that production specialization significantly affects the level of investment and costs, with capital-intensive areas such as dairy farming generating the highest costs. A decline in investment value was recorded in the case of farms engaged in, among other things, horticultural production, other permanent crops, pasture cattle breeding, and mixed production.

AIM AND METHODS

The purpose of the study was to examine the determinants of investment in Polish agriculture, including the determinants of investment propensity, investment plans, and innovative investments[2]. The survey employed a quantitative methodology, utilizing a computer-assisted telephone interview (CATI).

The sample was constructed to reflect the structure of Polish farms in terms of size, production type, and voivodeship. To achieve this, minimum quotas were set for key categories to ensure adequate representation (Table 1). Ultimately, 800 interviews were obtained.

Although the selection was not purely random, it was structured to enable generalization to the broader population of farms. After data collection, analytical weights were applied to adjust the sample to the actual distribution of farms in Poland. These weights were calculated based on official statistics from Statistics Poland (GUS)

Table 1. Minimum number of interviews by category

Criterion	Minimum number of interviews	Final number of interviews
Farm size		
up to 5 ha	300	335
above 5 to 20 ha	300	311
above 20 ha	100	154
Production type		
crop production	300	347
livestock production	100	110
mixed production	300	343
Voivodeship	at least 30 interviews in each	at least 30 interviews in each

Source: authors' work.

[2] The completed survey was part of a larger study aimed at assessing the functioning of the guarantees provided by Bank Gospodarstwa Krajowego (BGK) within the framework of the Agricultural Guarantee Fund (Fundusz Gwarancji Rolnych) established in 2019. The survey was carried out by IMAS International on behalf of BGK [BGK 2024].

and jointly accounted for farm size, production type, and voivodeship. This procedure corrected any over- or under-representation resulting from the use of minimum quotas and ensured that the weighted sample accurately reflects the population of Polish farms.

The original telephone interview questionnaire used in the study consisted of a section of closed and semi-open questions, arranged as follows: metrics (M1–M4), questions about threats and barriers to development (S1–S6), questions about the financial situation of farmers, realized and planned investments and their sources of financing (P1–P14), questions about access to financing, financial products, and plans for financing (Z1–Z15).

The survey was conducted between December 12, 2024, and January 29, 2025, by IMAS International on behalf of the National Development Bank. Respondents were owners or co-owners of farms. Participants were informed about the purpose of the survey, its anonymous character, and the voluntary nature of participation.

Frequency analysis and binary logistic regression were conducted. Observations with at least one "difficult to say" response in either the independent or dependent variables were excluded from the dataset before particular analyses. This decision was made because such responses are inherently ambiguous and do not provide interpretable information for the variables under the study. Moreover, the number of cases with "difficult to say" answers was very small, which limits their analytical value and could introduce instability or bias in the results if retained. Excluding these observations ensured that the analyses were based on clearly defined categories and improved the robustness and clarity of the findings.

There was some variation in the sets of predictors for particular regression models, but every model included variables regarding basic properties of surveyed entities, such as their size, production type, macroregion, etc. Due to space constraints, only statistically significant coefficients for logistic regression are described in the main text. The collected data were statistically analyzed using R version 4.5.1.

For the regression model employing investment plans as the dependent variable, a composite variable measuring concern about threats to Polish agriculture was used as an additional predictor. It was constructed as the mean score across 12 items rated on a scale from 0 (not threatening at all) to 10 (very threatening). These items included perceived risks such as climate regulations, market competition, demographic shifts, inflation, and access to investment capital. The internal consistency of the scale was acceptable (Cronbach's $\alpha = 0.78$), supporting the aggregation of items into a single index.

The innovativeness of the investment was assessed based on respondents' self-reported opinions. Farmers were asked a direct question regarding whether they considered the investment innovative. No external or objective measures (such as technological benchmarks or expert evaluations) were applied.

Sample characteristics

Descriptive statistics were calculated to summarize the key characteristics of the surveyed farms ($N = 800$) after applying weighting. The majority of farms specialized in plant production (69.55%), while 15.23% specialized in animal production, and 15.22% in mixed production.

In terms of geographic distribution, the largest share of farms was located in the eastern macroregion (27.15%), followed by Mazowieckie voivodeship (15.99%), central (14.82%), and northern (14.32%) macroregions. Smaller proportions were found in the northwestern (11.91%), northern (9.84%), and northwestern (5.97%) regions.

Regarding farm size, over half of the farms (52.02%) were smaller than 5 ha. Farms between 5–10 ha accounted for 16.29%, those between 10–20 ha for 20.69%, and farms larger than 20 ha for 11.00%.

When asked about changes in liquidity over the past year ($N = 789$), 55.70% reported no change, 36.64% reported a deterioration, and 7.66% reported an improvement. Similarly, for income changes ($N = 781$), 49.49% reported no change, 40.43% reported a decrease, and 10.08% reported an increase.

In terms of investment activity, 35.63% of farms reported making an investment in the past 12 months, while 42.91% planned to invest in the next three years. Among those who invested, 67.54% characterized their investment as innovative ($N = 242$).

Regarding the financial situation ($N = 786$), 12.86% of respondents rated their situation as poor (Bottom 2 Box), 55.87% as neutral, and 31.28% as good (Top 2 Box). The majority of farms (71.58%) did not have

financial support instruments (e.g., credits, loans), while 28.42% did. When asked about funding applications in the past year, 59.94% had not applied, 10.32% applied unsuccessfully, and 29.74% applied successfully. The financing gap, calculated as the percentage of farms applying for financing in the last year that did not receive financing under the terms applied for, is 25.86%. Looking ahead, 34.48% of farms planned to apply for funding in the next year.

RESULTS

Making an investment

A binary logistic regression was conducted to examine the predictors of whether a farm in Poland made an investment in the past 12 months (0 = no, 1 = = yes). The model included variables related to production type, macroregion, farm size, financial changes, financial situation, and funding activity. The analysis was based on weighted survey data ($N = 760$). Model diagnostics indicated no issues with multicollinearity (all $VIFs < 5$) and no influential observations/outliers.

The model was statistically significant, $\chi^2(20) = 107.55$, $p < 0.001$, indicating that the set of predictors reliably distinguished between farms that did and did not invest. Compared with the null model ($AIC = 934.5$), the full model demonstrated substantially better fit ($AIC = 878.0$). The model's Tjur's R^2 was 0.135, indicating a moderate level of predictive discrimination. All coefficients for the model are presented in Table 2.

Farms specializing in plant production were significantly less likely to invest compared to those focused on animal production. Farms located in the northwestern macroregion were also less likely to invest than those in the Mazowieckie voivodeship. In terms of farm size, farms ranging from 10 to 20 ha were significantly more likely to invest than those under 5.

Farms that reported an increase in income over the past year were more likely to invest than those with no change in income. Similarly, farms that assessed their financial situation as neutral or positive were more likely to invest than those with a negative assessment.

Finally, farms that had applied for funding in the past year – whether unsuccessfully or successfully – were significantly more likely to have made an investment (Table 2).

Investment plans

A binary logistic regression was conducted to identify predictors of whether a farm in Poland plans to make an investment within the next three years (0 = no,

Table 2. Logistic regression results for making an investment

Variable	*B*	*SE*	*z*	*p*
Intercept	−1.614	0.425	−3.797	<0.001***
Farm type: plant production (vs. animal)	−0.773	0.236	−3.269	0.001**
Farm type: mixed production (vs. animal)	−0.432	0.295	−1.468	0.142
Macroregion: Southwest (vs. Mazowieckie voivodeship)	0.096	0.383	0.251	0.802
Macroregion: North (vs. Mazowieckie voivodeship)	0.390	0.323	1.207	0.227
Macroregion: East (vs. Mazowieckie voivodeship)	0.035	0.262	0.134	0.893
Macroregion: Northwest (vs. Mazowieckie voivodeship)	−0.921	0.348	−2.645	0.008**
Macroregion: Central (vs. Mazowieckie voivodeship)	0.049	0.290	0.168	0.867
Macroregion: South (vs. Mazowieckie voivodeship)	−0.238	0.302	−0.786	0.432
Farm size: 5–10 ha (vs. <5 ha)	0.297	0.240	1.234	0.217
Farm size: 10–20 ha (vs. <5 ha)	0.927	0.224	4.143	<0.001***
Farm size: >20 ha (vs. <5 ha)	0.509	0.289	1.762	0.078
Liquidity: worsened (vs. no change)	0.273	0.243	1.127	0.260

Table 2. Logistic regression results for making an investment (cont.)

Variable	*B*	*SE*	*z*	*p*
Liquidity: improved (vs. no change)	0.553	0.345	1.604	0.109
Income: decreased (vs. no change)	0.161	0.234	0.687	0.492
Income: increased (vs. no change)	0.627	0.312	2.011	0.044*
Financial situation: neutral (vs. Bottom 2 Box)	0.741	0.291	2.542	0.011*
Financial situation: good/very good (Top 2 Box) (vs. Bottom 2 Box)	0.924	0.320	2.891	0.004**
Has financial instruments (vs. no)	0.100	0.203	0.492	0.623
Applied for financial instrument: unsuccessfully (vs. no)	1.179	0.281	4.199	<0.001***
Applied for financial instrument: successfully (vs. no)	0.694	0.190	3.646	<0.001***

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

$\chi 2(20) = 107.55$, $p < 0.001$, Tjur's R2 = 0.135.

Reference categories for categorical variables are indicated in parentheses.

Source: authors' work.

1 = yes), based on weighted survey data (N = 760). The model was statistically significant, $\chi^2(23) = 258.6$, $p < 0.001$, and showed a substantial improvement in fit over the null model (*AIC* = 779.4 vs. 980.6). Tjur's R^2 was 0.309. All coefficients for the model are presented in Table 3.

Farms that had made an investment in the past 12 months were more likely to plan future investments than those that had not. Farms with a neutral or positive assessment of their financial situation were also more likely to plan investments. Having financial support instruments was associated with a higher likelihood of planned investment, as was having unsuccessfully applied for funding in the past year. Farms that intended to apply for funding in the next year were significantly more likely to plan investments. Finally, greater concern about threats to Polish agriculture was associated with a lower likelihood of planning.

Model diagnostics indicated no issues with multicollinearity (all *VIFs* < 5), no influential outliers, and no violations of the linearity of the logit for the continuous predictor (concern about threats to Polish agriculture).

Innovativeness of the investments made

A binary logistic regression was conducted to examine the predictors of whether a farm's investment in the past 12 months was innovative (0 = no, 1 = = yes), using weighted survey data (N = 219). The model was statistically significant, $\chi^2(21) = 34.03$, p = = 0.034, and showed an improvement in fit compared to the null model (*AIC* = 264.1 vs. 276.5). Tjur's R^2 was 0.109. All coefficients for the model are presented in Table 4.

Farms specializing in plant production were more likely to report innovative investments compared with those focused on animal production. Farms located in the eastern macroregion were significantly less likely to report innovative investments than those in Mazowieckie voivodeship. Additionally, farms with a neutral or positive assessment of their financial situation were more likely to report innovation.

Model diagnostics indicated no issues with multicollinearity (all *VIFs* < 5), no influential outliers, and no violations of the linearity of the logit for the continuous predictor (monetary value of investment).

DISCUSSION

Determinants of investment propensity

The data from the conducted research confirm that investment decisions in agriculture are strongly determined by a range of structural, economic, and spatial

Table 3. Logistic regression results for investment plans

Variable	*B*	*SE*	*z*	*p*
Intercept	−1.745	0.686	−2.543	<0.001*
Farm type: plant production (vs. animal)	0.286	0.259	1.104	0.270
Farm type: mixed production (vs. animal)	−0.101	0.332	−0.303	0.762
Macroregion: Southwest (vs. Mazowieckie voivodeship)	−0.188	0.432	−0.435	0.663
Macroregion: North (vs. Mazowieckie voivodeship)	−0.516	0.361	−1.430	0.153
Macroregion: East (vs. Mazowieckie voivodeship)	−0.460	0.290	−1.586	0.113
Macroregion: Northwest (vs. Mazowieckie voivodeship)	−0.200	0.350	−0.570	0.568
Macroregion: Central (vs. Mazowieckie voivodeship)	−0.150	0.317	−0.473	0.636
Macroregion: South (vs. Mazowieckie voivodeship)	−0.272	0.320	−0.850	0.395
Farm size: 5–10 ha (vs. <5 ha)	−0.375	0.264	−1.419	0.156
Farm size: 10–20 ha (vs. <5 ha)	0.197	0.247	0.795	0.427
Farm size: >20 ha (vs. <5 ha)	0.562	0.322	1.746	0.081
Liquidity: worsened (vs. no change)	0.449	0.266	1.689	0.091
Liquidity: improved (vs. no change)	−0.004	0.370	−0.011	0.991
Income: decreased (vs. no change)	−0.204	0.254	−0.802	0.422
Income: increased (vs. no change)	0.405	0.335	1.208	0.227
Investment made in the past 12 months (vs. no)	0.932	0.190	4.901	<0.001***
Financial situation: neutral (vs. Bottom 2 Box)	1.275	0.343	3.715	<0.001***
Financial situation: good/very good (Top 2 Box) (vs. Bottom 2 Box)	2.072	0.373	5.549	<0.001***
Has financial instruments (vs. no)	1.001	0.225	4.454	<0.001***
Applied for financial instrument: unsuccessfully (vs. no)	0.799	0.324	2.462	0.014*
Applied for financial instrument: successfully (vs. no)	−0.045	0.209	−0.217	0.828
Plans to apply for funding (vs. no)	1.510	0.194	7.770	<0.001***
Concern about threats to agriculture	−0.179	0.069	−2.601	0.009**

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

$\chi^2(23) = 258.6$, $p < 0.001$, Tjur's $R^2 = 0.309$.

Reference categories for categorical variables are indicated in parentheses.
Source: authors' work.

Table 4. Logistic regression results for innovativeness of the investments made

Variable	*B*	*SE*	*z*	*p*
Intercept	−0.686	0.918	−0.748	0.455
Farm type: plant production (vs. animal)	1.054	0.426	2.474	0.013*
Farm type: mixed production (vs. animal)	0.275	0.516	0.533	0.594
Macroregion: Southwest (vs. Mazowieckie voivodeship)	−0.517	0.838	−0.617	0.537
Macroregion: North (vs. Mazowieckie voivodeship)	−0.277	0.688	−0.403	0.687
Macroregion: East (vs. Mazowieckie voivodeship)	−1.270	0.588	−2.158	0.031*

Table 4. Logistic regression results for innovativeness of the investments made (cont.)

Variable	*B*	*SE*	*z*	*p*
Macroregion: Northwest (vs. Mazowieckie voivodeship)	−0.360	0.810	−0.445	0.656
Macroregion: Central (vs. Mazowieckie voivodeship)	0.043	0.678	0.064	0.949
Macroregion: South (vs. Mazowieckie voivodeship)	−0.922	0.662	−1.394	0.163
Farm size: 5–10 ha (vs. <5 ha)	−0.722	0.488	−1.480	0.139
Farm size: 10–20 ha (vs. <5 ha)	−0.128	0.421	−0.305	0.761
Farm size: >20 ha (vs. <5 ha)	−0.250	0.636	−0.393	0.695
Liquidity: worsened (vs. no change)	0.327	0.438	0.747	0.455
Liquidity: improved (vs. no change)	−0.344	0.556	−0.618	0.537
Income: decreased (vs. no change)	−0.062	0.419	−0.148	0.882
Income: increased (vs. no change)	0.180	0.547	0.328	0.743
Financial situation: neutral (vs. Bottom 2 Box)	1.367	0.588	2.327	0.020*
Financial situation: good/very good (Top 2 Box) (vs. Bottom 2 Box)	1.630	0.641	2.541	0.01*
Has financial instruments (vs. no)	−0.186	0.398	−0.467	0.640
Applied for financial instrument: unsuccessfully (vs. no)	0.221	0.522	0.423	0.672
Applied for financial instrument: successfully (vs. no)	−0.033	0.375	−0.089	0.929
Monetary value of investment made in the past 12 months	0.000	0.000	1.197	0.231

*$p < 0.05$.

$\chi^2(21) = 34.03$, $p = 0.034$, Tjur's $R^2 = 0.109$.

Reference categories for categorical variables are indicated in parentheses.
Source: authors' work.

factors, and remain consistent with findings in the existing literature on the subject [Wieliczko et al., 2019, Bórawski et al. 2020, Zielonka et al. 2021, Zmyślona and Barczak 2025, Zmyślona et al. 2025].

Our findings indicate that farms specializing in plant production tend to invest less than those focused on livestock production. This may be due to the need for significant technological investments, which are relatively more demanding for livestock farms. In contrast, plant production farms less frequently incur investment outlays due to the specificity of production, which is more dependent on natural conditions and characterized by a lower level of mechanization than farms focused on animal production.

Clear regional differences have been identified, especially lower investment activity in the northwestern macroregion of the country compared with Mazowieckie voivodeship. These findings contribute to the literature highlighting the role of local conditions, such as the level of infrastructure development, agrarian structure, and availability of support measures in investment activity [Bórawski et al. 2020, Kiryluk-Dryjska et al. 2021, Kozera et al. 2021]. Combining the results of our research with findings from Grzelak and Kiełbasa [2014], Bórawski et al. [2020], Kozera et al. [2021], and Sadowski et al. [2021], it becomes evident that regional differences in investment activity are significant and dynamic, with no single region maintaining permanent dominance over time. This is beneficial from the point of view of the development of the country and the objectives of the "Strategy for Sustainable Development of Rural Areas, Agriculture and Fisheries 2030" [MRiRW 2023].

The significant impact of farm size on the propensity to invest is confirmed by the literature reviewed. Medium-sized farms show higher investment activity than smaller farms, which is the result of their greater financial potential and easier access to support pro-

grams [Lorencowicz and Cupiał 2013, Wicki 2019, Wieliczko et al. 2019], access to loans and grants, and their potential to recover their costs more quickly.

The study results also clearly indicate the importance of the farm's economic situation. Both income growth in the last year and a neutral or positive subjective assessment of the financial situation were significant predictors of investment activity, which is consistent with the theory of the rationality of investment decisions and previous analyses of the effect of direct subsidies, equity on investment capacity [Zielonka et al. 2021, Zmyślona et al. 2025] and generally the possibility of greater use of financial leverage [Wieliczko et al. 2019]. Greater equity and financial optimism encourage thoughtful development activities.

Finally, it was noted that farms that applied for external funds – both successfully and unsuccessfully – were more likely to declare making an investment. This is an interesting observation, since the very attempt to apply for financing is associated with a higher likelihood of investment. The application process involves needs analysis and the preparation of a business plan, so it requires strategic planning and activity from the farmers applying for the funds. Thus, those entrepreneurial farmers who have a legitimate investment need seek another source of financing their investment. Once incurred, the expense of preparing an application for funds can pay off in the future, as the application itself can serve as the basis for other proceedings [Grzelak and Kiełbasa 2014, Czubak et al. 2021].

Predictors of investment plans

Our research shows that farms that invested in the past 12 months were more likely to plan further investments. This may be due to the fact that investment-active farms, already having both infrastructure, experience, and competence, continue to expand.

Financial stability increases the willingness to take investment risks. This is supported by the finding that farms with a neutral or positive assessment of their financial situation and access to financing were significantly more likely to plan investments than those with a negative assessment and no access to investment funding. Interestingly, even farms that unsuccessfully applied for financing were more likely to plan investments, which was also observed in previous periods.

Farms intending to apply for financing in the following year were more likely to plan investments. This result is not surprising, as investment plans are often linked to plans to obtain financing.

Heightened concern about agriculture's future tends to reduce investment planning. Pessimism and uncertainty about the future of the agricultural sector can effectively discourage investment. This result can be explained by the real options approach (ROA), according to which, in a situation of unfavorable economic conditions, investments are suspended or delayed in order to obtain more information about future conditions. As noted by Dessart et al. [2019], when faced with sunk costs and uncertainty about the future benefits of adopting new sustainable practices, farmers may prefer to delay investment decisions in order to maintain flexibility and adapt to changing conditions.

Predictors of innovative investments

Important factors correlating with the innovativeness of farmers' investments are the type of production, the macroregion, and the assessment of the financial situation. Farms engaged in plant production are more open to modern technologies, which is perhaps partly correlated with the arrangements of the European Green Deal [EC 2019], but not only. An increase in the share of organic and precision farming, in accordance with the provisions of the European Green Deal, may require innovation in crop production and plant protection, especially in terms of technology.

The greatest impact on innovation in crop farms may be exerted by mechanisms related to small-scale trialing, which helps with gradual implementation of technological practices, followed by full-scale or partial-scale adoption of innovative technologies, lower investment irreversibility, and a shorter return on investment horizon than in livestock farms. In animal breeding, many innovations are infrastructural and irreversible, with a high capital threshold and lower trialability, i.e., slower, incremental adoption [Sunding and Zilberman 2001].

Farms in the eastern macroregion also declared less innovative investments compared to the Mazowieckie voivodeship. This may be due to more difficult access to financing than in the Mazowieckie voivodeship.

Farms with a neutral or positive assessment of their financial situation were more likely to report

innovative investments. This can be explained by the fact that the sense of financial stability increases the propensity for innovative, and therefore perhaps riskier, investments.

Future drivers and challenges for agricultural investment

Looking ahead, the future of agricultural investment will increasingly be shaped by broader policy frameworks and systemic challenges, among which it is worth mentioning climate change adaptation, ESG requirements [Leite de Almeida et al. 2024], and the European Green Deal [EC 2019].

The results of this study indicate a high share of innovative investments among active farms. However, an important question emerges: is this observed innovativeness a proactive market response or a regulatory adaptation? Future research should seek to disentangle whether farm-level innovation is being driven primarily by external policy incentives or by endogenous, entrepreneurial motivations. Understanding this distinction may help policymakers refine their support mechanisms.

Structural inequalities and risks of uneven development

While investment activity is generally rising, our data confirm that it is concentrated in specific regions and farm types. Larger farms and those located in well-developed regions such as Mazowieckie voivodeship are significantly more likely to invest, particularly in innovation. This spatial and structural polarization may exacerbate inequalities between rural areas, limiting the potential for inclusive development [Prus et al. 2021]. Without targeted support for smaller farms and undercapitalized regions, the investment gap may deepen, reinforcing cycles of stagnation in less developed areas of the country.

CONCLUSIONS AND RECOMMENDATIONS

The analysis confirms that both structural and financial determinants strongly shape investment behavior in Polish agriculture. Larger farms, economically stronger units, and those located in more developed regions exhibit significantly higher investment activity, whereas farms facing financial constraints or operating in structurally disadvantaged areas demonstrate lower investment readiness. These patterns will become even more relevant as agriculture adapts to emerging regulatory frameworks, including environmental compliance, ESG requirements, and the transition toward climate-smart production.

Addressing structural disparities requires targeted support instruments. Simplified grant procedures and tailored financial tools dedicated to small and medium-sized farms, particularly in less developed regions, could help mitigate the uneven distribution of investment activity. Strengthening advisory and educational services remains essential for increasing farmers' capacity to design effective investment plans and navigate funding opportunities. In parallel, policy measures that promote climate-smart and digital technologies may enhance both productivity and resilience, supporting the sector's transition toward sustainable production.

The empirical results allow for several evidence-based recommendations. First, farms with neutral or good financial standing show the highest responsiveness to external support instruments, suggesting that credit guarantees and preferential loans would substantially stimulate investment activity in this group. Second, the analysis demonstrates that the mere act of applying for funding (regardless of the outcome) is strongly associated with investment propensity, indicating that simplifying application procedures and expanding advisory support could meaningfully increase the number of farms entering the investment process. Third, medium-sized farms (10–20 ha) exhibit the strongest likelihood of investing, highlighting them as a strategically important group for modernization policies. Fourth, crop farms invest less frequently but show higher innovativeness when they do, which implies that tailored instruments should simultaneously stimulate basic investment activity and support innovative technologies in plant production. Fifth, regional differences in innovative investment (particularly the lower propensity in the eastern macroregion) point to the need for region-specific financial instruments aimed at reducing structural disparities. Finally, ele-

vated concern about future sectoral risks is negatively associated with investment planning, suggesting that risk-mitigation tools such as investment insurance, guarantee schemes, or stabilization mechanisms may be critical for sustaining long-term investment activity.

Taken together, these findings indicate that financial determinants primarily shape the capacity to invest, while structural determinants shape the direction and intensity of investment behavior. Effective policy should therefore combine improved access to capital with instruments that strengthen adaptive capacity, particularly in regions and production systems with lower investment potential.

Our study is based on one-year cross-sectional data, which limits the possibility of analyzing investment trends over time. While the results identify key structural and financial determinants of investment activity, longitudinal or panel data would be required to capture dynamic adjustment processes and temporal changes in farmers' investment behavior. Future studies should therefore extend the analytical framework to multi-year observations.

Future research should additionally explore behavioral and institutional barriers to accessing investment support, particularly through qualitative studies that examine why some farmers refrain from applying for public funds and how institutional frameworks might be improved to address this. A deeper analysis of how digital transformation, precision farming, and automation influence both the scale and efficiency of investments would also provide valuable insights for policy and practice. Ultimately, policy that supports balanced, inclusive, and forward-looking investment will be crucial for sustaining the resilience, competitiveness, and ecological responsibility of Polish agriculture.

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INWESTYCJE W ROLNICTWIE: STRUKTURALNE I FINANSOWE UWARUNKOWANIA AKTYWNOŚCI INWESTYCYJNEJ GOSPODARSTW ROLNYCH W POLSCE

STRESZCZENIE

Cel: Badanie dotyczy strukturalnych i finansowych czynników determinujących działalność inwestycyjną polskich gospodarstw rolnych z uwzględnieniem skłonności do inwestowania, planowanych inwestycji oraz innowacyjnych inicjatyw inwestycyjnych. **Metody:** Badanie opiera się na danych zebranych w ramach reprezentatywnej dla całego kraju ankiety CATI przeprowadzonej wśród 800 właścicieli lub współwłaścicieli gospodarstw rolnych w okresie od końca 2024 r. do początku 2025 r. Wykorzystując modele regresji logistycznej, identyfikujemy kluczowe czynniki prognostyczne dotyczące przeszłych inwestycji, przyszłych planów inwestycyjnych oraz innowacyjności ostatnich inwestycji. **Wyniki:** Wyniki podkreślają znaczącą rolę wielkości gospodarstwa, kondycji finansowej, wcześniejszej działalności inwestycyjnej oraz wykorzystania zewnętrznego finansowania w kształtowaniu decyzji inwestycyjnych. Na skłonność do inwestowania i wdrażanie innowacji wpływają również różnice regionalne i rodzaj produkcji (roślinna kontra zwierzęca). Gospodarstwa, które ubiegały się o finansowanie, niezależnie od wyniku procesu, były bardziej skłonne do inwestowania, co sugeruje, że samo planowanie strategiczne koreluje z działalnością inwestycyjną. **Wnioski:** Badanie stanowi wkład w literaturę dotyczącą modernizacji rolnictwa, a jego wyniki dostarczają praktycznych zaleceń dla decydentów politycznych dążących do promowania rozwoju obszarów wiejskich poprzez ukierunkowane wsparcie inwestycyjne. Sektor rolniczy w Polsce przechodzi znaczącą transformację spowodowaną wprowadzeniem przepisów dotyczących ochrony środowiska przyrodniczego, ramami ESG oraz przejściem na produkcję zrównoważoną. Te zmiany wymagają nie tylko kapitału finansowego, lecz także zdolności adaptacyjnych, planowania strategicznego i wsparcia instytucjonalnego, aby zapewnić

rozwój zrównoważony i inkluzywny. Ukierunkowane różne rodzaje polityki poświęcone małym i średnim gospodarstwom rolnym, zwłaszcza tym działającym w regionach znajdujących się w niekorzystnej sytuacji i mającym ograniczony dostęp do kapitału, mają zasadnicze znaczenie dla wzmocnienia ich wydajności i konkurencyjności. Poprawa jakości usług edukacyjnych i doradczych mogłaby pomóc rolnikom w opracowaniu skuteczniejszych strategii inwestycyjnych i uzyskaniu lepszego dostępu do możliwości finansowania, zwłaszcza na obszarach o niższym poziomie aktywności inwestycyjnej.

Słowa kluczowe: inwestycje w rolnictwie, wielkość gospodarstwa, innowacje, finansowanie publiczne, Polska, regresja logistyczna

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EXCISE TAXATION, MARKET INNOVATION, AND REGULATORY BLINDNESS: EVIDENCE FROM THE BALTIC SEA REGION

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ABSTRACT

Aim: This study examines divergent trends in alcohol control policies across Baltic and Nordic countries, focusing on the efficacy of excise taxes as a public health instrument. It aims to identify why systematic increases in excise duties often fail to achieve the intended reductions in consumption, indicating that decision-makers ignore changing consumer behavior and technological progress in production processes – a phenomenon called legal blindness. **Methods:** The study employs a comparative policy analysis across eight Baltic Sea Member States. Data selection criteria focused on national excise legislation and the Excise Movement and Control System (EMCS) reporting between 2020 and 2025. Statistical data was accessed via the European Commission's Taxation and Customs Union databases and cross-referenced with national reporting from the respective Ministries of Finance. The review protocol involved a systematic search of peer-reviewed literature using the keywords: alcohol excise tax, EMCS data fragmentation, and alcohol policy. The study provides comparative regulatory and fiscal evidence from eight Baltic Sea Member States, drawing on EMCS movement data and national excise legislation for the period 2020–2025. **Results:** Findings reveal a significant discrepancy between policy goals and outcomes. Preliminary analysis suggests that minor technical discrepancies in the interpretation of EU excise categories, combined with technological shifts toward low-alcohol content products, may lead to systemic data fragmentation. Furthermore, evidence suggests that aggressive taxation often triggers a shift toward legally underclass products, which are frequently underrepresented in official statistics, thereby distorting the view of policy effectiveness. **Conclusions:** The study concludes that traditional excise-heavy policies are becoming less effective due to generational shifts in consumption and rapid product innovation. To overcome current so-called legal blindness, policymakers must move beyond strict compliance with EU instruments and adopt evidence-based frameworks that account for technological market evolution. Improved data integration is essential to mitigate the so-called grey market risks and ensure public health objectives are met.

Key words: alcohol, consumption, generation, excise tax, revenue

JEL codes: H20, H21, E21

INTRODUCTION

The regulation of alcohol circulation presents a persistent and multifaceted challenge to public health, fiscal stability, and commercial integrity across the European Union (EU), particularly within the Baltic and Nordic region. Over the past decade, national governments have increasingly relied upon systematic alcohol excise tax hikes as a primary policy lever to lower per capita consumption and meet public health objectives.

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This approach, however, has increasingly exposed a significant tension between regulatory compliance and effective market oversight, leading to a state this paper terms so-called legal blindness. This research argues that while EU Member States adhere strictly to the legal and technical requirements of the EU's excise framework, the structure of these regulations generates systemic data fragmentation, thereby rendering policy goals ineffective and concealing crucial market dynamics.

The core challenge is that the existing regulatory architecture, which relies on raw-material-based tax groups, has been outpaced by rapid industrial and social evolution. Contemporary policy is failing to account for two critical market drivers. Firstly, technological innovation enables the production of low-alcohol and hybrid beverages that often exploit regulatory loopholes. Secondly, a profound generational shift is evident, where cohorts such as Generation Z exhibit distinct, lower-consumption habits and an increasing preference for low-alcohol alternatives. Evidence suggests a correlation between declining consumption and generational shifts; however, further panel data analysis is required to establish a direct causal link. These findings should be viewed as preliminary indicators of a broader trend. These factors suggest that recent reductions in officially reported absolute alcohol consumption are likely attributable to unexamined social and technological trends rather than to tax increases alone. The resulting policy deficit is compounded by the fact that national policy relies on data that cannot reliably correlate tax revenue with consumption patterns or the holistic public health impact of modern, ingredient-diverse products. Academic researchers have performed different aspects of excise tax for alcohol in the Baltic countries [Rovira et al. 2022], including deeper analysis in Estonia [Trasberg 2020]; in Lithuania [Bartkus 2019, Rehm et al. 2025] with several important aspects of cross-border trade [Zirgulis 2024] and with deep and comparative analysis in the Baltic countries and Poland [Rehm et al. 2023a, Rehm et al. 2023b] in five European countries [Manthey et al. 2024].

The concept of regulatory blindness constitutes an original analytical contribution of this study, capturing the systemic divergence between legal compliance and effective economic oversight in alcohol excise policy. This article seeks to address the central research question: what is the impact of low harmonization and systemic data volatility within the EU's alcohol regulatory framework on the effectiveness of national public health and fiscal policies, specifically considering the contemporary shifts in consumption patterns across the Baltic and Nordic region?

To answer this, the study adopts a multidisciplinary approach with a high degree of procedural transparency. The authors examined the practical gaps in EU excise directives across eight Baltic Sea Member States, using the EUR-Lex database to conduct legal and policy analysis. The authors provided a comparative analysis of primary regulatory tools, based on national legislative documents and data from the European Union Agency for Fundamental Rights (FRA). Statistical data on tax revenue and alcohol movements were accessed through the European Commission's Excise Movement and Control System (EMCS) reporting for the period 2020–2025. This allows for a replicable comparison between official excise reporting and observable market outcomes. To elaborate on econometric modeling, the authors apply the principal–agent model to theoretically frame the issue of asymmetric information between the state (principal) and the alcohol industry (agent).

THE EU REGULATORY FRAMEWORK AND ITS PRACTICAL GAPS

Council Directive (EU) 2020/262 serves as the principal legal instrument regulating alcohol excise duties and the movement of excisable alcohol products across the EU, both with suspended and effective excise tax coverage. In the case of trade of alcohol with suspended excise tax coverage in the EU, a computerized EMCS control system is used – it records and monitors the movement of excise goods within the EU [EMCS 2023]. According to EU Regulation 2022/1637, it is allowed to move goods without paying excise tax in any of the Member States before a decision is made to release particular goods in the chosen country into free circulation, and by that moment, paying excise tax according to the Member State in which it will be sold. Council Directive 92/84/EEC establishes minimum alcohol excise tax rates for major excise tax groups – each Member State may set rates above the minimums and implement a more detailed framework of excise tax groups, provided they correspond to the major ones.

The legal framework for the intra-Union movement of alcohol is underpinned by a dual-coding system: the Combined Nomenclature (CN) code and the Excise Product Code (EPC). The CN, an eight-digit international product classification governed by Council Regulation (EEC) 2658/87, provides granular detail on various alcohol products for customs and statistical purposes. Conversely, the EPC, detailed in Commission Regulation (EC) No 684/2009, offers a restricted system of eight universal codes for excisable alcohol, applicable across all Member States. The limited number of EPCs introduces a requirement for subjective classification: Member States retain distinct national excise tax group structures, permitting the consignee to interpret the applicable tax rate group based on the received EPC. Despite legal compliance, this interpretive flexibility has demonstrably led to classification errors on the receiving side, particularly when the misinterpretation did not affect the tax revenue collected. Moreover, while national systems utilize detailed classifications, international reporting to bodies such as Eurostat relies on the four primary categories established by Council Directive 92/84/EEC: beer, wine, spirits and intermediate products. The need to consistently translate between granular national tax categories (linked to EPC) and broad international reporting groups creates systemic data volatility, leading to unavoidable discrepancies that compromise statistical integrity. This leads to a practical gap in statistics and overall oversight of the industry. In particular, Member States' actors follow the law, but market trends become less obvious, and political goals aimed at supporting some local alcohol industries cannot be achieved.

Article 32 of Council Directive (EU) 2020/262 sets the amount of alcoholic beverages a private individual may transport for his or her own use – it is the main regulatory framework for border trade. The authors do not analyze volumes and types mentioned in this list – this law has been issued to regulate alcohol flow over the borders for private purposes, as among EU countries, borders are mainly open. It is important that there is such a regulatory framework to prevent illegal actions and to set clear rules for private individuals and entrepreneurs dealing with alcohol sales to foreigners of Member States. It also has opened a practical gap – alcohol purchase tourism or so-called border trade where the main goal is not to obtain in the neighboring Member State alcohol of that country, but to use excise rate differences for optimizing expenses on alcohol purchases. It is not a phenomenon of Baltic states, but global and especially active among countries having comparably easy border crossing conditions. This practical gap in legislation has led to an established network of specialized alcohol shops along the border of countries having reasonable differences in excise tax rates or other limitations, habits, and rules. For example, Estonian beer brewers sell their production to border trade shops in Latvia so Estonian and Finnish customers could obtain their local or favorite beer for a way lower price than in their homeland. This does not support local Latvian beer brewers, nor the excise tax revenue of Estonia, but it keeps Estonian beer dominant in Estonia to avoid transition of Estonian consumers to Latvian beer due to lower price. It also increases Latvian excise tax revenue and lowers Estonian alcohol consumption rates in statistical outlooks, which is important to politicians. Sometimes this practical gap correlates with control elements and taxation policy among the states, encouraging them to exceed limits and purposes, tempting private individuals to violate this directive for private financial interests. For example, Baltic trucks from Italy on their way home, having additional space for one or two pallets, sometimes do not hesitate to obtain some pallets of wine or sparkling that is not taxed in Italy but is highly taxed in the destination country. Such discrepancies and a lack of harmonization among Member States create practical gaps in the regulatory framework and lead to legal or even illegal practices.

Any European state has a system to regulate the market of alcohol, and the efficiency of this system is an essential condition for competitiveness. In several countries of Europe, alcohol excise tax has a more significant impact on the state budget and the economy than in others, while alcohol's effect on human health and social safety is similar depending on consumption level. Therefore, it is important to regulate alcohol market and consumption as such. One way is to determine the appropriate excise tax for each group of alcohol: to ensure maximum revenue in the state budget while reducing the shadow economy risk and reducing alcohol consumption level. It is mandatory to inspect the efficiency of the alcohol controlling system in each

country separately as they are rather different, built not only on the united EU regulatory framework, but also on national laws and regulatory acts. While the dilemma – to support state budget, industry, or health system – stays the same in every country, let's look at five tools that attempt to solve the dilemma.

The first tool similar in all countries around the Baltic Sea, is regulation by excise tax – all groups of alcoholic beverages are taxed: with different rates, but with exclusions when the rate is zero. Different excise tax rates allow for the management of consumer choice, directing them towards low alcohol content beverages, assuming they are less harmful to health and social safety. Germany has an exception for wine as the majority of Central and Southern European countries support their traditional wine industry; therefore, it is worth comparing these countries (Table 1).

After analyzing data in Table 1, it is obvious that apart from different excise tax rates, there is no unified approach to taxing all alcoholic beverages, but the vast majority of Baltic Sea countries tax all alcohol. There is a practical gap in the regulatory framework that confuses traveling Europeans, as in stores, there is no information on the amount or application of excise tax.

The second tool is drinking age [IARD 2022] – each state has its rules on the age at which it is allowed to obtain and consume alcoholic beverages [FRA 2017]. In Germany, Denmark, Finland, and Sweden, this age depends on alcohol content and premises as well, but in general, the age is as depicted in Table 2.

The third tool is state-controlled sales: among these countries, only Sweden and Finland have such a system, and even they have recently started easing this policy. Sweden has decided to permit alcohol sales outside of state-owned Systembolaget shops and public bars and restaurants (HRC) [Aeberhard and Greenall 2024,

Table 1. Application of the alcohol excise tax in the Baltic Sea region by country in 2025

Alcohol type	Denmark	Germany	Poland	Lithuania	Latvia	Estonia	Finland	Sweden
Ethyl alcohol	A	A	A	A	A	A	A	A
Intermediate products	A	A	A	A	A	A	A	A
Still wine	A	NA	A	A	A	A	A	A
Sparkling wine	A	IO	A	A	A	A	A	A
Beer	A	A	A	A	A	A	A	A

A – applicable, NA – non-applicable, IO – for import only.

Source: own work based on EMCS product movement data and Council Directive 92/84/EEC.

Table 2. Alcohol consumption minimum age in the Baltic Sea region by country in 2025

Alcohol type	Denmark	Germany	Poland	Lithuania	Latvia	Estonia	Finland	Sweden
Strong alcohol	18	18	18	20	18	18	20	20
Wine	16	16					18	20
Beer	16	16					18	18
HoReCa	18	18					18	18

HoReCa – segment of spirits, wines, and beverages for hotels, restaurants, and catering.

Source: own work based on FRA database [2024].

Carruthers 2024]. The government of Sweden, starting 1 June 2025, allows small distillers, wineries, and breweries to sell alcohol on their premises, but with rather strict limitations that have not dramatically changed the existing situation on the market. At the moment, apart from Systembolaget and HRC, only alcoholic beverages up to 3.5% of alcohol were permitted for sale in grocery stores in Sweden. In Finland, changes occurred already in June of 2024: beverages with up to 8% alcohol content are now allowed to be sold in grocery stores – previously, the limit was 5.5% alcohol content, with the rest sold in state-owned Alko stores with limited working hours, similar to Systembolaget in Sweden. In Finland, it has impacted state-owned stores' sales due to longer working hours and a wider network of grocery stores compared to the state-owned Alko chain of shops. Also, Baltic states' governments have considered a state-owned chain for alcohol sales, but this idea has not been implemented.

The fourth tool is the working hours of shops, or, as the author's name suggests – time limit. In Sweden and Finland, it refers to the working hours for state-owned liqueur stores. In Finland, there are more options for alcohol sales in grocery stores; therefore, there is a time limit for them as well, but not for HRC, unlike in Sweden. All three Baltic states have time limits for grocery stores; each country acts differently, but starting 1 August 2025, a new amendment to the law came into force in Latvia, which made time limits more similar to the practice in Lithuania, with minor differences [Saeima 2004]. Over time, this could become a trend in all three Baltic states as this regulatory tool has proven to be effective – Estonia, in a short time, reports an unprecedented increase in alcohol sales in the border area with Latvia. To compare countries around the Baltic Sea, see data in Table 3.

Part of alcohol market regulation are also marketing restrictions and limits: to promote and popularize alcoholic beverages: rules in each country are rather different. For this research, it is important to note that in each of the countries around the Baltic Sea there are laws that limit one or another type of alcohol marketing or all alcohol in general. It is an important tool that does not encourage current and potential consumers to obtain alcohol; especially, it is important towards children.

To evaluate particular countries in the usage of the previously mentioned five legal tools, look at data in Table 4. From a geographic point of view, it appears that the farther to the north, the more united the countries along the coastal side of the Baltic Sea are in terms of alcohol market regulation. This is also due to economic relations between the Baltic states and Scandinavia: obviously, there are negotiations among countries to reduce border trade, which spoils attempts by one country to decrease alcohol consumption, while in a neighboring country with no border restrictions, it is possible to obtain the desired beverage at a much lower cost. If Estonia wants investments from Finland, it has to make some compromises. Also, for Latvia, excise tax revenue is not the prevailing goal, as seen from the continuous rise in excise tax and the adaptation of the alcohol market to neighboring countries.

MARKET AND GENERATIONAL SHIFTS: THE ROOT OF LEGAL BLINDNESS

In this paper, market innovation is understood as technological and compositional changes in alcoholic beverages that alter their regulatory and fiscal classification without changing their functional consumption role. Legal blindness in the alcohol industry

Table 3. Alcohol shops' working hours in the Baltic Sea region by country in 2025

Weekday	Denmark	Germany	Poland	Lithuania	Latvia	Estonia	Finland	Sweden
Weekdays				10–20	10–20		9–20 (8–21)a	10–18
Saturday	00–24	00–24	00–24	10–20	10–20	10–22	9–18	10–13
Sunday				10–15	10–18		–	–

[a]Everyday grocery stores, up to 8% alcohol content beverages.

Source: own work based on national statutes, including the Law on Circulation of Alcoholic Beverages of 2024.

Table 4. Alcohol excise tax applicability in the Baltic Sea region by country in 2025

Regulation	Denmark	Germany	Poland	Lithuania	Latvia	Estonia	Finland	Sweden
Excise tax for all alcohol	A	W&LS	A	A	A	A	A	A
Drinking age	A	A	A	A	A	A	A	A
State shops							A	A
Time limit				A	A	A	A	A
Marketing limitations	A	A	A	A	A	A	A	A

A – applicable, W&LS – except for wine and local sparkling

Source: own work based on national statutes, including the Law on Circulation of Alcoholic Beverages of 2024.

arises both from industry development that has reached a level of maturity exceeding the existing regulatory framework and from generational shifts that introduce new patterns of consumption. The nature of alcoholic beverages has evolved significantly over the past century, and even more rapidly since the beginning of the twenty-first century, with production technologies and product innovation outpacing regulatory frameworks and policy-making cycles. Alongside these developments, more or less deliberate attempts have emerged to leave this new market reality insufficiently transparent.

For example, while legal requirements for labeling alcoholic beverages are formally fulfilled, final consumers often remain uninformed about substantive changes in product composition or production methods. Producers and marketers may avoid explicitly communicating that a familiar product is now produced differently – whether to reduce costs, optimize excise tax treatment, or introduce new flavors, colors, or characteristics. As a result, even for researchers, shelf-level information may be difficult to interpret accurately. Similarly, commercial research providers such as Nielsen or IWSR often rely on wholesaler data reported or reproduced in accordance with established classification conventions. For instance, a table wine historically produced from grapes may later be produced from local fruits or berries while retaining the same brand identity. If such products are reclassified as fruit wines, sales data may misleadingly appear as a novelty effect, or researchers may fail to locate the product within its expected category, leading to distorted interpretations.

Regardless of the underlying reasons, the outcome is a growing discrepancy between actual market developments and recorded data, which constrains both academic and commercial research. An even more concerning stage of this process is reflected in official state statistics, which subsequently inform business decisions, scientific analyses, and public policymaking.

In this study, legal blindness is operationalized as the systemic divergence between official tax revenue reports (based on raw material EPC codes) and actual market consumption (based on final product categories). For example, the study identifies a reporting error rate in which low-alcohol hybrids are classified as beer for tax purposes but marketed as cider beverages or cocktails, creating data fragmentation that masks a noticeable shift in consumer behavior not captured in traditional excise statistics.

Fragmented data significantly compromises the reliability of econometric analyses concerning state budget revenues derived from alcohol excise duties, as consumption frequently deviates into unanticipated excise tax categories rather than projected ones [Piattoeva and Saari 2022]. For instance, discrepancies often arise when comparing official reports: one might indicate a decline in beer sales offset by a rise in cocktails, while a second, based on raw materials for taxation, shows an increase in beer and a decline in ciders or spirits. An analyst lacking the linkage data to reconcile these reports may inadvertently select

a single, misleading dataset, potentially generating two divergent, yet equally inaccurate, results. This deficiency directly impairs the accuracy of excise tax revenue planning. A critical compounding factor is the ignorance bias that arises when the total revenue target is met or exceeded; this success obfuscates the underlying issue of data inaccuracy and flawed analysis [Romensaka 2021]. Such carelessness poses a substantial long-term risk and is often compounded in countries where excise tax revenue is not fiscally significant. However, these nations are often highly dependent on the stability of the alcohol industry, making correct market analysis paramount. To enhance clarity, it is essential to correlate tax data (based on raw materials) with consumption data (based on product type) and market performance using a unified unit of measurement. Currently, reports often deliberately use incompatible measurements, perpetuating this regulatory blindness. For example, official reports in Latvia – similar to those in many EU Member States – provide one set of data based on raw material for excise revenue and another detailing alcohol types by volume. These are incompatible. Conversely, the methodology for reporting consumed pure alcohol by taxation group (as submitted annually by national statistical offices to Eurostat and the OECD) is considered the most appropriate, particularly when aligned with excise tax revenue to accurately model the economic impact on the state budget.

The reliance on consumed volumes per alcohol type, without detailing the pure alcohol content derived from specific raw material groups, renders an inadequate basis for evaluating public health objectives. This lack of coherent data critically hinders the assessment of public health policies aimed at curbing alcohol consumption [Manthey et al. 2024]. A core difficulty is that the type of alcohol consumed cannot be reliably matched to the tax revenue it generates or to the raw material from which it is derived. Chemically, all consumed alcohol has the same formula; however, the holistic health impact necessitates a broader understanding of the raw material's effect on human health and behavior [Raipalis and Sloka 2025]. Components such as sugar content, liquid density, acidity level, carbon dioxide presence, and residual yeasts all influence consumer health outcomes. Consequently, reliable public health policy demands more comprehensive data on alcohol circulation than currently provided. Current health policy is primarily built upon a narrow, raw-material-based excise tax analysis, which provides consumption rates of pure alcohol, alongside alcohol type statistics that only allow the raw material and exact pure alcohol content to be inferred, not confirmed.

Latvia, like its Nordic counterparts, explicitly aims to reduce total pure alcohol consumption per capita to enhance public health indicators. Scandinavian policies and supporting research already demonstrate a clear trend toward low-alcohol consumption as an established means of achieving these health targets. This policy context is increasingly juxtaposed against the established behavioral shift of Generation Z, who have demonstrated distinct habits and attitudes towards alcohol consumption, a phenomenon extensively documented in recent scientific literature [Kraus et al. 2019]. The global beverage market reflects this change, with low-alcohol-content beverages emerging as a significant, decade-long trend with associated public health benefits. This raises a crucial policy question for the Baltic States: how effectively are they leveraging this valuable market and social trend to encourage either reduced alcohol intake or total abstinence within their populations? Since low-alcohol alternatives directly contribute to lowering total pure alcohol consumption, a focused policy approach that integrates and promotes this current market development is prudent, while simultaneously addressing the critical question of what will replace alcohol consumption in social contexts. Furthermore, at least some light is shown by recent research on non-tobacco smoking products that each state attempts to deal with separately [Sauka 2025].

ECONOMETRIC MODEL AND ACADEMIC PRECEDENTS

The principal–agent framework is introduced as an interpretative analytical tool rather than as a formal econometric model and is therefore positioned after the empirical and institutional analysis. This

framework is particularly well-suited to analyzing the regulation of alcohol circulation, as it captures the challenge of maintaining legal compliance while preserving effective oversight of market dynamics and emerging consumption trends. Within this model, the principal is the state, while the agent is the distributor or producer – typically a wholesaler releasing products into the retail market – who also, to some extent, reflects the preferences and behavior of final consumers.

As noted by Williams [2015], the principal–agent model is especially applicable in contexts characterized by a significant role of private information. In the present case, this private information concerns the distributor's decisions on how to report sales data and product classifications to state statistical authorities or commercial research providers. The framework builds on the seminal contribution of Holmstrom and Milgrom [1987]. Although these studies are relatively early, their central insight remains highly relevant: when an agent controls an asset or process on behalf of a principal, uncertainty arises because the principal's expectations depend on the agent's actions. While both parties influence one another, they do so to different degrees and through distinct mechanisms.

Applied in this study, the model describes a situation in which the government (the principal) mandates reporting obligations for a merchant or distributor (the agent) and subsequently observes discrepancies in the reported data. This setting represents a classic case of asymmetric information, where the agent possesses private knowledge – such as detailed sales data and interpretations of product classifications – that the principal cannot perfectly verify without incurring additional monitoring and enforcement costs. The objective of the principal (P) is not only to secure accurate data for tax revenue collection and market oversight, but also to identify emerging market trends and anomalies, which often manifest precisely through such discrepancies. Conversely, the agent (A) seeks to maximize profit while balancing two competing considerations: the administrative burden associated with high-precision reporting and the reputational costs that may arise if significant inconsistencies are detected.

Based on the principal–agent framework, authors formulate the following hypothesis: asymmetric information regarding product innovation allows the agent (industry) to minimize tax liability while the state (principal – P) remains "blind" due to rigid EPC classifications. Future research should derive the equilibrium implications of this misalignment.

In our model, the principle sets a level of reporting stringency (S). A high S means mandatory, detailed cross-checking with EMCS, while low S means more trust-based reporting. The government also sets an audit cost (C_A) and a potential loss of industry control (L_{IC}) if it fails to monitor. Agent (A) chooses a level of reporting precision (R_p). A high R_p means meticulously cross-checking every detail with EMCS. A low R_p means investment of rational accuracy and data of good intentions, which may contain discrepancies. For A achieving high R_p has an administrative cost (C_R). This cost includes employee time, system updates and thorough data validation. The higher the precision, the higher the cost: $C_R = f(R_P)$, where f is an increasing function. The discrepancy (D) between the reported data and the true data is $D = Q_T - Q_R$. If D is a small, random error (e.g., due to a low R_P) it can be valuable for the P. These small inconsistencies can signal emerging market trends or changes in production methods (e.g., a cider like beverage produced from beer). We propose to call this benefit (B_{info}). If D is large, it is negative for the P, as it suggests systemic error, loss of market control or tax revenue. The cost is C_D.

Utility for the P is U_P, where Q_R *is* revenue, S is audit cost and D is control loss:

$$U_P = Q_R + B_{\text{info}} - S - D.$$

The B_{info} is only positive for small, useful discrepancies. The C_A increases with the level of stringency the government imposes (S). The loss of control (L_{IC}) increases if the discrepancy becomes too large, suggesting a lack of oversight.

Utility for A is U_A, where Q_T is profit, Q_R is tax, RP is cost of reporting and D is cost of reputation:

$$U_A = Q_T - Q_T - R_P - D.$$

The reputational cost (C_{rep}) is a penalty imposed if the government's audit reveals a very large discrepancy. This cost increases with the scale of D.

The core of this revised model is the government's choice of stringency (S). If the government sets a very

high S, it forces the A to choose a high level of precision (R_P) to avoid the reputational cost. This leads to very little or no discrepancy ($D \approx 0$). This way, the government gets accurate data, but it incurs high audit costs and loses the valuable early warning information from the small discrepancies that would help to indicate shifts and development in the industry. If the government sets a very low S, the A is free to choose a low R_P to save on administrative costs (C_R). This way, the government's data would have many discrepancies. Some may be valuable information (B_{info}), but others may become large enough to signify a loss of control, leading to significant future costs (L_{IC}). The optimal strategy for the government is to find the balance: a level of S that incentivizes businesses to maintain an appropriate level of precision. This level of precision saves businesses from unnecessary administrative costs, while still generating small, informative discrepancies that the government can and should use to trace new trends and prevent a major loss of control. This model explains why the government may not be in a hurry to force perfect data alignment. The current system, with its inherent imperfections, might be a low-cost method of gathering valuable market intelligence. Similar research relevant to this model is conducted in behavioral economics [McCaffery and Slemrod 2006], because the legal framework cannot cover everything and there has to be a role for citizens to take their part in fulfilling laws and regulations.

CONCLUSIONS

The study provides evidence consistent with the emergence of regulatory blindness as an unintentional yet systemic outcome of the current excise taxation framework. This phenomenon arises from structural friction between the granular CN codes and the highly restrictive EPC, which generates information asymmetry within the regulatory system. As a result, discrepancies emerge that are not necessarily indicative of tax evasion but nevertheless undermine the statistical integrity required for reliable policy evaluation and economic analysis.

The findings further suggest a potential disconnect between systematic increases in excise tax rates and the achievement of intended public health outcomes. In particular, technological innovation enabling the production of low-alcohol beverages, alongside observable generational shifts in consumer behavior, appears to play a significant role in shaping consumption patterns. These dynamics remain insufficiently incorporated into current policy design, indicating the need for further longitudinal research to disentangle fiscal effects from broader social and technological trends.

Despite the technical shortcomings observed at the EU regulatory level, the analysis identifies a clear trend toward sub-regional policy harmonization across the Baltic and Nordic regions. Legislative adjustments related to excise taxation, availability, and market regulation increasingly reflect pragmatic responses to locally observed policy inefficiencies and the need to coordinate regulatory approaches with neighboring countries to mitigate unintended cross-border effects.

The application of the principal-agent framework reveals that the state, acting as the principal, currently operates under a persistent cost-benefit dilemma regarding data precision and regulatory oversight. While the imperfections embedded in the existing reporting system may function as a low-cost mechanism for capturing early signals of market change through minor discrepancies, reliance on such passive information gains poses long-term risks. Future governance strategies should therefore shift from merely tolerating imperfect data toward actively leveraging these discrepancies as a source of market intelligence, enabling policymakers to anticipate structural shifts rather than responding only after fiscal or regulatory control has been compromised.

Finally, the analysis underscores a clear policy imperative to move toward a unified and coherent data standard. The effectiveness of future alcohol control policies depends on addressing the systemic weaknesses identified in the current framework. This requires a fundamental transition toward a holistic, consumption-based data system that moves beyond raw-material-based classifications and mandates the reporting of consumed pure alcohol by product type. Such a reform is essential to ensure that policymaking is grounded in reliable empirical evidence capable of accurately modeling both the fiscal implications and the public health consequences of contemporary consumption trends.

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OPODATKOWANIE AKCYZOWE, INNOWACJE RYNKOWE I REGULACYJNA ŚLEPOTA W REGIONIE MORZA BAŁTYCKIEGO

STRESZCZENIE

Cel: W niniejszym badaniu przeanalizowano rozbieżne trendy w polityce kontroli alkoholu w krajach bałtyckich i nordyckich ze szczególnym uwzględnieniem skuteczności podatków akcyzowych jako instrumentu zdrowia publicznego. Celem artykułu jest określenie przyczyn, dla których systematyczne podwyżki akcyzy często nie przynoszą zamierzonego efektu w postaci zmniejszenia konsumpcji, wskazując, że decydenci ignorują zmieniające się zachowania konsumentów i postęp technologiczny w procesach produkcyjnych – zjawisko to nazywane jest ślepotą regulacyjną. **Metody:** W badaniu zastosowano porównawczą analizę polityk publicznych obejmującą osiem państw członkowskich regionu Morza Bałtyckiego. Kryteria doboru danych koncentrowały się na krajowych regulacjach dotyczących akcyzy oraz raportowaniu w systemie EMCS w latach 2020–2025. Dane statystyczne pozyskano z baz danych Dyrekcji Generalnej ds. Podatków i Unii Celnej Komisji Europejskiej i zweryfikowano je poprzez zestawienie z raportami krajowych ministerstw finansów. Procedura przeglądu literatury obejmowała systematyczne wyszukiwanie publikacji recenzowanych z wykorzystaniem słów kluczowych: „akcyza na alkohol", „fragmentacja danych EMCS" oraz „polityka alkoholowa". Badanie dostarcza porównawczych dowodów regulacyjnych i fiskalnych z ośmiu państw regionu Morza Bałtyckiego, opartych na danych o przemieszczaniu wyrobów akcyzowych w systemie EMCS

oraz na krajowych regulacjach akcyzowych z lat 2020–2025. **Wyniki:** Uzyskane wyniki wskazują na istotną rozbieżność między celami polityki publicznej a jej efektami. Wstępna analiza sugeruje, że niewielkie techniczne różnice w interpretacji unijnych kategorii akcyzowych, w połączeniu z przesunięciami technologicznymi w kierunku produktów o obniżonej zawartości alkoholu, mogą prowadzić do systemowej fragmentacji danych. Ponadto zebrane dowody wskazują, że agresywna polityka podatkowa często powoduje przesunięcie popytu w stronę produktów prawnie niedoklasyfikowanych lub objętych niższym opodatkowaniem, które są niedostatecznie reprezentowane w oficjalnych statystykach, co skutkuje zniekształconą oceną skuteczności polityki. **Wnioski:** W artykule stwierdzono, że tradycyjne polityki silnie oparte na akcyzie tracą na skuteczności w warunkach zmian pokoleniowych w konsumpcji oraz dynamicznych innowacji produktowych. Aby przezwyciężyć obecną „regulacyjną ślepotę", decydenci powinni wyjść poza ścisłe przestrzeganie unijnych instrumentów prawnych i wdrażać podejścia oparte na dowodach empirycznych, które uwzględniają technologiczny rozwój rynku. Kluczowe znaczenie ma poprawa integracji danych, pozwalająca ograniczyć ryzyko „szarej strefy" oraz zapewnić realizację celów zdrowia publicznego

Słowa kluczowe: alkohol, konsumpcja, pokolenie, podatek akcyzowy, dochody

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REVIEW PAPER

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MANAGERIAL COMPETENCIES IN MANAGEMENT THEORY – A LITERATURE SYNTHESIS AND A CLASSIFICATION PROPOSAL

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ABSTRACT

Aim: This paper synthesizes and systematizes concepts of managerial competencies in management sciences and organizational economics, with particular emphasis on linking competencies to resource allocation, costs, and organizational economic performance. **Methods:** The study is a review-based and theoretical approach. A critical literature analysis was conducted, combining synthesis and comparison of definitional approaches, classifications, and competency models. Sources were selected from domestic and international literature indexed in Scopus, Web of Science, and Google Scholar, with an emphasis on post-2020 publications that address digitalization, uncertainty, and crisis conditions. **Results:** The review confirms substantial terminological ambiguity and fragmentation, which limit comparability across studies and weaken practical applicability. As an authorial contribution, the paper proposes an integrative classification that consolidates dispersed models into seven overarching competency groups: strategic and business; leadership; managerial and organizational; cognitive and meta-competencies (including adaptability and resilience); social and communication; technical and knowledge management; and human resource management. Evidence from empirical studies suggests that interpersonal, planning, and adaptive competencies are consistently crucial for managerial effectiveness across various sectors, while a recurring competency gap persists between current and desired profiles. **Conclusions:** Managerial competencies should be conceptualized as a dynamic human capital resource shaping operational efficiency, adaptive capacity, and economic performance. Competency models are justified for HRM diagnosis, development, and succession planning, provided they are contextualized to sector-specific conditions and VUCA-related challenges.

Key words: managerial competencies, management, human capital, organizational effectiveness

JEL codes: J24, M12, L20

INTRODUCTION

Contemporary organizations operate in a dynamic environment characterized by rapid economic changes, escalating globalization, and heightened market uncertainty. In such an environment, the role of managers becomes particularly significant as they make decisions amid limited information and heightened risk. They are responsible not only for current resource management but also for the organization's ability to adapt, develop, and achieve sustainable economic efficiency. The pressure for efficiency, arising from

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market competition and stakeholder expectations, makes managerial competencies one of the key factors determining the effective functioning of organizations and the rational management of resources.

From the perspective of organizational economics, managerial competencies should be perceived as a crucial element of human capital that influences the allocation of resources, the level of incurred costs, and the financial results achieved. Decisions made by managers pertain to various aspects, including investment directions, work process organization, employment structures, and methods of employee motivation. Consequently, these decisions have a direct impact on labor productivity, the efficiency of organizational processes, and the competitiveness of enterprises. The literature in management science and organizational economics emphasizes that the quality of managerial competencies significantly determines an organization's ability to achieve economic goals and build a sustainable competitive advantage.

AIM AND METHOD

Despite the extensive body of literature on the subject, the issue of managerial competencies is characterized by significant ambiguity, evident in the multitude of definitions, classifications, and dispersed theoretical models. The lack of a coherent and synthetic approach complicates the comparison of research results and the practical application of scientific knowledge in organizational management. Consequently, the aim of this article is to synthesize and systematize the concepts of managerial competencies presented in scientific literature. The article is situated within the fields of management science and organizational economics and is theoretical in nature, encompassing an analysis of selected conceptual approaches without conducting original empirical research. The review is narrative-critical with elements of organization (systematization of concepts and models). This means the goal is not to exhaustively enumerate the entire body of work or conduct a meta-analysis, but rather to reconstruct the main currents, identify definitional disputes, and integrate dispersed classifications into a coherent model. The selection of literature was purposeful and issue-driven: it included classical works that shaped the language and frameworks of research (e.g., Boyatzis) and contemporary publications (post-2020), as the conditions of management (digitization, uncertainty, crises) alter the structure of competency requirements. Some earlier frameworks do not directly address adaptive and digital competencies.

Both Polish and foreign literature were included complementarily: international sources provide a reference to dominant models and trends, while domestic sources allow for capturing the institutional context and management practices within Polish organizations (terminology, HRM practices, sectoral specificity). The search was conducted in Scopus, Web of Science, and Google Scholar databases, with selection based on content relevance, source quality, and connection to the research problem.

The literature selection followed a purposeful, issue-driven logic consistent with a narrative-critical review approach. Sources were included if they (1) explicitly addressed managerial competencies or closely related constructs (e.g., management or leadership competencies) and (2) contributed to definitional clarification, proposed classifications or models, or provided empirical evidence on competency profiles, competency gaps, or relationships between competencies and effectiveness.

Priority was given to peer-reviewed journal articles, scholarly monographs, and review papers indexed in Scopus and Web of Science. Google Scholar was used as a complementary search engine to identify additional relevant publications and citations. The core of the review focused on post-2020 publications, reflecting the increased relevance of digitalization, uncertainty, and crisis-related competency requirements; seminal and classical works were included to ensure conceptual continuity and enable meaningful comparison.

Publications were excluded if they (1) discussed competencies in a generic manner without a managerial or leadership focus, (2) constituted non-scholarly opinion pieces lacking conceptual or methodological grounding, (3) duplicated content already captured in higher-quality sources, or (4) provided insufficient information to assess their relevance to the research problem. Screening progressed from title and abstract review to full-text assessment, with final inclusion determined by thematic relevance, source quality, and contribution to the study's objectives of synthesis and systematization.

The author's contribution to this work consists of:

- organizing the ambiguous definitional approaches to managerial competencies by juxtaposing them within a conceptual framework;
- integrating dispersed classifications into an original structure of seven competency groups;
- indicating how the individual competency groups connect with the economic dimension of management (resource allocation, costs, efficiency), enhancing the applicability of the synthesis for HRM practice and controlling;
- formulating an original, synthetic definition of a manager, developed based on a critical analysis and integration of selected literary approaches, serving as a reference point for further discussions on managerial competencies.

THE MANAGER AS A SUBJECT OF THE MANAGEMENT PROCESS

When considering managerial competencies, it is worthwhile to start with a definition of the role of a manager, as the scope and nature of competencies are directly determined by the functions performed and the responsibilities of the position. Only by defining who a manager is and what tasks they perform can the concept of managerial competencies be properly organized. Therefore, the definitions of a manager and their basic functions are presented first, followed by a discussion of the concept of competencies and their importance in management processes.

A manager is a person who performs management functions in accordance with the objectives, tasks, and responsibilities assigned to their position. They are responsible for planning and implementing strategies, setting goals, coordinating work, and evaluating results, with a primary focus on operational management, which involves directing the day-to-day activities of the organization [Tohatan 2020]. In this sense, their role is not limited to performing procedures but includes having a real impact on the effectiveness of the organization.

Managerial effectiveness refers to the ability to achieve sustainable results while maintaining team engagement. Management effectiveness encompasses not only the achievement of quantitative goals but also the building of relationships and conditions conducive to long-term cooperation [Horstman et al. 2023]. At the same time, the best managers go beyond day-to-day operational coordination by implementing developmental and innovative solutions that can generate revenue growth and even lead to industry change [Austin 2017]. The role of a manager, therefore, combines operational and developmental dimensions.

A manager is also a person in a managerial position, responsible for managing people, controlling the implementation of tasks, and making decisions necessary for the organization's functioning in a changing environment [Leśniewski 2024]. This requires striking a balance between control and flexibility in responding to change. Management is therefore a complex process that requires knowledge and experience, and a managerial career is a gradual one, depending, among other things, on competence and conscious development planning. An effective manager should develop technical, interpersonal, and personal skills, creating a coherent professional profile [Pashovska 2025].

It is also important to distinguish between the roles of a manager and a leader. A manager focuses on planning, organizing, and controlling activities, while a leader sets the direction for development, builds a vision, and inspires and motivates employees [Wooi 2020]. These roles are not contradictory but complementary, as modern organizations require both efficient management and change-oriented leadership. In the literature, the functions of a manager are described as a set of related activities, including classic management functions as well as decision-making and leadership roles. To organize these approaches, Table 1 summarizes the main functions of a manager based on the concepts of Tutova [2020] and Rogowski [2022].

The presented approaches to the functions and roles of a manager have been integrated in this study into a single, synthetic definition of a manager, formulated by the author based on an analysis of the literature on the subject. This definition organizes the scattered approaches and provides a point of reference for further consideration of managerial competencies.

For the purposes of this article, a manager is understood as a person performing a managerial function in an organization, responsible for planning, organizing, coordinating, and controlling activities, as well as making decisions that affect the achievement

Table 1. The key functions of a manager in an organization

Function	Scope and significance
Planning	Setting organizational goals and directions of development, making strategic and operational decisions, analyzing information, and planning actions under conditions of uncertainty and risk.
Organizing	Allocation of human, financial, and material resources; designing organizational structures; task division; and ensuring conditions for achieving organizational objectives.
Leading and leadership	Direct influence on employees through communication, motivation, inspiration, and the development of engagement and trust-based relationships.
Human resource management	Recruitment, development, appraisal, and compensation of employees; supporting the development of team competencies; and shaping attitudes conducive to achieving organizational goals.
Control and performance evaluation	Monitoring goal attainment, comparing results with plans, identifying deviations, and undertaking corrective actions.
Decision-making and economic role	Making decisions affecting costs, economic efficiency, and financial performance; rational resource management; and accountability for economic outcomes.
External relations and adaptation	Responding to market, technological, and social changes; adapting the organization to environmental conditions; and integrating internal objectives with market requirements.

Source: the author based on Tutova [2020] and Rogowski [2022].

of organizational goals and economic efficiency. The role of a manager encompasses both managing day-to-day operations and initiating development activities, which require integrating technical, organizational, and interpersonal competencies, as well as elements of leadership focused on building employee engagement, fostering trust-based relationships, and enabling the organization to adapt in a changing environment.

COMPETENCE AS A FIELD OF RESEARCH IN MANAGEMENT SCIENCES

Qualifications versus competencies

In the academic literature, the concept of competence is interpreted ambiguously, as reflected in the numerous definitions used in management sciences. One of the most frequently cited definitions is proposed by Boyatzis, who conceptualizes competencies as enduring, internal characteristics of an individual – such as motives, traits, skills, and knowledge – that are expressed through effective and superior job-related behaviors and performance outcomes [Boyatzis 1982, Armstrong and Taylor 2016].

An important extension of this discussion is the distinction between competencies and qualifications (Fig. 1). Qualifications are formal and institutional in nature, encompassing knowledge, experience, and official credentials that authorize individuals to perform specific professional tasks [Konieczny 2023]. Competencies, by contrast, refer to the ability to effectively apply these resources in practice and are primarily manifested in an individual's behavior within specific organizational contexts [Balcerzyk and Zapała 2020].

The literature also emphasizes the dynamic nature of competencies, which evolve with experience and changes in the socio-economic environment. In the context of generational change and increasing uncertainty, formal qualifications alone are insufficient if they are not accompanied by adaptive competencies and a capacity for continuous learning [Ruszaj and Błażejewski 2021]. Accordingly, qualifications may be viewed as a formal resource, whereas competencies represent a key determinant of effective individual performance in professional roles.

The literature increasingly emphasizes the importance of key competencies for future managers.

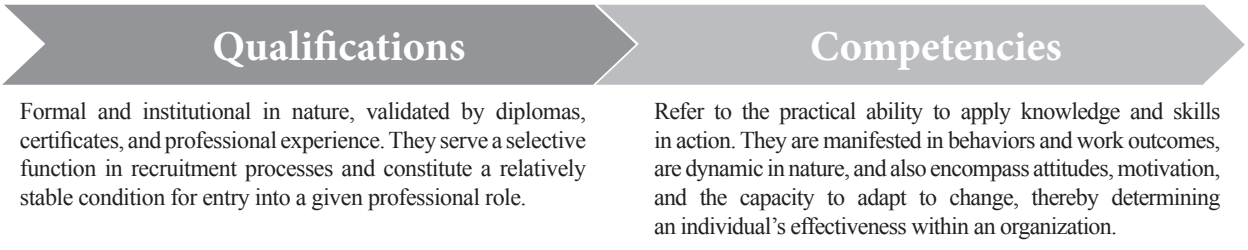

Fig. 1. Differences between qualifications and competencies in theoretical perspective
Source: the author based on the literature review.

Analyses published, among others, in *Forbes* highlight creativity and innovation, empathy, active listening skills, well-developed emotional intelligence, as well as perseverance in achieving goals and maintaining organizational stability [Westfall 2019].

At the same time, scholars emphasize that a defining characteristic of contemporary organizations is the need for permanent change, which shifts the emphasis toward adaptive and higher-order competencies. These competencies encompass not only responding to new conditions but also the active co-creation of change and the resolution of problems emerging at the intersection of established solutions and a new socio-economic order [Kwiatkowski 2018].

A comparison of theoretical perspectives reveals that definitional debates primarily focus on the scope of the competence construct. Classical approaches emphasize relatively stable individual attributes and their relationship to superior performance, which facilitates the development of selection-oriented models but is often criticized for underestimating the influence of organizational context. In contrast, contemporary approaches emphasize the developmental and situational nature of competencies, making them more responsive to the VUCA environment; however, they often result in an excessive broadening of the construct, which reduces research comparability and complicates the implementation of competency models. In practical terms, this implies that the usefulness of a given definition depends on its purpose: selection and performance appraisal require more measurable approaches, whereas development and change management call for dynamic conceptualizations.

The evolution of the competency approach in management theory

The scope of managerial competencies is closely linked to the roles and functions performed by managers and therefore evolves in line with organizational development and changes in the external environment. The expansion of competency frameworks constitutes a response to contemporary and future challenges. In the traditional management model, characteristic of the formative period of capitalism, managers were expected primarily to possess specific bodies of knowledge and skills oriented toward planning, control, and supervision of work – requirements that differ in many respects from those prevailing today.

Contemporary management approaches shift the emphasis toward interpersonal relationships, with the ability to build trust-based relationships emerging as a key managerial competency domain. As a result, the importance of competencies related not only to employee engagement in organizational processes but also to fostering employee satisfaction, well-being, and job satisfaction has increased significantly [Skowronek 2022].

Managerial competencies in relation to other categories of competencies

Individual and organizational competencies differ primarily in terms of their level of analysis and the functions they perform in management processes. Individual competencies refer to the attributes, behaviors, and capabilities of an individual that determine effectiveness, employability, and career development. They encompass not only knowledge and skills but also attitudes, motivation, and the ability to adapt to changing work conditions.

Organizational competencies, by contrast, are collective in nature and result from the integration of individual employees' competencies with organizational resources, structures, and processes. Their core lies in the organization's capacity to coordinate activities, leverage knowledge, and achieve sustainable competitive advantage. In Škrinjarić's framework, individual competencies serve as the starting point for the development of organizational competencies; however, it is their alignment with strategic objectives and the organization's operating context that ultimately determines economic and organizational outcomes [Škrinjarić 2022]. Accordingly, individual competencies focus on individual potential, whereas organizational competencies reflect the organization's ability to transform this potential into measurable results.

Definitions and key theoretical assumptions

Effective shaping of employees' behavioral outcomes requires appropriate leadership at managerial levels. Managerial competencies extend beyond the formal coordination of tasks to include active involvement in employee development and the implementation of organizational solutions. By influencing employees' attitudes and behaviors, managers create conditions that foster engagement and organizational commitment. In this respect, managerial competencies are broader in scope than employee competencies, as they focus on coordination, influence, and aligning individual actions with organizational objectives, rather than solely on the execution of individual tasks. As indicated by Alebiosu et al., the level of managerial competencies significantly determines an organization's ability to leverage employees' behavioral potential and achieve its intended outcomes effectively [Alebiosu et al. 2022].

Managerial competencies can be defined as a set of attributes and resources that enable effective leadership and organizational management in the face of change and uncertainty. They encompass motivation, knowledge, managerial and interpersonal skills, as well as personality traits that support constructive and low-conflict goal attainment. Consistent with contemporary competency-based approaches, managerial competencies should be measurable, developable, and explicitly linked to the responsibilities associated with a given managerial role, thereby enabling their systematic assessment and practical application in management practice [Heina 2020].

Key groups of managerial competencies

A review of the relevant literature suggests that managerial competencies constitute a complex, multidimensional construct encompassing both the manager's individual resources and their ability to influence others and operate effectively within complex organizational structures. Scholars emphasize that managerial competencies are dynamic, contextual, and hierarchical in nature, and that their scope extends beyond employee competencies by focusing on coordination, leadership, and accountability for organizational outcomes.

In response to the fragmentation of existing theoretical perspectives, an original classification is proposed that integrates the most frequently identified definitional and empirical themes. The classification follows a logic "from economic outcomes to managerial behaviors", grouping competencies into seven overarching, high-level domains that allow for further industry-specific elaboration:

1. Strategic and business competencies – including strategic orientation, goal setting and prioritization, economic analysis, innovativeness, and the assessment of decision impacts on organizational performance [Fanelli et al. 2020, Heina 2020, Szczepańska-Woszczyna and Gatnar 2022].
2. Leadership competencies – referring to inspiring and engaging employees, exerting influence, building trust-based relationships, as well as ethical conduct and social responsibility [Fanelli et al. 2020, Heina 2020, Skowronek 2022, Wyrzykowska et al. 2024].
3. Managerial and organizational competencies – encompassing decision-making, team management, task delegation, coordination of activities, and the resolution of problems and conflicts [Fanelli et al. 2020, Heina 2020, Szczepańska-Woszczyna and Gatnar 2022].

4. Cognitive competencies and metacompetencies – associated with analytical and conceptual thinking, learning capability, adaptability to change, and resilience under conditions of uncertainty and crisis [Barczak 2021, Ahti et al. 2023].
5. Social and communication competencies – including effective communication, empathy, teamwork, employee motivation, and relationship management with stakeholders [Heina 2020, Szczepańska-Woszczyna and Gatnar 2022, Wyrzykowska et al. 2024].
6. Technical competencies and knowledge management – referring to industry-specific expertise, the use of information technologies, and the acquisition, analysis, and organization of information, particularly important in knowledge-based organizations [Szczepańska-Woszczyna and Gatnar 2022].
7. Human resource management competencies – encompassing recruitment, employee development and motivation, support for autonomy, and the application of appropriate leadership styles [Głowienka 2022].

A common element across the analyzed perspectives is the emphasis on the fact that managerial effectiveness does not result from the possession of isolated skills but rather from the integration of multiple competency domains, including metacompetencies that enable action under dynamic and complex conditions. At the same time, the literature remains definitional and classificatory heterogeneous: classical approaches emphasize relatively stable individual characteristics [Boyatzis 1982, Armstrong and Taylor 2016], whereas more recent perspectives highlight the contextual, developmental, and adaptive nature of competencies [Skowronek 2022].

The synthesizing contribution of this article lies in organizing these approaches into a coherent model of seven overarching competency domains and in demonstrating their applicability across different organizational contexts (stable, crisis, digital, and sector-specific). Compared with earlier classifications, the model places particular emphasis on the role of metacompetencies as a higher-order layer [Barczak 2021, Ahti et al. 2023], distinguishes human resource management as an autonomous domain of managerial competencies [Głowienka 2022], and incorporates the growing importance of technological and knowledge-intensive components in smart organizations [Prokopowicz 2022].

The proposed seven-domain classification is conceptually grounded in classical competency theory; however, it extends and reorganizes existing approaches in several important ways. In line with Boyatzis's competency perspective, it conceptualizes competencies as resources manifested in behavior and linked to effectiveness. At the same time, it shifts the analytical emphasis beyond individual performance outcomes toward the economic dimension of managerial decision-making (e.g., resource allocation, costs, and efficiency). Compared with broad skills-based taxonomies that typically group competencies into technical, interpersonal, and conceptual domains, the proposed model retains these core distinctions but unpacks them into more specific and actionable domains suited to contemporary organizations (e.g., separating leadership from managerial–organizational execution and distinguishing social communication competencies as a distinct cluster). Moreover, unlike many earlier classifications in which human resource management is treated as a subset of leadership or general managerial skills, the present model conceptualizes HRM competencies as an autonomous domain, reflecting managerial responsibility for staffing, development, appraisal, and motivation processes. Finally, the framework explicitly elevates metacompetencies (e.g., learning capability, adaptability, resilience) to a higher-order layer that enables effective functioning under VUCA conditions and complements sector-specific technical competencies as well as knowledge management. This positioning clarifies the added value of the proposal: it integrates previously fragmented models into a coherent structure while simultaneously linking competency domains to managerial actions that influence organizational economic outcomes.

Managerial competencies and organizational effectiveness

The significance of managerial competencies is reflected in their multidimensional impact on organizational functioning and effectiveness. Competent managers play a key role in achieving organizational objectives by helping

employees understand these goals and by coordinating individual and team activities [Dler and Tawfeq 2021]. Managerial competencies also facilitate the efficient use of limited resources, enabling cost reduction and minimizing waste, which in turn enhances economic efficiency.

Authors further emphasize the role of managers in adapting organizations to rapidly changing environments by initiating development activities, supporting adaptive processes, and ensuring the availability of up-to-date knowledge. An important dimension of managerial competencies is also ethics and social responsibility, which foster trust, reduce conflicts, and create conditions for smooth and stable organizational functioning [Dler and Tawfeq 2021].

Review of empirical research

Research on managerial competencies focuses on identifying and systematizing the skills and attributes necessary for effective fulfillment of managerial roles in dynamic organizational and market conditions. These analyses encompass various management levels and sectoral contexts, with a particular focus on adaptive, leadership, decision-making, and interpersonal competencies, as well as metacompetencies that facilitate learning and long-term development.

An example of this line of research is a study conducted among managers of cinema facilities in Poland, which found that work-related attitudes and people-management skills, supporting team motivation and engagement, are central to the current competency profile. Technical, interpersonal, and conceptual competencies, which facilitate decision-making and development planning, were also highly valued. The study further identified a gap between the current and desired managerial competency profiles, confirming the need for systematic development of competencies [Pytel 2023].

Complementing these findings, Prokopowicz [2022] highlights the importance of managerial competencies in the development of smart organizations. Strategic, analytical, and leadership competencies were emphasized as essential for integrating digital technologies into organizational processes and effectively managing knowledge and innovation in uncertain conditions. Social and communication competencies were also identified as crucial for fostering employee engagement in technology-driven environments.

Empirical evidence from Sikorski and Kowalczyk [2024], examining sales team management practices in retail banking, shows that highly effective managers exhibit strong planning and organizational competencies, including advance action planning, clear communication of goals, and systematic monitoring of their implementation. Interpersonal competencies – such as individualized employee approaches, regular feedback, and the application of diverse motivational techniques – were found to be key differentiators between more and less effective managers.

The influence of organizational context is further confirmed by Kmecova and Juracka [2023], who found that the application of managerial competencies is significantly affected by company size rather than sector. The highest levels of competencies were observed in large enterprises, suggesting a link between organizational scale and the maturity of management processes.

In summary, contemporary empirical research confirms the growing importance of adaptive, leadership, and interpersonal competencies, while emphasizing the role of technological and organizational context and the analysis of competency gaps. These findings indicate that effective management requires the integration of multiple competency domains, tailored to the dynamic and uncertain conditions in which organizations operate. A summary of the key empirical findings is presented in Table 2.

The empirical studies reviewed, however, differ in terms of managerial levels examined, methods of competency assessment (self-assessment, 360-degree evaluation, or indirect indicators), and definitions of effectiveness (sales results, supervisor evaluations, organizational metrics). Consequently, some findings are directional rather than strictly comparable. This highlights the need for standardized operationalization of competencies and a clear distinction between competencies as self-reported and those manifested in observable behaviors. The synthesized empirical results provide a foundation for deriving practical implications for management practice. The following chapter discusses the practical applications related to the development of managerial competencies and the use of competency models within organizations.

Table 2. Cross-sectional conclusions from empirical studies on managerial competencies

Area of conclusion	Content of the conclusion	Sources
Interpersonal and leadership competencies	Regardless of sector, interpersonal and leadership competencies – such as communication, motivation, relationship building, trust, and an individualized approach to employees – constitute a key factor differentiating more effective managers from less effective ones.	Pytel 2023, Sikorski and Kowalczyk 2024
Organizational and planning competencies	Managerial effectiveness is strongly associated with the ability to plan activities, clearly formulate goals, systematically monitor their achievement, and act consistently, which supports more efficient use of human resources and higher operational effectiveness.	Sikorski and Kowalczyk 2024
Adaptive competencies and metacompetencies	Under conditions of crisis and high uncertainty, the importance of adaptive competencies and metacompetencies – such as resilience to change, learning capability, and cognitive flexibility – increases, complementing and often exceeding the relevance of procedural competencies.	Ahti et al. 2023, Rippel and Huzar 2023
Digital competencies and knowledge management	In smart organizations, the integration of managerial competencies with digital competencies and the ability to manage knowledge and innovation becomes critical, shifting the managerial role toward that of a technology – process integrator.	Prokopowicz 2022
Competency gap	Empirical evidence indicates a gap between managers' current and expected competencies, which justifies the use of competency models in HRM as tools for diagnosis and development planning.	Pytel 2023

Source: the author based on the review of empirical research.

PRACTICAL IMPLICATIONS FOR MANAGEMENT

Empirical findings and literature reviews consistently indicate that managerial competencies – particularly those related to interpersonal and leadership skills – are crucial for effective team management across various organizational sectors. Studies confirm that successful managers exhibit strong communication skills, the ability to motivate employees, individualized approaches to team members, and the capacity to build trust-based relationships, all of which directly enhance organizational effectiveness [Pytel 2023, Sikorski and Kowalczyk 2024].

From a management practice perspective, a key implication is the need for systematic development of managers' soft skills, which research shows differentiate highly effective managers from less effective ones to a greater extent than purely technical competencies. This includes developing abilities in planning, assessing employee potential, providing constructive feedback, and applying a range of motivational tools beyond financial incentives [Sikorski and Kowalczyk 2024].

The findings also underscore the value of competency models as tools to support human resource management. Such models can provide a foundation for designing managerial development programs, succession planning, and identifying gaps between current and desired managerial competency profiles. However, the effectiveness of competency models depends on their flexibility and alignment with industry-specific requirements and contemporary organizational challenges, such as digital transformation and crisis management [Prokopowicz 2022, Rippel and Huzar 2023].

For managers and practitioners, it is particularly important to view competencies not as a static set of attributes, but as a dynamic resource that requires continuous development and updating. Research highlights that the deliberate cultivation of managerial competencies contributes to organizational resilience, enhances team collaboration, and increases the organization's capacity

to adapt under conditions of uncertainty and environmental change [Pytel 2023, Rippel and Huzar 2023].

The proposed seven-domain framework can be operationalized as a practical HRM tool by translating each domain into a concise set of observable behavioral indicators and embedding them within role-specific competency profiles. First, organizations can construct a competency matrix (seven domains × managerial level/role) that distinguishes core competencies (required across roles) from contextual competencies (sector-, function-, or project-specific). Second, assessment can combine structured behavioral interviews and 360-degree feedback with role-relevant simulations or work-sample tasks (e.g., case-based decision scenarios for strategic--business competencies, conflict-resolution simulations for social-communication competencies, and change-leadership exercises for metacompetencies). Third, gaps identified between current and target profiles can be linked to individualized development plans, mentoring or coaching, rotational assignments, and targeted training modules aligned with each domain.

Importantly, the framework facilitates the integration of competency development with controlling and performance management by enabling the monitoring of selected organizational indicators that are plausibly influenced by managerial decisions (e.g., process efficiency, employee turnover and engagement, error rates, or cost deviations), while avoiding an overly narrow, short-term outcome focus. Such an approach enhances the practical applicability of the proposed synthesis and supports evidence--informed selection, development, and succession planning under VUCA conditions.

CONCLUSIONS

The literature review indicates that managerial competencies constitute a complex, multidimensional construct encompassing strategic, leadership, managerial, social, communication, cognitive, technical, and human resource management competencies. Contemporary theoretical perspectives emphasize the dynamic and contextual nature of managerial effectiveness, highlighting that it does not stem from isolated skills but from the integration of multiple competency domains – often referred to as metacompetencies – that enable adaptation to change and effective functioning under conditions of uncertainty. In line with the article's objectives, the synthesis and systematization of managerial competency concepts have allowed for the organization of key theoretical approaches and the identification of competency domains considered essential in contemporary management.

The findings further suggest that managerial competencies should not be applied in organizations as a general catalog of desired traits, but rather as a practical tool to support managerial decisions and HRM processes. In practice, this implies applicability on three complementary levels. First, at the level of diagnosis and role alignment, it is appropriate to develop competency profiles tailored to management level and function (e.g., operational, sales, project-based, or research and development roles), with a distinction between core and contextual competencies. Second, at the development level, recurring empirical findings regarding competency gaps justify designing development programs focused on interpersonal and leadership competencies, planning and organizational skills, and adaptive metacompetencies, using tools that facilitate the transfer of learning to practice. Third, at the organizational outcomes level, managerial competencies should be analyzed in relation to economic performance, as they influence costs, productivity, and resource allocation through decisions regarding work organization, staffing structure, and coordination of activities.

It should be noted that the limitations of this article include its theoretical and literature-review nature, without original empirical research, as well as the fact that the selected literature, despite following defined criteria, does not exhaust the full body of research in the field. Consequently, future research should focus on empirically verifying the proposed managerial competency classification, particularly by identifying gaps between current and desired competency profiles of managerial staff, as well as on standardizing operationalization and measurement methods for competencies.

The contribution of this article lies in the proposed classification of seven managerial competency domains and the corresponding definition of a manager, which organizes dispersed theoretical perspectives and provides a conceptual framework applicable to both empirical research and the design of HRM and control tools. This

framework enhances the practical applicability of the competency concept by emphasizing the need to link competency assessment with organizational performance indicators in a methodologically controlled manner, without reducing competencies solely to short-term outcomes.

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KOMPETENCJE MENEDŻERSKIE W TEORII ZARZĄDZANIA – SYNTEZA LITERATURY I PROPOZYCJA KLASYFIKACJI

STRESZCZENIE

Cel: Celem artykułu jest synteza i systematyzacja koncepcji kompetencji menedżerskich prezentowanych w literaturze nauk o zarządzaniu oraz ekonomii organizacji. Szczególny nacisk położono na powiązanie kompetencji menedżerskich z racjonalną alokacją zasobów, kosztami oraz wynikami ekonomicznymi organizacji. **Metody:** Artykuł ma charakter przeglądowo-teoretyczny. Zastosowano analizę krytyczną literatury oraz metodę syntezy i porównania podejść definicyjnych, klasyfikacji i modeli kompetencyjnych. Dobór źródeł obejmował literaturę krajową i zagraniczną (artykuły naukowe, monografie, prace przeglądowe) z wykorzystaniem baz Scopus, Web of Science i Google Scholar. Analiza uwzględniała dorobek klasyczny, jednak zasadniczy trzon przeglądu stanowiły publikacje po 2020 r., odnoszące się do współczesnych uwarunkowań zarządzania (m.in. cyfryzacji, niepewności i kryzysów). **Wyniki:** Przegląd potwierdził istotną niejednoznaczność terminologiczną i rozproszenie ujęć kompetencji menedżerskich, co utrudnia porównywanie wyników badań oraz wdrażanie modeli kompetencyjnych w praktyce. Na podstawie syntezy uporządkowano kompetencje w siedem nadrzędnych grup: strategiczne i biznesowe; przywódcze; zarządcze i organizacyjne; poznawcze i metakompetencje (adaptacja, odporność); społeczne i komunikacyjne; techniczne oraz zarządzanie wiedzą; zarządzanie zasobami ludzkimi. Zestawienie badań empirycznych wskazuje, że niezależnie od sektora kluczowe dla skuteczności menedżerów są kompetencje interpersonalne, planistyczne oraz adaptacyjne, a także występowanie luki między profilem aktualnym a oczekiwanym. **Wnioski:** Kompetencje menedżerskie należy traktować jako dynamiczny zasób kapitału ludzkiego determinujący sprawność operacyjną, zdolność adaptacji i efektywność ekonomiczną organizacji. Z punktu widzenia praktyki zasadne jest wykorzystywanie modeli kompetencyjnych w HRM do diagnozy, rozwoju i planowania sukcesji, z jednoczesnym dostosowaniem do kontekstu branżowego i wyzwań środowiska VUCA.

Słowa kluczowe: kompetencje menedżerskie, zarządzanie, kapitał ludzki, efektywność organizacyjna

CONTENTS
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