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Lost in knowledge and regional development terminology: review of knowledge-based concepts and their singularities

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Abstract: The proliferation of concepts such as "knowledge region", "learning region", and "innovative region" in regional development discourse has led to significant terminological ambiguity. This article presents a systematic literature review of over 500 indexed sources to clarify and compare the most widely used knowledge-based regional development models. By analysing five key terms—knowledge region, learning region, innovating region, innovative region, and region of knowledge—the study identifies their conceptual foundations, components, and geographic applications. While many of these terms share overlapping characteristics, the findings reveal important distinctions in their emphasis on governance structures, the role of universities, and regional innovation strategies. The review also highlights the evolution of certain models, such as the transition from learning to innovating regions. Notably, the study underscores the centrality of regional governance in shaping knowledge regions, which emerge as the most coherent and widely applicable model. The article concludes by advocating for the use of consistent terminology in academic and policy contexts and suggests future research avenues focused on benchmarking good practices and refining regional development models. This work contributes to greater conceptual clarity in the field and supports more effective policy-making in knowledge-based regional development.

Keywords: knowledge-based development; regional development; innovation; regions; literature review

Introduction

The global dynamics of regional development are in a constant state of flux, directly affecting all sectors and also all of the different regional development models used worldwide. In recent decades, there has been a process of adaptation to new trends, in which innovation, research, and knowledge have become key mechanisms for addressing societal challenges and needs. Gone are the traditional approaches that focused on large industrial estates associated with mass manufacturing and production. Instead, today, it is common to find science parks, research centres, and large business hubs characterised by a strong emphasis on innovation and technology.

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This transformation process has been the subject of analysis and debate by various authors and has led to the emergence of two key concepts. The first is the knowledge society, a term which was originally made popular by Drucker (1969) and later developed by Sakaiya (1995). The second is the knowledge economy, which has been analysed by authors such as Cooke (2001), Powell and Snellman (2004), and Mokyr (2011). These two terms have spawned an almost infinite range of related concepts and framed a new development paradigm centred on knowledge and its application at a certain territorial scale. This has, however, had an impact which has varied in importance and relevance in different parts of the world (Gingrich 2025).

The list of such concepts may seem almost endless, but the most commonly used and recognised include: learning regions (Florida 1995, Morgan 1997, Hudson 1999, Keane and Allison 1999, Hassink 2001), knowledge regions (Del Rosario et al. 2004, Qvortrup 2006, Sotarauta and Pulkkinen 2011), knowledge-based regions (Ananian 2014), innovative regions (Zhou and Xin 2003, Zhou 2005, Wixted 2009, Capello and Lenzi 2013, De Marchi and Grandinetti 2017), innovating regions (Etzkowitz and Klofsten 2005, Pinto 2009), regional innovation systems (Cooke et al. 1997, Cooke 2001, Kadlec et al. 2023), regional innovation ecosystems (Butler and Gibson 2013, Luo et al. 2017), regions of knowledge, smart regions (Roth et al. 2013), and creative knowledge regions (Bontje et al. 2011).

Regions foster growth and innovation via agglomeration, thereby positioning themselves as key targets for international industrial and innovation policies (Cardoso et al. 2025). Given the wide variety of terminologies in use, it is essential to clearly identify the components, action models, and key success cases that the literature associates with each term. This is relevant not only for clarifying the academic debate, but also because these models and terminologies are recurrently employed by policymakers in the design of regional development policies.

The objective of this article is to provide a clear and structured point of reference for academics and policymakers when engaging with knowledge-based regional development models. Rather than offering an exhaustive or purely descriptive overview of existing terminology, the article seeks to systematically compare and critically assess the most widely used concepts in the literature, identifying their conceptual foundations, core components, and key successful cases.

By doing so, the article addresses a recurrent problem in both academic and policy debates: the conceptual overlap and inconsistent use of terms such as knowledge region, learning region, innovating region, innovative region, and region of knowledge. This ambiguity often hampers cumulative knowledge building and weakens the analytical precision of regional development strategies. The contribution of this article lies in its capacity to disentangle these concepts, clarify their singularities, and assess their relative coherence, with particular attention to the role attributed to governance structures and universities.

To achieve this goal, we carried out a systematic literature review focusing on the most prominent academic concepts linking knowledge, innovation, and regional development. This approach is guided by the following research questions:

- What conceptual dimensions and territorial dynamics characterise the main knowledge-based regional development models identified in literature?
- To what extent do these concepts overlap, diverge, or represent evolutionary trajectories over time?
- How do these models differ in the importance they assign to regional governance structures and institutional arrangements?

The article is structured as follows. After this introduction, the second section details the methodological approach, explaining the systematic literature review process and the criteria applied for inclusion and exclusion. The third section presents the main results of the review, including both descriptive patterns and conceptual characteristics of each model. The fourth section discusses the findings in relation to the research questions, emphasizing conceptual convergence, divergence, and governance implications. Finally, the conclusion summarises the main contributions and outlines future research avenues.

Methodology

The methodological approach was divided into two task stages. The first consisted of searching for all the terms that link the terms "knowledge" and "innovation" with development and then collecting all existing references to them. This initial stage was intentionally broad and exploratory, in order to avoid premature conceptual exclusion and to capture the diversity of approaches used in the literature. To do this, we made an initial selection of concepts that included the following terms: knowledge region, learning region, innovating region, innovative region, region of knowledge, knowledge-based region, smart region, regional innovation system, regional innovation ecosystem and creative knowledge regions.

After this first selection, we discarded the concept regional innovation system following a preliminary analytical assessment, on the understanding that this was one of the characteristic components of some of the other terms that were analysed. We also decided to eliminate the term regional innovation ecosystem because, as well as being a characteristic component in itself, it was more closely related to the connections established between different regional elements than to development models based on innovation and knowledge. Similarly, the concept of creative knowledge regions was excluded due to its limited presence in academic publications and because it was considered a reference to a rather small subset of the more widely referenced

knowledge regions. The term knowledge-based region was discarded due to its lack of representation, while smart regions were excluded because they are linked to the use of technology as a tool for responding to the needs of local citizens and improve decision-making processes rather than to an explicit regional development model. The smart region emphasizes digitalization, technological infrastructure, and efficiency in governance, whereas the included models (e.g., knowledge, learning, innovating regions) focus on cognitive, institutional, and systemic capacities for the generation and application of knowledge as a regional development tool. On this basis, the smart region concept was considered to depart from the epistemological core of knowledge-based regional development addressed in this study.

We initially worked with two databases: Scopus and Web of Science. However, after collecting and comparing all the references that they provided, we decided to work exclusively with Scopus, as it covered almost all the references and offered a sample size that was sufficiently large to meet the objectives of our project.

The second phase of applying the methodology focused on a literature review inspired by both the model used by Edvardsson and Durst (2017), who studied links between universities and development, and those proposed by Vom Brocke et al. (2009) and Jesson et al. (2011), for the other five terms studied: knowledge region, learning region, innovating region, innovative region, and region of knowledge. This phase followed principles commonly applied in systematic and structured literature reviews in the social sciences, whereby predefined research objectives and research questions guide the selection and screening of texts.

Based on our selection of conceptual elements, we downloaded all of the references for each term that were available in the Scopus database from the earliest records indexed in the database up to 27th December 2024 (Figure 1). Although Scopus was formally launched in 2004, it provides retrospective coverage of a substantial number of peer-reviewed journals relevant to regional studies and innovation research. Moreover, the key concepts analysed in this article emerged predominantly from the early 1990s onwards, which limits the potential impact of earlier publication gaps on the scope and conclusions of the review.

Once the bibliographic compilation was complete, we filtered our references to eliminate any unrelated articles, based on their titles and abstracts. In this context, unrelated articles refer to publications that, despite using similar terminology, did not address regional development processes, lacked a territorial analytical perspective, or employed the selected concepts in a purely descriptive or rhetorical manner. We then subjected the resulting sample to a final conceptual review by reading the complete full texts and discarding any that did not meet the objectives of our study or respond to the research questions posed in this article. During this analysis, we worked with two datasets: the initial sample, to identify possible patterns in the use of a given concept, and the final sample, to analyse the component parts of these concepts. To

further enhance transparency and replicability, the list of excluded articles can be made available upon request.

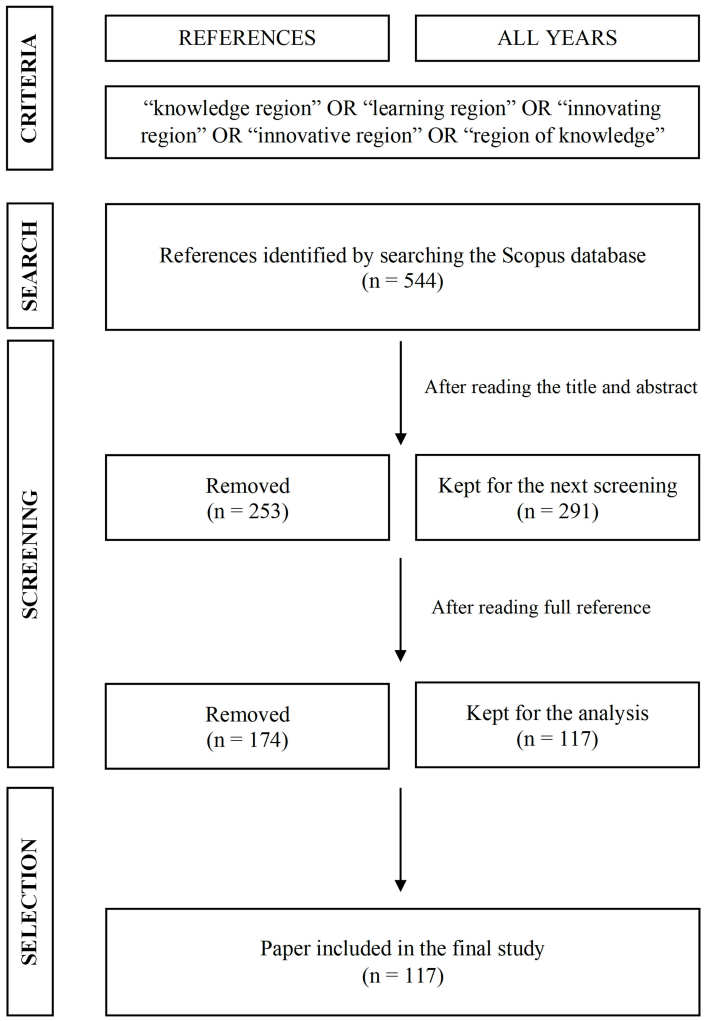

Figure 1. Stages of the literature review developed

Results

The results are presented in two parts. First, we describe the characteristics of the reviewed literature, including its geographic scope, methodological approaches, and temporal distribution. Second, we summarise the main conceptual patterns identified in the analysis, highlighting points of convergence and divergence between the different knowledge-based regional development models.

Characteristics of the sample

The initial sample of 544 bibliographical references exhibited considerable differences in the number of articles associated with each selected terms (Table 1). The "learning region" accounted for 55% of the references, followed by the "innovative region" at 31%, while the remaining terms each registered less than 10%. Furthermore, the evolution of terms revealed a surge from 2000 (Figure 2). Although isolated instances appeared earlier—such as the "knowledge region" in 1951—the terms under study achieved traction in early 1980s, followed by a sharp increase in usage after 2000.

Table 1. Sample used in the study

Term	Total	% of total
Knowledge region	55	10.11
Innovative region	169	31.07
Innovating region	9	1.65
Learning region	293	53.86
Region of knowledge	18	3.31
Total	544	100.00

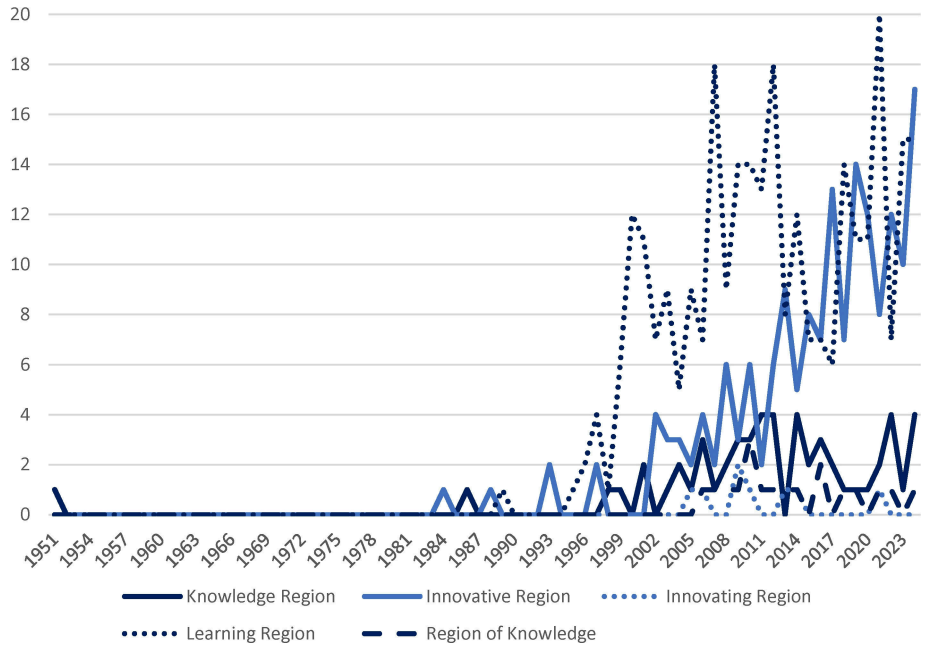

Figure 2. Evolution of number of references to each term (1951-2024)

Region of knowledge, innovating region and innovative region are terms that were primarily used in Europe, whereas learning region and knowledge region showed a

wider distribution across several continents (Table 2). In general, references to these concepts were characteristically European, although it is important to note that their use in Asia and North America was also significant.

Table 2. Origins of all the references to each term, by continent (%)

Terminology/Continent	Africa	Asia	Australia & Oceania	Europe	North America	South America
Knowledge region	0.00	21.54	0.00	52.31	23.08	3.08
Innovative region	0.00	15.18	0.89	61.61	20.54	1.79
Innovating region	0.00	0.00	0.00	66.67	33.33	0.00
Learning region	1.44	14.08	5.05	61.73	16.97	0.72
Region of knowledge	3.70	3.70	11.11	74.07	3.70	3.70

Components and characteristics of the concepts

The following section presents the results concerning the components and characteristics identified for each term associated with knowledge-based regional development. To facilitate interpretation of this second part of the results, we present each term in a consistent sequence: we begin with its origin and the way it is framed in the literature, then outline its main components and actors (including governance where relevant), and finally list illustrative examples of good practices identified in the references reviewed. Each term closes with a brief synthesis of its most characteristic elements and what differentiates it from the closest alternatives.

Knowledge region

The first models identified relating to this concept focused not only on the regional scale but also on the local level. This was particularly true of references to knowledge cities (Del Rosario et al. 2004, Ergazakis et al. 2004, Yigitcanlar et al. 2008). Various authors have questioned whether city-level good practices could be viably extrapolated to a more extensive dimension through the development of environments for creation, leadership, collaboration, skills, and the creation of knowledge (Reffat 2010).

It has also often been suggested that the existence of certain specific preconditions is an essential requirement for planning a successful regional project capable of creating such elements as a skilled population, higher education, infrastructure, science parks, incubators, and regional actors (Corona et al. 2006, Piñol Alabart 2019). Each territorial model begins by adapting the main components to its own specific reality, with these tending to share key criteria such as playing a leading role in research (Qvortrup 2006), intellectual capital (Pasher and Shachar 2010), institutional entrepreneurship (Sotarauta and Pulkkinen 2011), and the role of regional actors as facilitators of innovation and development (Corona et al. 2006). There is an apparent

dependence on knowledge in their activities. This requires collaboration between businesses and universities (Ghemawat 2005) and granting university institutions a key role in promoting regional development and in achieving knowledge region status.

Various authors have emphasised the crucial role of regional governance in knowledge regions, highlighting how it orchestrates various processes. These include: promoting the need for industrial reconversion towards knowledge-based activities (Lakshmanan and Chatterjee 2006, Chatterjee and Lakshmanan 2009, Lakshmanan et al. 2015), developing policies and projects to create, attract and retain talent (Heidemann et al. 2012, Piñol Alabart 2019), collaborating in international development projects related to knowledge regions (Krigul 2011), and/or working on other initiatives tailored to meet each region's specific circumstances. There is no single and universal formula for a successful regional model, each case must adapt its components to meet the needs of its own unique characteristics (Fromhold-Eisebith 2009).

Examples of knowledge region projects identified in this study include: the Ruhr Valley in Germany (Heidemann et al. 2012, Fromhold-Eisebith 2012) and the potential development of a joint project between Tallinn and Helsinki (Krigul 2011). Amongst non-European projects, it is relevant to highlight examples of good practices in Israel (Pasher and Shachar 2010), references to metropolitan areas in the USA, such as New York and Chicago, case studies in Ottawa and Quebec, in Canada, and even examples from Mexico (Corona et al. 2006, Lakshmanan et al. 2015).

The knowledge region is most clearly characterised by its emphasis on preconditions and a broad set of components (skills, institutions, infrastructure), with governance playing an explicitly orchestrating role. This centrality of governance and coordinated knowledge-based transformation is also what most clearly differentiates it from the other terms reviewed.

Learning region

This concept was introduced by Richard Florida (1995), who compared the mass production region with the learning region. The framework is built upon key terms such as knowledge creation, knowledge-based business production, and networks of innovative companies linked to a particular territory. These regions have been established on a foundational structure with four key components that facilitate the analysis of their respective regional models: manufacturing infrastructure (companies), human infrastructure (human capital), physical infrastructure (the local territory), and communications and industrial governance (Florida 2007, Rutten and Boekema 2007).

The business sector is the primary recipient of any new territorial dynamics associated with the knowledge economy that are implemented during the process of industrial reconversion (Hudson 1999, Asheim 2007). Trends that are introduced as a result of new activities undertaken by these companies tend to focus on industrial

reconversion (Morgan 1997, Rutten and Boekema 2007) and to highlight the importance of competitive specialisation as a regional driving force. This is clearly based on clusters (Hassink 2005, Słowiński and Guerin 2011, Hervas-Oliver and Sedita 2024) and/or on the expansion and strengthening of entrepreneurship (MacLeod 2000).

Human capital tends to play a crucial role in nurturing the business sector by fostering its innovative character (Hauser et al. 2007), especially in terms of digital skills, which is a field in which learning regions have proved their ability to serve as tools that promote improvement (Abalakina et al. 2022). The role of universities is also emphasised, not only as educational institutions, but also as direct stimulators of regional economic development (Keane and Allison 1999, Maskell and Törnqvist 2003, Christopherson and Clark 2010). They are one of the main pillars upon which the typical models for learning regions have been developed (Rutten et al. 2003, Azman et al.2014). Universities must allow and enable society to develop through education, research, and the transfer of knowledge, they are also actively involved in regional strategy (Grau 2016).

Governance structures must also adapt to new realities. It is therefore possible to identify the need to develop a system of regional collaboration that involves the main actors that are active in a particular territory (Butzin 2000, Duke 2000). This has given rise to the emergence of networks that are purely focused on innovation as a mechanism for promoting regional dynamisation (Benneworth et al. 2014) and/or on innovation systems that provide a foundation for fostering regional development (Cooke 2014). This focus on innovation translates into regional policies that directly aim to promote an innovative culture (Hassink 2001, Perry 2014), attract well-known companies (Van Geenhuizen and Nijkamp 2006), and take advantage of the link between space and knowledge in order to make them more dynamic (Hassink and Klaerding 2012, Rutten and Boekema 2012, Rutten and Boekema 2013). The structure has to be adapted to the singularities of each case, but it also needs to be defined, particularly in the case of a quadruple helix structure: academia, industry, government and society (Lincoln et al. 2024).

The success stories detected in the literature relating to cases of learning regions were mainly located in Germany (Thinesse-Demel 2010, Reghenzani-Kearns and Kearns 2012), with examples such as the Ruhr Valley (Pommeranz 2000) and Aachen (Olbertz and Brandt 2002). Other key references included Ontario, in Canada (Wolfe and Gertler 2001), Galicia region, in Spain (González-López 2019), and the Peak District National Park, in the United Kingdom (Saxena 2005).

The learning region is most distinctive for its focus on learning processes and networked collaboration as the engine of regional renewal, closely tied to industrial reconversion and human capital. Compared with the knowledge region, it is less framed around preconditions and more around relational capacity (firms-institutions-skills) and adaptive governance arrangements.

Innovating region

These regions are understood as an evolution of what are commonly known as learning regions, although their structures tend to visibly differ from them. While learning regions relate to a model based on the relationship between businesses and consumers, innovating regions develop through the creation of companies that have developed as a result of research (Etzkowitz and Klofsten 2005). Their most distinctive feature is the presence of either an entrepreneurial university (Guerrero-Cano et al. 2009) or a research-focused university that works in what constitutes a strategic field at the regional level. This results in the emergence and promotion of new knowledge-based areas that favour regional development (Etzkowitz 1983).

These environments characteristically receive a significant level of private investment in R&D&I. This explains their high volume of patent applications of different types and their high percentage of employment in high/medium-tech companies (Pinto 2009). These regions typically exhibit indexes of human capital and economic indicators that are close to the European average. They also stand out as dynamic environments with high rates of employment of people whose educational qualifications align well with the needs and requirements of the innovative companies that locate within their systems of regional innovation.

Examples of innovating regions would include Stuttgart, Karlsruhe, Freiburg, Tübingen, Oberbayern, Oberpfalz, Mittelfranken, Köln, Braunschweig, Darmstadt, Rheinhessen-Pfalz, North Brabant, Oresund, Blekinge, Linköping, and Skane (Etzkowitz and Klofsten 2005, Pinto 2009, Pinto and Guerreiro 2010). Such innovating regions are defined by research-driven renewal and the centrality of (entrepreneurial) universities in generating new firms and knowledge-based activities. This is what differentiates it most from learning regions: it foregrounds research-to-firm dynamics and measurable R&D outputs, rather than primarily learning networks around existing firms.

Region of knowledge

Region of knowledge takes its name from the Regions of Knowledge Programme, a component of the European Union's Seventh Framework Programme. This was one of several initiatives undertaken by the European Commission that aimed to achieve the gradual integration of regions through benchmarking exercises focused on R&D&I (Corpakis 2012). The programme sought to promote research clusters and to link them together within a shared cooperative ecosystem comprising local and regional institutions, universities, private sector, and research centres. However, while the initiative aimed to establish connections among these actors, it was possible to observe characteristics specific to each of the regional actors featured in the documentation relating to the programme.

The bibliography relating to this concept did not characterise it, nor did it provide any in-depth analysis of its specific contents and components, or of their relation

to knowledge-based regional development. The most frequently encountered terms referred to examples in Europe, which were associated with the EU programme and its unique characteristics and results.

The most outstanding examples of good practices, and of territories recognised as regions of knowledge which could be found outside the references used for the current study, include: the Liberec region in the Czech Republic, Malopolska, in Poland, Tallinn, in Estonia, and Manizales (Carrillo et al. 2007) in Colombia.

In practice, region of knowledge is most distinctive as a programme-linked label rather than a fully developed analytical model in the academic literature reviewed. It differs from the other terms by being primarily defined by the architecture and outputs of a specific EU initiative, with comparatively limited conceptual detail on internal components beyond that framing.

Innovative region

Compiling a taxonomy of innovative regions is a complex task (Kowalski 2022), as it implies defining a concept which involves understanding innovation as a tool for promoting regional development (Zhou 2005, Caragliu and Nijkamp 2012). Innovative regions are urban areas (Hean 2022) in which key components appear in specialised clusters which are based on collaborations between different actors (Walshok and Stymne 2008, Wixted 2009). They have a high capacity for absorbing knowledge and innovation (Cooke 2012, Capello and Lenzi 2013) and a plentiful availability of highly skilled human capital (Bernard et al. 2014, Demin et al. 2023). The business sector serves as the foundation upon which regional development is based on innovation (Asheim 2018). In these regions, governance serves an economic function: it is primarily aimed at meeting the needs of the business sector (Cooke 2012) and is an essential mechanism for creating a fully developed innovative region (Etzkowitz and Zhou 2017).

There are several European programmes, such as smart specialisation (Asheim 2018), which support these innovative trends, and many regions have also developed benchmarking projects (Nielsen and Nielsen 2008). The search for good practices acknowledges regional disparities in levels of both public and private innovation and investment (Lee 2011).

We detected some more technologically advanced regions and others that were still in the early stages of development. This unequal distribution of levels of innovation may have been the result of the presence, or absence, of a number of specific local circumstances, such as: entrepreneurial universities (García-Rodríguez et al. 2017), high-tech companies, SMEs (Hervás-Oliver et al. 2021) and/or a regional policy framework that actively promotes innovation (Camagni et al. 2014).

Broadly speaking, we observed that the use of this concept was often associated with the recent trend of using indicator systems to assess the innovative capacity of European regions. Projects promoted by the European Commission, such as the

European Innovation Scoreboard (EIS) and the Regional Innovation Scoreboard (RIS), are examples of initiatives that have actively generated the use of new terminology and concepts to qualify the level of innovation (Calignano 2022).

Another example was the proposal made by De Marchi and Grandinetti (2017), which classified regions as being highly innovative, moderately innovative, weakly innovative, and innovatively backward, all of these included the broader concept of the innovative region. The use of innovation-related terminology was detected in media headlines such as: "The 20 Most Innovative Regions in Europe" and "The Most Innovative European City". There were also similar examples referring to previous indicator-based systems.

Some of the most relevant examples that we identified included: Munich (Stenke 2008), North Jutland, West Midlands, and Blekinge (Nielsen and Nielsen 2008), Veneto, Emilia-Romagna, Piedmont and Lombardy, in Italy (De Marchi and Grandinetti 2017), the Prague - Central Bohemia region and South Moravia region, in the Czech Republic (Bernard et al. 2014), Vienna, Brussels, and Syddanmark (Camagni and Capello 2013), Skåne, Styria, Midi-Pyrénées, and Bavaria (Cooke 2012), and even Beijing (Zhou and Xin 2003, Zhou 2005) and Europe (Ogrean and Herciu 2022).

The innovative region is most characteristic for its cluster-based organisation, high absorptive capacity, and business-centred innovation dynamics, with governance framed as an enabling economic mechanism. It differs most clearly from the innovating region by being less explicitly tied to research-origin firm creation around entrepreneurial universities, and more broadly associated with territorial innovation capacity, clusters, and benchmarking approaches.

Discussion

Following the research questions, this article examines the conceptual foundations, components, and geographic applications of the five models reviewed. It identifies key points of convergence and divergence, with particular attention to their implications for governance structures, the role of universities, and regional innovation strategies. Finally, it analyses the evolution of certain models—such as the transition from learning regions to innovating regions—and considers their relevance for current policy and research agendas.

Definitions of the concepts

The methodology applied made it possible to gather specific definitions of the concepts studied and to obtain an overview of the most characteristic components associated with each reference. In response to the first analytical research question, which focuses on the conceptual dimensions characterising knowledge-based regional development

models, our research confirmed that the most representative and widely cited definitions of the reference concepts were the following:

- *Knowledge region*: a territorial unit with abundant human and social capital, containing structures, organizations and people actively engaged in generating development through science, technology and innovation, and whose interactions result in a high concentration of technology-based firms and highly skilled knowledge workers and entrepreneurs (Qvortrup 2006).
- *Learning region*: a regional development concept in which the main actors (politicians, policymakers, chambers of commerce, trade unions, higher education institutions, public research establishments, and companies) are strongly, but flexibly, connected with each other and are open to both intra-regional and inter-regional learning processes (Hassink 2001).
- *Innovating region*: a space that has the capacity to develop within the existing technological paradigms and which is periodically renewed by the emergence of new technologies and of companies that originate from its base of academic research (Etzkowitz and Klofsten 2005).
- *Region of knowledge*: an initiative that aims to support trans-national learning and mutual cooperation between research-driven clusters, bringing together regional authorities and development agencies, public research organisations, industry and any other relevant stakeholders (Bruno et al. 2011).
- *Innovative region*: a place characterised first and foremost by the fact that its production system is led by companies that adopt decisive innovation strategies and are thereby able to establish an advantage over other cities and regions. Over time, such areas have gradually developed a range of technological externalities that facilitate the dissemination of innovation between local companies. Moreover, in recent decades there has been a surge in the relevance of innovative regions in governance systems, with the participation of actors, including companies, government agencies, and civil organizations, taking responsibility for investment and location decisions (Barquero 2012).

With reference to the second question, our findings indicated that the terms knowledge region and learning region addressed similar themes and typically referred to the same realities. In general, the data compiled suggested that the use of one or other of these terms often depended on the personal preferences of the academics or institutions using them. Learning region was the more widely used term, perhaps because of its longevity and the fact that it was used in the influential work by Richard Florida (1995, 2007), but the most recent academic references analysed showed that use of the two concepts has tended to overlap.

Use of the term regions of knowledge stood out from the rest due to its inherent specificity and association with an EU funded programme. In contrast, there were so many different references to the terms *innovative region* and *innovating region* precluded any precise delineation of any possible overlap between their components. That said, these two terms did provide empirical support for the research question concerning the evolutionary trajectories and overlaps between knowledge-based regional development models; specifically, we found academic evidence suggesting that the term innovating region could have evolved from learning region. In fact, it was possible to detect the constant updating of the latter term, which tends to refer to the same elements as knowledge regions. We therefore concluded that all three terms referred to regional models sharing enough common features to be considered equivalent.

Patterns of use of each term

One dimension of the analysis examined whether the identified concepts displayed consistent temporal, territorial, or contextual patterns of use, exploring whether each term was linked to a specific geographic area, time period, or any other parameter that could explain its use instead of another alternative. Our findings yielded no well-defined patterns linking a specific concept to a given continent or geographic location.

While some terms were more frequently used in some geographic areas than in others (Table 3), there was nothing to suggest that any particular term was exclusively used in one specific territory. There are references to the Ruhr Valley, Tallinn-Helsinki, Israel and New York as knowledge regions, to Stuttgart, Skåne and Øresund as innovating regions, to Valencia and Ontario as learning regions, and to Blekinge, Piedmont and Beijing as innovative regions.

Table 3. Examples of regional references to each of the terms

Terminology	Examples
Knowledge region	Ruhr Valley (2009), Tallinn–Helsinki (2011), Israel (2010), New York and Chicago (2010), Ottawa (2006), Quebec (2009)
Innovating region	Stuttgart (2003), Karlsruhe (2007), Freiburg (2007), Tübingen (2007), Oberbayern (2007), Oberpfalz (2007), Mittelfranken (2007), Köln (2007), Braunschweig (2007), Darmstadt (2007), Rheinhessen-Pfalz (2007), North Brabant (2008), Skåne (2009), Blekinge (2009), Linköping (2009), Øresund (2009)
Region of knowledge	Liberec (2011), Malopolska (2011), Tallinn (2011), Manizales (2011)
Learning region	Ruhr Valley and Aachen (2003), Ontario (2006), Valencia (2010), Peak District National Park (2010)
Innovative region	North Jutland and Syddanmark (2008), West Midlands (2008), Blekinge and Skåne (2009), Veneto (2012), Emilia-Romagna (2012), Piedmont and Lombardy (2012), Prague region and South Moravia (2014), Vienna and Styria (2013), Brussels (2013), Midi-Pyrénées (2010), Bavaria (2011), Beijing (2014)

This diversity of references was one of two key outputs from the study sample. The

second finding concerns regional and demographic variations detected among the examples collected for each case. For example, the term knowledge region was found in references ranging from whole countries (Israel) to large conurbations (New York) and even to more extensive realities (such as the Ruhr Valley). The same occurred in other cases, such as references to Beijing as an innovative region and to the Peak District National Park as an innovating region. It was therefore almost impossible to identify any definitive usage pattern for the terminology. Fromhold-Eisebith (2012) had pointed to the inherent difficulty in classifying a knowledge region via indicators or statistical data—a challenge that extended to all other terms analysed in this study.

The role of regional governance

Finally, the analysis focused on the role assigned to regional governance across the different conceptual models focused on finding which of these terms was/were most closely linked to models of regional governance. Our findings highlighted the fact that governance plays a key role in three cases: knowledge regions, learning regions and innovative regions. Governance is organised into systems that adapt to the requirements of each territorial reality. These may have a triple helix – public sector, universities, and businesses (Leydesdorff and Etzkowitz 1998); a quadruple helix – with the addition of civil society as a fourth element (Ahonen and Hämäläien 2012, Carayannis and Grigoroudis 2016); or a quintuple helix – also incorporating sustainability and environmental change (Dubina et al. 2012) or the media structures (Simón 2020).

One important factor highlighted by previous authors in indexed contributions is that there have been numerous references to governance as a key component in knowledge regions. In contrast, in the other cases that were analysed, governance was identified as an important factor, but there was less consensus about this than over the concept of knowledge regions. For the reasons previously discussed, we therefore selected this term as the preferred concept for analysing governance in the context of knowledge-based regional development.

Taken together, the analysis provides a clear response to the first research question, which concerns the conceptual dimensions and territorial dynamics characterising knowledge-based regional development models. The findings show that, despite differences in terminology, these models share a common analytical core centred on the generation, circulation, and application of knowledge at the regional level. At the same time, they diverge in the relative emphasis placed on specific dimensions, such as the role of universities, innovation systems, or governance arrangements. This confirms that knowledge-based regional development should be understood not as a single model, but as a family of closely related conceptual approaches shaped by different analytical and policy priorities.

With regard to the second research question, which addresses the degree of overlap, divergence, and evolution among these concepts, the results indicate a

strong continuity rather than sharp conceptual breaks. Several terms—particularly knowledge region, learning region, and innovating region—can be interpreted as successive or partially overlapping formulations that reflect evolving academic and policy discourses over time. This suggests that conceptual change in this field is often incremental and cumulative, rather than driven by the emergence of entirely new paradigms. By making these overlaps and trajectories explicit, the article contributes to clarifying long-standing ambiguities in the literature and provides a more coherent basis for future comparative research.

Finally, the analysis also provides a clear response to the third research question, which concerns the territorial use of these concepts and the role of governance across different regional contexts. The results show that the examined terms are applied to a wide variety of territorial scales and socio-economic realities, without consistent geographic or temporal patterns that would justify a strict conceptual differentiation based on context alone. Instead, differences in usage appear to be closely linked to how governance structures are articulated within each model, particularly in terms of institutional coordination, stakeholder involvement, and policy orientation. This finding reinforces the view that governance acts as a key mediating factor in the application of knowledge-based regional development concepts, helping to explain their flexibility and adaptability across diverse territorial settings.

Conclusions

In recent years, there has been a notable increase in the study of regional development models based on knowledge and innovation. This has seen the emergence of seemingly countless new terms and concepts related to this type of economic transformation and their growing influence upon political decision-making. This situation has, in turn, created a need to clarify the meaning of this terminology and to achieve greater consensus in the academic debate surrounding its use. The objective of the current article was to do this and we believe that we have been largely successful in achieving this, with the discussion section providing a clear definition of each of the terms studied.

Our research approach, which involved conducting a systematic review of relevant literature, provided the ideal tool for achieving our initial objectives, although it also revealed a number of indirect limitations. These were mainly related to the selection and use of terminology. It was evident, for example, that the term regions of knowledge failed to meet the requirements necessary for it to be considered comparable with some of the others. Similar problems were found when we sought to identify the patterns of use of the different terms considered, we found that neither the approach adopted nor the characteristics of our sample enabled us to identify any clear patterns.

The extent of the duplication of content was one of the most interesting findings of this study, particularly relating to the use of the terms knowledge regions and learning

regions. The unique contribution of this article lies in how it focuses on analysing how these territorial projects have been structured in terms of governance. It identifies knowledge regions as the most suitable and representative term. While that of learning regions possesses enough interesting elements to warrant further exploration, we did not detect the same degree of consensus over its essential components. As a result, we would recommend political decision-making bodies to use the term knowledge regions when justifying the selection of a specific model, due to its conceptual relevance and its alignment with the governance and development structures of such territories. Identifying good practices should rely on demographic, socioeconomic, and/or sectoral benchmarking, acknowledging the non-transferability of terminology and the need for contextual adaptation.

As far as the future of this research field is concerned, it should be noted that the volume of indexed references referring to knowledge regions is limited. The authors therefore recommend that future lines of research should also analyse non-indexed articles. This would make it possible to provide a more up-to-date and comprehensive definition of what knowledge regions imply, based on contributions from previous authors and also any other additional components that may have been identified in the meantime. Finally, we should underline that it may, at some point, be interesting to pass from a strictly academic perspective to one involving a direct analysis of good practices in the real world. Such a methodological shift should examine how the terminology in question could be applied to concrete realities. It is also important to assess whether it would be feasible to develop a theoretical base model for a knowledge region that could subsequently be applied in other contexts.

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The central role of destination image in tourist competitiveness

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Abstract: Already-existing models of tourist destination competitiveness rooted in the resource-based view theory often omit competition within the sector, which was presented in the model of five competitive forces by Porter. This limits their explanatory value. It is not the aim of the paper to neglect their outcomes, which have been confirmed in numerous further publications. However, the paper aims to expand dominant views and incorporate the outcome of industrial organisation (IO). Tourist destination superiority is reflected in visitors' choices. These decisions result from the perceived value that visitors expect from consuming tourism products of particular destinations. As a result, the destination image can be indicated as the central element of the destination competitiveness-establishing process. The paper aims to propose a theoretical model of relations which leads to establishing a particular level of a destination's competitiveness. The paper is based on already published relations and rules that have been creatively incorporated into a new form of the destination competitiveness model. The model is expected to have an informative and explanatory value, which helps to understand the processes leading to establishing destination competitiveness. The model was not empirically tested as it does not offer new relations, instead, it combines relations that have been proven in contemporary literature.

Keywords: competitiveness model; destination competitiveness; decision sets; destination image; expected value

Introduction

Tourist destinations, by their very nature, spatial units, are often defined in a way that underlines their similarities to company-like entities (Pechlaner 1999, Gnoth 2004), especially their way of competing in the tourism market is highlighted in such an approach (Flagestad and Hope 2002, Żemła 2016). Consequently, most destination competitiveness models presented so far in the literature (Dwyer and Kim 2003, Heath 2003, Ritchie and Crouch 2005) were rooted in the resource-based view (RBV) (Barney 1991, Teece et al. 1997) and in Porter's (1990) concept of competitive and comparative advantage. RBV postulated that companies competing in the global environment

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should rather secure a generally high level of competitiveness (competitiveness as a non-relative value) than compare this level with the competitors from their industry (competitiveness as a relative value) as it was suggested earlier on by Porter (1985) and industrial organisation economics (IO) (Cho 1998). This postulate of RBV was incorporated into cited destination competitiveness models. As a consequence, destination competitiveness was perceived as a value strictly connected with destination sustainable development (Ritchie and Crouch 2005). This reflects quite precisely the way the destinations create their competitiveness, however, in the presented paper, it is suggested that the success of particular destinations starts from their ability to attract visitors in a competitive environment more effectively than their competitors do. That is why the paper attempts to incorporate the outcome of IO into the established models.

An example of rare attempts to combine the outcome of RBV and IO in the analysis of tourism destination competitiveness is the study by Flagestad and Hope (2001) in the context of winter sports destinations in Europe. According to them, the RBV and Porter perspective (IO) may be seen as complementary streams of theory in strategic management and developing sustainable competitive advantage (Flagestad and Hope 2001). The dispute between RBV and IO approaches to the explanation of destinations' competitiveness (Sucandrawati et al. 2023) is also mirrored in differences between demand and supply-oriented models analysing tourism development and flows (Zhang and Jensen 2008).

The paper argues that destination superiority is reflected in visitors' choices (Woodside and Sherell 1977, Woodside and Lysonski 1989). These decisions result from the perceived value that visitors expect from consuming tourism products of particular destinations. A characteristic of the tourism market is a high dependence on these estimations on subjective perceptions instead of tested knowledge, as tourists usually do not have their own and current experiences regarding most of the destinations they put in their choice/consideration sets (Decrop 2006). As a result, the destination image is of pivotal importance for the destination competitiveness-establishing process (Kastenholz 2002). Understanding the process of destination image formation (Gallarza et al. 2002) is the key element of establishing destination competitiveness. In this sense we develop a theoretical model of relations which leads to establishing a particular level of a destination's competitiveness.

Literature review

Competition in the tourism market takes place primarily between destinations (Go and Govers 2000, Ritchie and Crouch 2000, Altinay and Kozak 2021), and competitiveness is crucial for a destination's success and for ensuring its prosperity (Gooroochurn and Sugiyarto 2005, Cronjé and du Plessis 2020). When deciding on their tourist trip,

tourists are primarily interested in the opportunities to spend time at the destination, and only then do they choose service providers in the previously selected destination.

Despite the relatively high popularity of destination competitiveness among researchers of tourism-related phenomena (Altinay and Kozak 2021, Xu et al. 2021), there is a visible lack of agreement on the meaning of this concept and the appropriate methods of studying it (Cronjé and du Plessis 2020, Tleuberdinova et al. 2024). A few extended reviews (Cronjé and du Plessis 2020, Mior Shariffuddin et al. 2023, Xu and Au 2023) found out lately that there was no universal set of items, attributes or indicators to measure the competitiveness of tourism destinations. It is assumed that the concept of destination competitiveness has its sources both in research on the competitiveness of spatial systems within the broadly understood regional studies stream and in the rich literature on the competitiveness of enterprises (Dwyer et al. 2001).

The first studies concerning the methodology of analysing destination competitiveness appeared in the literature only in the 1990s (Vanhove 2007). Initially, they were based on one of two sources: comparative analysis or strategic management. The approach rooted in comparative analysis is mainly based on a comparison of individual competitiveness factors, especially those for which comparable data is available, i.e. primarily elements related to natural and anthropogenic tourist attractions, infrastructure and communication accessibility. The advantage of this approach is the possibility of a relatively objective and unambiguous comparison of the level of competitiveness of many compared tourist destinations. At the same time, the disadvantage is excessive focus on elements classified as comparative advantage factors and excessive detachment from relatively difficult-to-measure elements related to the process of creating a tourist offer and perception of the tourist destination as a uniform entity. This approach was the basis for, among others, the Tourism Competitiveness Monitor (Gooroochurn and Sugiyarto 2005) and works analysing price competitiveness (Dwyer et al. 2000, Dwyer et al. 2002, Magnion et al. 2005). Basically, this trend includes works devoted to the multi-factor analysis of the tourist attractiveness of an area (Hu and Ritchie 1992, Hong-Bumm 1998).

In some definitions and approaches (Bordas 1994, d'Hauteserre 2000, Altinay and Kozak 2021), destination competitiveness is identified with its position in the tourism market and/or its market share, and the primary task for destination managers is the implementation of an efficient competitive strategy (Poon 1993), while in others (Ritchie and Crouch 2000, Dwyer and Kim 2003), the emphasis is primarily on the fact that all entities of a given socio-economic system permanently benefit from the development of tourism, essentially equating destination competitiveness with its sustainable development (Ritchie and Crouch 2005). Ritchie and Crouch (2005) define destination competitiveness as its ability to increase tourism expenditure, to increasingly attract visitors while providing them with satisfying, memorable experiences, and to do so in a profitable way while enhancing the well-being of destination residents

and preserving the natural capital of the destination for future generations. Further studies (Dwyer 2023) within this approach also underlined residents' well-being as a required outcome of destination competitiveness. Thus, in the first approach, the market is indicated as a place to verify a destination's competitiveness level. This approach is also described as dynamic (Neto et al. 2020). In contrast, in the second, a similar role is played by the processes taking place within this destination. The approach presented by Ritchie and Crouch (2005) has so far gained more followers, and the model of competitiveness of a tourist destination built by these authors is currently by far the most frequently cited in the literature on the subject (Vanhove 2007, Cronjé and du Plessis 2020). High acceptance for the Ritchie and Crouch model and the whole approach derived from the RBV theory does not change the fact that the final effect is often very challenging in practice implications and requires the development and analysis of a huge number of factors. For example, Crouch (2011) studied the relative significance of 36 attributes of destination competitiveness, which were based on the Ritchie and Crouch (2005) model. The Dwyer and Kim (2003) model lists even more - 83 indicators. Similarly, the Travel and Tourism Competitiveness Index (TTCI) comprises 90 individual indicators distributed among 14 different pillars (World Economic Forum 2019), while Hanafiah and Zulkifly (2019) applied 41 indicators in their studies. According to numerous studies, factors that contribute to tourism destination competitiveness include, among others, openness to international trade, technology, infrastructure, social improvement in the quality of life of society, the environment, price competitiveness, and human resources (Tleuberdinova et al. 2024). According to Roman et al. (2020), the factors influencing tourism competitiveness might be divided into two broad types (Table 1): those that establish or maintain the capacity to be competitive and those that can create a competitive advantage (Tleuberdinova et al. 2024).

It is apparent that the models and approaches to destination competitiveness underlining the effectiveness of competition with other destinations and focusing on attracting visitors and the market position are at least partially rooted in Industrial Organisation (IO) theory and Porter's (1985) model of Five Competitive Forces. According to Dwyer and Kim (2003) destination competitiveness would appear to be linked to the ability of a destination to deliver goods and services that perform better than other destinations on those aspects of the tourism experience considered to be important by tourists. The other approaches are much more developed under the influence of the Resource-Based View (RBV). These models and approaches (Table 2), especially those of Ritchie and Crouch (2005), often use Porter's (1990) theory of competitive advantage of nations and the concept of competitive and comparative advantage. According to this concept, a location (country, region, city, etc.) may build its competitiveness on comparative and/or competitive advantage (Wardana and Sukaatmadja 2020, González-Rodríguez et al. 2023). The first contains all inherited assets indepen-

dent of being purposely shaped in the short term, while the second describes how the possessed assets are used (Ribes et al. 2011).

Table 1. The basic elements and relations in destination competitiveness models

Ritchie and Crouch model	Dwyer and Kim model
Destination Competitiveness and Sustainability	Destination competitiveness ↔ Socioeconomic prosperity
↑	↑
Qualifying and amplifying determinants	Destination management ↔ Situational factors ↔ Demand
↑	↑ ↑ ↑
Destination policy, planning and development	Resources (endowed, created, supporting)
↑	
Destination management	
↑	
Core resources and attractors	
↑	
Supporting factors and resources	

Table 2. Theories of the most cited models of tourist destination competitiveness

Theory	Main statements	Perception of competitiveness	Authors
Industrial organisation economics	- Five forces of competition (the threat of new entrants, the bargaining power of suppliers, the bargaining power of buyers, the threat of substitute products or services, and rivalry among existing competitors) - Three core competitive strategies: cost leadership, differentiation, and focus. - Sources of competitive advantage are sought in the company's environment, and above all in the closer environment	- Companies should compare their level of competitiveness with the competitors from their industry (competitiveness as relative value)	Porter (1985)
Resource-based view	- A company's competitive advantage stems from its unique, valuable, rare, and inimitable resources, both tangible and intangible, rather than just its external market position.	- Companies competing in the global environment should secure a generally high level of competitiveness (competitiveness as a non-relative value)	Barney (1991), Prahalad and Hammel (1996), Teece et al. (1997)
Competitive advantage of nations	- Competitive and comparative advantages as sources of competitiveness of national (regional and local) economies - Significance of clusters - Diamond of national competitive advantage	- Locations need to build their competitive advantages based on a continuous improvement process taking place in economic entities located in a given national economy. - The wealth of nations is created, not inherited	Porter (1990)

Methodology

The paper is conceptual in its nature, and relations already proven in contemporary literature are used to build a proposed model of tourism destination competitiveness. Instead of empirical confirmation, deductive reasoning is used. Deductive reasoning aims to justify the premises, from a broader understanding to a more particular one (Urano et al. 2023). In the presented paper, the final aim is to develop a new approach to understanding the tourism destination competitiveness issue by combining the dominating so far view based on industrial organisation economics and resource-based view. The central issue for the development of the proposed model was the extended literature review, collecting rationales for the model.

The rationales for the proposed model

Porter's idea of competitive and comparative advantages of an area is the starting point for the creation of the model (Table 3). To better reflect the situation in the tourism market, this terminology was adjusted, and the terms localisation and tourism offer were used. It is postulated that the comparative advantage of a destination is derived from its location in natural, social, cultural and economic space. Almost all tourist attractions playing a focal role in attracting visitors (apart from contemporarily purposely built attractions) can be put into this category (Zhang and Jensen 2007). This statement suggests that the comparative advantage of destinations should be perceived as more prominent than in the original Porter's concept. However, in the case of tourism destinations, there is one more crucial factor: their localisation regarding main markets emitting tourism traffic and transportation infrastructure (Prideaux 2000, Varela and Navaro 2015), and both are behind the destination's purposeful shaping. Based on a particular location and its features, stakeholders involved in its development (public authorities, local and international enterprises, DMOs, third-sector representatives and others) create the destination's tourism product (Buhalis 2000), which can be described as in Middleton's (1994) classical model.

A tourism destination, by its nature, differs from most commercially competitive products. The product of the tourism sector is an experience that is delivered by a destination to its visitors (Sugathan and Ranjan 2019). This experience is produced not by a single firm but by all players who affect the visitor experience, namely, tourism enterprises (such as hotels, restaurants, airlines, tour operators, etc.), other supporting industries and organizations (such as the arts, entertainment, sports, recreation, etc.) and DMOs (whether private, public, or private– public partnerships) (Ritchie and Crouch 2011). Still, tourism destinations compete in the tourism market similarly to companies (Żemła 2016). For example, according to Flagestad (2002), a destination is perceived as a collective producer in a firm-like structure coordinating complementary services according to the needs and preferences of the target market, segmented and

Table 3. Major rationales for the creation of the proposed model of tourist destination competitiveness

Rationale	Theoretical background	Consequences	References
Special approach to Porter's concept of competitive and comparative advantage in the case of tourist destinations	- Competitive advantage of nations - Ritchie and Crouch's model of destination competitiveness	- The comparative advantage of destinations should be perceived as more prominent than in the original Porter's concept. - Underlining the role of location as a base for a tourist destination's competitiveness	Porter (1990), Ritchie and Crouch (2000)
Firm-like nature of competition between tourist destinations	- A firm as a metaphor of a destination - Destination as a product	- A destination's success starts with attracting the required number of desired visitors and satisfying their needs	Bieger (1998), Pechlaner (1999), Flagestad (2002), Żemła (2016)
The link between tourist attractiveness, destination choice, and perceived customer value	- Expected value theory - Tourist attractiveness concept - The choice set theory	- Prospective visitors chose their destinations relying on their perception of the value possible to get by visiting particular locations	Woodside and Sherell (1977), Woodside and Lysonski (1989), Woodruff (1997), Decrop (2006), Sanchez et al. (2006), Kim and Perdue (2011)
The role of destination image in destination choices by travellers	- The choice set theory - Destination image theory	- Prospective visitors do not create their decision setting out of the real products but rely on their limited and subjective knowledge. - Tourist destination marketers invest resources to create a favourable and desirable image.	Woodside and Sherell (1977), Woodside and Lysonski (1989), Pike and Ryan (2004), Decrop (2006), Kim and Perdue (2011), Stylidis (2022), Yang et al. (2022)
The need to integrate the outcomes of the resource-based view, industrial organisation economics, when developing tourist destination competitiveness	- Resource-based view - Industrial organisation economics - Discussion between RBV and IO and attempts to integrate them	- Building the competitiveness of a destination within the sector (IO) is insufficient, and it is necessary to manage the benefits and costs of tourism development in a way that secures the sustainable development of the destination (RBV) - Destinations should not only secure a generally high level of competitiveness (RBV), but the success of particular destinations starts with their ability to attract visitors in a competitive environment more effectively than their competitors do (IO)	Porter (1985), Barney (1991), Teece et al. (1997), Cho (1998), Flagestad and Hope (2000)

marketed as one unit under one brand. Similarly, Pechlaner (1999) defines it as a process-oriented unit of competition, which must be able to provide products and offers for defined target groups and guest segments.

The management-rooted theory of destination competitiveness, focused on the firm-specific characteristics of destinations, emphasises the notion of competitive advantage to explain why some locations are more successful than others in the tourism market (Tleuberdinova et al. 2024). As a result, one can state that a destination's success starts with attracting the required number of desired visitors and satisfying their needs (Carolici et al. 2006). Consequently, destination competitiveness is rooted in consumers' market decisions, and the choice set theory (Woodside and Sherell 1977, Woodside and Lysonski 1989, Decrop 2006) is helpful for better understanding competition between destinations. In the case of the tourism market, customers make choices between products (destinations) which are totally or at least partially unknown to them (this is because the decision is made in temporal and spatial distance from the product consumption) (Pan et al. 2021). It means that the prospective visitors do not create their decision sets out of the real products but rely on their limited and subjective knowledge of them (Tapachai and Waryszak 2000, Serrano-Arcos et al. 2021). As a result, the destination image can be indicated as the central element of the destination competitiveness-establishing process (Kastenholz 2002). Therefore, tourist destination marketers invest resources to create a favourable and desirable image, encouraging potential travellers to visit or revisit their destination (Martins 2015).

According to the rich literature on the destination image, it can be analysed through its three components: cognitive, affective and conative (Pike and Ryan 2004, Stylidis 2022, Yang et al. 2022). Additionally, it is created based on different sources, which leads to highlighting the difference between organic and induced images (Wang et al. 2021, Karri and Dogra 2023). The first is out of destination control, while the other is the effect of purposefully established, mainly marketing, messages (Gartner 1989, Szubert et al. 2021). In the case of tourism destinations, the special role of organic image can be mentioned (Chon 1990, Wang et al. 2023). Destination brands, which are geographic names, are much better recognisable than corporate brands, and often, a destination attracting visitors does not start its marketing actions with a "tabula rasa". People receive their knowledge about different places around the world from their education process (Szubert and Żemła 2019), media, including social media (Kim et al. 2017, Sun et al. 2021) and other people (Jalilvand 2017). Destination image is susceptible to stereotypes (Rahayu et al. 2017, Karri and Dogra 2023). Additionally, the destination image is strongly influenced by images of a bigger territory it belongs to (such as a country or a region) and by the images of smaller units (cities, resorts) located inside (Szubert et al. 2021).

Customer expected value is influenced by destinations' images (expected benefits and costs of visiting particular places) that a particular prospective visitor possesses

(Albaladejo and Díaz-Delfa 2021). Customer choices are shaped by this perception of values (Decrop 2006) but also by his/her characteristics (social, psychological, and previous experiences) and by numerous situational factors (Lindberg et al. 2019). This relation between a destination, its location, offer and image and a visitor and his/her choices is fundamental for the destination to attract tourists and establish its position in competition with other destinations (Buhalis 2000). However, following Ritchie and Crouch (2005) and other RBV-based models, building the competitiveness of a destination within the sector is insufficient. It is necessary to manage the benefits and costs of tourism development in a way that secures the sustainable development of the destination and the competitiveness of local tourism businesses (Ritchie and Crouch 2005, Nowak and Ulfik 2018).

Results

The classical model of the production process of tourism services (Figure 1), as presented by Smith (1994), was taken as a starting point for constructing the proposed model. This model presents how a tourism product is created and helps to understand the steps in establishing an attractive offer of a destination. This attractive offer stands for a most important reason why tourists choose to visit the destination, which is the necessary condition, still not a sufficient one, of a destination's competitiveness.

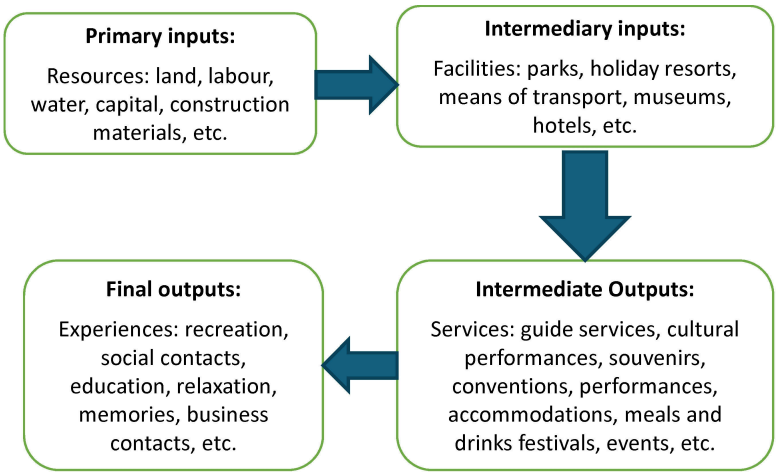

Figure 1. Smith (1994)'s model of the tourism production process. Source: own evaluation based on Smith (1994)

Smith (1994) distinguishes three stages of this process. Primary inputs to the system – resources such as land, labour, water, capital, construction materials, etc., must be transformed into intermediate inputs, which are all tourist facilities, such as parks, holiday resorts, means of transport, museums, hotels, etc. Only from them do we obtain

intermediate outputs, i.e. accommodation, catering, guide services, festival and museum services. The most important postulate of the cited model, however, is to indicate the need for further planned transformation of these elements, so that they become the final outputs of the production process - i.e. the consumer's experiences, which can be defined as recreation, education, business contacts, memories, adventure, etc. The first stage leads to the achievement of a specific service potential by a given entity, which reflects the tourism product being ready to be offered to visitors. The condition for starting the proper phase of service production is the emergence of a consumer. In contrast to other services, in tourism, the only external factor in the production of services is almost always the participation of the service recipient. Analysing the production of services in a tourist destination, it can be seen that this participation is also much broader than in most other service markets. The task of the first phase of the production of the tourist product is to create a broad offer consisting of many substitute and complementary elements, the acceptance of which by the consumers is reflected in their choices, i.e. the decisions to visit a specific destination. However, the fundamental task of the consumer in the process of product production is not only to devote his/her time and effort to the consumption of the offered services, but above all to choose from among the services and forms of spending time offered on site, those that best suit his/her preferences and possibilities. The tourist not only chooses which elements of the offer proposed to him by the service providers he will use, but also decides when and how. In addition, his/her final experience related to undertaking a tourist trip depends to a large extent on his/her attitude, behaviour and emotional involvement, which in Smith (1994)'s model is identified with the tourist product, which reflects the last, third stage of Smith (1994)'s tourist product production process.

The Smith (1994)'s model of tourism production can be also useful in understanding how the competitiveness of a destination is being established. Particular phases of the production process illustrate how the destination and its product gain their ability to attract tourists and build their value proposal. The basis for creating a high expected value by the tourist destination is therefore resources that are shaped by the natural and historic conditions. They are related primarily to particular location. They constitute the primary inputs to the production process. It can be assumed that these conditions are the result of the location of the tourist destination in a specific place in geographical, social and economic space. Location is to considered also in relation to individual tourist traffic emission markets, other tourist areas and traditional communication routes. All these features of a location are permanent and independent of the current activities of entities managing tourism. We also note that, unlike corporate markets, in the case of competition between destinations, from the very beginning, there will be privileged areas and those whose location makes it difficult to build a competitive tourist offer.

Nevertheless, the location and its features itself does not determine the value expected by the potential tourists. Equally important is the effective use of a given location. Creation of a competitive tourist offer depends on both the intentional and unintentional actions of all entities shaping the tourist destination product, as well as on the fixed features of the location. These actions concern both the real sphere related to the broadly understood development of tourism space, including tourism investments, planning and policy, as well as the information sphere, related to, among others, the flow of information between entities co-creating the destination product and the promotion of the destination among potential investors. The large number of entities participating in the process of shaping the destination product and the complex relationships between them, as well as a number of other features of the destination product, mean that in most cases there is no single entity that would fully control, steer and bear responsibility for shaping the destination offer.

In order to create the high value expected by potential visitors, it is also necessary to appropriately disseminate information about the offer. This should be aimed at establishing a favourable image of the destination and its tourist product. The destination choice depends primarily on the destination-specific package of benefits, the provision of which is expected by a visitor in connection with the stay in the destination. This perception is rooted in the destination's image. It should be remembered that the image depends on both the fixed elements of the location, the actual tourist offer and purposeful and accidental actions aimed at shaping it. It also depends on a number of uncontrollable and difficult to predict events, including decisions by celebrities, artists, journalists and other media workers, which make information about a given area appear in the media or in art independently of the promotional policy conducted in the destination. The image of a specific destination is also influenced by the image of larger tourist areas in which it is located, which, in a sense, is also a result of its location. As a response, destination managers and marketers put special attention on destination branding (Szondi 2007, Vesalon and Creţan 2019) and studying negative stereotypes that may negatively influence the destination image (Szubert and Żemła 2019, Szubert et al. 2021, Gajić et al. 2023).

The value expected by the consumer is primarily the effect of the first phase of production of tourist services in Smith (1994)'s model. Therefore, offering an expected value higher than that of competitors may have its source in three basic elements. Firstly, it may be a higher level of primary inputs than in the case of competitors. Secondly, it may be a higher level of perfection of the process of their transformation into secondary inputs, allowing for the creation of a better tourist offer. Finally, remembering that expected value is a specific idea of what a tourist can expect in a given destination, and a potential visitor makes a comparison not based on real facts, but on his incomplete knowledge and ideas about them, the source of a higher assessment of

expected value may be the development of a desired image of the destinations' product in the eyes of visitors.

The model of destination competitiveness

Based on the above argument, it is possible to build a model showing the basic relationships leading to the competitiveness of a tourist destination (Figure 2). The expected value, and indirectly the competitiveness of a tourist destination, is influenced by three main factors: location, destination's offer and the destination image whereby the location indirectly influences the expected value through its impact on the tourist offer and on the image, which is also dependent on the offer. Based on these three elements, a tourist choosing a destination will assess the expected customer value offered by individual tourist destinations. However, different people will make different decisions in different situations based on assessing the value offered by a tourist destination. This will be influenced by both situational factors and the characteristics of the buyer himself/herself, such as financial, time and informational limitations, as well as psychophysical, political or legal factors. Situational factors may include the current mood, interactions with people from the surroundings, current weather, and information provided by the media at a given moment. These factors can cause a shift in the hierarchy of importance of individual selection criteria, and also affect the particular focus on the consequences of the latest information obtained by the potential tourist making the choice.

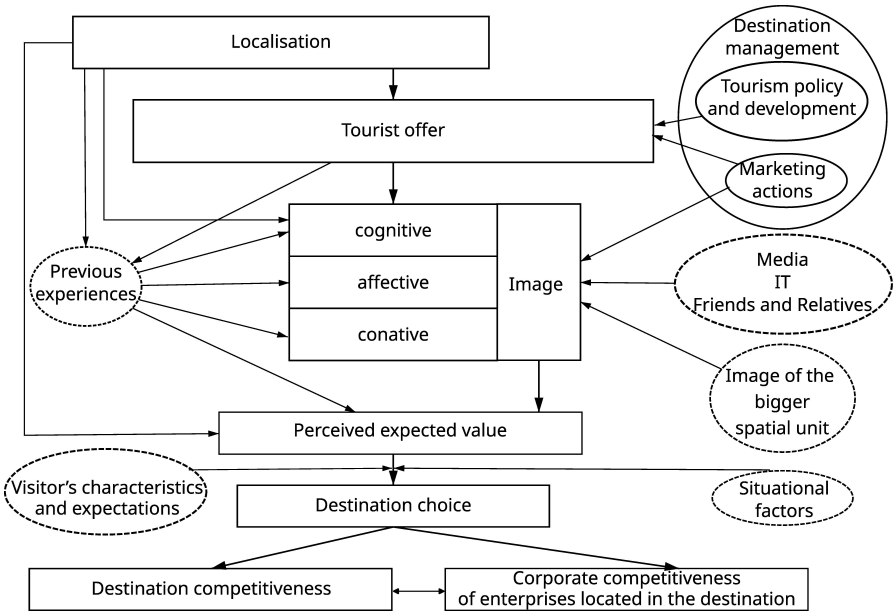

Figure 2. The proposed model of tourist destination competitiveness

Discussions

The presented model of destination competitiveness offers a new approach to the issue as it combines approaches typical for the industrial organisation economics (Porter 1985) and for the resource-based view (Hamel and Prahalad 1994). It is based on works published so far, and enriches these works by the simultaneous use of concepts often perceived as contrary (Flagestad and Hope 2001). That was possible by underlining consumers' point of view and making the destination image the central issue of the model. Even though such an approach had not been offered by the literature, all relations building the model were already studied and proven. That is the reason why the model can be presented as a theoretical construct without detailed empirical justification. The approach to destination competitiveness presented in the model is expected to be useful for a better understanding of the phenomenon for both practitioners and theoreticians of destination management.

Practitioners, especially destination policymakers, may benefit from the model by developing long-term strategies and improving destination performance (Baggio et al. 2010), acknowledging the role of localisation, offer, and image in the creation of visitors' expected value (Pandža Bajs 2015). Especially, the role of destination image is to be underlined as prospective visitors do not build their expectations on the real offer but on their perception of it (Gallarza et al. 2002, Kastenholz 2002). For scientists, the model is the next step towards a more comprehensive understanding of relations conditioning the long-term success of a destination (Bain 2009, Lewis-Cameron and Brown-Williams 2022).

Conclusions

Similar to any other publication, the presented paper is influenced by several limitations, which indicate the direction of future studies. Destination competitiveness is an extremely complex issue, and any model presenting it must rely on significant simplifications. This is also the case with the presented model. It is focused on its core, constituted by the relation of localisation, offer, destination image, expected value, and competitiveness, but the factors influencing these elements are only mentioned and need to be further developed, especially as most of them are also studied in detail in the literature.

The presented model also does not repeat the content of the most prominent previous destination competitiveness models, such as the Ritchie and Crouch (2000, 2005) and Dwyer and Kim (2003) ones, which focus on the relation between the competitiveness and sustainable development of a destination. Offering a high expected value to prospective visitors is a prerequisite condition of destination competitiveness. However, it should never be perceived as the only or sufficient condition. The

destination's sustainable development must also be secured. A clear illustration of the relation between localisation, offer, image, expected value, and destination sustainability, strongly underlined by Ritchie and Crouch (2000, 2005), is the most desired outcome of prospective studies. The question of transferring the market success into the long-term sustainability of a destination is the key. However, the difficulty of this task results not only from the complexity of the term "destination competitiveness", but also from the fact that destination sustainability itself is differently understood (Hunter 1997, Jørgensen 2024) and difficult to operationalise (Butler 2005, McCool et al. 2013).

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Alcohol consumption patterns in modern Russia: an analysis of regional differences

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Abstract: In the last 20 years, there has been a change in drinking habits in Russia, characterized by a decrease in the amount and potency of alcohol being consumed. This article aims to identify regional distinctive features in alcohol consumption patterns in Russia. The study uses panel data from RLMS-HSE annual surveys based on a representative sample of the population for 2014, 2018, and 2022, and Russian official statistics on alcohol purchases and consumption. The research results confirm that the northern style of alcohol consumption persists in the Ural, Siberia, and the Far East regions of Russia. A shift towards a mixed drinking pattern is apparent in most of the country, particularly noticeable in Moscow, Central Russia, and the Northwestern federal district. Southern wine-producing regions do not demonstrate a transition to the "southern" wine-oriented model of alcohol consumption, exhibiting relatively low levels of alcohol consumption per capita. Overall, beer remains the dominant and most popular alcoholic beverage in all regions of Russia. This study contributes to understanding regional differences, as well as economic and institutional factors that influence alcohol consumption. The territorial characteristics of alcohol intake highlighted in the article help outline potential strategies for regulating alcohol policy in Russia.

Keywords: alcohol consumption patterns; national drinking habits; regional economy; Russian longitudinal monitoring survey; Russia

Introduction

For many years, Russia has been among the leading countries in terms of alcohol consumption per capita (United Nations 2024). Despite the fact that there has been a decrease in the average annual volume of alcohol consumed in the last two decades (EMISS 2024) recorded a reduction from 10.8 litres of absolute alcohol per capita being consumed in 2010 to 8.44 litres in 2023), alcoholic beverages remain an integral part of the lifestyle of a significant portion of the country's population. The so-called "northern" model of alcohol consumption was characteristic of Soviet and post-Soviet Russia (Pozdnyakova 2011, Radaev 2022), associated with a focus on spirits (typically

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vodka). In the 1990s, alcohol sales volumes in the country increased significantly, however, since the 2000s, there have been changes both in the volumes and in the structure of alcohol consumption. In particular, there has been a shift from strong alcoholic beverages to predominantly beer consumption, which in some publications was defined as a transition to a "Central European" model or a "mixed" style of alcohol consumption (Popova et al. 2007, Martynenko and Roshchina 2014, Radaev 2016). Additionally, there has been a growing proportion of residents (especially among the youth) who completely abstained from alcohol consumption (Radaev et al. 2020, Radaev and Roshchina 2021). The reasons for such transformations were often attributed to economic factors and changes in the income of various socio-demographic groups of the population (Martynenko and Roshchina 2014, Kotelnikova 2015, Razvodovskiy 2021, Eltsov and Khorkina 2023), government policy and regulation of alcohol prices (Radaev and Kotelnikova 2016, Neufeld and Rehm 2018, Kossova et al. 2023), as well as generational changes in cultural values (Radaev 2020, Kueng and Yakovlev 2021, Kondratenko 2022).

Russian society is characterized by a large geographical extent and diversity of values and lifestyles of different population groups. The country exhibits notable disparities among its regions regarding socio-economic development indicators, living standards, and the ethnic, cultural, and religious makeup of its population. According to Zasimova and Kolosnitsyna (2020), who analyzed Rosstat data from 2010 to 2016, alcohol consumption per capita in Russia varied significantly across different regions, ranging from 1.1 to 17.8 litres. The southern regions of European Russia, particularly the North Caucasus republics where Islam is predominantly practised, exhibited the lowest consumption rates. In contrast, the northern regions of European Russia and the Far East recorded the highest alcohol consumption rates, exceeding 10 litres of industrial alcohol per capita. Additionally, Moscow, the Moscow region, St. Petersburg, and the Leningrad region also showed relatively high levels of alcohol consumption (Zasimova and Kolosnitsyna 2020). These regional variations in alcohol consumption levels were influenced by factors such as the unemployment rate, population size of the administrative-territorial entity, overall urbanization, climatic conditions, and regional government policies on alcohol sales and restrictions (Kossova et al. 2017, Kolosnitsyna et al. 2017).

Regional characteristics of alcohol consumption models in Russia at the present stage remain insufficiently studied. The focus is rarely on a regional analysis not only of the volumes of consumed alcohol and varieties of alcoholic beverages, but also on the accompanying situations of alcohol consumption (during meals or outside of them, at home, in a bar or restaurant, at gatherings, etc.). Nevertheless, these parameters allow for a better understanding of the specifics of alcohol consumption models (northern, southern, mixed) in different regions of Russia, and on this basis, predicting and adjusting the direction of alcohol policy.

Methodology

There is a wide variety of alcoholic beverages, but the most common worldwide are beer, wine, and spirits (Grigg 2004). Typically, when describing a specific model of alcohol use, authors tended to emphasize the frequency and quantity in which each of the three previously mentioned beverages was consumed. The widely recognised classification of alcohol consumption models generally divided them into northern (or Northwest) and southern (or Mediterranean) types (Hupkens et al. 1993, Grigg 2004, Marinelli et al. 2014, Brierley-Jones et al. 2014, Bloomfield et al. 2017).

Since beer is mainly a grain-based beverage, and grains can be grown not only in southern but also in relatively northern latitudes, beer is often considered part of the northern model. However, beer is also popular in southern countries. Spirits, typically strong drinks with an alcohol content of 30-50%, are also characteristic of northern latitudes. The raw materials used to produce spirits are diverse, comprising sugarcane, beets, potatoes, corn, barley, wheat, rice, grapes, various fruits, and a wide array of other plants. Therefore, unlike wine and even beer production, the making of spirits is not significantly affected by climate-related constraints (Grigg 2004).

In the southern or Mediterranean model of alcohol consumption, wine is the predominant beverage (Table 1). The noticeable rise in the consumption of beer, ciders, and spirits in recent decades was seen as an indication of globalization's impact on drinking culture, particularly in countries with traditionally high wine consumption per capita, such as Portugal, Italy, France, Spain, and Greece. For example, Italian researchers expressed concern that young people were drinking wine less frequently and associated this drink only with festivities. However, alcohol consumption did not decrease; wine was simply replaced by other alcohol (typically stronger), leading to changes in consumption patterns.

Table 1. Main characteristics of alcohol consumption models

	Southern (Mediterranean) model	Northern model
Dominant alcohol beverage	wine	beer and spirits
Regularity	quite regularly, alcohol is part of everyday life	weekends, holidays
Amount of alcohol consumed	moderate drinking	binge drinking
Relation to meals	during meals or before meals as an aperitif, in restaurants, during home dinners (home drinking pattern)	outside of meals, often outside the home (traditional or social drinking pattern)
Focus	quality of the drink	quantity of the drink
Purpose	enjoyment of taste, food decoration, relaxation	socialisation, fun
Consequences	often absent	noisy, uncontrollable behavior, violation of social norms

Source: compiled based on Hupkens et al. (1993), Grigg (2004), Marinelli et al. (2014), Brierley-Jones et al. (2014), Bloomfield et al. (2017), Holmes and Anderson (2017)

The transition from the southern to the northern alcohol consumption model faced criticism due to the northern model's association with alcohol abuse, binge drinking, and the tendency to consume alcohol outside the home. Interestingly, the decrease in wine consumption was attributed by authors to a lack of knowledge about this drink among young people (Marinelli et al. 2014).

The northern and southern models differ not only in the type of beverage consumed but also in the character of alcohol consumption. Despite globalization diversifying consumption models, there were certain stable features in alcohol consumption specific to the northern or southern type (Holmes and Anderson 2017).

In the northern model, alcohol consumption was typically associated with celebrations or special occasions, frequently occurring in social settings and serving as a means of socialization, often without the accompaniment of food. One of the negative aspects of this model was the tendency towards excessive alcohol consumption, such as binge drinking. In the southern model, alcohol, specifically wine, was integrated into everyday life. Wine was consumed quite frequently, but moderately, usually during meals, in the company of family or friends, for relaxation and pleasant conversation (Brierley-Jones 2014). In Mediterranean countries, the taste and aromatic properties of wine were valued, with special importance placed on specialized vessels and serving to match the atmosphere of the gathering.

Due to geographical reasons, the northern type of alcohol consumption was more common, while the southern model was mainly characteristic of winemaking countries and regions where wine was directly produced. In addition to dividing countries into northern and southern, there was another division that focused on the dominant type of beverage consumed. In this concept, countries were divided into beer-focused, wine-focused, or spirits-focused (Holmes and Anderson 2017, Bentzen and Smith 2018).

For a long time, the traditional division in the wine world was between "old" and "new" world. The "old world" referred to wine-oriented European countries – the pioneers of wine production (Greece, France, Italy, Spain, Portugal, Germany, Austria, Hungary, as well as Armenia and Georgia), while the "new world" included wines from the "big six" countries (USA, South Africa, Chile, Argentina, Australia, and New Zealand) (Anderson and Pinilla 2018, Giacomarra et al. 2020, Ivanková et al. 2021). Belonging to the "old world" was determined by factors such as traditions, producer craftsmanship, connection with a specific region of grape cultivation, its historical and cultural heritage, quality standards, exclusivity, and production methods used (Banks and Overton 2010, Overton et al. 2012). In "old world" countries, the social representation of wine was associated with national identity, tradition preservation, while in "new world" countries, wine production was seen as a creative, innovative, and often experimental process. Wine consumption was considered an act of social interaction – hence the phenomenon of social drinking or alcohol consumption for the purposes of social capital formation (Mouret et al. 2013).

From a geographical perspective, Russia should be classified in the "old world" category, with some nuances. Contrary to traditions in the "old world", Russian wines are often characterized by grape variety rather than the region of origin (Giacomarra et al. 2020). In this sense, Russian wine culture is closer to the "new world," yet Russian winemaking has evolved under the influence of European traditions and technologies, evident in the names of wineries and how Russian wines are positioned by the producers themselves (Klimenko et al. 2023, Klimenko and Krivosheeva-Medyantseva 2024).

It is worth noting that over the past twenty years, many countries once focused on spirits have transitioned to beer, and Russia is among those countries (Kossova et al. 2017, Radaev 2022). Beer is currently the most popular alcoholic beverage among the Russian population. The wine culture in Russia can be characterized as developing. There are many factors that can influence the choice of wine over other alcoholic beverages; among them the awareness of local producers and brands and the established characteristics of the national wine culture (Boncinelli et al. 2019).

Aiming to identify regional differences in alcohol consumption patterns among the Russian population (for the period from 2014 to 2022), the empirical basis of the study included the following data:

1) Official statistics: a) information on the volumes of per capita alcohol consumption by the population, collected by the Ministry of Health of the Russian Federation; b) data on retail sales of alcoholic products from industrial production, collected by the Federal Service for Alcohol Market Regulation and Tobacco Control (FSRAR 2024).
2) Results of all-Russian longitudinal sociological research obtained within the framework of the Russian Longitudinal Monitoring Survey on Socio-Economic Status and Health of the Population of National Research University Higher School of Economics (RLMS-HSE 2024). In surveys conducted on the Russian population using a probability-stratified, multistage territorial sampling method (Table 2), detailed and representative data were collected on the types of alcoholic beverages consumed, the quantities consumed, and the frequency of consumption within the 30 days preceding the survey.

Table 2. Characteristics of the sample in the sociological study RLMS-HSE (number of respondents)

Year	RF	Moscow	CFD	NFD	FEFD	VFD	SibFD	UFD	SFD
2022	17465	1570	3298	1511	428	3862	2039	1456	2272
2018	17258	1506	3316	1652	443	4128	2139	1567	2507
2014	16436	1513	3305	1713	476	4264	2227	1504	2463

Source: RLMS-HSE (2024)

Note. For tables and figures here and later in the article: RF – Russia; CFD – Central Federal District (without Moscow); NFD – Northwestern Federal District; FEFD – Far Eastern Federal District; VFD – Volga Federal District; SibFD – Siberian Federal District; UFD – Ural Federal District; SFD – Southern Federal District; NCFD – North Caucasus Federal District.

The authors of this article used data from RLMS-HSE for the years 2014 (23rd wave), 2018 (27th wave), and 2022 (31st wave). Respondents living in the territories of the federal districts of the Russian Federation (excluding the North Caucasus Federal District, for which there was insufficient data for regional representation) were selected from the entire surveyed sample. The sampling design of the RLMS-HSE study allowed for separately analysing and considering the survey results for the population of Moscow.

Discrepancies in the indicators from official statistics gathered by the Ministry of Health and Rosstat, along with the outcome of population survey results, are the result of variations in methodological approaches to data collection and processing. At the same time, as Radaev (2022) rightly pointed out, statistical data on the volume of alcohol consumption and survey data on the share of its consumers effectively complement each other, because despite differences, the overall trends and structure of alcohol consumption are reflected in a similar manner.

Results

Regional differences in alcohol consumption in Russia: an analysis of official statistics

The transformation of alcohol culture in Russia aligned to global trends, characterized by a decline share of spirits consumption and a raising number of abstainers. Research by Kotelnikova (2015) and Radaev (2022) demonstrated fluctuating dynamics of alcohol consumption indicators in Russia, but the overall trend was the diversification of the northern consumption model.

Since the early 2000s, observations have revealed a decrease in per capita consumption of vodka and spirits, alongside a corresponding increase in beer consumption. While wine consumption indicators have also risen, they lag significantly behind beer and vodka. This disparity has been partly due to Gorbachev's anti-alcohol campaign and the economic difficulties of the 1990s, which impacted the grape-growing industry, a sector still attempting to recover (Klimenko and Krivosheeva-Medyantseva 2024). By 2022 (Table 3), beer was the most popular alcoholic beverage among Russians (66.57 million litres consumed), followed by vodka (7.77 million litres) and wine (7.65 million litres). Researchers have also identified a cyclical nature to alcohol consumption, noting that regional prosperity and urbanization are positively associated with alcohol consumption (Kossova et al. 2017, Kotelnikova and Radaev 2017, Razvodovskiy 2021).

Regional comparisons of alcohol preferences in the period from 2008 to 2012 showed that against the general background of decreasing alcohol consumption in the population in the Northern European part of Russia and the Far East, there was an opposite trend of increasing alcohol consumption: in 15 regions, including the Central-Chernozem zone, the Southern Volga region, and Transbaikalia, the rise in absolute

alcohol consumption was attributed to a significant increase in beer consumption, as vodka consumption either decreased or remained stable (Kossova et al. 2017).

Table 3. Average per capita consumption of industrially produced beer, wine, and vodka in 2014, 2018, and 2022

	Beverage	RF	Moscow	CFD	NFD	FEFD	VFD	SibFD	UFD	SFD	NCFD
2022 in litres per capita	beer	57.8	38.3	64.4	59.7	66.6	64.5	65.1	77.1	48.1	13.8
	wine	6.6	9.7	7.7	10.5	6.3	5.0	5.3	6.7	6.3	1.5
	vodka	6.7	5.1	7.9	8.8	10.1	7.3	6.2	7.2	4.9	1.9
2022 in litres of pure ethanol per capita	beer	2.9	1.9	3.2	3.0	**3.3**	3.2	3.2	**3.8**	2.4	0.7
	wine	0.8	**1.1**	0.9	**1.2**	0.7	0.6	0.6	0.8	0.7	0.2
	vodka	2.7	2.0	3.2	**3.5**	**4.0**	2.9	2.5	2.9	1.9	0.7
2018 in litres per capita	beer	56.0	43.4	60.0	55.4	85.9*	58.9	60.4*	65.2	52.9	12.5
	wine	5.9	8.9	6.7	9.3	5.9*	4.4	4.8*	6.3	5.4	1.3
	vodka	6.3	5.7	7.4	8.5	9.5*	7.0	5.4*	6.5	4.1	1.3
2018 in litres of pure ethanol per capita	beer	2.8	2.1	3.0	2.7	4.2*	2.9	3.0*	3.2	2.6	0.6
	wine	0.7	1.0	0.8	1.1	0.7*	0.5	0.6*	0.7	0.6	0.2
	vodka	2.5	2.3	2.9	3.4	3.8*	2.8	2.2*	2.6	1.6	0.5
2014 in litres per capita	beer	69.4	44.5	69.6	100.5	90.9	73.8	65.0	82.7	56.1	21.5
	wine	6.6	8.9	7.5	10.4	8.4	5.3	5.2	6.7	5.0	1.8
	vodka	6.7	5.9	7.1	9.2	11.9	7.1	6.8	7.3	3.5	1.3
2014 in litres of pure ethanol per capita	beer	3.4	2.2	3.4	5.0	4.5	3.6	3.2	4.1	2.8	1.1
	wine	0.8	1.0	0.9	1.2	1.0	0.6	0.6	0.8	0.6	0.2
	vodka	2.7	2.3	2.9	3.8	3.8	3.0	3.2	3.0	1.4	0.5

Sources: FSRAR (2024); Rosstat (2024); the Ministry of Health (2024)
Note: The data marked (*) reflect the 2018 territorial changes moving Zabaykalsky Krai and the Republic of Buryatia from SibFD to FEFD; the updated adult population figures for both the FEFD and SibFD have been incorporated in calculations. The data for 2014 reflects the territorial boundaries that were in effect at that time.

Historically, different territories of Russia were characterized by different ethnocultural and confessional norms and traditions regarding alcoholic beverages. The spread of Islam in the North Caucasus led to lower indicators of pure alcohol consumption per capita in the southern regions, whereas in the north-western and north-eastern territories with cold climates and challenging living conditions, these indicators were several times higher than the national averages. As researchers (Mulik et al. 2020) pointed out, living in northern latitudes was considered one of the risk factors for alcoholization of the population due to the prolonged exposure to low temperatures and the short daylight hours during the winter period. Additionally, alcoholic beverages were relatively more popular in Moscow, St. Petersburg and their surrounding regions; higher levels of alcohol consumption in these regions were facilitated by tourist attractiveness, developed hospitality and restaurant businesses, and higher incomes of residents.

Overall, regional differences in alcohol consumption indicators were influenced by urbanization, population size, unemployment rates of the administrative-territorial entity, and the climate characteristics of the region. Government regulation measures were another significant factor in shaping regional differences in the volume and structure of alcohol consumption (Kolosnitsyna et al. 2017, Zasimova and Kolosnitsyna 2020). Following 2009, rising excise taxes drove up alcoholic beverages prices, and by 2011, mandatory federal restrictions on evening and night-time sales were introduced. Previously, Russian regions could regulate the presence and requirements of these restrictions at their discretion. Statistical analysis showed that in regions with stricter restrictions, alcohol consumption indicators, including moonshine consumption, were noticeably lower (Kolosnitsyna et al. 2017, Zasimova and Kolosnitsyna 2020). Currently, anti-alcohol policies are standardized across regions, enforcing minimum retail prices for spirits and sparkling wines alongside uniform sales hours.

Analysing regional indicators through official statistics, the Ministry of Health of the Russian Federation reported that in 2018 and 2020, average per capita alcohol consumption (registered and unregistered alcohol) was 9.4 and 9.1 litres of pure alcohol per year, respectively. Against this backdrop, alcohol consumption levels were above average in the North-Western, Volga, Ural, Siberian, and Far Eastern Federal Districts (reaching 11.6 litres). These regions also exhibit the most pronounced gap between consumption and sales figures of alcoholic beverages, indicating the widespread use of unregistered alcohol (Figure 1).

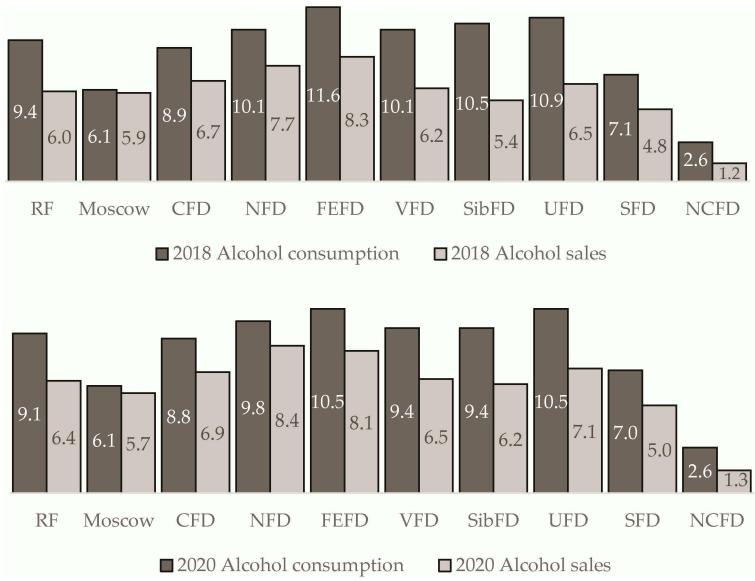

Figure 1. Consumption and retail sales of alcohol in Russia in 2018, 2020 (litres of pure alcohol per capita per year)
Source: Russian Research Institute of Health (2021)

Another set of data was presented in the EGAIS system (FSRAR 2024), reflecting retail sales of various categories of alcoholic beverages in Russia. We examined the period from 2014 to 2022. Against the backdrop of the prevailing popularity of beer, a decline in its consumption volumes was observed (from 8068 to 6657 million litres per year). Minimal fluctuations with a tendency towards stability were recorded for other categories of beverages. In 2022, vodka (777 million litres sold) and wine (765 million litres respectively) ranked second and third in popularity among alcoholic beverages. Other types of alcohol lagged behind in sales volume compared to this leading trio (Figure 2).

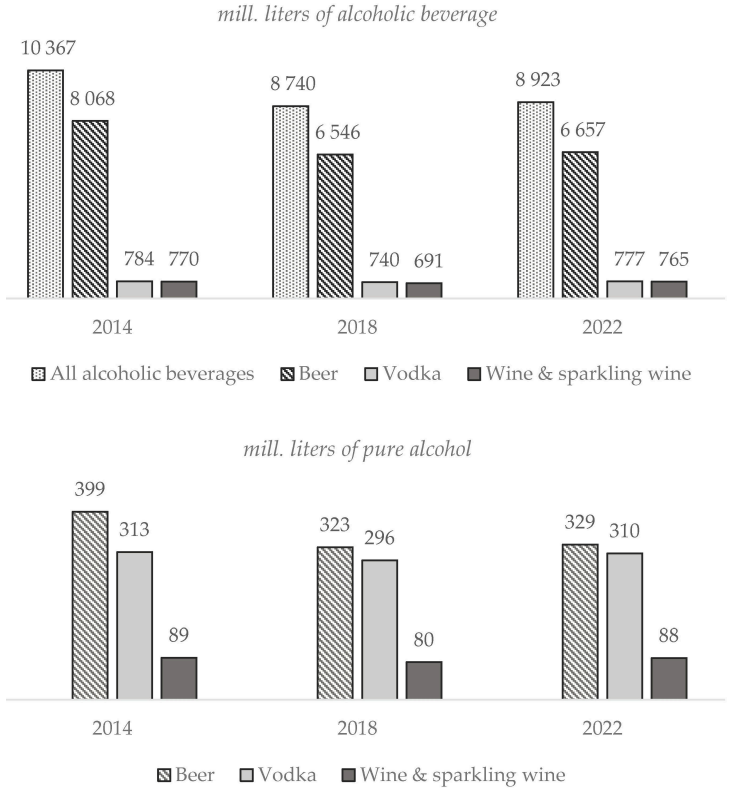

Figure 2. Retail sales of alcoholic beverages in the Russian Federation according to the Unified State Automated Information System – EGAIS (FSRAR) data for the years 2014 to 2022. Source: FSRAR (2024)

The calculation of per capita consumption of industrially produced beer, wine, and vodka for the adult population (over 18 years old) of Russia showed that beer was the dominant type of alcohol not only in terms of the volume of consumption of the beverage itself but also in terms of the volume of pure ethanol consumed with beer. However, it should be noted that beer consumption volumes in Russia were gradually decreasing, especially in Moscow, the North-western and Southern federal districts. At the same time, the highest per capita beer consumption in 2022 was observed in the

Ural, Far Eastern, and Siberian federal districts (Appendix Figure A1). Throughout all the analysed years, vodka consumption in the Far Eastern and North-western federal districts significantly exceeded the average values. In 2022, the amount of ethanol consumed per capita from beer in almost all federal districts, except the North-western and Far Eastern ones, exceeded the amount of pure alcohol consumed with vodka.

It should be noted that Russian citizens obtained the smallest amount of ethanol from wine. The most "wine-oriented" regions turned out to be Moscow and the North-western federal district. In the Southern federal district, where most of the Russian winemaking enterprises are located, wine consumption was lower than the average level. It can be concluded that the southern regions of Russia are characterized by moderate alcohol consumption, meanwhile, the spread of the southern (wine-oriented) model of alcohol consumption was not yet confirmed.

Features of alcohol consumption models in the regions of Russia

The RLMS-HSE adult questionnaire included a part dedicated to alcohol consumption, which we analysed for the years 2014, 2018, and 2022 in regard to how often respondents drank alcoholic beverages in the last 30 days. Based on 2018 data (this question was not asked in 2022), the proportion of regular drinkers—consuming alcohol at least once a week—was the highest in Moscow (44%), the North-western Federal District (44%), as well as the Ural (43%) and Volga (39%) federal districts. In contrast, the Far Eastern Federal District had the lowest frequency of regular drinkers (23%), while the consumption pattern in Russia's Central regions remained consistent (Table 4).

Table 4. The frequency of alcoholic beverages consumption in the last 30 days (in %)

	Frequency	RF	Moscow	CFD	NFD	FEFD	VFD	SibFD	UFD	SFD
2018	every day	1	3	1	2	1	0	1	1	1
	4-6 times a week	2	4	2	2	-	1	3	3	1
	2-3 times a week	12	13	12	12	11	12	11	16	10
	once a week	23	24	23	28	11	26	19	23	22
	2-3 times a month	35	30	36	29	51	34	39	33	41
	once a month	26	26	25	27	27	26	27	24	26
2014	every day	2	3	2	1	1	1	1	3	1
	4-6 times a week	1	2	2	2	2	1	2	1	0
	2-3 times a week	10	12	10	13	12	12	7	11	7
	once a week	26	30	27	35	23	25	21	27	23
	2-3 times a month	36	28	33	31	39	38	38	34	45
	once a month	24	24	26	17	23	22	31	25	25

Source: RLMS-HSE (2024)

Note. Here and throughout the article, statistics from RLMS-HSE surveys are presented without options "do not know," "refusal to answer," and "no answer."

According to the structure of alcohol consumption from 2014 to 2022 (Table 5), beer was the leading choice (consumed by approximately half of respondents in the month prior to the survey). In contrast, fortified wine and strong spirits (such as brandy as whiskey) were consumed least frequently. Against this backdrop, beer consumption increased in the North-western (+8%), Volga (+7%), and Ural (+6%) federal districts.

Table 5. Alcohol beverages consumed in the last 30 days (in %)

	Year	Answer	RF	Moscow	CFD	NFD	FEFD	VFD	SibFD	UFD	SFD
Have you consumed mass-produced beer in the last 30 days?	2022	yes	56	43	53	51	59	60	59	66	54
		no	44	57	47	49	41	40	41	34	46
	2018	yes	54	49	50	43	55	56	61	63	57
		no	46	51	50	57	45	44	39	38	44
	2014	yes	51	44	50	43	64	53	56	60	51
		no	49	56	50	57	36	47	44	41	49
Have you consumed mass-produced dry wine or sparkling wine in the last 30 days?	2022	yes	26	48	30	28	13	18	23	19	19
		no	74	52	70	72	87	81	78	81	81
	2018	yes	24	39	29	29	18	18	22	19	18
		no	76	61	71	71	82	82	78	81	82
	2014	yes	22	29	21	29	14	20	21	18	19
		no	78	71	79	71	86	80	79	82	81
Have you consumed mass-produced fortified wine, including martini, vermouth, in the last 30 days?	2022	yes	9	15	7	8	4	9	9	7	4
		no	91	85	93	92	96	90	91	93	96
	2018	yes	7	7	8	8	3	9	6	8	4
		no	93	93	92	92	97	92	95	92	96
	2014	yes	9	10	8	9	6	12	8	8	7
		no	91	90	92	91	94	88	92	92	93
Have you consumed cognac, whiskey, liqueur in the last 30 days?	2022	yes	16	23	16	15	7	15	15	12	16
		no	84	77	84	84	92	84	85	87	84
	2018	yes	15	20	18	14	3	12	9	15	15
		no	86	80	82	86	97	88	91	85	85
	2014	yes	16	22	16	20	4	15	14	15	17
		no	84	78	84	80	97	85	86	86	84
Have you consumed vodka in the last 30 days?	2022	yes	31	24	28	34	61	40	23	25	33
		no	69	76	72	65	39	60	76	75	67
	2018	yes	37	29	33	37	57	46	32	36	40
		no	63	71	67	63	43	54	68	64	60
	2014	yes	39	32	39	40	49	45	36	36	36
		no	61	68	61	60	51	56	64	64	64

Source: RLMS-HSE (2024)

At the same time, vodka consumption decreased nationwide (from 39% to 31%), with notable declines in Central Russia (from 39% to 28%), Siberia (from 36% to 23%),

and Ural (from 36% to 25%). Vodka remained popular in the Volga Federal District (45% in 2014, 40% in 2022) and even more in the Far East, where consumption increased from 49% to 61%. Thus, the consumption pattern in the Far East aligned with the "northern" type, characterized by a limited variety of drinks consumed less frequently but with a higher alcohol content.

Wine was not a popular choice for most surveyed Russians (on average, 24% of the population consumed it). In the southern regions of Russia (where wine production is actively developing and wine tourism is promoted), the percentage of respondents who consumed wine at least once a month did not exceed 19%. However, wine consumption increased in Moscow (from 29% in 2014 to 48% in 2022) and in Central Russia (from 21% to 30%). Therefore, at the regional level, a shift from a northern to a mixed model of alcohol consumption was observed.

Regarding the accompaniment of meals with alcoholic beverages, most Russians drank alcohol during meals (at least 89%). Changes were observed in the attitudes linked to the consumption of alcoholic beverages before meals: 27% of Russians preferred an aperitif in 2014 and 56% in 2022. The alcohol consumption without food was not common, although it increased from 22% to 30% over the last eight years (Table 6).

Table 6. Preferences in alcohol consumption (in %)

Question asked	Year	Answer	RF	Moscow	CFD	NFD	FEFD	VFD	SibFD	UFD	SFD
Do you drink alcoholic beverages before meals?	2022	yes	56	53	66	40	57	50	58	69	41
		no	44	47	33	58	44	49	42	31	57
	2018	yes	56	14	30	22	12	36	34	39	17
		no	44	85	70	78	88	63	66	61	83
	2014	yes	27	17	34	16	16	37	25	31	19
		no	73	83	65	84	84	63	75	69	80
Do you drink alcoholic beverages during meals?	2018	yes	93	90	94	96	99	92	89	91	95
		no	7	9	6	4	1	8	10	9	5
	2014	yes	89	88	52	91	91	87	89	85	92
		no	11	12	48	9	9	13	11	15	7
Do you drink alcoholic beverages without food?	2022	yes	30	23	35	31	10	27	32	36	28
		no	69	77	64	66	89	72	68	64	70
	2018	yes	24	20	28	22	7	24	29	34	15
		no	75	80	72	78	93	76	70	66	84
	2014	yes	22	19	25	18	12	23	22	31	17
		no	78	80	75	82	87	76	78	69	82

Source: RLMS-HSE (2024)
Note. The question "Do you drink alcoholic beverages during meals?" was not asked in 2022.

Against this background, the most noticeable regional differences and dynamics were observed in terms of alcohol consumption before meals. Aperitifs had become

most popular in Moscow (an increase from 17% in 2014 to 53% in 2022), in the Central Federal District (from 34% to 66%), the Far Eastern Federal District (from 16% to 57%), and the Southern Federal District (from 31% to 69%). The consumption of alcoholic beverages without food (closer to the northern model) was most common in the Central, North-western, Siberian, and Ural Federal Districts (about a third of respondents). In these regions (except the Southern Federal District), there was an increase of at least one-tenth of respondents in this indicator. The residents of the Far East consumed the least alcohol without food (not exceeding 12%).

The increasing popularity of beer among Russians was determined by the fact that from 2014 to 2022, this drink had been the most consumed in most regions of the country (in terms of volume and number of days per month when the beverage was consumed). In 2022, beer was most consumed in the North-western (more than 1 litre per day – 45% and from 5 to 10 days per month – 23%) and Ural (42% and 21% respectively) Federal Districts. Most residents in regions consumed dry wine and sparkling wine, but not frequently (from 1 to 4 days per month). In the capital and surrounding regions of Central Russia, where wine was more popular, half of the respondents indicated that they did not drink more than 500 grams of wine per day (Moscow – 51%, Central Federal District – 56%). In Siberia and Ural, comparing to Central Russia, larger quantities of wine were consumed. Consumption of fortified wine was also infrequent, with consumption volumes comparable to regular wine (Table 7, Table 8).

Table 7. Consumer-reported volumes of industrially produced alcohol beverages consumption, 2022 (in %)

Alcohol beverage	Frequency	RF	Moscow	CFD	NFD	FEFD	VFD	SibFD	UFD	SFD
Beer	up to 0.5 litres	36	53	36	29	50	38	31	30	32
	from 0.5 to 1 litre	32	31	37	25	39	28	30	27	48
	more than 1 litre	30	15	26	45	11	29	37	42	20
Dry wine, sparkling wine	up to 0.5 litres	47	51	56	44	79	46	28	44	35
	from 0.5 to 1 litre	42	41	35	42	21	45	56	37	63
	more than 1 litre	10	9	8	13	0	7	14	19	3
Fortified wine	up to 0.5 litres	51	49	49	50	75	56	44	55	63
	from 0.5 to 1 litre	39	40	44	36	25	37	43	32	38
	more than 1 litre	8	11	7	14	0	6	8	13	0
Spirits (cognac, whiskey, liqueur)	up to 0.5 litres	72	75	79	65	100	68	58	70	86
	from 0.5 to 1 litre	24	24	18	31	0	26	35	30	14
	more than 1 litre	2	1	1	3	0	2	4	0	0
Vodka	up to 0.5 litres	49	56	51	49	55	49	37	38	64
	from 0.5 to 1 litre	46	42	46	46	42	45	55	55	34
	more than 1 litre	3	2	1	5	3	3	4	7	1

Source: RLMS-HSE (2024)

Table 8. Consumer-reported frequency of industrially produced alcohol beverages intake, 2022 (in %)

Alcohol beverage	Frequency	RF	Moscow	CFD	NFD	FEFD	VFD	SibFD	UFD	SFD
Beer	from 1 to 4 days	76	73	80	71	77	76	78	74	83
	from 5 to 10 days	17	18	15	23	8	16	17	21	15
	more than 10 days	4	8	3	5	0	3	3	5	2
Dry wine, sparkling wine	from 1 to 4 days	94	94	95	94	86	91	93	98	99
	from 5 to 10 days	4	5	4	5	0	6	3	1	1
	more than 10 days	1	1	0	0	0	0	1	1	0
Fortified wine	from 1 to 4 days	93	91	95	92	50	92	95	97	100
	from 5 to 10 days	4	7	4	0	0	7	0	0	0
	more than 10 days	1	2	1	0	0	0	0	3	0
Spirits (cognac, whiskey, liqueur)	from 1 to 4 days	92	93	91	91	63	93	94	98	92
	from 5 to 10 days	5	7	6	8	0	5	1	2	5
	more than 10 days	1	1	2	0	0	0	1	0	3
Vodka	from 1 to 4 days	83	76	84	80	76	85	84	82	87
	from 5 to 10 days	11	17	12	15	6	9	8	10	9
	more than 10 days	3	7	2	3	0	2	2	7	1

Source: RLMS-HSE (2024)

Following beer, vodka remained the second most popular drink among Russians (although its consumption continued to decrease). For most Russians, the frequency of vodka consumption and the amount consumed did not exceed 4 times a week and 500 grams. However, more than half a litre of vodka was consumed daily mainly in Siberia (35%), Ural (30%), and the north-western territories (31%). Among those surveyed who consumed alcohol at least once a month, other spirits (cognac, whiskey, liqueur) were consumed more frequently in comparison to vodka. Moscow, the North-western and the Far Eastern Federal Districts led in consumption frequency in this category, while the Siberian and Far Eastern Federal Districts led in the volume of spirits consumed.

Discussion

Reducing alcohol consumption is a critical task for many nations. The drive to lower the rate of alcohol use among the population is motivated by several key factors including the adverse effects of alcohol abuse on life expectancy (Danilova et al. 2020, Kossova et al. 2020, Kuznetsova 2020), and the societal and economic consequences, such as reduced labour productivity, increased crime rates, temporary economic losses, social insecurity, and the stigmatization of individuals struggling with alcohol dependency, as well as their families (Ivanková et al. 2021).

In the early 2000s, Russia ranked among the top five countries globally in terms of alcohol consumption per capita, facing a significant issue of excessive drinking.

To address this concern, a series of government interventions were implemented, such as establishing a unified state automated information system to monitor the production and distribution of alcoholic beverages (EGAIS). Additionally, regulations were put in place, including restrictions on alcohol advertising during specific hours and limitations on alcohol sales, aiming to tackle the situation prevalent in the 1990s and 2000s (Radaev and Kotelnikova 2016, Neufeld et al. 2020a, 2020b, Andreev and Churilova 2024). Besides, the blood alcohol limits while driving were lowered, and stricter restrictions were introduced on drinking in public places. All above mentioned measures proved their efficiency in Russia (The Lancet 2019). Generational shifts in values were observed in Russia – over the years, an increasingly smaller proportion of young people consumed alcohol. Alcohol consumption among young people also tended to be irregular (Blazhko et al. 2021, Kondratenko 2022). Therefore, the shift in Russia's alcohol consumption pattern towards reducing both the quantity and strength of alcohol consumed was evident (Radaev and Roshchina 2021).

Scholarly literature identified several main groups of factors that intersect to shape regional differences in alcohol consumption in Russia (Martynenko and Roshchina 2014, Kossova et al. 2018, Sadykova 2023, Andreev and Churilova 2024). They are: socio-economic factors, state regulatory measures, sociocultural factors, geographic and climatic factors.

Socioeconomic factors associate increased alcohol consumption with rising incomes. High alcohol consumption in Russia was more prevalent among middle-aged men with high and very high incomes (Pozdnyakova et al. 2011, Kossova et al. 2018, Shalnova et al. 2020, Karamnova et al. 2021, Sadykova 2023). However, as incomes grew, preferences shifted toward less alcoholic beverages (beer, wine), while vodka sales and their share in consumption exhibited a negative correlation with regional GDP growth and household income. Low-income restricted access to strong legal alcohol, creating conditions for the consumption of illicit alcohol and surrogates, which were more economically accessible for low-income groups —particularly in regions such as Siberia and the Far East (Nemtsov 2009, Razvodovsky and Zotov 2021). Medical and demographic studies recorded the highest alcohol-related mortality rates in these regions (e.g., Chukotka, Magadan Oblast, Buryatia) (Nemtsov 2016, Kossova et al. 2018, Lebedeva-Nesevrya and Gordeeva 2023, Andreev and Churilova 2024).

Another significant factor is urban vs. rural residence. According to Sadykova's (2023) study based on RLMS-HSE data, urban residents consumed alcohol more frequently than rural ones, but rural areas showed higher volumes of pure alcohol consumption, particularly among men. Regarding the link between alcohol consumption and crime rates, regional data vary. Lebedeva-Nesevrya and Gordeeva (2023) emphasized that retail alcohol sales did not always correlate with negative consequences. For example, Moscow exhibited high alcohol sales without a corresponding rise in crime or morbidity, whereas regions with low sales (e.g., the Siberian Federal District)

maintained high rates of these issues — likely due to a high share of illicit alcohol in consumption.

The second group comprises *state regulatory measures* governing alcohol production and consumption. In Russia, common policies include restricting alcohol sales hours, increasing alcohol prices, and setting minimum prices for certain beverages. However, some researchers argued that strict restrictions (e.g., limiting retail alcohol sales to just two hours a day in some regions) had only temporary effects and might have even exacerbated problematic drinking. Such measures targeted the average consumer but failed to account for high-risk groups (e.g., binge drinkers, consumers of alcohol surrogates) (Pozdnyakova et al. 2011, Andreev and Churilova 2024).

The third group involves *sociocultural factors*, particularly the influence of ethnic and religious norms. For instance, the contemporary re-Islamization of populations in southern Russian republics (Chechnya, Dagestan, Ingushetia, etc.) had led to a noticeable decline in alcohol consumption in the North Caucasus Federal District. In the early 2000s, these republics had consumption rates close to the national average (Kornekova and Baykov 2016). Religiosity's impact on reduced alcohol consumption—or complete abstinence—was especially pronounced in rural areas (Lebedeva-Nesevrya and Gordeeva 2023, Sadykova 2023). Higher education also reduced the frequency and volume of alcohol consumption in both urban and rural settings, with a more pronounced effect in rural regions (Sadykova 2023).

The most debated factors are *geographic and climatic*. Northern regions with cold climates tended to exhibit a "*northern*" model of alcohol consumption (predominantly strong spirits), while warmer, wine-producing regions followed a "*southern*" model. Russian data partially supported this pattern: remote, cold areas consistently showed high consumption of strong alcohol, whereas southern regions, despite a general trend toward diversifying the "northern" model, had not significantly shifted toward wine but increasingly favoured beer.

Additionally, recent data confirmed a spatial pattern in consumption, revealing spatial zonation in regional alcohol trends. The centre of consumption shifted from central Russia to the east: at the beginning of the century, Moscow had the highest consumption rates, but eastern regions then led (Kornekova and Baykova 2016).

Understanding regional differences in alcohol consumption patterns is crucial for designing effective public policies to reduce alcohol-related harm. Alcohol consumption significantly impacts the gender gap in life expectancy in Russia, directly and indirectly (through traffic accidents, injuries, and other external causes) increasing mortality—particularly among men. Consequently, regions with higher alcohol consumption exhibited wider gender mortality gaps, reaching 10–12 years in Russia (and up to 16 years in some regions) (Kossova et al. 2018).

The findings of this study allow us to observe alcohol consumption changes across Russia. We view this research as a crucial step toward understanding the various

drinking behaviours of Russians. The dominance of a certain alcoholic beverage can serve as a significant indicator of a shared drinking culture and societal values in the region. Given Russia's vastness and its multicultural population, a singular pattern of alcohol consumption cannot be established. Therefore, it is essential to investigate the differences in drinking habits of Russians within the context of the regional structure.

The multiplicity of data sources used in this research is because both official statistics and survey-based data have their limitations. Government statistics often account only for the volumes of officially traded alcoholic products, while information on the consumption of illegal alcoholic products is calculated based on other indicators (for example, the number of poisonings and deaths related to alcohol). At the same time, survey data can also be incomplete, as people often conceal the true situation when it comes to alcohol consumption. Furthermore, respondents' perceptions of the quantity of alcoholic beverages they consume may be distorted. Therefore, the present study is an attempt to consolidate existing data on alcohol consumption in Russia into a cohesive picture.

Conclusions

Present-day Russia displays significant regional variations in socio-economic development and living standards (Bondarenko and Gubarev 2020). An examination of alcohol consumption studies, official statistics, and sociological surveys spanning the last two decades indicates an uneven transformation of alcohol consumption patterns across different regions in Russia.

While there is a general trend towards diversification and a gradual decrease in the consumption of alcoholic beverages, beer remains the preferred choice among the Russian population. Notably, the consumption of beer is significantly declining in Moscow, the North-western, and Southern federal districts.

Analysis based on various indicators such as sales volumes of different types of alcohol, alcohol strength, consumption levels and frequency per month, inclusion of alcohol in meals, and temporal patterns reveals a distinctive northern alcohol consumption model observed in Ural, Siberia, and the Far East. These regions exhibit higher consumption rates of various alcoholic beverages, including beer, wine, and spirits, with less potent drinks consumed slightly less frequently but in larger quantities (Appendix figures A1, A2).

A shift towards a "mixed" model of alcohol consumption is apparent throughout most other regions of the country, with this trend being particularly prominent in Moscow, Central Russia, and the North-western district centred around St. Petersburg. These areas demonstrate high per capita alcohol consumption rates and a clear preference for beer in terms of volume. Over the past two decades, wine consumption has grown in European Russia, accompanied by a significant increase in alcohol consump-

tion during meals. The South of Russia, with a higher proportion of Muslim populations in the republics of the North Caucasus, shows the lowest alcohol consumption rates. The wine-producing regions in the country have not yet shown a clear shift towards a "southern" model of alcohol consumption.

Analysing regional characteristics and transformation trends in alcohol consumption models can provide insights into the macroeconomic and institutional factors influencing the consumption of addictive substances. The identified territorial specifics can guide the development of federal and regional alcohol policies. This study can be further developed through the analysis of the socio-demographic specifics of alcohol consumption patterns among the population of Russian macro-regions.

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Appendix

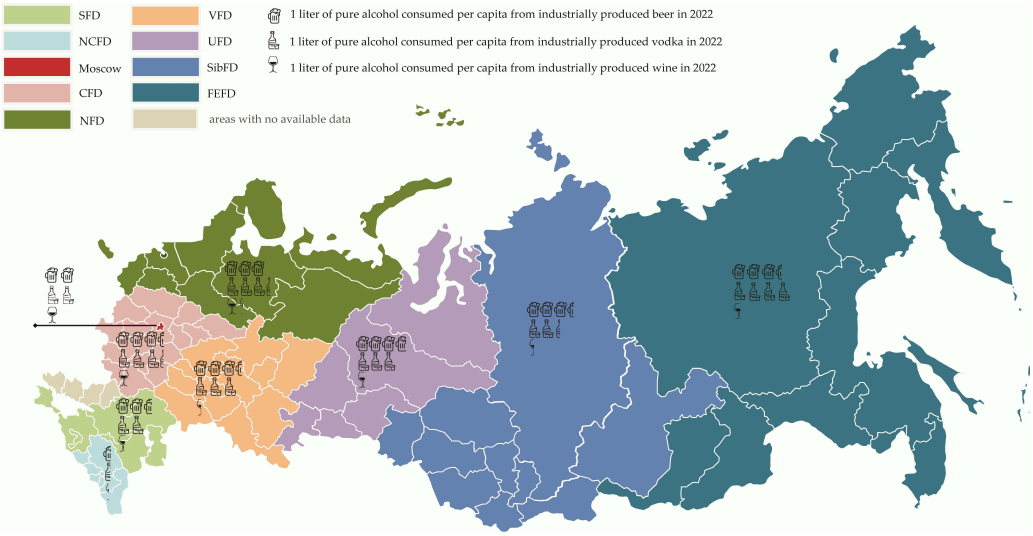

Figure A1. Regional differences in the consumption of industrially produced alcoholic beverages (beer, vodka, and wine) in litres of pure ethanol per capita by federal district, 2022

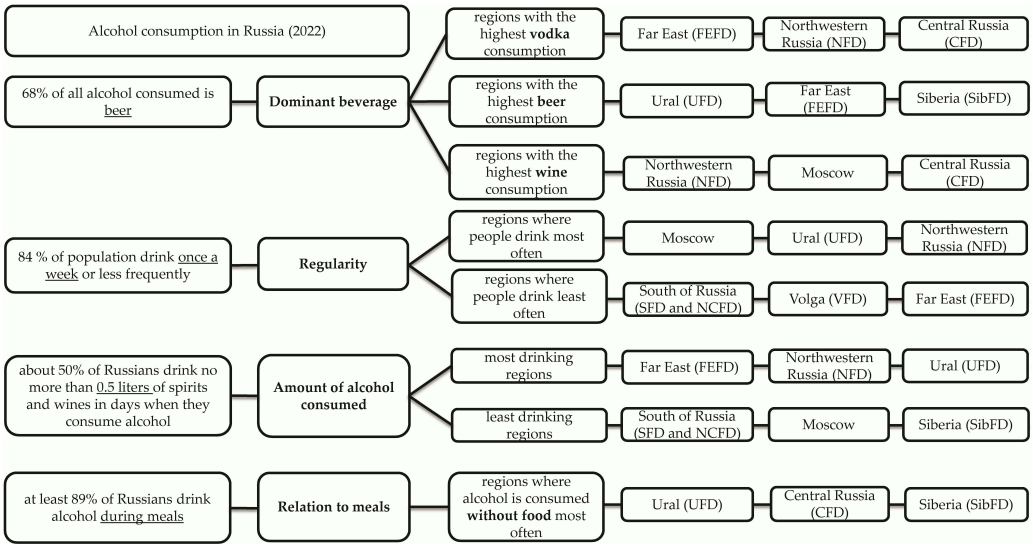

Figure A2. Main characteristics of alcohol consumption in Russia

Tourist perception on slum tourism in Rio de Janeiro

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Abstract: This study analyses tourists' comments provided by visitors who participated in guided tours to the pacified favelas of Rio de Janeiro, specifically Rocinha, Santa Marta, Vidigal, Cantagalo, Pavão-Pavãozinho, and Babilônia-Chapéu Mangueira, as documented on the TripAdvisor platform. The primary objective is to examine the motivations underlying tourists' visits, including the appeal of exploring areas perceived as risky, the curiosity to observe the living conditions of socioeconomically disadvantaged communities, social motivations, and the pursuit of photographic viewpoints overlooking the city's hills. In addition, the study explores visitors' emotional and psychological responses when confronted with the realities of life in Rio de Janeiro, widely known as the "Cidade Maravilhosa" (Wonderful City). The analysis investigates tourists' perceptions and experiences during these guided tours, aiming to identify the main experiential dimensions and the emotional impact associated with engagement in the socio-cultural dynamics of favela communities.

Keywords: slum tourism; favela tours; social tourism; tourist gaze; urban exploration

Introduction

Slum tourism is a controversial form of tourism that involves visiting economically disadvantaged neighborhoods worldwide and has grown significantly in recent years (Sarrica et al. 2021, Altamirano 2023). Historically rooted in the fascination with poverty, motivations for this kind of tourism have evolved (Nisbett 2017). It simultaneously emerged in places like Cape Town, Johannesburg, and Rio de Janeiro, where it presented specific characteristics, becoming known as the Favela Tour. In South Africa, slum tourism is linked to neighborhoods' historical roles in the anti-apartheid struggle (Frenzel 2013). Meanwhile, in Rio de Janeiro, tourism in pacified favelas began with a government program that led to the creation of the Providencia favela museum,

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guided tours, and hostels. This development has been supported by guide training, promotional efforts, and dedicated websites (Menezes 2010).

Scholars from various fields (e.g., sociology, anthropology, economics, tourism) have analyzed the phenomenon, especially the organized tours in favelas (Mano et al. 2017). Recently, the discussion around slum tourism has shifted towards a social tourism framework, with visitors seeking not only unconventional experiences but also deeper understanding of the effects of urban poverty on the daily lives of residents and in their interaction with those who visit the favela (Ma 2010, Apchain 2023). This shift highlights the desire to grasp the socioeconomic challenges in these urban areas. So far, to the best of our knowledge, no study has delved into the perspective of visiting favelas as a form of social awareness and engagement in community spirit. Furthermore, the study presents for the first time a comparison between visitors' comments regarding the five most touristic favelas in the south of Rio de Janeiro, with different characteristics in terms of community spirit, resilience and organized tours. Thus, the study aims to answer four research questions:

- How do visitors perceive life in each of the favelas under study?
- What kind of emotions are shared by visitors after the tour?
- What experiential factors are most memorable to visitors?
- Are there substantial differences in the emotions expressed by visitors from favela to favela?

This study examines how visitors perceive and describe their experiences during tours, with particular attention to the narratives that emerge around place, community, and transformation. Although participants' comments inevitably include references to emotions and perceptions, the focus of this research is not behavioral psychology. Instead, the study is situated within tourism and geographical research, where the analysis of visitors' perceptions and experiences is a relevant and legitimate methodological approach (Urry 2002, Lew and McKercher 2006). By adopting this perspective, the article contributes to the understanding of how tourism shapes the representation and interpretation of urban spaces, particularly in contexts of social change.

Although this research is based on the qualitative dimension of visitors' narratives, it is important to acknowledge that this approach does not allow for a direct quantification of the socio-economic transformations associated with favela tourism after pacification. To address this limitation, we complement our discussion with references to secondary studies that provide quantitative evidence, such as the increase in tourist flows and employment opportunities documented in previous works (Dos Santos 2011, Barbosa and Menezes 2016). This integration of qualitative and quantitative perspectives helps situate our contribution within a broader understanding of tourism-related changes in these urban contexts.

The phenomenon of slum tourism

From early visits to impoverished neighborhoods in the 19#super[th] century to modern practices, slum tourism has attracted the affluent and mainstream tourists (Dürr 2012, Iranmanesh and Kamalipur 2024). Historical examples include tours of immigrant neighborhoods like New York's Five Points and London's East End (Frenzel 2013). The term "slum" originally described clandestine visits by wealthy Londoners to observe illegal activities (Steinbrink 2012). Today, slum tourism typically occurs through guided tours using various transportation modes. Favela tours are increasingly organized by private firms, non-governmental organizations (NGO), and charities (Nisbett 2017). In some locations, small local operators manage tours, while in more established destinations, larger companies provide additional services such as accommodation and entertainment (Frenzel and Blakeman 2015). While critics argue that slum tourism is voyeuristic (Dos Santos 2011, Gui and Zhong 2024), proponents claim it supports community development through economic benefits and other advantages (Frenzel 2013, Fagerlande and Mees 2021).

Favela tours

Rio de Janeiro, widely known as the "Cidade Maravilhosa" (Wonderful City), holds a distinct allure in the collective imagination of global tourists, who are attracted by its musical heritage, coastal landscapes, and cultural festivities such as carnival and New Year's Eve celebrations (Fagerland and Mees 2021). The term "favela" denotes densely populated, precarious housing clusters in Rio de Janeiro, typically erected on land not legally owned by the residents (Freire-Medeiros 2011). The controversy surrounding tourism in favelas is mainly related to moral and ethical issues between hosts and guests (Altamirano 2023). The emergence of guided tours in favelas stirred controversy in Rio de Janeiro and Brazilian society, often criticized as voyeuristic and exploitative of the impoverished residents (Dos Santos 2011, Gui and Zhong 2024). In response to these allegations, tour operators initiated social initiatives aimed at enhancing the living conditions of favela inhabitants. Concurrently, there has been a perceptible shift in Brazilian societal attitudes toward tourism activities within favelas, emphasizing the social dimension of such endeavors, despite lingering skepticism among the elite (Fagerlande 2023). Presently, favela tourism is officially recognized by political authorities as an urban tourism product, prompting investments in infrastructure and the professional development of tourist guides (Angelini 2020).

The tourist gaze on favelas

The mode of visitation, whether through a jeep window or a cable car, affects the depth of immersion in favela life, with direct contact fostering intimate interactions with

locals (Muldoon and Mair 2016). Visitors' expectations shape their behavior, with their anticipation of an "authentic" experience influencing how they perceive the destination (Freire-Medeiros 2007, Apchain 2025). Tourists often arrive with preconceived notions, seeking to witness "what they want to see," influenced by their imagination and representations of the favela (Sarrica et al. 2021). Favela visits are "reality tours," distinguishing between social tours, which emphasize authenticity and respect, and dark tours, driven by voyeuristic curiosity about poverty and violence (Gómez et al. 2019). Today, tourist perspectives are widely shared on social media, influencing trends, and promoting destinations (Sarrica et al. 2021).

The role of tour guides

Tour guides assume a pivotal role in favela tourism through their meticulous preparation and introduction of narratives to visitors. These narratives exhibit variations, ranging from abstract to formal or personal accounts, all underscored by an emphasis on the social benefits of the tours (Frenzel and Blakeman 2015). Tour routes undergo subtle modifications based on each guide's perspective and corresponding narrative, strategically employed to prompt discussions on social, political, economic, or religious issues (Angelini 2020). Conversely, many favela tourists grapple with the moral implications of their curiosity about "the other side," fearing their interest may be perceived as voyeuristic (Burgold and Rolfes 2013). Thus, tour guides influence tourists' perception of considering their visit as morally acceptable, but also as beneficial for the inhabitants of the favela (Frenzel and Blakeman 2015). In this sense, guides function as curators of the tourist experience in favelas, particularly concerning the comprehension of poverty and the ramifications of tours on the residents' way of life (Butler 2012).

The spirit of the community

Community tourism in favelas serves as a tool for poverty alleviation, impacting residents directly or indirectly (Silva et al. 2014, Fangelande 2020, Aquino and Andereck 2024). Unlike mass tourism, it emphasizes cultural awareness and the preservation of local customs (Gómez et al. 2019). Residents of tourist-friendly favelas have developed itineraries that reflect their realities and cultural values (Freire-Medeiros 2011, Aquino and Andereck 2024). Community-based tourism requires minimal infrastructure, focusing on authentic experiences in natural and cultural settings (Fagerland and Mees 2021). These tours challenge negative stereotypes and reveal the communal spirit of favela life, showing that most residents are welcoming and not involved in crime (Frenzel 2013). Interactions between tourists and locals are significant, as culture and identity become the central elements of the exchange (Dürr 2012, Clift et al. 2025).

Curiosity between "us-them"

Favela tours are driven by both curiosity and social motivations. These tours romanticize poverty, offering an "authentic" experience of Rio's disadvantaged areas, which fuels intrigue (Dos Santos 2011, Gui and Zhong 2024). While tourists may not openly express interest in poverty, their participation reflects a curiosity about it (Rolfes 2010). Media portrayals further encourage tourists to see favelas as exotic, depicting residents as content and living simple, authentic lives (Frenzel 2013). This portrayal emphasizes the "us-them" divide, heightening curiosity about the perceived disparities (Dürr 2012). Initially, stereotypes around violence and drugs drive interest, but direct interactions with the people and place often challenge or reduce these misconceptions (Rolfes 2010).

The adventure of visiting favelas

Favela tourism epitomizes an experiential quest for authenticity, the exotic, and risk, all consolidated within a singular setting. These tourism adventures, labelled by Freire-Medeiros (2009) as "urban safari", are anticipated and embraced by participants. Despite traveling through the economically disadvantaged areas of the favela, tourists feel a sense of relative security, since the violence prevalent in these areas is not directed at visitors. According to Steinbrink (2012), the concept of experiencing "safe danger" or an "isolated adventure" only partially elucidates the motivation behind tourists visiting impoverished urban areas. In essence, the tour provides a means for tourists to understand the extent of the risk of visiting favelas, despite the guides' protection (Rolfes 2010). Tourists feel the need to be cautious and respect a certain ethical code of the community, in a context in which they perceive themselves as potential prey (Apchain 2025).

Urban exploration as motivation

The term urban exploration serves as a comprehensive framework delineating urban practices wherein participants engage in the visitation of locales offering nontraditional experiences (Fraser 2012). These unconventional or informal urban encounters manifest as spectacles that the tourist, adopting the role of an explorer, captures through the lens of their camera or mobile device (Freire-Medeiros 2011). Prospective visitors, having consumed exotic photographs by other photographers prior to their arrival, actively seek to document these places firsthand, thereby imbuing their experience with a sense of completeness (Menezes 2010). These images traverse the globe rapidly through social networks, constituting the individual contribution of each tourist to the propagation of the phenomenon and the revelation of the reality of life in favelas (Dürr 2012).

The authenticity of favela tours

The concept of authenticity in tourism was initially addressed by Boorstin (1961), positing that mass tourism constitutes a spectacle founded on the repetition of staged actions designed to attract and gratify tourists, thus rendering it an inauthentic product. In this context, favela tourism, being an alternative product characterized by direct interaction and limited dissemination, holds the potential for greater authenticity (Freire-Medeiros 2007). In the case of Rio de Janeiro's favela tours, visitors can experience emotions through on-site visits to constructed spaces, strolling through the streets, and interacting with residents, whether partaking in socially oriented tours or more voyeuristic endeavours, colloquially known as dark tours (Freire-Medeiros 2011, Fargeland 2022).

Methodology

The investigation was operationalized through a mixed-methods approach, as the combination of both methodologies allowed for the precision of quantitative methods (frequency analysis) and the depth provided by qualitative methods (content analysis). This data triangulation enhanced the credibility and robustness of the study.

Study area

The study area comprised the five most visited pacified favelas in Rio de Janeiro (Figure 1), selected based on their higher levels of tourist traffic; they were: Rocinha, Santa Marta, Vidigal, Cantagalo (Pavão-Pavãozinho), and Babilônia-Chapéu Mangueira.

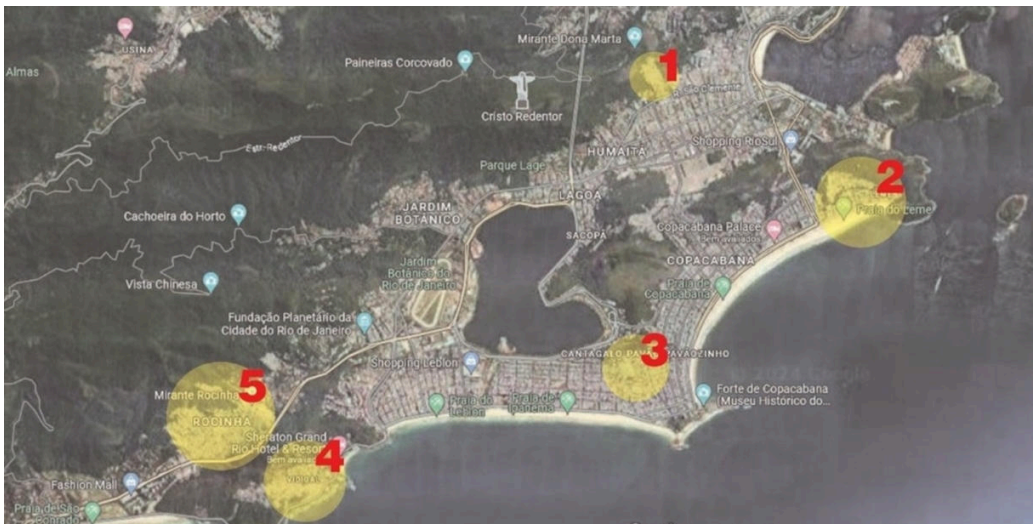

Figure 1. Location of the favelas under study 1). Santa Marta; 2). Babilônia-Chapéu; 3). Cantagalo, Pavão-Pavãozinho; 4). Vidigal; 5). Rocinha. Source: Google Maps (2025)

Rocinha, Rio de Janeiro's largest favela, houses about 70000 residents across 147 hectares with 25742 homes (Giannella and Catalá 2025). Its rapid growth from the 1950s was driven by the city's expansion into Barra da Tijuca (Frisch 2012). Located in the affluent southern zone, Rocinha benefited from federal investment through the Growth Acceleration Programs (PAC I and II), attracting fast-food chains, restaurants, and retail (Pereira et al. 2017). Rocinha was legally recognized as a formal neighborhood in 1993 and became an official tourist attraction in 2006 (Law 4405/2006). Under the protection of the Pacification Police Unit (UPP), Rocinha is regarded as a trendy or middle-class favela (Richmond 2019). Following the 2014 World Cup, the rise in hostels led to increased real estate prices, prompting Cummings (2015) to describe this shift as "favela gentrification".

The Santa Marta favela, located on Morro Dona Marta in Rio de Janeiro's Botafogo neighborhood, had 3908 residents and 1076 buildings across 54.305m² as of 2020 (Giannella and Catalá 2025). The land originally belonged to the neighboring Colégio Santo Inácio, which in the 1930s allowed employees to use part of Morro Dona Marta as housing. Unlike other favelas, Santa Marta has a rich history of community organization (Mano et al. 2017). This favela gained international recognition after Michael Jackson filmed his 1996 music video "They Don't Care About Us" there, despite initial disapproval from local authorities (Freire-Medeiros 2011). Recognizing its potential for tourism, the site was later turned into a themed space dedicated to the artist (Mano et al. 2017). In 2010, Santa Marta became the first favela involved in the "Rio Top Tour" initiative, transforming pacified favelas into tourist destinations (Freire-Medeiros 2011).

Vidigal, is home to 4860 residents and covers 162.14 ha (Giannella and Catalá 2025), is named after Major Miguel Nunes Vidigal, a former commander of Rio de Janeiro's Military Police, who was granted the land in 1820 (Conde and Magalhães 2021). From 1940, bars started occupying the area, giving rise to the favela. Since its pacification in 2012, Vidigal offers stunning views of Leblon and Ipanema beaches (Fagerland and Mees 2021). Tourist interest grew after the reduction in violence (Freire-Medeiros 2011, Clif et al. 2025). The rise of tourism began with the opening of two hostels in 2010 and escalated after pacification, leading to an increase in tourist accommodations (Kalaoum and Santiago 2020).

Cantagalo, Pavão-Pavãozinho favela complex, located in southern Rio de Janeiro, is strategically positioned near Ipanema and Copacabana, close to the city's hotels and tourist attractions (Fagerlande and Mees 2021). The Favela Museum, established in 2008 as a Non-Governmental Organization, has been instrumental in promoting community-based tourism (Portilho 2018). This prime location has attracted tourism promoters, leading to increased investments in hostels within the favela (Fagerland and Mees 2021). Infrastructure developments enhancing accessibility include the Cantagalo, Pavão-Pavãozinho lookout elevator, a new metro connection, and an inclined

plane to Rua Saint Romain, which improve connectivity with surrounding tourist areas and support the strategic positioning of hostels (Portilho 2018).

Babilônia-Chapéu Mangueira, located on Morro da Babilônia in Rio de Janeiro's Leme neighborhood, had an estimated population of 35466 as of 2021 (Giannella and Catalá 2025). Established in 1915, the favela has developed significantly over the years, especially since becoming part of the Pacifying Police Units in 2011. In the 1970s and 1980s, it became a model for other settlements due to proactive initiatives by community representatives (Silva et al. 2014). Attractions include a trail to Pedra do Urubu and a cable car with stunning views. CoopBabilônia leads community engagement projects, enhancing awareness of local social initiatives and tourism, while urban projects have created notable sites in the area, such as a viewpoint over Copacabana (Fagerland and Mees 2021).

Sample

A total of 6830 coded references were identified across 2643 comments made by tourists who visited the five most frequented favelas in Rio de Janeiro, specifically: Rocinha, Santa Marta, Vidigal, Cantagalo, Pavão-Pavãozinho, and Babilônia-Chapéu Mangueira (Table 1).

Table 1. Sample characterisation

Name	Comments	Reviewers' nationality
Rocinha	998	Brazilian: n = 262 (26.3%); Other nationalities: n = 736 (73.7%)
Santa Marta	883	Brazilian: n = 220 (24.9%); Other nationalities: n = 663 (75.1%)
Vidigal	428	Brazilian: n = 250 (58.4%) Other; nationalities: n = 178 (41.6%)
Cantagalo, Pavão-Pavãozinho	286	Brazilian: n = 23 (8.0%); Other nationalities: n = 263 (92.0%)
Babilónia-Chapéu Mangueira	48	Brazilian: n = 39 (81.2%); Other nationalities: n = 9 (18.7%)

Source: Authors' work based on TripAdvisor

Procedures

Data was collected from Tripadvisor.com between June and December 2023 and analysed according to Bardin's (2011) guidelines, which emphasised converting raw texts into organized data aligned with a defined corpus. The pre-analysis phase focused on identifying elements for analysis and classification into predefined categories from the theoretical framework. During the initial coding phase, content was segmented into units of analysis (words, sentences, paragraphs) and categorized accordingly. After quantifying the frequency of these units, intermediate coding grouped initial categories and refined the analysis. Final coding involved reclassifying categories based on literature findings and recounting their frequency in comments. This process utilized both inductive reasoning for data simplification and deductive reasoning for

theoretical alignment. The analysis was operationalized using MAXqda and SPSS software, culminating in a line-by-line examination to identify testimonials that validated the earlier results.

Results

The analysis of the content of the reviews enabled an understanding of tourists' experiences during their visits to the favelas, providing a deeper and more detailed insight into their experiences. The comments were coded and subsequently categorized according to the themes extracted from the literature review (e.g. Frenzel and Blakeman 2015, Fagerland and Mees 2021). The categories extracted from the content analysis were described in Table 2.

Table 2. Definition of the categories under study extracted from the literature review

Categories	Definitions	References
Authenticity	An emotional feeling achieved through the realistic contact with the place, the inhabitants, and their way of life.	Boorstin (1961), Freire-Medeiros (2007), Gómez et al. (2019)
Guide Experience	The guide takes on the role of curator, leading the tour narrative and connecting visitors with the community. Guides are often members of the community and provide a sense of security for visitors.	Butler (2012), Burgold and Rolfes (2013), Frenzel and Blakeman (2015)
Urban Exploration	The activity of exploring parts of the city that offer non-traditional experiences. The urban explorer's trophies are the photos that portray each experience.	Menezes (2010), Dürr (2012), Fraser (2012)
Community Spirit	Community members are welcoming in their interaction with tourists. The sense of "community mutual help" is perceived by visitors.	Frisch (2012), Silva et al. (2014), Kalaoum and Santiago (2020)
Adventure	The adventure of visiting the favelas is characterized by an experience of romanticized and controlled risk, which serves as motivation for the visit.	Cejas (2006), Freire-Medeiros (2011), Steinbrink (2012)
Curiosity	Social differences and a certain romanticization of poverty pique the curiosity of visitors, who see favelas as exotic places.	Rolfes (2010), Dürr (2012), Frenzel (2013)

Source: Authors' work based on TripAdvisor

To better understand tourist perceptions, comments were separated into positive and negative categories, revealing patterns of satisfaction and dissatisfaction (Table 3). Analysing 6830 comments, results showed that positive perceptions (81.3%) outweighed negative ones (18.7%), especially in Authenticity and Community spirit, where all comments were favourable.

Tourists visiting Rocinha described their experience as an authentic glimpse into the 'real' Rio de Janeiro, contrasting it with traditional tourist areas. These tours provided deep insights into local culture, residents' daily lives, and Brazil's social dynamics,

Table 3. Distribution of positive and negative comments by category

Categories	Perception	n(%)
Authenticity	Positive	988 (100%)
(n = 988)	Negative	–
Guide Experience	Positive	965 (55.3%)
(n = 1743)	Negative	778 (44.7%)
Urban Exploration)	Positive	1647 (96.1%)
(n = 1710	Negative	66 (3.9%)
Community Spirit	Positive	781 (100%)
(n = 781)	Negative	–
Adventure	Positive	560 (62.9%)
(n = 890)	Negative	330 (37.1%)
Curiosity	Positive	610 (85.3%)
(n = 715)	Negative	105 (14.7%)

Source: Authors' work based on TripAdvisor

enabling visitors to challenge media-driven stereotypes about violence in favelas. While acknowledging the existence of violence, tourists emphasized that Rocinha was not the war zone often depicted. A significant aspect of the tours was the interaction between guides and residents, which enriched the experience and grounded it in local realities. The expertise of guides was deemed essential for a successful tour, contributing to visitors recommending the experience as one of the most memorable of their lives. Tourists appreciated direct interactions with residents through conversations, storytelling, and sharing traditional food, creating profound connections that elevated the visit beyond mere tourism. About half of the comments highlighted the adventure aspect, prompting recommendations for anyone wanting to explore the authentic side of the city. However, the ethical implications of turning poverty into a tourist attraction remained contentious. Overall, the tours were seen as striking experiences that satisfied a desire for knowledge and understanding through direct engagement with the community.

Santa Marta emerged as a compelling tourist destination, allowing visitors to gain a profound understanding of local life and culture. Authenticity was a major draw, as tourists engaged directly with residents, experiencing the genuine essence of community life. The stark contrast between breathtaking views and the fragile local infrastructure highlighted Brazil's social inequalities. The tour guide's role was vital, as they provided an unfiltered perspective of the area, with many visitors praising their friendliness and extensive knowledge, which fostered a sense of belonging. Morro Santa Marta offered an alternative to conventional tourist spots, rich in culture and history yet marked by social and economic challenges. Accounts frequently mentioned the favela's precarious living conditions, such as inadequate sanitation, juxtaposed with stunning panoramas. Visitors were often captivated by the residents' simplicity

and the community's strong bonds, leading to emotional connections that encouraged repeat visits. Initial apprehensions about safety evolved into feelings of warmth and acceptance that surpassed adventure-seeking expectations. Cultural and historical elements, including the location of Michael Jackson's "They Don't Care About Us" music video, further stimulated visitors' curiosity and enhanced their experiences in this vibrant community.

The tours in Vidigal provided cultural immersions seen as authentic experiences, rich in sensory engagement. Visitors described their time in the favela as memorable, filled with unique smells, sounds, and interactions. Guidance from a resident enhanced the experience, fostering a sense of hospitality and safety from the community. This interaction helped visitors challenge stereotypes about favelas, allowing them to appreciate the area's beauty and culture. The educational aspect of the tour offered deeper insights into life within the favela and its historical evolution, promoting a respectful connection with the community. The hike to Morro Dois Irmãos combined adventure with discovery, although safety remained a priority throughout. Ultimately, visiting Vidigal sparked curiosity, serving as a symbol of Brazil's social inequalities while accentuating its cultural and touristic significance. This experience transcended conventional tourism, emphasizing direct engagement and insights into the community.

Cantogalo, Pavão-Pavãozinho offered vibrant views, graffiti, community projects, and interactions with residents highlighted cultural authenticity. Visitors shared sincere, detailed accounts of their experiences, heavily influenced by local guides who provided unique perspectives. Rather than merely depicting poverty and violence, the favelas were portrayed as dynamic communities, rich with life, where residents engaged in work, education, and mutual support. Many visitors, initially apprehensive, reported feeling warmly welcomed by locals despite the challenges they faced. The favelas were seen as adventure destinations, allowing tourists to explore unconventional urban environments that defied stereotypes. This curiosity to witness the "other side" of Rio de Janeiro drove many to visit, creating a stark contrast with more tourist-centric neighbourhoods like Ipanema and Copacabana. Visitors' comments reflected the significant and visible differences between these areas, emphasizing the unique experiences offered in the favelas compared to traditional tourist attractions. Overall, the narratives illuminated the complexity and vibrancy of favela life.

In Babilônia-Chapéu Mangueira, urban exploration was a prominent attraction. Despite its accessibility, tourists reported that trailhead signage was problematic. While the area was generally safe, visitors were advised to check for any ongoing clashes or police operations before their trip. The climb to Morro da Babilônia was challenging but offered rewarding panoramic views of Rio de Janeiro, making it a sought-after adventure destination. Security remained a major concern among tourists, with mixed reviews about the presence of UPP. While interaction with locals and hiring a guide – preferably one from the favela – was emphasized, half of the feedback on guides was

negative, often due to a lack of empathy and understanding of the community from those unfamiliar with its dynamics. Tourists appreciated the strong sense of community, noting the locals' openness and willingness to help, which contrasted sharply with the negative stereotypes often associated with favelas. Visitors reported a peaceful and authentic environment, challenging the media's portrayal of danger and hostility.

This direct interaction with the residents helped to transform preconceived notions, providing a more positive perspective of the favela experience. The testimonials were generally positive and strongly recommended the tours, highlighting the importance of experiencing Rio de Janeiro in a manner that transcended traditional tourist attractions (Table 4).

Table 4. Line-by-Line analysis of categories under study

Categories	Line-by-line
Authenticity	*This was the most authentic, informative, and fun tour I've ever been on. I felt like I was part of the community, and it helped me understand how people live.* *This tour was the most authentic because it allowed me to interact with locals and hear stories from the past and present.*
Guide experience	*The guide lives in the favela, so he doesn't just offer the typical tourist photo-opportunity tour. He makes us feel like part of the favela (...) he shared his knowledge about how the favela operates, its rules, the respect among the residents.* *The guide was young, inexperienced and didn't live in favela. However, many argue that visiting without a guide is much worse, because they feel more lost and insecure.*
Urban exploration	*One of the best views of Rio de Janeiro (...) leave behind fear and prejudice and prepare your camera for the best shots of the city.* *It's a maze of tiny winding streets with sharp bends and turns linked by dangerous steps.*
Community Spirit	*We appreciate the kindness with which we were treated and were impressed by the strong community spirit (...). Almost half of the money we paid for the tour is used to fund projects that benefit the favela.* *It's a community that, despite its problems, functions as a whole to help each individual.*
Adventure	*I took the tour to experience an adventure into the unknown, but it exceeded all my expectations. It is a vibrant place with beautiful views and wonderful people who are always ready to help.* *The favela is controlled by criminals who carry war weapons (...) it's a very dangerous adventure, we saw armed men.*
Curiosity	*I was very curious to visit a calm, pacified, and safe favela.* *This tour is a disgrace and very sad how they exposed the poor like animals. Nobody wants someone to come to their house to see how you live, and even less if you live in this decadent situation.*

Source: Authors' work based on TripAdvisor

The study aimed to identify tourist preferences among the favelas analysed, counting positive and negative comments in various categories, and adjusting the results proportionally based on the sample size (Table 5). Notably, the Authenticity and Community spirit categories garnered no negative feedback, indicating that tourists appreciated the authentic experiences and sense of unity in their visits. Conversely, the Guide experience received the highest percentage of negative comments, ranging from 44.0% to 50.0%, and highlighting widespread dissatisfaction with tour guides across all favelas. Tourists stated that guides lacking familiarity with the favela, either

through residency or long-term experience, led to less engaging interactions with the local community.

Table 5. Distribution of positive comments and negative comments by favela (n = 6830)

		Rocinha	Santa Marta	Vidigal	Cantogalo, Pavão-Pavãozinho	Babilónia-Chapéu Mangueira
Authenticity (n = 988)	n	358	332	186	107	5
	% positive	100%	100%	100%	100%	100%
	% negative	-	-	-	-	-
Guide experience (n = 1743)	n	602	490	415	228	8
	% positive	55.6%	55.5%	55.7%	53.9%	50.0%
	% negative	44.4%	44.5%	44.3%	46.1%	50.0%
Urban exploration (n = 1713)	n	617	412	411	234	39
	% positive	96.0%	96.4%	96.4%	94.9%	97.4%
	% negative	4.0%	3.6%	3.6%	5.1%	2.6%
Community Spirit (n = 781)	n	264	238	208	65	6
	% positive	100%	100%	100%	100%	100%
	% negative	-	-	-	-	-
Adventure (n = 890)	n	444	210	136	78	22
	% positive	62.8%	62.9%	63.2%	62.8%	63.6%
	% negative	37.2%	37.1%	36.9%	37.2%	36.4%
Curiosity (n = 715)	n	373	269	17	47	9
	% positive	85.3%	85.1%	88.2%	85.1%	88.9%
	% negative	14.7%	14.9%	11.8%	14.9%	11.1%

Source: Authors' work based on TripAdvisor

Regarding the Adventure category, despite safety concerns being prevalent, only about one-third of visitors reported dissatisfaction, suggesting that the adventure aspect generally exceeded expectations. In the Curiosity category, feedback was largely positive, although a minority of tourists expressed remorse after witnessing a reality starkly different from their own, with some describing their experiences as sad and exploitative. While the Urban Exploration category yielded minimal negative comments, some tourists felt their expectations were unmet due to unplanned construction and challenging access within the favelas. Overall, these findings illustrate a complex interplay of positive experiences and notable areas for improvement in the context of tourism in favelas.

The results indicated that Rocinha received the highest percentage of positive comments, which may be attributed to its status as the largest favela in Rio de Janeiro and its perception as the "favela of the moment" among the public. However, it also recorded the highest percentage of negative comments, which may be explained by issues related to overcrowding and safety concerns. Although Rocinha was considered safer than other favelas, the violence associated with drug trafficking and conflicts

between rival groups could pose risks, especially when tourists were not accompanied by a local guide.

Discussion

Favela tours are controversial and, in the perspective of most researchers, connoted with the exploitation of poverty through voyeurism. Regardless of its positive and negative aspects, slum tourism has seen increasing demand around the world, which generates some controversy as it raises ethical concerns about the exploitation of poverty as a tourist attraction. While some argue that this form of tourism can raise awareness and contribute to the local economy (Cardoso et al. 2022), others criticize it for turning human misery into spectacle, disrespecting the dignity of residents, and perpetuating negative stereotypes (Iranmanesh and Kamalipour 2024). Favela tours allow visitors to connect with the reality of marginalized communities. Considering the results of our study, this "reality check" may, as Moya-Latorre (2022) states, be considered a celebration of urban life. In an educational perspective, it promotes a change in mentalities regarding the marginalization in large cities, by showing the spirit of resilience of inhabitants (Altamirano 2022a). Furthermore, whoever visits the favelas is confronted with a life lesson about community spirit, characterized by the union of people in a common feeling of sharing and mutual help (Angelini 2022), which contrasts with the feeling of loneliness and social disconnection that affects inhabitants in an urban context (Moore et al. 2022, Ljubojevic 2025). The increasing visibility of favela tours has also a political impact. Tourists' perceptions, and behavioural reactions during and after their visit can be seen as the trigger for authorities to take political actions (Frezzel et al. 2015, Altamirano 2022a).

Despite some tenuous efforts to improve the lives of favela communities, inhabitants deal daily with problems of accessibility, health, safety, and lack of basic social services (Altamirano 2022a). To Light et al. (2025), the lack of political intervention in the rehabilitation of decaying urban locations reduces their interest in the eyes of tourists. In this line of thought, favelas have been historically neglected by Brazilian local and federal governments and the upper class (Altamirano 2022b). An example of the importance of government intervention was the pacification of favelas, through police actions. The immediate consequence of these actions was the emergence of guided tours, which started tourism in favelas (Freire-Medeiros 2011).

Theoretical and practical contributions

This research aimed to analyse the visitors' comments objectively and without any type of prejudice to understand their opinions regarding the experience of visiting five of the most touristic favelas in the city of Rio de Janeiro.

The study's contributions to current bodies of knowledge can be approached from two different perspectives. In theoretical terms, to the best of our knowledge, this is the first time that the opinions of visitors to the five most touristic favelas in Rio de Janeiro have been simultaneously compared. The favelas under study are located in different parts of the city, present specificities regarding their social dynamics, which makes their individual and collective analysis pertinent. Hence, the study contributes to a better understanding of tourists' opinions regarding the experience resulting from visiting five favelas.

The study reveals that the tourists' opinions on TripAdvisor about visiting favelas are made up of different factors, which complement each other under the direction of the tour guide. Furthermore, the words of the tour participants do not show voyeuristic feelings regarding the poverty of the places and their people. Instead, the feelings reveal respect for the inhabitants' resilience and community spirit, but also a desire to explore the other side of the city. In practical terms, local authorities responsible for promoting tourism, despite all the controversy surrounding visits to favelas, can use tours not from the perspective of exploiting poverty but to create greater awareness among visitors to the city about the problem of urban poverty. Simultaneously, tours can improve the living conditions of favela, generating revenue for local businesses and creating jobs for inhabitants.

Limitations and suggestions for future research

Despite the results, some limitations of the study are acknowledged. A limitation of this study concerns the impossibility of identifying the nationality of visitors other than Brazilians, although we did not detect a difference of opinion between national and foreign visitors. Additionally, we must consider that there are many tour participants who do not leave comments on the TripAdvisor platform and, therefore, we do not know whether their opinions would be in line with those recorded and subsequently analyzed. Furthermore, the study does not differentiate between experiences relating to short-term tours and longer experiences, which include accommodation, and allows for deeper contact with the inhabitants and life in the favela. In methodological terms, the fact that we chose to classify the data into categories previously defined through a literature review can also be seen as a limitation, as other categories could have been explored. Furthermore, the interpretation of visitors' words may lead to some subjectivity, inherent to qualitative studies.

Future research could address how favela tour experiences influence tourists' general perception of the Rio de Janeiro city image. Furthermore, investigations could explore the perspectives of tour guides and residents regarding the increase in tourism in favelas, as well as interaction with tourists. Considering the impact images can have on urban studies and in particular on this theme, it would be equally interesting to add

photos reporting the experiences of visiting favelas. These approaches will allow us to obtain a better understanding of the role of tourism in the social dynamics of favelas.

Conclusions

One of the conclusions that can be drawn from this study is that although the favelas under study have their own specificities described previously, namely different locations, multiple points of tourist interest and different types of community projects, the results did not reveal major variations in each of the classes analysed, referring to each favela. There were also no substantial differences in opinion between local and foreign visitors regarding the categories under study. Another important conclusion to be drawn from this work is that, in the words of tourists, visiting favelas is mainly a very positive experience, which allows the visitors to immerse themselves in a reality parallel to daily life on the other side of the city. This reality bath is reported as social learning, without pejorative contours. Overall, positive comments represent more than 80.0%, which leaves no doubt as to overall the satisfaction of the favela tour experience.

Concerning the categories analysed, *Authenticity* collected only positive comments regarding the tours of all the favelas, which highlighted the genuineness of each place, the hospitality of their inhabitants, and the reality of life in the favelas. These results suggest that positive emotions resulting from visiting the favela contribute to the tourist's perception of the authenticity of the place.

Regarding the *Guide Experience*, the comments highlight the decisive role in making tours unforgettable, thus unequivocally contributing to visitor satisfaction. The comments reveal that the guides, in addition to organizing and leading the visit, are the visitor's link with the community, thus giving them a sense of security and, at the same time, building the narrative that serves as an itinerary for the visit. This category presents the highest percentage of negative comments, which express visitors' dissatisfaction when expectations regarding the guide's performance, irrespective of the favela they visit. Negative comments concerning visits with guides who haven't lived or live in the favela provide a less positive experience because they are more unfamiliar with reality and don't have as much interaction with the local community.

With regard to *Urban exploration*, tourists often highlight the privileged location of the favelas, which allows them to view the city from a different perspective. Many visitors describe the experience positively, highlighting the opportunity to confront preconceived ideas with reality and to engage with the social and cultural aspects of favela life. However, for some, expectations are not fully met, as the encounter with unplanned construction, infrastructural limitations, and restricted accessibility contrasts with the more romanticized or adventurous image they initially held. In these cases, disappointment arises not from the authenticity of the favela itself, but from the gap between imagined representations and the material and physical conditions

encountered on site. The tourist as explorer confronts the preconceived idea of the favela with reality, and in this sense, the comments reveal great satisfaction with the experience, where exploration has a positive connotation and merges with the social and cultural aspects of life in the favela. For some tourists that seek urban exploration, the experience falls short of their expectations in these favelas, due to the slums' characteristics, unplanned construction, and difficult access.

The comments that fall into the *Community Spirit* category are all positive, with praise for the spirit of resilience, sharing, and working together, despite the difficulties of those who live in the favela. Visitors admire this mutual help between the inhabitants, which contrasts with the everyday isolation of life in cities. Visitors are surprised by the gestures of kindness and affection of the residents who welcome them, which is contrary to the news that reports the climate of violence in the favelas. Many tour organizers share a portion of the revenue with the community, which is seen as a way of helping residents.

Comments falling within the *Adventure* category are mostly positive, where visitors compare initial expectations with reality. The adventure of visiting the favelas is characterized by a certain risk, controlled by the tour guide, who assumes the role of protective host. The adventure of favela tours is, in the words of the participants, a mixture of facing unknown territory, leaving their comfort zone, with cultural nuances such as capoeira and music and social nuances in coexistence with the people of the favela. There is a moderate amount of negative feedback regarding the adventure component of the tours, with comments being negative across most favelas. This indicates that a considerable number of tourists consider that safety issues are the most addressed.

Regarding the category of *Curiosity*, the comments suggest that one of the reasons for the visit is to witness the precarious way of life of part of the population of Rio de Janeiro (Freire-Medeiros 2011). Observing the daily lives of people who live with few conditions makes some tourists want to discover another reality other than theirs, although few openly admit that this is the purpose of the visit. Curiosity is never approached in the sense of fascination with difference, but from a social perspective and awareness about poverty. The small percentage of negative comments suggests that curiosity as a motive for visiting favelas is generally met with positive experiences, but a small number of tourists still feel their curiosity was not satisfied. After visiting the favela, these tourists felt some remorse for seeing a reality different from their own, a poorer reality.

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Energy efficiency measures and social composition in district-heated large housing estates of Budapest

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Abstract: In Hungary, 'Panelprogram' was the most prominent support scheme for renovating prefabricated large housing estate buildings erected in the socialist era. Despite the perceptible results, a considerable share of these buildings remains without thermal insulation. The study explores whether there is a relationship between the social composition of district-heated large housing estates in Budapest and the occurrence and complexity of energy renovation projects implemented in their buildings. It also seeks to understand the nature of these relationships and identify which aspects of social composition and renovation activities are linked. The analysis utilises quantitative data by combining physical attributes of buildings with census-derived socio-demographic indicators and employs correlation analysis to address the research questions. The study reveals that window replacement is less common where municipally owned flats are prevalent, while longer residence positively influences renovations. The results indicate that lower socioeconomic status of new residents moved in between 2000 and 2009 had a negative impact on certain building-level refurbishments. Despite the significant findings, the relationships identified are not always straightforward. This may be attributed to the highly complex decision-making processes within large housing estate buildings, where local or institutional factors may partially override the influence of the variables examined.

Keywords: large housing estate; social status; retrofit; energy efficiency gap

Introduction

Following the political transition, the privatisation process in Hungary, like other East-Central European countries, led to residents of large housing estates becoming the owners of a housing stock that was in poor technical condition and exhibited particularly low energy efficiency (Csizmady 2003, Nedučin et al. 2019). In contrast to those built in several Western European countries (Blanc and Stébé 2004, Monclús and Medina 2016), the social status of the housing estates in Hungary (and generally in

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East-Central Europe) remained relatively stable both before and after the transition (Csizmady 2003, Kovács et al. 2018). After the regime change, the state withdrew from managing and maintaining large housing estates, shifting the responsibility to the new owners. The lack of a sense of ownership mentality, cooperation, and adequate legal regulation of residential communities (Marin et al. 2023, Pirrus and Leetmaa 2023) contributed to the rapid physical deterioration of the building stock (Csizmady 2003, Janky and Kocsis 2022, Pirrus and Leetmaa 2023). To mitigate the worsening problems, various rehabilitation programmes were launched across ECE countries (Nedučin et al. 2019). In Hungary, the most significant public support scheme targeting the refurbishment of large housing estate buildings was the 'Panelprogram', introduced in the early 2000s and announced in multiple phases until 2014. The funding covered a range of measures, including thermal insulation, window and door replacement, heating system upgrades, and solar panel installation (Szabó and Bene 2019).

Although current EU policies – through evolving urban and territorial planning paradigms (Sütő et al. 2010, Salamin 2021), and most notably via the Energy Efficiency Directive and the Energy Performance of Buildings Directive – continue to support the energy-efficient renovation of multi-apartment residential buildings actively, Hungary has not launched any national scheme comparable in scale to the 'Panelprogram' since 2014 (Szabó and Bene 2019, Ámon et al. 2024).

In 2023, 57% of Hungarian district-heated flats with single-pipe heating systems particularly – accounting for approximately half of the housing estate stock – had not undergone thermal insulation, while only 46% were equipped with cost allocators that enable consumption-based billing (BME 2023). In 2017, approximately 23.3% of Budapest's housing estate buildings had been thermally insulated, and 20.9% were undergoing renovation or had undergone other refurbishment measures (Szabó and Bene 2019).

Despite the considerable achievements of the 'Panelprogram', a significant proportion of Budapest's large housing estate stock still requires renovation (Szabó and Bene 2019). The barriers to refurbishment are best understood within the theoretical framework of the energy efficiency gap, which highlights the divergence between technically feasible efficiency levels and the actual performance of buildings (Hirst and Brown 1990, Palmer and Walls 2017). The literature extensively classifies and examines (Hirst and Brown 1990, Weber 1997) barriers to energy retrofits, particularly in multi-family buildings. The range of obstacles in such buildings is extensive, and their interrelationships are highly complex (Cirman et al. 2013, Matschoss et al. 2013, Nair et al. 2017). Nevertheless, it is broadly recognised that individuals of different age groups, educational backgrounds, and financial means tend to support energy renovations to varying degrees. Accordingly, the social composition of a housing estate's ownership structure can significantly influence the feasibility of implementing energy efficiency refurbishments (Nair et al. 2010).

The article seeks to address the following research questions:

- (Q1) To what extent do different types of renovations occur in combination with others within buildings and in buildings belonging to the same large housing estate, regarding particularly the co-occurrence of thermal insulation with window replacement, heating system upgrades, or the installation of renewable energy sources?
- (Q2) Is there a link between the volume and depth of renovations in large housing estates in Budapest and their social composition?

The paper examines a well-defined segment of Budapest's housing stock that accounts for approximately 30% of the capital's dwelling units. Although large housing estates accommodate a substantial share of Budapest's population, publicly available census data are not accessible at this spatial scale. To obtain such data is methodologically demanding – as a result, studies that apply quantitative methods focusing on individual housing estates are relatively rare. Moreover, existing research on large housing estates typically adopts a segmented approach, focusing either on their social composition and its transformation over time or on their physical condition and energy performance (Csizmady 2003, Kovács et al. 2018). Studies that explicitly analyse these two dimensions in an integrated manner – using multiple social and physical variables – remain largely absent. Furthermore, even within these strands, analyses addressing large housing estates in Budapest as a whole are more common than estate-specific examinations. Finally, this research builds on earlier frequently cited studies in terms of both the renovation measures analysed (Szabó and Bene 2019) and the housing estates delimited (Iván 1996, Csizmady 2003). This ensures comparability with previous findings and enables a longitudinal examination of selected aspects of housing estates over time. The research provides a strong empirical foundation and a valuable complement to qualitative studies that address the barriers to renovation and the social dimensions of the energy efficiency gap (Nair et al. 2010, Klöckner and Nayum 2016, Klöckner and Nayum 2017, Palm and Reindl 2018).

Social status of large housing estates in Hungary

According to the definition used by the Hungarian Central Statistical Office (KSH 2011), a housing estate refers to a group of medium- or high-rise residential buildings, mostly constructed using prefabricated panel technology between 1960s and 1990.

In Hungary, large housing estate construction peaked in the 1970s (Kovács and Douglas 1996), serving not only to alleviate the housing shortage common across the Soviet sphere of influence but also to fulfil ideological and political objectives. The social composition of housing estate residents was notably homogeneous in terms of age structure, reflecting the political motivations of the time (Kocsis 2012).

In the 1990s, as suggested by Kovács and Douglas (1996), Hungarian large housing estates – particularly those built in the 1970s and 1980s – should have experienced a trajectory of social decline similar to that detected in Western Europe (Blanc and Stébé 2004, Monclús and Medina 2016). On the contrary, this trend has remained limited or negligible in Hungary. As in other East-Central European countries, Hungarian large housing estates have continued to provide homes primarily for the lower-middle and middle classes (Kovács et al. 2018). Their relatively stable social status over time can be attributed to the fact that socialist housing policies did not permit the creation of large segregated urban areas. Due to the chronic shortage of budgetary funding for centrally initiated housing construction, private ownership of flats in centrally assembled housing estates had already begun to play an increasingly important role well before the regime change (Kocsis 2012). The privatisation that followed only further increased the proportion of private ownership (Kovács et al. 2018). While this is associated with low residential mobility (Jackson and Evans 2017), the high rate of private ownership also makes housing estates significantly more resistant to segregation and abrupt social decline (Musterd et al. 2017), especially in comparison to urban areas dominated by rental housing (Rohe and Stewart 1996, Szafrańska 2015, Monclús and Medina 2016).

Despite low mobility rates, residential satisfaction in Hungarian large housing estates remains relatively high (Herfert et al. 2013), though differences between estate generations are still evident. For example, in estates built during the 1950s, a younger and more educated population has begun to move in – a shift partly driven by generational change, as many original residents have since passed away, leading to earlier turnover compared to newer estates (Csizmady 2003, Kovács et al. 2018). This process is further encouraged by the fact that certain housing estates that were built during this period were relatively well-located, had sufficient green spaces, and were constructed with traditional brick technology, making them more favourable compared to prefabricated panel buildings (Kocsis 2012, Kovács et al. 2018). The social status of estates built in the 1950s and 1960s was positively influenced by the fact that the earliest generation of housing estates was considered relatively desirable and popular places to live, especially compared to the deteriorated and neglected inner-city housing stock. Their popularity was further reinforced that they were mostly not built using prefabricated panel technology and their number was relatively few (Kocsis 2012). As Konrád and Szelényi (1969) point out, groups with higher social status typically sought to move into better-quality housing and were generally able to do so.

In contrast, the social status and overall perception of the large housing estates built in the 1970s were low and have become considerably lower over time, due to various reasons, such as poorer locations, lower social status of residents, a lack of social and commercial infrastructure, spatial segregation, and a high number of buildings (Kocsis 2012). Consequently, in the post-transition period, housing estates built in the 1950s and smaller-scale, higher-quality developments completed in the late 1980s

or early 1990s achieved comparatively more substantial market positions. In line with that, according to the 2011 census, housing estates built in the 1970s or finished in the 1980s were in the most disadvantaged position regarding both the social status and age structure of their residents (Kovács et al. 2018). However, with few exceptions, social heterogeneity of large housing estates in Hungary has protected them from severe social decline (Csizmady 2003, Kovács et al. 2018).

Prevalent physical and energy efficiency challenges of large housing estates in Hungary

After the 1990s, a wave of commercialisation swept through housing estates. Developers and entrepreneurs took advantage of the concentrated purchasing power of these areas, and estates became populated with various services and amenities – supermarkets, hair salons, beauty parlours, tanning salons, and accounting offices commenced appearing on the ground floors of residential buildings (Szafrańska 2015, Antypenko and Benkő 2022). However, many of these businesses moved into former storage rooms, garages, or basement areas (Antypenko and Benkő 2022). While not initially intended for such functions, this repurposing contributed to an economically more viable use of these spaces. The transformation also brought about a new challenge: a growing shortage of parking spaces, storage rooms, etc., exacerbated by general economic growth and the increasing financial capacity of the middle class residing in these areas (Dekker and van Kempen 2004, Szafrańska 2015, Antypenko and Benkő 2022).

Following privatisation, former tenants of housing estates became owners of a low-energy-efficiency housing stock (Bănică et al. 2020, Janky and Kocsis 2022). Modern thermal insulation was largely absent from these buildings, and windows often failed to seal properly (Csizmady 2003; Janky and Kocsis, 2022). During the socialist era, residential energy was generally cheap; thus, the energy efficiency of heating systems was not a priority. There was a general lack of knowledge about such technologies and limited access to appropriate materials and financial resources. These factors also contributed to the poor sound insulation performance of the buildings (Csizmady 2003, Janky and Kocsis 2022). The earlier generation of large housing estate buildings equipped with two-pipe systems, allowing for regulation at the radiator-level, though not for individual heat metering. The later generations of large housing estates were typically equipped with vertically distributed, single-pipe heating systems, which did not allow neither radiator-level temperature regulation nor household-level heat metering (Egedy 2003, Csoknyai and Doholuczki 2022, BME 2023) due to budgetary constraints. At a later stage, bypass sections were introduced to a certain number of buildings, enabling radiator-level temperature regulation (Csoknyai and Doholuczki 2022). Due to the absence of household-level measurability of heating consumption, residents paid heating costs based on the floor area of their flats. This situation

prevented households from influencing their often sharply increased heating expenditures following the political transition (Herrero and Ürge-Vorsatz 2012). From the very beginning, the combination of subsidised energy prices, non-energy-efficient building structures, and unregulated heating systems led to significant energy waste (Buzar 2007, Herrero and Ürge-Vorsatz 2012, Canale et al. 2019, Janky and Kocsis 2022).

Energy efficiency gap and the driving factors behind renovation implementation

The factors influencing the renovation of buildings, including housing estates, and their interrelations can be examined within the theoretical framework of the energy efficiency gap. According to this framework, a certain difference between the actual level of energy efficiency achieved and the level that could be achieved using available technologies and practices exists (Hirst and Brown 1990). The literature on the energy efficiency gap frequently emphasises barriers that hinder renovation efforts, and several studies propose classifications of these barriers. For example, Weber (1997) identifies four types of barriers: institutional, market-conditioned, organisational, and behavioural. Meanwhile, Hirst and Brown (1990) distinguish only two main categories: structural and behavioural barriers.

The social and human dimensions of energy-efficient renovations are often linked to behavioural barriers. Attitudes toward the existence and consequences of climate change, perceptions of the effectiveness of energy renovations, and the availability of information about expected costs, impacts, inconveniences, and payback periods all strongly influence whether renovations are implemented – from the perspective of the person or entity making the decision (Nair et al. 2010, Klöckner and Nayum 2016, Klöckner and Nayum 2017, Palm and Reindl 2018).

In the context of East-Central European large housing estates, where private homeowners predominate (Pirrus and Leetmaa 2023), the financial resources available for renovation require careful scrutiny, as they are directly or indirectly determined by the economic status of these homeowners (Dimitrova et al. 2019). Since they are often financially responsible for the implementation of renovations (either in part or in full), their socioeconomic position plays a critical role. Considering that a wide range of private owners decide renovations, the role of the lowest-income residents within the community is particularly significant (Matschoss et al. 2013, Nair et al. 2017). Although there may be few, if they establish themselves as an opinion leader, they can potentially hinder renovation efforts (Huber et al. 2011, Matschoss et al. 2013, Nair et al. 2017, Palm and Reindl 2018, Streimikiene and Balezentis 2019).

The literature indicates that many of the aforementioned barriers are linked to various socioeconomic and demographic factors. Several studies have pointed out a positive correlation between educational attainment and support for energy invest-

ments, the adoption of energy-saving and efficiency-enhancing technologies, and environmentally motivated efforts to reduce consumption (Nair et al. 2010, Mills and Schleich 2012, Brounen et al. 2013). Level of education is also positively associated with rational decision-making regarding energy investments. However, this relationship is nuanced by findings that energy-related knowledge and awareness of consumption-reduction practices do not necessarily depend on formal education levels (Mills and Schleich 2012, Brounen et al. 2013).

Level of education also significantly affects another key determinant of renovations: income level, which in turn influences financial security and social mobility (Večerník 2013) – and thus the economic means available for implementing renovations (Klöckner and Nayum 2016, Dimitrova et al. 2019). Age is another important factor linked to renovation barriers. Older households typically have lower-than-average incomes, undermining their financial ability to contribute to renovation projects. Their willingness to take on debt is also lower, partly because they are less likely to commit to long-term investments such as energy efficiency measures (Streimikiene and Balezentis 2019). Likewise, unemployment remains a significant socioeconomic constraint, often intertwined with low educational status and income (Rahmani and Groot 2023) and closely tied to the availability of renovation funding (Klöckner and Nayum 2016, Dimitrova et al. 2019).

Methodology

The datasets analysed in this study were provided by the FŐTÁV District Heating Division of BKM Nonprofit Ltd. and the Hungarian Central Statistical Office (KSH). The dataset from BKM-FŐTÁV – although not exhaustive – included information on various physical characteristics of district-heated buildings in Budapest, their functional use, and the energy-related interventions carried out in these buildings. During the data cleaning process, buildings presumed to belong to housing estates were filtered from the database based on use type (residential), year of construction, and building structure. To develop housing-estate-level data, it was crucial to determine the association of buildings with specific housing estates. This classification was accomplished through geocoding in QGIS software, utilising the address database linked to the buildings. During the geocoding process, additional filtering was applied: only residential buildings that could be distinctly identified as belonging to a housing estate, based on their geographical location, were retained.

The identification of individual housing estates was carried out concerning ‘A lakótelep’ (‘The large housing estate’) by Csizmady (2003) and ‘Budapesti falanszterek’ (‘Phalansters in Budapest’) by Iván (1996), both of which provided lists and geographical locations of identifiable housing estates in Budapest. A limitation of the BKM-FŐTÁV database was that the methodology and system of data collection

were not publicly disclosed, and not all buildings within a given housing estate were included in the dataset. After the necessary filtering, the number and share of residential buildings recorded per housing estate (regardless of estate size) were not uniform, resulting in a total sample size of N=2064 buildings. Based on the available data, 51 independent housing estates in Budapest were identified (Figure 1).

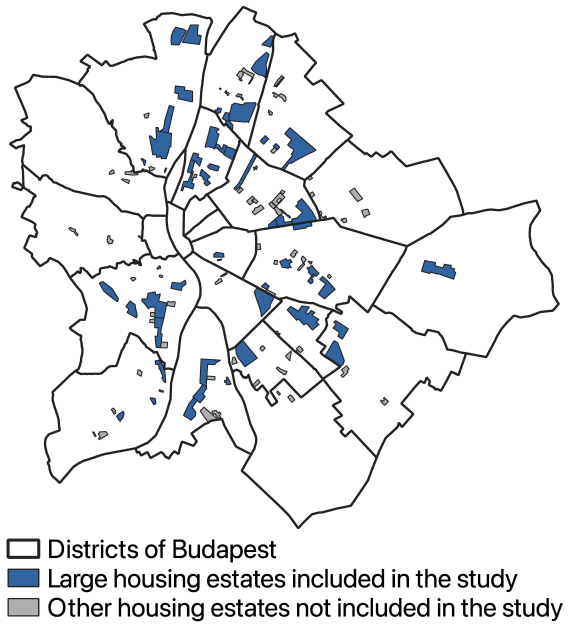

Figure 1. Large housing estates of Budapest. Source: authors, after Iván (1996), Csizmady (2003)

Additionally, the study incorporated census data from 2011 and 2022, collected and provided by the KSH. Within the framework of this research, census data were requested in an aggregated form at the level of the 51 defined housing estates. Although the census data were aggregated by housing estate, they were sufficient to answer the research questions. To retrieve housing-estate-level census data, KSH required spatial delineation of each estate based on addresses; this was achieved using the address data from the dataset provided by BKM-FŐTÁV. This approach ensured that census data were only requested for buildings included in the database of BKM-FŐTÁV, resulting in complete overlap between the two datasets.

In the census data, the unit of analysis was the household/household head and the flat. The requested variables included information on the household heads' educational attainment, employment status, age, and other socio-economic characteristics. In the case of dwellings, variables such as floor area and the presence of air conditioning were examined, which served as proxies for the income level of households (Szabó and Bene 2019, Thomson et al. 2019). As a result of the data request, aggregated

census data was available for each of the 51 housing estates identified using the BKM-FŐTÁV data. These data offered insight into the proportional demographic and socio-economic characteristics of the household heads living in each housing estate, reflecting the status of the whole household (e.g., proportion of household heads with university education in a given estate), as well as the attributes of the inhabited flat.

The data provided by BKM-FŐTÁV was also analysed independently to explore whether correlations existed between the physical characteristics of the buildings and the volume of energy retrofits implemented in them, as well as whether relationships existed among the various retrofit types themselves. For this analysis, Pearson's correlation was applied. No transformation was required as the variables were measured on ordinal or binary/dichotomous scales. However, the dataset also included categorical variables, such as building structure type, which could take values such as 'prefabricated panel', 'monolate concrete', or 'conventional brick'. For correlation purposes, 'prefabricated panel' and 'monolete concrete' values were merged into one category and converted into two dummy (binary) variables, which could then be included in the correlation analysis. In other cases, textual variables were projected onto an ordinal scale – for instance, the level of renovation (none, partial, complete).

We employed Pearson's correlation analysis to examine the relationship between the social composition of household heads in each estate and the volume of energy retrofits implemented in the housing estate buildings. This required aggregating BKM-FŐTÁV-provided data to the housing estate level. The resulting dataset contained information on the percentage of buildings within each estate that underwent specific energy retrofits, allowing the analysis to be performed across 51 housing estates.

Naturally, this methodological approach involved several limitations:

- (1) Since census data were available only at the housing-estate level for this study, building-level correlations could be examined only within the BKM-FŐTÁV dataset, limited to relationships between physical attributes and completed energy retrofits.
- (2) Although the census offered wide-ranging demographic and socio-economic data on the population, it did not directly assess income or welfare. These could only be inferred to a limited extent, requiring assumptions based on the highest educational attainment, employment status, activity level, and the presence of air conditioning.
- (3) The census data were retrieved using the address database from BKM-FŐTÁV, the data collection method and representativeness of which were unknown. The data collection did not occur in a specific year; data have been collected continuously over the past two decades. A review of the data was conducted in 2023, which did not involve a complete reassessment of all buildings included in the sample. Not every building within each housing estate was included in the data

by BKM-FŐTÁV. Additionally, the number of buildings included in the dataset varied among large housing estates, ranging from 4 to 150, reflecting the size of each estate. As such, the census data alone could not be used to draw definitive conclusions about the social composition of the examined housing estates; they must be interpreted in conjunction with the data of BKM-FŐTÁV. The data should therefore be understood as aggregated building-level data grouped by housing estate, rather than as representative estate-level data. Consequently, the social status of the estates themselves is only briefly examined in this study, primarily for contextual purposes.

- (4) The temporal scope of the data analysed in this study was somewhat limited. As noted earlier, large-scale housing estate renovation programmes were launched in the 2000s. The paper draws on census data from 2011 and 2022. Consequently, census-based information on social status was not available for periods preceding the implementation of measures. The implications and relevance of this limitation for the interpretation of the findings are discussed in the concluding remarks.
- (5) Within the scope of the present research, data on the renovation status of the entire building stock of Budapest was not available; therefore, no direct comparison with the sample could be conducted.

The main strengths of the applied methodology and data employed in this study derived from a complete overlap between the two datasets on renovation activities and social status which further originate from two separate sources. In other words, the same set of buildings was included in both the renovation-related and the social-status datasets, enhancing the relevance and robustness of the correlation analysis. Additionally, the retrieval of census data was based on an address-level database, an improvement over earlier studies (Csizmady 2003, Kovács and Szabó 2017) that primarily relied on census tracts to identify housing estate buildings.

Study area

In Hungary, the 'Panelprogram' – introduced in the 2000 Széchenyi Plan – was the most prominent initiative targeting the energy-efficient renovation of prefabricated panel buildings. The scheme was announced several times in multiple phases from 2005 to 2014. The subsidy typically required one-third financial participation from private owners, with the remaining two-thirds covered equally by the state and the local municipality. The programme supported, among other things, the implementation of thermal insulation, window replacement, heating system modernisation, and later, the installation of solar panel systems, as well as comprehensive renovations (Egedy 2003, Szabó and Bene 2019). Heating system modernisation primarily consisted

of installation of thermostatic valves and heat cost allocators. While the former was responsible for enabling radiator-level control of heating consumption, the latter ensured consumption-based heating billing (Lantos and Várföldi 2019, BME 2022). Accuracy of heat cost allocation has been criticised; however, their installation does not require a complete overhaul of the heating system, making them a considerably more cost-effective alternative to individual heat meters. As a result, many homeowner communities opt for this solution (Lantos and Várföldi 2019).

The multi-owner decision-making process associated with renovations in multi-unit buildings is significantly shaped by the legal form adopted by resident communities and the related regulations. Two legal forms dominate in Hungary: condominium associations ('társasház') regulated by Act CXXXIII of 2003, and housing cooperatives ('lakásszövetkezet'), governed by Act CXV of 2004. In condominiums, flats are privately owned, while the common areas of the building, such as stairwells or elevators, are jointly owned by all residents. In housing cooperatives, while flats are also generally private, the shared parts of the building belong to the cooperative. In both legal forms, the primary decision-making body is the general assembly, where most of the resolutions require a simple majority of those present. One of the key differences lies in voting rights: in condominiums, votes are weighted according to ownership shares (i.e., the floor area of the apartment relative to the total building area), while in cooperatives, each unit typically holds one vote. In housing cooperatives exceeding a certain membership threshold, a defined set of decision-making powers may be delegated to elected representatives. Executive powers are exercised by an elected board in the case of housing cooperatives, whereas in condominium associations these functions are performed by a manager appointed under a contractual agreement (Országgyűlés 2003, Országgyűlés 2004, Tóth and Kocsis 2025).

Results

This section begins with a brief overview of the social composition of Budapest and large housing estates included in the analysis based on census data. It then examines the physical characteristics and renovation-related aspects of the large housing estates, before presenting the results of the correlation analyses conducted.

Social composition of Budapest and large housing estates

Publicly available census data, together with those specifically requested for the purposes of this research, enabled a concise summary of selected key aspects of the social composition of Budapest and the housing estates included in the analysis. It is essential to emphasise that data on social composition for large housing estates should be interpreted considering the limitations discussed in the Methodology section. The following

description is intentionally concise and aims to provide contextual background for the analysis, complementing the factors identified in the earlier literature. A detailed estate-level analysis falls beyond the scope of the present paper and will be addressed in ongoing research.

Between 2011 and 2022, the average age of household heads in Budapest increased by 0.5 years, from 52.3 to 52.8. Over the same period, the proportion of household heads holding a university or college degree rose from 36% to 43%, while the share of those with only primary education declined substantially, from 15% to 9%. The proportion of household heads with secondary (i.e. high school) education – which was 34% – remained broadly unchanged at the city level. Between 2011 and 2022, the share of households without any unemployed members increased by 6%, reaching 96%. In 2022, 37% of dwellings in Budapest were equipped with air conditioning. The proportion of privately owned dwellings increased slightly, by 1%, to 94%. However, the share of households occupying their flat as owners was lower, at 81% in 2022. Between 2011 and 2022, the prevalence of private renting increased: in 2011, 12% of households occupied their flat under a rental tenure, compared to 18% in 2022.

The average age of household heads in the housing estates in the research was 53.6 years in 2022, indicating a slightly older age structure than the Budapest average. In contrast to city-level trends, the proportion of household heads with a university degree in the examined housing estates remained unchanged at 34%. At the same time, the share of household heads with only primary education declined markedly, from 18% to 11%, although this proportion remained slightly higher than the Budapest average. In 2022, the share of households without unemployed members in the examined housing estates matched the city-level figures, representing a 7% increase from 2011. The proportion of dwellings equipped with air conditioning exceeded the Budapest average by 1%. The share of privately owned dwellings in the housing estates was lower than the city average in both census years, falling from 79% in 2011 to 76% in 2022. Correspondingly, the proportion of households living under a rental tenure was higher than the Budapest average, amounting to 20% in 2011 and 23% in 2022.

Overall, the social status of the large housing estates studied here appeared to be somewhat below the Budapest average. It is nevertheless important to note that considerable variation could be observed among the housing estates, with those located in the outer districts of the city generally exhibiting lower levels of social status.

Correspondence between the examined housing estate sample and the overall Budapest housing stock

Most buildings in the sample featured prefabricated panel walls and structural systems; the proportion of slab blocks was similarly high in terms of built form. The majority of buildings in the sample were 9 to 12 storeys high, contain no more than

100 dwellings and have no more than four stairwells. Relationships can naturally be observed among the physical characteristics of the buildings. As noted earlier, it is essential to emphasise that the sample was not representative, and thus no general conclusions could be drawn regarding these relationships.

When discussing the physical characteristics of the buildings in this sample, it is important to note how they differed from the general patterns of housing estates in Budapest. Although a considerable portion of housing estate buildings are heated by central boilers serving individual buildings (Egedy 2003, Tóth and Kocsis 2025), the sample included only buildings supplied with district heating. This, of course, significantly limited the number of housing estates that could be delineated in the research. While studies covering a broader range of housing estates in Budapest (Iván 1996, Csizmady 2003, Szabó and Bene 2019) identify between approximately 115 and 150 housing estates, the buildings analysed in the present study were concentrated in 51 housing estates. Nevertheless, the large-scale, "emblematic" large housing estates —typically built after the 1970s, which make up the majority of housing estates—were included in the sample. The distribution of the housing estates in the sample by district corresponded proportionally to the samples of the cited studies, with districts having more housing estates associated with relatively more housing estates in this study (Szabó and Bene 2019). In terms of building structure, the sample in the present study was over-represented by buildings constructed with prefabricated panel technology, particularly at the expense of monolete concrete buildings (Szabó and Bene 2019).

#1## Renovation characteristics of the buildings in the study

Examining the buildings of the 51 identified housing estates involved in the research, it can be stated that by 2023, 51% of them had heating cost allocation systems installed. 31% of the buildings in the study underwent full thermal insulation, and windows were replaced entirely in 22%. Only a negligible proportion of the buildings – just 1% – use renewable energy sources (Figure 2).

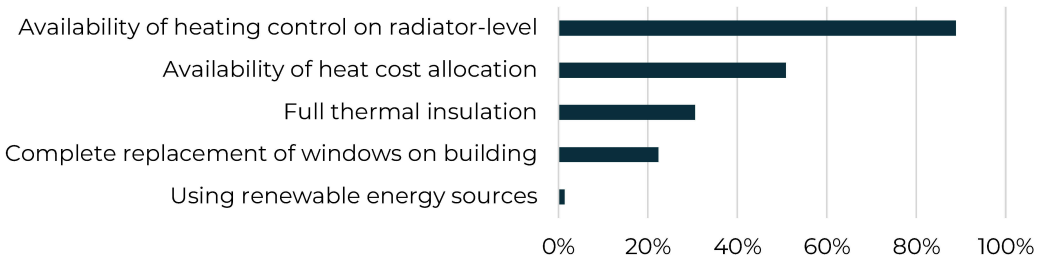

Figure 2. Proportion of buildings that underwent different types of renovations in the sample, based on the dataset provided by BKM-FŐTÁV

However, it is salient to highlight that the percentage of buildings equipped with heating systems that allow individual radiator-level regulation was particularly high, at 89%. This aspect, however, should be treated differently from the others. In housing estate buildings with a two-pipe heating system installed at the time of construction, some degree of household-level control over heating consumption was already ensured from the beginning (Csoknyai and Doholuczki 2022). On a national level, such buildings accounted for approximately half of the total housing estate stock (BME 2023). In light of these factors, it is essential to emphasise that the possibility of household-level heating consumption control was originally inherent in some cases. In contrast, in others, it was the result of renovations.

Examining the sub-samples based on the physical characteristics of individual buildings, significant differences could be observed in the average renovation levels between buildings taller and shorter than the sample median (Figure 3).

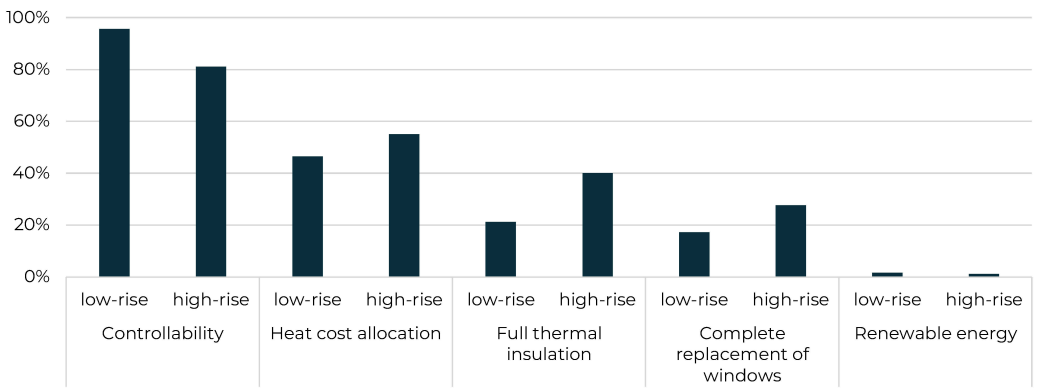

Figure 3. Proportion of renovated buildings whose height is taller or shorter than the median (nine storeys) in the sample, based on the dataset provided by BKM-FŐTÁV

In housing estates where the average building height exceeded the median value of the entire sample (nine storeys), buildings generally had a higher rate of renovation. An exception was the controllability of heating consumption per radiator, which was more common in housing estates with lower buildings. Mapping various aspects of energy renovations revealed which housing estates had the highest proportion of renovated buildings (Figure 4).

In most housing estates, the proportion of buildings equipped with manual heat controls or thermostatic valves suitable for household-level heating consumption regulation exceeded 34%. Due to the relatively widespread availability of manual and thermostatic valves, no clear patterns emerged correlating location and physical characteristics of the housing estates with the availability of regulation. The distribution of various energy efficiency investments across housing estates reflected the previously

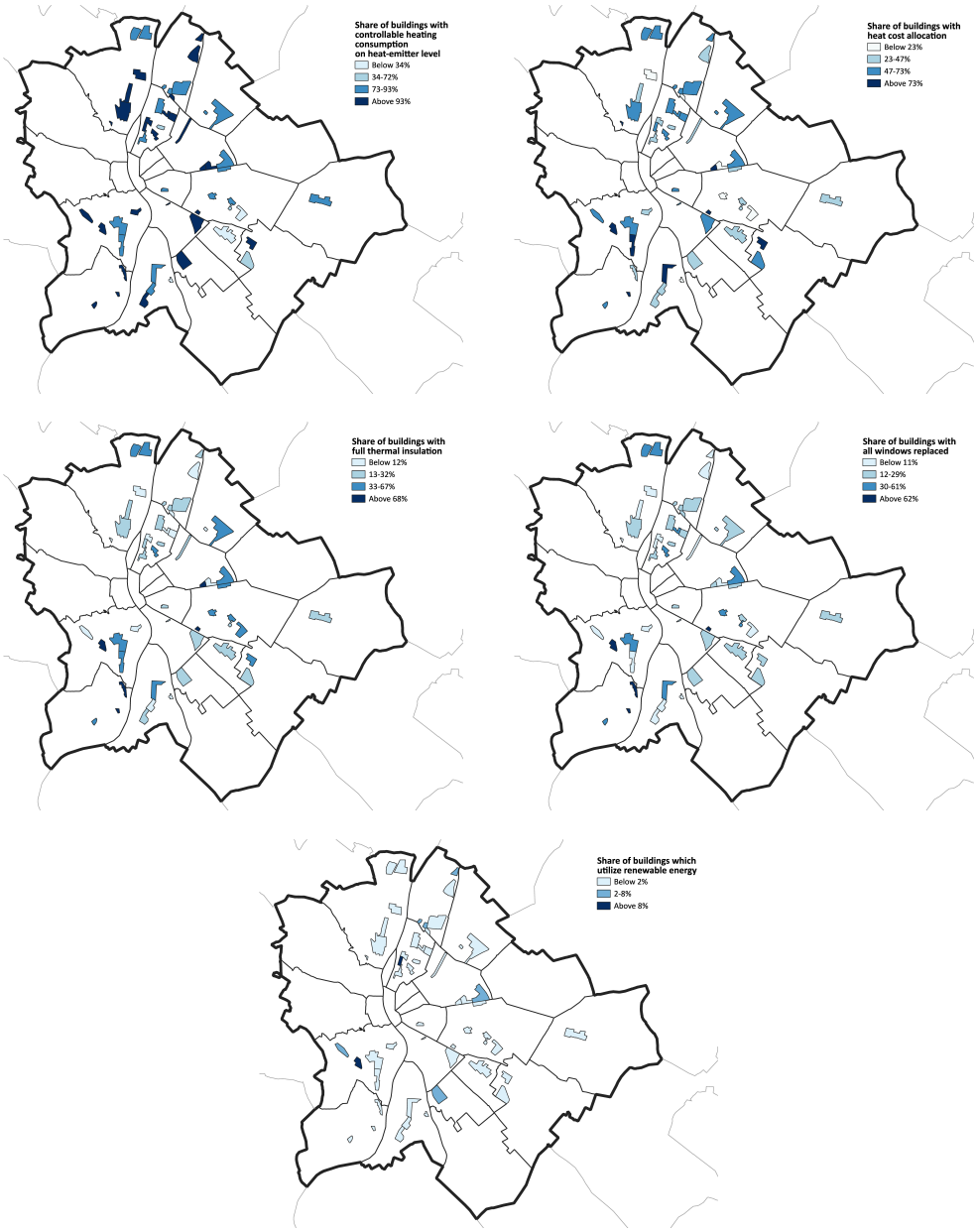

Figure 4. Proportion of renovated buildings in the housing estates in the sample. Dataset provided by BKM-FŐTÁV

presented observations, namely that renovations occurred more frequently in larger-scale housing estates with generally taller buildings – this is especially evident in the cases of thermal insulation and heat cost allocation. This phenomenon was previously observed by Szabó and Bene (2019). According to them, higher renovation rates in

multi-apartment buildings were partly driven by how the Panelprogram supported only the renovation of residential buildings using prefab technology, a significant portion of which belong to the taller buildings with more flats. Additionally, the relatively lower per-unit renovation costs of larger buildings, combined with the greater fear of depreciation among their owners, may have motivated these renovations.

Relationship between renovations

The abbreviations and coding used in the correlation matrices presented below are listed as follows (Table 1). The relationships between the physical characteristics of buildings and the completed energy renovations were examined at the building level.

Table 1. Abbreviations and coding used in the correlation analysis

Variable	Abbreviation	Coding applied if any
BUILDING-LEVEL DATA		
Number of flats	apt_num	
Number of above-ground storeys	storeys	
Number of staircase units	stairc	
Building structure	struct	prefabricated panel and monolete concrete = 0; brick = 1
Year of construction	y_built	—
Thermal insulation of enclosing structures	insul	no insulation = 0; partial insulation = 1; full insulation = 2
Replacement of windows	win	original = 0; partially replaced = 1; fully replaced = 2
Use of renewable energy	renew	no renewable use = 0; renewable use = 1
Availability heat controls on radiators (heat emitters)	heat_ctrl	no = 0; yes = 1
Availability of heat cost allocation	c_share	no = 0; yes = 1
CENSUS DATA ON HOUSING ESTATE-LEVEL		
educated	Proportion of household heads with higher education	
area_60_79	Proportion of apartments sized 60-79 m²	
aircond	Proportion of apartments equipped with air conditioning	
avg_age	Average age of household heads	
move_90-22	Year of the household head's move to the current address, from before 1990 to 2022, grouped in 10-year intervals	
years_res	Average number of years household heads have lived at current address	
own_prop	Proportion of household heads with ownership rights	
1_emp	Proportion of households with one employed person	
unemp	Average number of unemployed persons per household	
inact	Average number of inactive persons per household	
priv_own	Proportion of apartments privately owned	
mun_own	Proportion of apartments owned by local municipality	

In order to properly evaluate the findings that follows, some notes should be added regarding the addressed technical aspects and measures. In the analysed dataset, the variable referring to *thermal insulation* took three values: the building was either not insulated, partially insulated, or fully insulated. Full insulation refers to the insulation of the entire building façade, whereas partial insulation typically covered only the narrower end walls of the building. Data on window replacement likewise took three values. In this context, *partially replaced* generally indicated that only a certain, unspecified proportion of households within the building have replaced their original windows. The *availability of radiator-level heating controls* allows for household-level regulation of heating consumption, thereby providing the functional precondition for the installation of heat cost allocators. Heat cost allocators calculate each household's share of total building-level heating costs based on radiator heat output and indoor room temperature. If a household reduces heating consumption, its allocated share decreases accordingly, making heating expenditures controllable at the household level (Csoknyai and Doholuczki 2022).

The design of heating systems—whether single-pipe, single-pipe with bypass sections, or two-pipe—is of limited direct relevance for the purposes of this study. It is nevertheless important to note that the installation of radiator-level thermostatic controls and heat cost allocators requires either a single-pipe system equipped with bypass sections or a two-pipe heating system. It should be emphasised that in single-pipe heating systems, bypass sections were already incorporated at the time of construction, while in other cases, they were installed as part of later renovation works. However, no information was available on the proportion of buildings falling into these two categories. The proportion of buildings equipped with single-pipe systems featuring bypass sections or two-pipe heating systems aligns perfectly with the proportion of buildings with radiator-level heating controls. This is because a core functional purpose of both bypass sections and two-pipe heating systems is to enable radiator-level controllability of heating consumption (Csoknyai and Doholuczki 2022).

The correlation analysis of the entire sample (n=2064; Table 2) reflected fairly well the relationships among the physical characteristics of individual housing estate buildings. The number of storeys and staircases moderately influenced the number of apartments in these housing estates.

A moderately strong positive relationship could be observed between implementing thermal insulation and replacing windows in the full sample. The introduction of cost allocation was less frequently associated with thermal insulation, window replacement, and the possibility of regulating heating at the household level; the coefficients were positive but indicated relatively weak correlations. Based on the full sample, it could be stated that although the buildings included in the analysis were already, in many cases, equipped with heating systems that allowed heat control per radiator, this did not generally imply that heat cost allocation was also available.

Table 2. Association between physical characteristics and energy renovations in the full sample, based on the dataset of BKM-FŐTÁV

	apt_num	storeys	stairc	struct	y_built	insul	win	renew	heat_ctrl	c_share
apt_num	1									
storeys	**.508****	1								
stairc	**.439****	-.155**	1							
struct	-.298**	-.374**	-.200**	1						
y_built	.003	.041	.077**	-.158**	1					
insul	.076**	.216**	-.092**	-.165**	.025	1				
win	.027	.100**	-.073**	-.096**	.014	**.584****	1			
renew	.061**	-.020	.051*	-.061**	.021	.142**	.124**	1		
heat_ctrl	-.125**	-.216**	-.017	.175**	-.003	.033	.119**	.043	1	
c_share	.080**	.079**	-.045*	-.015	-.011	.312**	.303**	.101**	.361**	1

***. Correlation is significant at the 0.01 level*

**. Correlation is significant at the 0.05 level*

As mentioned in the previous subsection, renovations occurred more often in housing estates where the average building height exceeds the whole sample's median value (8.5 storeys, based on housing estate–level average building heights). Accordingly, the correlation analysis described above was also conducted on this subsample.

Compared to the full sample, a somewhat stronger association could be observed between thermal insulation and window replacement implementation (Table 3).

Table 3. Relationship between physical characteristics and energy renovations in housing estates where the average building height exceeds the median value (9 storeys) of the full sample, based on the dataset of BKM-FŐTÁV

	apt_num	storeys	stairc	struct	y_built	insul	win	renew	heat_ctrl	c_share
apt_num	1									
storeys	.012									
stairc	**.741****	-.170**	1							
struct	-.191**	-.072*	-.124**	1						
y_built	.084**	.029	.120**	-.151**	1					
insul	-.063*	.016	-.102**	-.083**	.048	1				
win	-.037	-.003	-.087**	-.091**	.073*	**.624****	1			
renew	.164**	-.006	.116**	-.018	.024	.080*	.093**	1		
heat_ctrl	.009	-.045	-.068*	.068*	.145**	.128**	.220**	.053	1	
c_share	.062	-.005	.008	.058	.067*	.329**	.341**	.100**	**.534****	1

***. Correlation is significant at the 0.01 level*

**. Correlation is significant at the 0.05 level*

It is also important to highlight that the relationship between radiator-level heating control and the implementation of heat cost allocation had significantly strengthened, reaching a moderate level. This suggested that radiator-level control more often coincided with installing heat cost allocators in buildings taller than the median. It is important to note that there was also a direct logical connection between the two factors: radiator valves are practically essential for enabling cost allocation, as they allow for the regulation of heating consumption, which in turn affects costs (Csoknyai and Doholuczki 2022).

The presented correlation matrices examined the relationships between physical characteristics and implemented renovations at the building level. Aggregation of the building-level data to the housing estate level revealed further associations.

The presented correlation matrix segment (Table 4) examined the relationship between the share of renovated buildings in housing estates and different types of renovation. A moderately strong relationship was observed between the share of buildings equipped with cost allocators and those that have undergone complete window replacement (f_win). The proportion of buildings with complete window replacement did show a notably stronger correlation with the share of fully insulated buildings. This latter also correlated with the share of buildings equipped with cost-allocators. In other words, in large housing estates with a higher proportion of thermally insulated buildings, the share of those with entirely replaced windows and cost allocators was also likely higher.

Table 4. Relationships between the proportions of buildings having undergone different types of renovation within the full sample, at the housing estate level, based on the dataset of BKM-FŐTÁV

	heat_ctrl	p_win	f_win	renew	c_share	insul
heat_ctrl	1					
p_win	.036	1				
f_win	.116	.117	1			
renew	.154	.083	.104	1		
c_share	.339*	.108	**.430****	.219	1	
insul	.077	.143	**.759****	.106	**.525****	1

***. Correlation is significant at the 0.01 level*

**. Correlation is significant at the 0.05 level*

In terms of renovation complexity and interconnection, more associations appeared at the estate level than at the building level. As Szabó and Bene (2019) pointed out, this might have resulted from renovations becoming more cost-effective when more dwellings were included, which might have also applied at the estate level, due to the fact that it is not uncommon for neighbouring buildings to be managed by the same management entity especially in the case of housing cooperatives.

Correlation between the proportion of renovated buildings and the social composition and socioeconomic characteristics of housing estates

Correlation analysis was performed to examine the relationship between the proportion of renovated buildings and the social composition of housing estates (Table 5). A moderately strong correlation was observed between the share of household heads with university degrees (educated) and the proportion of buildings with household-level controllable heating systems (heat_ctrl). Interestingly, a moderately strong positive correlation existed between the proportion of buildings with partially or fully replaced windows (p_win) and the share of privately owned apartments (priv_own). Conversely, a moderately strong but negative correlation existed between this renovation type and the proportion of municipally owned apartments (mun_own). This suggested that municipalities might have been less active in modernising their housing stock compared to private owners, whose own residency provided a direct incentive to implement renovations.

Table 5. Correlations between the proportion of renovated buildings and the social composition and socioeconomic characteristics of housing estates based on the 2022 census data of KSH and the dataset of BKM-FŐTÁV

	heat_ctrl	p_win	f_win	renew	c_share	insul	educated	area_60-79
educated	**.430****	.127	-.102	.228	.170	-.108		
area_60-79	.050	.087	.039	.272	-.006	.082	.192	
aircond	.099	.181	-.079	.285*	-.034	-.098	**.631****	**.481****
avg_age	-.004	-.035	-.095	.301*	.057	-.129	.016	.140
move_-90	-.155	.064	.199	.128	.168	.163	-.012	-.012
move_90-99	.048	.042	-.051	-.010	-.032	-.109	.046	**.486****
move_00-09	-.163	-.006	-.170	.137	-.176	-.121	-.154	.336*
move_10-19	.158	-.046	-.151	-.256	-.111	-.071	-.054	**-.425****
move_20-22	.187	-.117	-.037	-.085	-.034	-.008	.118	**-.422****
years_res	-.088	.110	.193	.101	.211	.166	.081	.127
own_prop	-.137	.335*	.088	.204	-.069	.038	-.126	.339*
1_emp	.307*	-.016	.074	-.105	.298*	.080	.362**	-.257
unemp	-.382**	-.114	.105	-.262	-.268	.063	**-.652****	-.283*
inact	-.142	-.046	.027	.229	.091	-.044	-.049	.132
priv_own	.091	**.456****	.127	.145	.010	.157	.250	.213
mun_own	-.162	**-.513****	-.079	-.194	.047	-.055	-.394*	-.096

***. Correlation is significant at the 0.01 level*

**. Correlation is significant at the 0.05 level*

Additionally, a moderately strong correlation was found between the share of apartments with air conditioning (aircond), the share of household heads with higher education, and the proportion of 60-79 square metre apartments. Finally, a moderately

strong, negative correlation was also observed between the share of household heads who received higher education and the number of unemployed household heads.

In the full sample, only weak correlations existed between the social composition and other socioeconomic characteristics of housing estates and the proportion of renovated buildings. The educational status of household heads and the ownership status of dwellings were somewhat linked to the possibility of household-level heating consumption regulation and the proportion of buildings that underwent window replacement. However, building-level renovations requiring broader cooperation among owners (insulation, installation of heat cost allocators, or use of renewable energy sources) could not be associated with the social composition of the housing estate.

Since buildings above the median height in the full sample underwent renovations at a higher rate, this subsample was also emphasised when examining correlations between social composition and renovation rates (Table 6). In this case, the median average building height of the delineated estates was 8.5 floors. The following correlation matrix below show only the housing estates where the average building height exceeds this threshold.

Table 6. Correlations between the proportion of renovated buildings and the social and socioeconomic characteristics of housing estates with an average building height exceeding the median (8,5 floors) of all surveyed estates, based on the 2022 census data of KSH and the dataset of BKM-FŐTÁV

	heat_ctrl	p_win	f_win	renew	c_share	insul	educated	area_60-79
educated	**.464***	.017	.066	.348	.276	.142		
area_60-79	.240	.156	.236	.204	.139	.288	.345	
aircond	.195	.179	-.081	.299	-.061	-.092	**.731****	.328
avg_age	.083	-.233	-.053	**.567****	.020	-.137	.102	.235
move_–90	.110	-.123	.318	**.435***	.267	.297	**.469***	**.443***
move_90-99	.114	.108	.384	**-.422***	.161	.266	-.183	.321
move_00-09	**-.427***	-.060	-.245	-.007	-.231	-.398*	**-.546****	-.128
move_10-19	-.008	-.083	-.365	-.351	-.278	-.275	-.279	-.265
move_20-22	.116	.197	-.065	-.117	-.015	-.001	.074	**-.423***
years_res	.123	-.078	**.408***	.286	.249	**.402***	.290	**.516***
own_prop	-.191	.201	.115	.326	-.225	-.035	-.280	.128
1_emp	**.412***	.224	.035	-.101	.347	.195	.441*	.106
unemp	**-.529****	-.111	.099	-.298	-.193	-.032	**-.770****	-.388
inact	-.061	-.206	.012	**.472***	.013	-.143	.037	.297
priv_own	.153	**.615****	.163	.254	-.003	.177	.180	.260
mun_own	-.168	**-.580****	-.191	-.321	.176	-.072	-.212	-.289

***. Correlation is significant at the 0.01 level*

**. Correlation is significant at the 0.05 level*

When examining housing estates with an average building height above the median value in the sample, the previously observed correlations strengthened significantly. The proportion of unemployed household heads did show a moderate negative correlation with the share of buildings equipped with heating systems that could be controlled on a household level. An additional correlation related to this physical aspect appeared in connection with the proportion of household heads who moved to their current address between 2000 and 2009. Notably, the data revealed a moderate negative correlation between the share of higher-educated household heads and that of those who relocated during this period. These results suggested that residents moving to housing estates between 2000 and 2009 were, on average, less educated, which might have indirectly influenced renovation activity. However, this should be considered alonside our earlier remark that implementing individual heating control was not always the direct outcome of building-level renovations (Csoknyai and Doholuczki 2022).

It is worth to mention the finding that the average age of household heads on the housing estate and the proportion of inactive household heads did show a positive, moderately strong correlation with the proportion of buildings utilising renewable energy sources. Although due to the low number of buildings using renewable energy, these results should be interpreted with caution. A moderately strong positive correlation was also evident between household heads' average length of residence and the proportion of buildings that have undergone complete window replacement and insulation. It could be assumed that the household head's age and years spent in the home were positively related to the ownership status (Kocsis 2012, Kovács et al. 2018), which might have, in turn, encouraged building-level renovations (Klöckner and Nayum 2016) – yet no significant correlation was found between ownership status and these factors. However, long-term residents might have felt a stronger sense of ownership over the building and, consequently were more likely to take actions to maintain or improve it (Rohe and Stewart 1996).

The relationship between renovated buildings and social composition based on 2011 census data was also analysed (Table 7). Since the 'Panelprogram' supported many housing estate renovations, investments from that period could substantially influence the results. Now we focus only on the previously presented subsample.

The 2011 census data revealed similar patterns in the proportion of renovated buildings to those observed in the 2022 data. The data from 2011 confirmed that residents who moved to housing estates between 2000 and 2009 typically had lower educational status levels, and these households also had higher unemployment rates. Notably, a previously unobserved but now moderately intense negative association emerged between the proportion of household heads who moved to housing estates during this period and the share of thermally insulated buildings. Although no direct correlation was observed between this type of renovation and either educational status or unemployment levels, it could be assumed that the socioeconomic status and

income levels of those who moved in during this period may have negatively influenced the implementation of building-level renovations.

Table 7. Correlation between the proportion of renovated buildings and the social and socioeconomic characteristics of housing estates with an average height exceeding the median (8,5 floors) of all surveyed estates, based on the 2011 census data of KSH and the dataset of BKM-FŐTÁV

	heat_ctrl	p_win	f_win	renew	c_share	insul	educated	unemp
educated	**.471***	.076	.030	**.418***	.248	.073		
area_60-79	-.119	.085	.170	-.015	-.198	-.018	.020	.095
avg_age	.260	-.125	.105	**.548****	.013	-.007	.194	-.311
move_-90	.157	-.102	.319	**.504***	.175	.291	.405*	-.430*
move_90-99	-.153	-.082	-.154	-.268	-.132	.030	-.218	.408*
move_00-09	-.363	-.082	-.286	-.202	-.374	**-.400***	**-.692****	**.557****
years_res	.084	-.061	.274	.127	.044	.364	-.089	-.140
own_prop	.088	**.526****	.202	.318	-.093	.229	.094	-.238
1_emp	.156	.111	-.105	.219	.104	-.058	.414*	-.170
unemp	**-.500***	.006	-.088	**-.425***	-.289	-.165	**-.822****	1
inact	-.037	-.197	.115	.351	-.009	.145	-.252	.029
priv_own	.145	**.657****	.203	.214	-.150	.165	.150	-.248
mun_own	-.164	**-.688****	-.145	-.262	.266	-.080	-.239	.307

***. Correlation is significant at the 0.01 level*

**. Correlation is significant at the 0.05 level*

Discussion

Literature highlights connections between age composition, educational attainment, related income status, homeownership, and implemented energy measures (Nair et al. 2010, Mills and Schleich 2012, Brounen et al. 2013, Klöckner and Nayum 2016, Streimikiene and Balezentis 2019). The present study provides substantial support for these observations using quantitative census data. Certain socioeconomic factors show correlations with specific building renovations, while the analysis of the 2011 census highlights the indirect interplay between educational status, unemployment, and renovation outcomes.

However, these relationships were not always straightforward or consistent. This is presumably because the quantitative methodology employed cannot account for a key influencing factor of building-level renovations: the difficulties of community-level decision-making (Matschoss et al. 2013). International literature also points out that the heterogeneity of homeowners can significantly hinder the approval and execution of renovations (Matschoss et al. 2013). According to the literature, this can be a severe problem in housing estates in Hungary and other East-Central European countries,

where the proportion of private owners is relatively high (Kovács et al. 2018, Janky and Kocsis 2022, Pirrus and Leetmaa 2023). In the case of Western and Northern European countries, municipal ownership in large housing estate buildings remained considerably high, as the vast majority of these are socially rented. While the present paper highlights the unfavourable association between municipal ownership and renovation outcomes, evidence from other countries points to different patterns. In the United Kingdom, the energy condition of municipally owned social rental housing is considered generally decent (Boardman 2010). Similarly, in the cities of former East Germany, the state allocated substantial public resources to renovating large housing estates as early as the 1990s. These cases suggest that municipal or state ownership can, under certain institutional conditions, mitigate the barriers arising from social heterogeneity within multi-owner residential buildings (Bernt 2020). At the same time, it is important to note that in multi-family buildings in Western European Countries, renovation is often associated with the phenomenon of renoviction. The term refers to the situation in which private landlords implement major refurbishments, leading to soaring rents and forcing lower-income households to relocate, thereby contributing to social segregation (Busà 2025). However, in Russia, for instance, the public ownership of housing did not prevent tenants from improving their living environment through small-scale, self-initiated renovations. Such practices not only enhanced the physical condition of dwellings but also fostered a sense of place attachment and strengthened ownership-like attitudes (Bernt 2020).

The results of the paper contribute to the theoretical framework of the energy efficiency gap. Low income associated with lower educational attainment and unemployment, as well as information deficits, are among the most frequently cited barriers (Nair et al. 2010, Mills and Schleich 2012, Brounen et al. 2013, Klöckner and Nayum 2016, Streimikiene and Balezentis 2019) to renovation in the energy efficiency gap literature (Hirst and Brown 1990, Weber 1997). The lack of financial resources available for renovations is typically classified within the categories of market-oriented (Hirst and Brown 1990) or structural (Weber 1997) barriers. The literature identifies a wide range of policy instruments aimed at addressing these constraints. Among these, financing schemes provided by Energy Service Companies (ESCOs) are particularly noteworthy, as they allow the cost of energy efficiency investments to be covered by the savings generated through the interventions. Such arrangements represent an effective means of mitigating high upfront investment costs. More conventional policy instruments supporting renovation activities include tax incentives related to renovation works or material costs, as well as preferential state-backed loan schemes (Bertoldi et al. 2021). In addition, lower educational attainment and an older age structure are often associated with information deficits, which constitute another frequently cited barrier to renovation. One commonly referenced policy response to this challenge is the implementation of information and awareness-raising programmes targeting both residents

and intermediary actors, such as building managers or homeowners' association representatives (Yeatts et al. 2017, Streimikiene and Balezentis 2019).

From the perspective of this research, it is imperative to highlight that the heterogeneity of residents is not only measurable in terms of age or education but also attitudes and values related to renovations (Nair et al. 2010). The lack of information among decision-makers may significantly influence the renovations implemented – in this case, private owner residents (Palm and Reindl 2018, Streimikiene and Balezentis 2019) – as well as the trust placed in other actors involved in the renovations (Nair et al. 2017). Furthermore, the effectiveness and role of subsidy policy distribution mechanisms may also be questioned, as they may likewise reduce the influence of social status in the implementation of renovations (Yeatts et al. 2017).

Although the factors examined in the study certainly play a role in the execution of renovations, in a multi-apartment condominium environment, many aspects influence renovation implementation (Cirman et al. 2013, Matschoss et al. 2013, Nair et al. 2017, Dimitrova et al. 2019, Janky and Kocsis 2022). These aspects – which this paper could not address due to its focus and applied methods – could overshadow the role of data derivable from the census. Drawing on the findings of this study, future research should employ in-depth qualitative approaches, such as interview-based investigations, to explore local dynamics and patterns, as well as the more nuanced aspects of social heterogeneity. In particular, it would be important to address residents' individual assessments of renovation processes, the performance and renovation-related attitudes of housing management actors (e.g., condominium managers or housing cooperative representatives), and the level of trust residents place in management (Cirman et al. 2013, Matschoss et al. 2013, Nair et al. 2017, Dimitrova et al. 2019, Janky and Kocsis 2022) – specifically in large housing estates of Budapest. Such research could contribute more deeply to the refinement and expansion of the behavioural and organisational dimensions identified within the theoretical framework of the energy efficiency gap (Hirst and Brown 1990, Weber 1997), thereby enabling a more comprehensive understanding of the factors shaping renovation outcomes in East-Central European large housing estates.

Conclusions

The study examined the correlations between energy efficiency investments implemented in district-heated panel housing estates in Budapest and the social composition of these housing estates. It is important to note that the correlations identified between the examined variables do not provide evidence of causal relationships. In other words, based on these results, it cannot be established that the social status of housing estates influenced their level of renovation, nor that the level of renovation affected their social status. Nevertheless, the validity and relevance of our findings are

supported by the fact that the social status of large housing estates has not undergone substantial change over the past over thirty years (Kovács and Douglas 1996, Csizmady 2003, Kovács et al. 2018). This relative stability can be attributed (Musterd et al. 2017) in part to the previously discussed high rates of homeownership (Kovács et al. 2018) and low levels of residential mobility (Jackson and Evans 2017, Durst and Huszár 2022).

The first research question of the paper examined the extent to which different types of energy renovation measures are interrelated at both the building and housing estate levels. Only a few correlations were found when correlation analysis was conducted at the building level among the renovations implemented. Based on the results, only two factors showed a moderately strong, statistically significant correlation: thermal insulation and window replacement. When examining buildings taller than the median of the full sample, another moderately strong positive correlation could be observed between heat cost allocation and radiator-level heating control. This correlation is partially logical, considering that the practical value of heat cost allocation lies in the controllability of heating. Compared to building-level analyses, somewhat stronger correlations were observed at the housing estate level between different types of renovations. This indicated that housing estates with a higher proportion of thermally insulated buildings typically had higher proportions of buildings with complete window replacement and heat cost allocators.

The second research question examined whether there is a correlation between the volume of implemented renovations and the social composition of housing estates. A moderately strong correlation was observed between households headed by individuals with a university degree and the proportion of buildings with heating systems that are controllable at the household level. Negative, moderately strong correlation existed between the proportion of municipally owned flats and the proportion of buildings that had undergone partial or complete window replacement, indicating the role of municipal ownership in the feasibility of household-level measures. Examining the sub-sample of housing estates taller than the median of the full sample, a moderately strong correlation was observed between the number of years the household head has lived at their current residence and the proportion of buildings that have undergone complete window replacement and thermal insulation. An analysis of the 2022 and 2011 data in the same subsample revealed that residents who moved to housing estates between 2000 and 2009 typically had lower educational status and lived in households with higher unemployment rates. Based on these associations, it can be assumed that the lower social status of those who moved in during this period might have had a negative impact on the implementation of building-level thermal insulation projects.

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Entrepreneurship and the environment at regional level in Poland: Non-linear relationships and challenges in the context of sustainable development

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Abstract: The non-linear relationship between entrepreneurship and the natural environment means that the impact of economic activity on the environment is not proportional to the growth of companies. The aim of the study is to analyze the variability and interdependencies between entrepreneurial activity and the natural environment, taking into account their spatial and temporal changes. The study used a literature review and statistical measures. Empirical data was collected for (102) municipalities in the Świętokrzyskie Region. The results of the analysis were presented in 2010, 2019, and 2022. Entrepreneurial activity shows variability, which stabilizes over time, indicating market maturity and the effectiveness of policies supporting entrepreneurship. We observe stability in the area of the environment. The results indicate a gradual decrease in the spatial diversity of entrepreneurship. Moreover, a weak and positive, albeit weakening, correlation is observed between the level of entrepreneurship and environmental quality. This finding does not suggest a significant conflict between economic development and environmental protection. The analysis emphasizes the importance of local conditions and points to the need for targeted regional policy measures, especially support for municipalities with low values on both measures, particularly in the south-eastern part of the region. It is therefore important to continue measures that support sustainable development. This should be done through the implementation of regional policy and support for new businesses. Such measures can help to reduce inequalities and improve living conditions in less developed regions. Systematic monitoring of policy outcomes and support for green transition remain key to sustainable development and reducing spatial disparities.

Keywords: entrepreneurship; natural environment; sustainable development; non-linear relationships; synthetic measure; Świętokrzyskie Region

Introduction

The relationship between the environment and entrepreneurship is complex, as economic activity can lead to either environmental degradation or promote sustainable

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development. Ma et al. (2024) highlight that regions serving as centers of economic activity play a key role in protecting natural resources and integrating environmental, social, and economic aspects to foster synergies and sustainable development. In turn, Kasztelan (2010) and Ahmad et al. (2022) emphasize that sustainable development requires the integration of ecological and social aspects, enhancing environmental quality. Key elements in this process are technological advances, environmental regulations, and renewable energy adoption, all helping to improve ecosystems and promote a balance between economic growth and environmental protection.

While socio-economic development offers clear benefits, it has also led to a decline in ecological resilience, especially because of intensive urbanization and industrial land use, which reduce ecosystems quality. Fan and Wei (2025) point out that understanding the interactions between economic activities and the environment is crucial in developing strategies to build resilient regions capable of coping with ecological crises. Furthermore, Wang et al. (2024) indicate that contemporary regional development planning incorporates socio-ecological resilience, defined as the ability to adapt and remain stable after crises such as climate change.

Socio-ecological resilience, which includes the adaptive capacity of socio-ecological systems, stands as a key element of urban planning (Naghibi et al. 2025). An important aspect is the integration of physical structures with socio-ecological networks, especially in the context of small urban parks, which act as catalysts for ecological and social change. Nguyen et al. (2021) point to the non-linearity of the relationship between environment and entrepreneurship. While economic development improves quality of life and creates jobs, intensive exploitation of natural resources, especially in resource-rich regions, leads to resource depletion and environmental degradation. In turn, they note a non-linear relationship between the level of economic complexity and entrepreneurial density, where an initial increase in complexity promotes development, but after a certain threshold hinders entrepreneurship.

The aim of the study is to analyze the variability and interdependencies between entrepreneurial activity and the environment, considering their spatial and temporal variations. Attention is paid to the analysis of log-linear models, correlations, and spatial autocorrelations to capture non-linear and regionally varying relationships that might have a significant impact on the further development of both areas. In this context, the research questions formulated are: How did the development of entrepreneurship in the municipalities of the Świętokrzyskie Region affect the state of the environment? What were the relations between the level of enterprises and the quality of the environment, especially in terms of sustainable development?

The originality of the article stemms from its interdisciplinary approach, combining economics and environmental sciences. Another important element of novelty is the focus on a specific research area—a peripheral region of the European Union—comprising rural, urban, and urban-rural municipalities of the Świętokrzyskie

Province, as a sparsely urbanized area with low business density. This approach allows for the formulation of new conclusions regarding local conditions and initiatives in the field of entrepreneurship and the state of the natural environment. An additional element of originality is the analysis of non-linear relationships between the level of entrepreneurship and the state of the natural environment at the local level. The study provides empirical evidence of a weakening (yet still positive) correlation over time. This suggests that companies gradually adapt to sustainable development requirements without a clear conflict between economic activity and environmental protection. This result is less evident in the literature on the peripheral regions of Eastern Poland and constitutes an important contribution to the discussion on the relationship between entrepreneurship and the natural environment in the context of contemporary development challenges.

Literature review

Entrepreneurship played a key role in economic development, job creation, and improving the quality of life. The development of the region was closely linked to the use of natural resources, but the increasing intensification of economic activity posed challenges for the environment. Assessing the relationship between the environment and entrepreneurship was crucial for sustainable development. Businesses, particularly in traditional industries, had a significant impact on the environment through emissions and resource consumption, and changes in the state of the environment could have affected their economic activities, for example, through increased costs or changes in demand. However, there were opportunities to combine economic and environmental objectives, e.g., by investing in environmentally friendly technologies or renewable energy. By doing so, companies could have supported environmental protection while remaining competitive and profitable.

Regmi et al. (2023) indicated that entrepreneurs played a key role in the transition to a sustainable economy, especially in the context of implementing green innovations and aligning business goals with environmental objectives. A sustainable economy also requires the efficient management of natural resources to reduce the risks associated with raw material scarcity and regulatory changes. As del Olmo-García et al. (2023) highlighted, entrepreneurship (including sustainable entrepreneurship) was a key element of sustainable development that combined economic, social, and environmental value, and its importance was growing in the face of the challenges of environmental degradation. According to Kumar Jha and Saran Pande (2024), entrepreneurs implementing sustainability concepts functioned as change agents by initiating social-institutional processes and extending the role of business beyond market success. Nevertheless, they encountered challenges in balancing environmental, economic, and social objectives and faced risks related to environmental degradation and unstable

financial performance. On the other hand, Shahid et al. (2023) emphasized that sustainable entrepreneurship was seen as a method of addressing social inequalities and environmental degradation, but the realization of its triple objectives faced numerous barriers, such as market risks, lack of appropriate regulation, or technological difficulties. Considering these challenges and opportunities, the circular economy appeared as a concrete approach operationalising the principles of sustainable entrepreneurship.

The circular economy (CE) promoted entrepreneurship, enabling resource savings and efficiency improvements, while contributing to environmental protection through recycling, reuse, and extending the life cycle of products. The issues of the circular economy were presented by González-Moreno et al. (2024), Wei (2022), and others. They pointed out that the closed-loop economy was a modern approach that changed the way companies operated, focusing on recycling, reuse, and extending the life cycle of products. The introduction of CE came with many challenges, such as changes in regulations, technologies, and production processes. Nevertheless, entrepreneurs recognized the potential of CE to save resources, improve efficiency, and build a positive image, improving the environment.

Synergies between the natural environment and the economy were key to sustainable development. The use of natural resources and production was to be carried out in a way that did not lead to their degradation. Analysing the interrelationship of these areas allowed the integration of economic and environmental objectives, identifying solutions that supported business development while protecting the environment. The joint analysis of these two areas allowed synergies to be identified, risks to be avoided, and innovations to be introduced that simultaneously promoted environmental protection and business development. In recent years, environmental variables became increasingly important in the evaluation of companies' activities, especially in the context of companies' environmental impacts, such as carbon footprint and sustainability. Climate change, stricter environmental regulations and the growing environmental awareness of consumers prompted companies to take environmental aspects into account in order to better forecast risks and take measures to reduce their negative impact on the environment.

Situated in central Poland, Świętokrzyskie Region was peripheral both nationally and within the European Union, mainly due to its remoteness from major economic centres and key transport routes. Although it faced uneven development, the Świętokrzyskie Region had potential for growth in sectors such as tourism, agriculture, and the food industry. Sustainable development, supported by investments in green infrastructure and pro-environmental education, could have contributed to improving the quality of life and increasing the competitiveness of the region (Dziekański and Prus 2020). The region faced the challenge of balancing economic development with the protection of natural resources, which was an important element in the pursuit of sustainable development. Socio-demographic processes in the urban and rural areas of

Świętokrzyskie Region were characterized by significant differences. In cities, population decline was a result of both urban development cycles and migration, while rural areas were facing depopulation. An aging population and an unstable labour market, leading to fluctuating levels of unemployment, posed major challenges. The spatial variation of these phenomena depended on the degree of urbanisation, functional structure and links to larger urban centres (Kiniorska, 2014).

Świętokrzyskie Region struggled with low competitiveness, stemming from insufficient development of transport and technical infrastructure, high unemployment, and low rates of innovation. Entrepreneurship and environmental issues were important factors in improving the region's competitiveness. The region suffered from a low level of environmental competitiveness due to problems such as air pollution, inadequate sewage, and declining investment in environmental protection. To reverse these trends, it was necessary to undertake actions within the framework of smart specializations that took advantage of the region's natural assets and resources, integrating entrepreneurship growth with environmental protection, which could have become the key to increasing the region's competitiveness on a national scale (Zając 2024).

There was a research gap concerning the analysis of non-linear relationships between entrepreneurship and the state of the natural environment at the local level, especially in municipalities in peripheral regions. Most of the research to date focused on the macroeconomic level (national or regional) and overlooked the specificity and dynamics of processes occurring in sparsely urbanized, peripheral areas with low entrepreneurship density. Previous analyses rarely used methods that captured threshold effects and nonlinearities, such as logarithmic transformations of variables and advanced weighting techniques, which limited a full understanding of the relationships under study. There was a lack of empirical research considering the process of entrepreneurship "maturation" in peripheral regions and its impact on the natural environment, which constituted a significant gap in the literature on sustainable development. This study filled this methodological gap by applying a CRITIC-logarithmization hybrid at the municipal level in a peripheral region of the European Union, which allowed the effect of entrepreneurship "maturation" to be captured in the absence of a strong conflict with the environment. As a result, the study provided findings using modern quantitative methods that enabled the identification of the gradual adaptation of enterprises to environmental protection requirements in local conditions.

Entrepreneurship contributed to economic and social development but faced challenges of environmental degradation and difficulties in achieving economic and environmental goals, leading to inconsistencies between theory and reality. The author's research hypotheses were: 1) In peripheral municipalities, an increase in the level of entrepreneurship was not statistically significantly correlated with a deterioration in environmental quality indicators, and, in some units, it coexisted with their

improvement. 2) There was significant spatial variation in the relationship between the level of entrepreneurship and the state of the natural environment in peripheral municipalities, which meant that this relationship was locally determined.

Methodology

The empirical data were collected for the spatial units of municipalities in the Świętokrzyskie Region of Poland (Figure 1). The selection of 2010, 2019, and 2022 for the study of entrepreneurship and the environment in Poland was determined by the availability of detailed statistical data (Statistics Poland), which allowed a comprehensive analysis of these periods. The year 2010 constituted the baseline following the global financial crisis, 2019 represented the pre-pandemic period, while 2022 made it possible to assess the impact of the COVID-19 pandemic on changes in the public space, considering the evolving social needs and sustainable development policies.

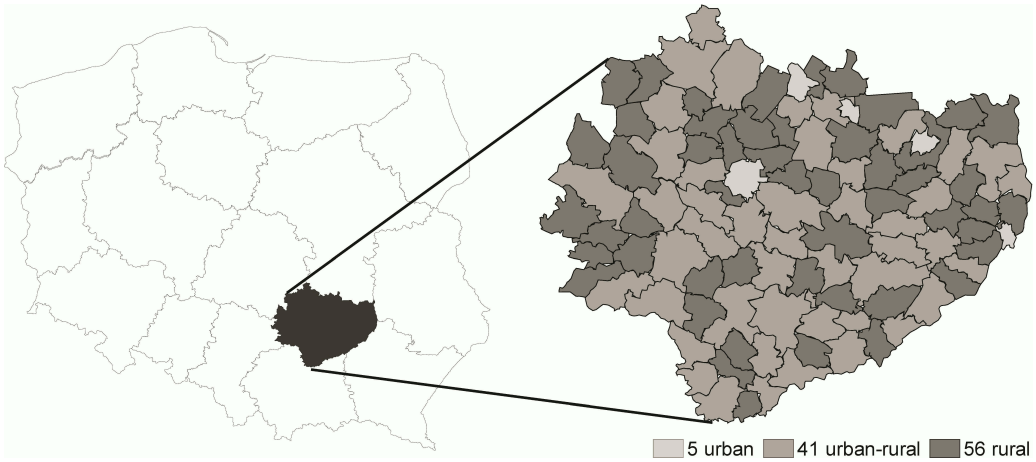


Figure 1. Study Area the Świętokrzyskie Region in Poland

The non-linear synthetic measure procedure, which considered the logarithmization of variables, constituted an effective tool for analysing economic and environmental changes. It enabled the identification of the dynamics of environmental changes in the municipalities of the Świętokrzyskie Region and allowed the assessment of whether these processes were accelerating, slowing down, or remaining stable. The stages of the research process and the construction of a synthetic measure using a non-linear (logarithmic) analytical model were as follows:

1. The selection of diagnostic variables involved a substantive approach, considering descriptive statistics, the coefficient of variation (0.10), inverse correlation matrix analysis (diagonal = 10), and the identification of stimulating and de-stimulating

variables. The study variables were selected to provide a comprehensive assessment of the impact of entrepreneurship on the environment, capturing both economic dynamics and environmental impacts (Table 1).

Table 1. Diagnostic variables describing entrepreneurship and natural environment by municipalities of the Świętokrzyskie Region

Diagnostic variables	Units of measurement	S/D
ENTREPRENEURSHIP		
Own income	PLNper capita	S
Property expenditures	PLN per capita	S
Entities registered	per 1000 population	S
SME entities (0-249 employees)	per 10 thousand residents	S
Entities newly registered in the REGON register	per 10 thousand population	S
Entities deleted from the REGON register	per 10 thousand population	D
Natural persons engaged in business activity	per 1,000 population	S
Business environment institutions	per 10,000 population	S
Share of newly registered creative sector entities in the number of newly registered entities in total	%	S
Registered unemployed	per 1,000 population	D
Employed	per 1,000 population	S
NATURAL ENVIRONMENT		
Expenses - Urban and rural cleansing	PLN per capita	S
Expenses - Maintenance of greenery in cities and municipalities	PLN per capita	S
Expenditures - Protection of atmospheric air and climate	PLN per capita	S
Expenditures - Sewage management and water protection	PLN per capita	S
Expenditures - Municipal waste management	PLN per capita	S
Water consumption per capita	m3 per capita	D
Share of industry in total water consumption	%	D
Treated wastewater per year discharged per capita	dam3 per capita	S
Population using treatment plants	%	S
Industrial and municipal wastewater requiring treatment	dam 3 per km2	D
Mixed waste collected during the year	kg per capita	D
Share of green areas in total area	%	S
Share of legally protected areas in total area	%	S
Number of natural monuments	pcs per km2	S
Woodland cover	%	S

Source: own compilation based on Statistics Poland data

Variables related to income, expenditure, and the number of enterprises allowed the analysis of the economic condition of the entrepreneurial sector. Conversely, variables related to utilities, environmental protection, water consumption, and waste management enabled the assessment of environmental quality. The relationship be-

tween entrepreneurship and the environment was reciprocal—economic activity could have exerted a negative impact on the environment, while changes in environmental conditions could have affected enterprises functionality. Effective management of these relationships was key to sustainable economic development and environmental protection. Their integration made it possible to identify non-linear relationships, such as the positive effects of eco-innovation or the negative consequences of intensive economic development.

2. The normalisation of the diagnostic variables by means of a zeroed unitarization procedure using a bifurcation $R(X_j) = \max(x_{ij}) - \min(x_{ij})$ was performed according to the formulas (Sompolska-Rzechuła 2021):

$$X_j \in S; Z_{ij} = \frac{x_{ij} - \min_i x_{ij}}{\max_i x_{ij} - \min_i x_{ij}} \tag{1}$$

$$X_j \in D; Z_{ij} = \frac{\max_i x_{ij} - x_{ij}}{\max_i x_{ij} - \min_i x_{ij}} \tag{2}$$

where: $\max x_{ij}$ denoted the maximum value of the j-th variable, $\min x_{ij}$ denoted the minimum value, x_{ij} represented the value of the j-th variable for a given object, and $Z_{ij} \in [0, 1]$ was the normalized value. S indicated a stimulant, and D indicated a destimulant (Kukuła and Bogocz 2014).

3. The weights of the diagnostic variables were determined using the CRITIC method, which allowed the assignment of different levels of importance, where the sum of weights w_j equalled 1, and a higher value of C_j indicated greater informativeness of a criterion. The weights were calculated according to the formulas (Slebi-Acevedo et al. 2019, Wang et al. 2023):

$$w_j = \frac{C_j}{\sum_{k=1}^{K} C_k}, j = 1, 2, ..., K \tag{3}$$

$$C_j = S_{j(Z)} \sum_{k=1} \left(1 - r_{jk}\right), j = 1, 2, ...K \tag{4}$$

where: C_j represented the information capacity of the j-th variable, $S_{j(Z)}$ denoted the standard deviation of normalized values, and r_{jk} was the correlation coefficient between variables.

4. The logarithmization of diagnostic variables stabilized data variability and better reflected non-linear processes, particularly when the rate of change varied over time. The transformation was conducted according to the formula:

$$x_i' = \log(x_i + 1) \tag{5}$$

where: x_i denoted the original value of the variable, and x_i' represented the transformed value. The constant addition prevented undefined logarithmic values.

5. The synthetic measure based on logarithmization transformed the data by reducing the influence of extreme values and improving comparability across variables. This approach ensured that variables with large-scale differences became comparable while preserving their relative importance. The synthetic measure was determined according to the formula:

$$q = \frac{\sum_{i=1}^{n} w_i * log(x_i + 1)}{\sum_{i=1}^{n} w_i} \tag{6}$$

where: q denoted the synthetic measure, x_i represented the diagnostic variable, and w_i was the assigned weight. The application of this method enabled precise monitoring of changes in entrepreneurship and environmental conditions in the municipalities of the Świętokrzyskie Region (Filipowicz et al. 2024).

6. The results and conclusions were derived using spatial visualization and statistical analysis. Maps illustrating spatial differentiation and descriptive statistics of correlation measures were prepared using Statistica software. The grouping of municipalities was conducted based on the mean ($\bar{x}$) and standard deviation (S_d) (Dziekański et al. 2024, Popławski et al. 2024). Distributional inequality was assessed via the Gini coefficient. Spatial dependencies were analysed using Moran's global I statistic (Anselin 1995), which enabled the identification of clusters of neighbouring units with similar values (Martinho 2013). Non-linear regression was applied to model complex relationships between variables using exponential, logarithmic, or polynomial functions.

Results

The synthetic measure showed greater variation according to the entrepreneurship measure, particularly in 2010, where values ranged from a minimum of 0.21 to a maximum of 0.82, with a coefficient of variation of 26.73 (Table 2). In 2019, the range was from 0.24 to 0.81 (coefficient of variation 24.55), and in 2022, from 0.29 to 0.78 (coefficient of variation 19.43), suggesting a decreasing trend in variation. In contrast, the measure -environment—had a smaller range of variation, with values between 0.32 and 0.75 (coefficient of variation 17.37) in 2022, between 0.29 and 0.68 (coefficient of variation 18.62) in 2019, and between 0.26 and 0.61 (coefficient of variation 19.25) in 2010. The trend for entrepreneurship was a decreasing variation, and for the environ-

ment, despite a smaller spread in 2010, the coefficient of variation was comparable until 2022. In the Świętokrzyskie Province, the decreasing volatility of entrepreneurship (from 26.73% in 2010 to 19.43% in 2022) with a simultaneous increase in the natural environment measure (average from 0.45 in 2010 to 0.54 in 2022) did not indicate a strong conflict between these spheres.

Table 2. Descriptive statistics of synthetic measures entrepreneurship and natural environment of municipalities in Świętokrzyskie Region in Poland

	2022		2019		2010	
	measures entrepreneurship	measures natural environment	measures entrepreneurship	measures natural environment	measures entrepreneurship	measures natural environment
Average	0.54	0.54	0.49	0.51	0.49	0.45
Minimum	0.29	0.32	0.24	0.29	0.21	0.26
Maximum	0.78	0.75	0.81	0.68	0.82	0.61
Lower (Quartile.)	0.46	0.48	0.42	0.45	0.37	0.39
Upper (Quartile.)	0.61	0.61	0.56	0.58	0.58	0.51
Range	0.49	0.43	0.57	0.39	0.61	0.35
Quartile. (Range)	0.15	0.13	0.14	0.13	0.21	0.12
Standard deviation	0.10	0.09	0.12	0.09	0.13	0.09
Coefficient of variation	19.43	17.37	24.55	18.62	26.73	19.25
Skewness	0.00	−0.55	0.21	−0.35	0.13	−0.43
Kurtosis	−0.19	−0.20	−0.01	−0.51	−0.54	−0.52
Gini coefficient	0.13	0.12	0.16	0.12	0.17	0.13

Source: own compilation based on Statistics Poland data

Statistical analysis showed a non-linear (logarithmic) relationship between environment and entrepreneurship, which was statistically significant, albeit weak, in 2022 ($r = 0.2665$) and 2019 ($r = 0.2071$), but weakened and became insignificant in 2010 ($r = 0.1780$), showing a clear trend of weakening of this relationship (Figure 2). The Lilliefors test showed that the distribution of entrepreneurship did not deviate significantly from normal in all the years studied, while the environment had a distribution significantly different from normal in each of the periods analyzed. It was recommended to further investigate the reasons for the declining correlation between environment and entrepreneurship and the reasons for the non-normality of the environment distribution, while emphasizing the non-linear nature of the relationship studied.

An analysis of data (2010, 2019, and 2022) revealed an increase in economic activity, as reflected in the number of entities, persons doing business, and persons employed.

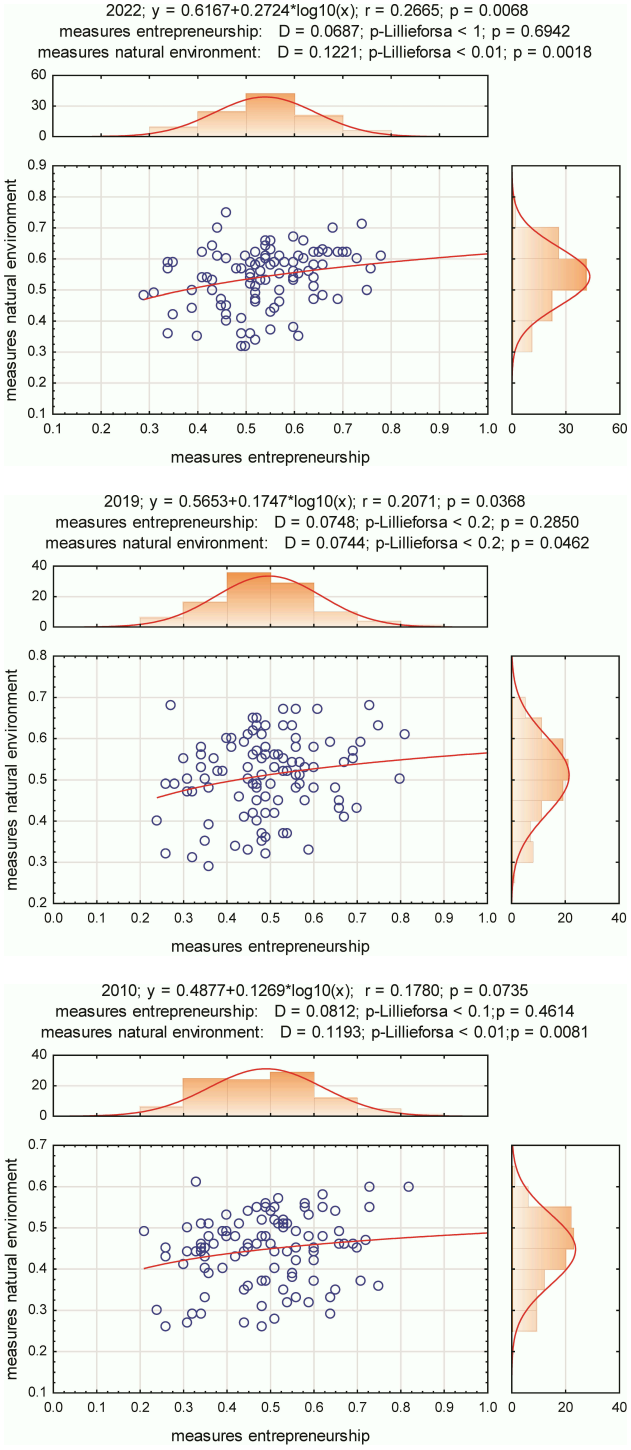


Figure 2. Distribution of synthetic measures for entrepreneurship and the state of the environment in the municipalities of the Świętokrzyskie Region in Poland. Source: own compilation based on Statistics Poland data

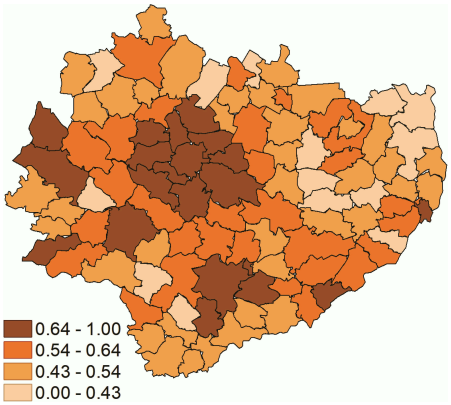
Moreover, the observed decrease in unemployment indicated the development of entrepreneurship (Table 3). At the same time, the environmental measure, reflecting various aspects of environmental protection, showed an upward trend, indicating an improvement in this sphere. The overall conclusion was a positive trend in both areas, potentially resulting from effective local policies. The analysis indicated non-linear relationships between the individual indicators, such as the lack of simple proportionality between the number of businesses and unemployment or between environmental expenditures and the environmental measure. The measure of entrepreneurship remained stable or slightly increasing. In the environmental sphere, there was an upward trend from 2010 to 2022, suggesting improvements in this area. Changes were also observed in individual environmental aspects, such as fluctuations in waste management, water consumption, or air protection, which required further detailed analysis. A general conclusion was that the study area had seen an increase in economic activity between 2010 and 2022, with a concomitant improvement in environmental indicators. The implication of these observations was the potential effectiveness of local policies supporting entrepreneurship and environmental protection. It was recommended to continue monitoring these indicators and to carry out more detailed analyses of the reasons for the observed trends and fluctuations in individual data categories.

An analysis of the relationship between entrepreneurship and the environment revealed the complex and often non-linear dynamics of change over time and space. The dynamics of entrepreneurship and the environment at the local level were complex, heterogeneous, and influenced by many factors. Entrepreneurship maps showed a clear tendency for higher values to be concentrated in the central and northwestern parts of the region, while lower values predominated mainly in the south and eastern areas of the province. In individual years, the units with the highest and lowest indicators were: 2022: Morawica (3) – Tarłów (2); 2019: Kielce (1) – Tarłów (2); 2010: Kielce (1) – Waśniów (2). Similarly, maps of the natural environment generally showed higher values in the central and northern parts of the province and lower values in the south and east, although the distribution of these areas changed over the years: 2022: Suchedniów (3) – Bejsce (2), Wilczyce (2); 2019: Busko-Zdrój (3), Daleszyce (3) – Sadowie (2); 2010: Bogoria (2) – Secemin (2), Osiek (3) (Figure 3).

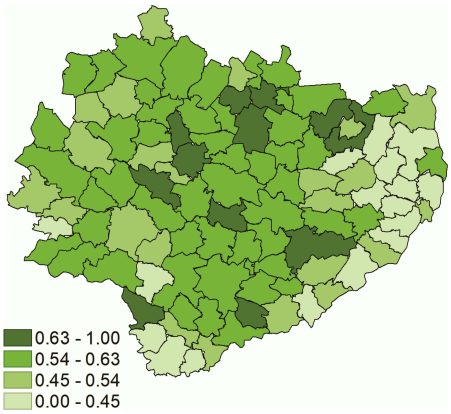
The entrepreneurship maps showed a tendency for higher scores to be concentrated in the central and northwestern parts of the region, while the environment maps generally showed higher scores in the central and northern parts of the region. In all maps, both indices remained less pronounced in the south and east. These maps also revealed some temporal changes in the distribution of areas with the highest scores. The overall conclusion underscored regional differences in the levels of both entrepreneurship and environmental quality, with some changes in their geographical distribution. Further research into the causes of these regional disparities and temporal changes should consider possible interactions between entrepreneurial and

Table 3. Selected characteristics of the groups of municipalities of Świętokrzyskie Region in Poland due to the synthetic natural environment

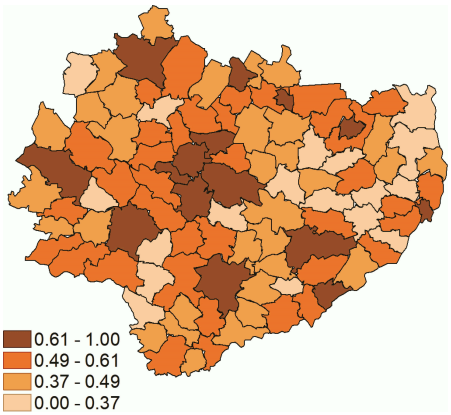
Variables	2022				2019				2010			
Number of units	12	50	23	17	20	36	30	16	18	41	25	18
Entities entered in the register	96.83	86.98	89.83	70.59	81.05	73.86	76.03	60.75	73.72	60.71	57.48	55.78
Entities newly registered in the REGON register	75.83	74.52	70.7	55.76	73.05	70.58	69.57	57.75	83.56	64.15	54.6	55.56
Entities deleted from the REGON register	46.5	41.52	40.17	30.94	50.6	40.17	42.7	26.75	51.22	41.8	29.28	36.83
Natural persons conducting business activity	77.42	71.18	70.39	53.53	65.3	59.31	59.7	45.75	60.72	49.71	46.4	43.89
Business environment institutions	355.03	297.33	328.68	264.4	354.21	309.97	354.76	289.84	435.81	353.77	369.26	324.41
Share of newly registered creative sector entities in the number of newly registered entities in total	5.91	5.00	4.68	6.46	4.71	4.92	3.99	3.75	5.13	3.25	2.96	3.8
Registered unemployed by gender in municipalities in total	28.33	27.76	32.13	36.18	34.45	33.67	36.9	37.81	75.5	62.41	56.24	63.44
Employed in the national economy	362.42	377.72	364.3	371.06	122.1	113.31	128.47	77.5	126.28	97.78	97.2	97.39
Synthetic measure entrepreneurship	0.57	0.55	0.52	0.49	0.52	0.51	0.49	0.43	0.56	0.48	0.47	0.46
Urban and rural cleansing	19.99	10.84	11.61	1.95	13.32	9.59	16.85	3.64	15.1	9.94	22.9	11.54
Maintenance of greenery in cities and municipalities	28.61	5.77	7.87	3.06	12.2	3.57	12.42	1.57	13.83	2.38	11.65	0.86
Protection of atmospheric air and climate	184.58	40.80	8.32	46.45	128.23	101.78	45.61	49.26	4.92	0.74	0.33	0.75
Wastewater management and water protection	194.06	106.28	57.83	23.32	307.55	119.39	51.06	17.27	234.61	105.3	59.24	22.83
Municipal waste management	193.76	164.56	164.22	105.29	91.16	82.69	91.11	61.37	13.01	3.98	4.41	1.97
Water consumption per capita	34.43	150.21	4949.10	32.13	105.91	122.81	3799.02	40.3	27.74	215.08	101.59	6014.08
Share of industry in total water consumption	0.82	4.00	15.07	7.61	1.63	4.3	9.76	11.46	2.52	4.81	6.78	12.83
Wastewater treated per year discharged	0.03	0.02	0.02	0.01	0.02	0.02	0.02	0.01	0.02	0.01	0.01	0.01
Population using treatment plants	0.68	0.53	0.49	0.24	0.55	0.5	0.44	0.23	0.38	0.27	0.2	0.2
Wastewater requiring treatment discharged to water or land	11.2	4.63	22.69	2.05	11.29	7.01	12.19	0.94	12.58	3.78	21.53	7.19
Total mixed waste collected during the year	142.26	142.45	161.84	141.3	102.76	115.23	132.89	124.36	116.59	78	84.06	87.01
Share of green areas in total area	0.77	0.25	0.57	0.14	0.45	0.3	0.42	0.15	0.67	0.22	0.17	0.33
Share of legally protected areas in total area	89.35	82.59	38.91	7.41	91.18	82.16	44.6	6.39	82.22	78.39	59.75	0.88
Number of natural monuments per 100 km²	11.15	6.75	8.61	6.09	8.65	6.36	7.96	4.54	10.43	6.45	5.46	6.55
Forest cover in %	34.08	29.84	24.03	10.71	33.53	29.16	22.43	15.16	36.58	29.61	19.25	13.88
Synthetic measure (natural environment)	0.67	0.59	0.49	0.38	0.63	0.55	0.46	0.35	0.56	0.48	0.41	0.31



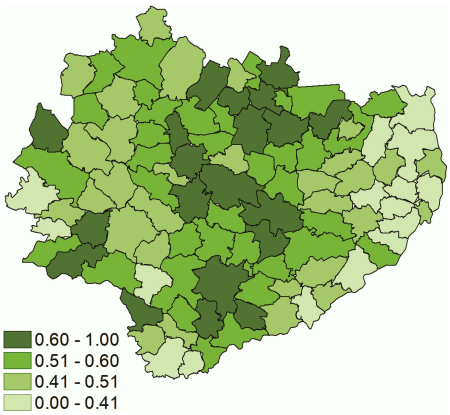
Syntethic measures entrepreneurship, 2022



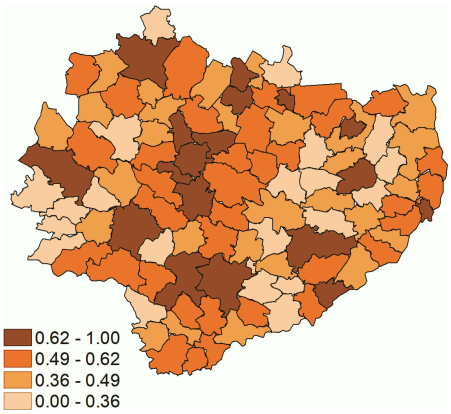
Syntethic measures natural environment, 2022



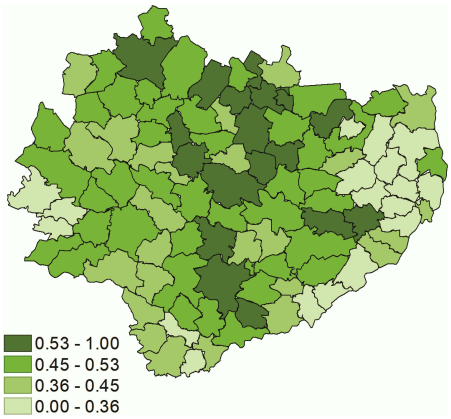
Syntethic measures entrepreneurship, 2019



Syntethic measures natural environment, 2019



Syntethic measures entrepreneurship, 2010



Syntethic measures natural environment, 2010

Figure 3. Spatial distribution of synthetic indicators for entrepreneurship and the state of the environment in municipalities of the Świętokrzyskie Region in Poland

environmental factors, location-specific characteristics, and the non-linearity of these changes. This approach supported the effective planning of local development and sustainable development strategies.

Logarithmic modelling of the relationship between entrepreneurship and the environment indicated that the initial impact of environmental variables on entrepreneurship was stronger and diminished over time. This approach to analysis better captured the non-linear nature of these relationships, considering realistic economic processes in which the initial, stronger impact diminished as firms adapted to new conditions. However, correlation between entrepreneurship and environmental protection remained loosely coupled despite these positive associations (Table 4).

Table 4. Results of Spearman rank correlation of synthetic measures entrepreneurship and natural environment and selected diagnostic variables of municipalities in Świętokrzyskie Region in Poland

	Entrepreneurship measures			Natural environment measures		
	2022	2019	2010	2022	2019	2010
Entities entered in the register	0.56	0.66	0.62	0.45	0.28	0.29
Entities newly registered in the REGON register	0.45	0.44	0.53	0.36	0.23	0.40
Entities deleted from the REGON register	0.24	0.23	0.44	0.38	0.38	0.35
Natural persons conducting business activity	0.57	0.61	0.57	0.51	0.34	0.33
Business environment institutions	0.41	0.65	0.63	0.13	0.03	0.05
Share of newly registered creative sector entities in the number of newly registered entities in total	0.62	0.69	0.78	0.07	0.07	0.14
Registered unemployed by gender in total municipalities	–0.57	–0.22	–0.04	–0.17	–0.09	0.21
Employed in the national economy by gender and place of residence (monthly data) (employed) (December 2022, 2023)	0.47	0.59	0.56	0.01	0.13	0.12
Synthetic measure entrepreneurship	1.00	1.00	1.00	0.29	0.16	0.16
Urban and rural cleansing	0.04	0.13	0.31	0.31	0.28	0.34
Maintenance of greenery in cities and municipalities	0.08	0.36	0.43	0.18	0.26	0.25
Protection of atmospheric air and climate	0.17	0.08	–0.14	0.12	0.32	0.07
Wastewater management and water protection	0.11	0.09	0.21	0.43	0.46	0.50
Municipal waste management	0.30	0.19	0.15	0.22	0.07	0.19
Water consumption per capita	0.24	0.19	0.08	–0.11	0.02	–0.11
Share of industry in total water consumption	0.22	0.45	0.55	–0.11	–0.17	–0.14
Wastewater treated per year discharged	0.41	0.50	0.52	0.48	0.34	0.28
Population using treatment plants	0.42	0.53	0.50	0.48	0.36	0.29
Industrial and municipal wastewater requiring treatment discharged to water or land	0.42	0.53	0.56	0.31	0.21	0.21
Total mixed waste collected during the year	0.00	0.28	0.50	–0.10	–0.15	0.10
Share of green areas in total area	0.23	0.43	0.46	0.17	0.07	0.11
Share of legally protected areas in total area	0.07	–0.05	–0.01	0.67	0.67	0.61

	Entrepreneurship measures			Natural environment measures		
Number of natural monuments per 100 km²	–0.02	0.05	0.13	0.11	0.09	0.17
Forest cover in %	0.05	0.16	0.02	0.49	0.39	0.45
Synthetic measure (natural environment)	0.29	0.16	0.16	1.00	1.00	1.00

Marked correlation coefficients are significant with p <.05000
Source: own compilation based on Statistics Poland data

In 2022, entrepreneurship had a medium correlation with environmental indicators such as waste management and water treatment, but there were also negative correlations with air protection and water consumption. An increase in entrepreneurial activity, especially among new enterprises, was associated with greater business involvement in environmental issues such as waste management, water, and forest cover, but some environmental variables, such as air protection, remained less strongly correlated with entrepreneurship.

Non-linear relationships suggested that initial entrepreneurial development may have led to negative environmental impacts, such as increased resource use and emissions. However, over time, as the sector matured, firms may have adopted more sustainable practices, which reduced negative environmental impacts. Entrepreneurship was strongly positively correlated with indicators of economic activity and negatively correlated with unemployment. The environment showed strong positive correlations with protected areas and forest cover, moderate correlations with water and wastewater management, and weak negative correlations with water consumption and the share of industry in this consumption. The weak positive correlation between entrepreneurship and the environment suggested that there was no strong conflict between these areas. It was recommended that further research be carried out into the factors that promote the co-occurrence of high entrepreneurship and a good environment, that changes in the correlation between unemployment and entrepreneurship be monitored, that protected areas be maintained and expanded, and that the analysis of the relationship between water consumption, waste management, and the environment be deepened. Further research was recommended into the causes of low correlation in the south-eastern municipalities of the Świętokrzyskie Province, where both synthetic measures achieved their lowest values.

Spatial analysis using Moran's I statistic showed differences in spatial autocorrelation for entrepreneurship and environment in 2010, 2019, and 2022 (Table 5). While entrepreneurship exhibited weak autocorrelation, suggesting a different spatial distribution, environmental variables such as air pollution and water management showed stronger autocorrelation. These differences suggested a non-linear relationship in which initial business development led to fragmentation (lack of uniform, consistent development), but over time, as regions developed and pro-environmental technolo-

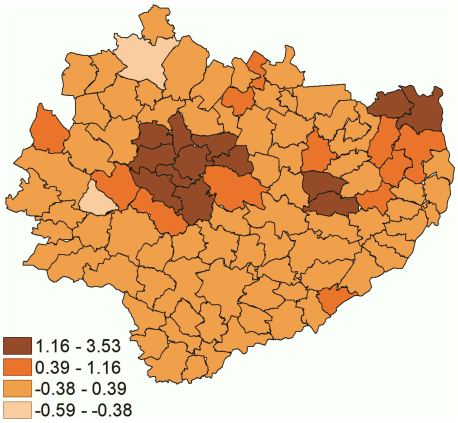
gies were introduced, pro-environmental activities became more coordinated. The results highlighted the variability of this relationship over time and space, which required further non-linear analysis. Consequently, future research should prioritize the study of regional factors influencing entrepreneurship, the causes of environmental clusters, and the inclusion of spatial relationships in strategic planning.

Table 5. Spatial autocorrelation for synthetic measures entrepreneurship and environment in municipalities of the Świętokrzyskie Region in Poland based on Moran's I global statistics

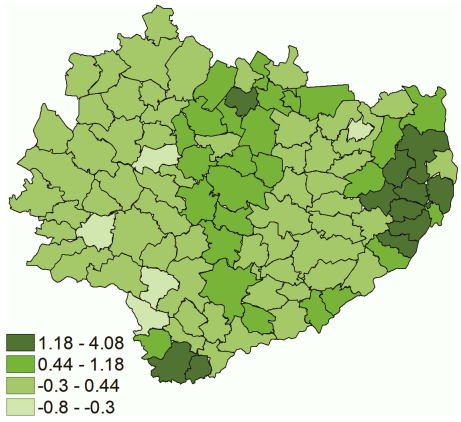
	2022	2019	2010
Variables analysed			measures entrepreneurship
Moran's I	0.391853	0.17253	0.08742
P-value	<0.000001	0.003834	0.122952
Variables analysed			measures natural environment
Moran's I	0.441107	0.404384	0.454805
P-value	<0.000001	<0.000001	<0.000001

Source: own compilation based on Statistics Poland data

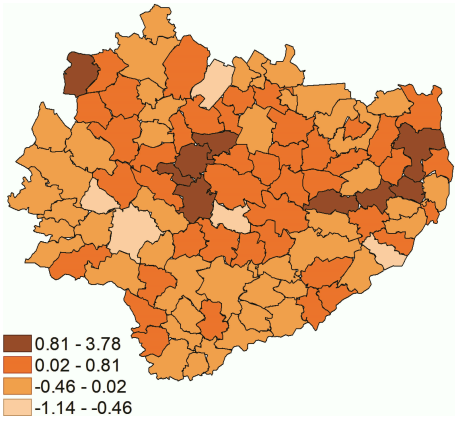
There are changes in the local autocorrelation over time for the municipalities in Świętokrzyskie, with different spatial patterns (Figure 4). In some municipalities the autocorrelation remained stable, indicating homogeneous neighbourhood patterns. Other municipalities showed significant fluctuations in autocorrelation, suggesting variability in local spatial patterns due to fluctuations in neighbourhood similarities and differences. The pronounced non-linearity of the results, manifested by extreme autocorrelation values at different times, indicated dynamic spatial changes. This non-linearity may have been the result of external factors such as demographic change, local policies, investment, urbanization, or migration, and highlighted the complexity of spatial relationships shaped by local conditions. Aspects of non-linearity were evident in changes in the strength and nature of entrepreneurial clusters and in fluctuations in environmental clusters at the local level from year to year, suggesting a dynamic evolution of spatial patterns. Visual analysis of the entrepreneurship maps of 2022, 2019, and 2010 suggested the existence of spatial autocorrelation, with potential hotspots in the central and northeastern parts of the region and cold spots in the southern and western parts, with some stability in the overall spatial distribution over the years. Analysis of the environmental index for 2010, 2019, and 2022 suggested the existence of spatial variation and autocorrelation in the study region. In general, areas with higher values of the environmental index were consistently concentrated in the eastern and partly southwestern parts of the region, while lower values (lighter shades) prevailed in the central and northwestern parts. There were regional clusters of areas with similar Environmental Index values, suggesting potential hot spots of better environmental quality and cold spots of poorer environmental quality.



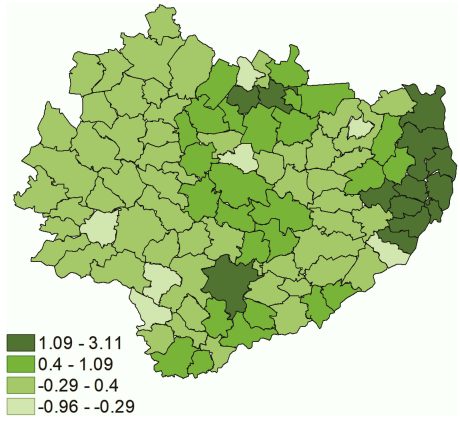
Syntethic measures entrepreneurship, 2022



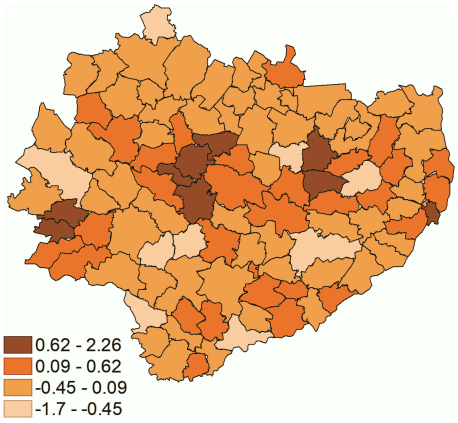
Syntethic measures entrepreneurship, 2022



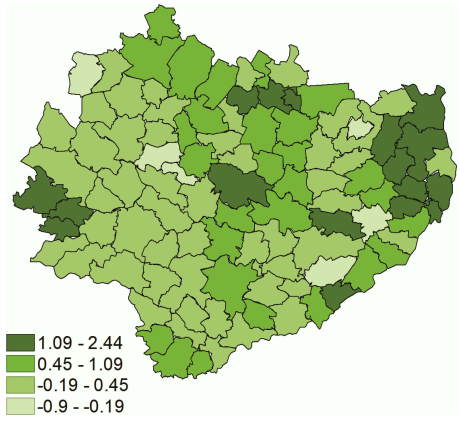
Syntethic measures entrepreneurship, 2012



Syntethic measures entrepreneurship, 2012



Syntethic measures entrepreneurship, 2010



Syntethic measures entrepreneurship, 2010

Figure 4. Spatial distribution of spatial autocorrelation indices of synthetic measures of entrepreneurship and environment in municipalities of Świętokrzyskie Region in Poland on the basis of Moran's measure of local autocorrelation.

The model, which was based on logarithmic transformations of the independent variables, indicated the non-linear nature of the relationship between the variables. The logarithmic transformation of the variables captured the effect of diminishing influence, where changes in the values of the independent variables had different effects on the dependent variable depending on the level of these variables. The changes were more pronounced at lower values of the variables, and the impact decreased as the variables increased. In analyses of the impact of entrepreneurship on the environment, independent variables such as investment in green technology or the intensity of industrial activity may have had a non-linear effect on the dependent variable (e.g., greenhouse gas emissions, consumption of natural resources). In the early stages, entrepreneurship could significantly improve the environment, but as the scale of activity and technological sophistication increased, the impact diminished. Such modeling made it possible to understand the changing impact of economic activity on the environment, which was important in the context of sustainable development.

Between 2010 and 2022, the non-linear regression model increasingly better explained the variability of the synthetic measure of the natural environment thanks to variables describing entrepreneurship, reaching the highest R coefficient of 0.618 in 2022. The strongest positive impact on the state of the environment in 2022 was exerted by the number of individuals conducting business activity, while the number of registered entities and unemployment had a negative impact. In 2019, newly registered entities and individuals conducting business activity were of key importance, with a clear negative effect of unemployment, while in 2010 the relationships were weak and statistically insignificant (Table 6). The observed evolution of the coefficients confirmed the non-linear nature of the relationship, indicating a gradual adaptation of the entrepreneurial sector to sustainable practices without any clear conflict with the environment. In 2010, the relationships between entrepreneurship and the state of the environment were weak and statistically insignificant, which may have been due to a less developed entrepreneurial sector and limited environmental awareness among companies. As a result, companies did not respond clearly to environmental protection requirements, which explained the lack of strong and statistically significant links.

It should be emphasized that the regression models had a limited capacity to explain the full variability of the analysed data, as reflected in the coefficient of determination (R^2) values ranging from 20% to 38%. This indicated the existence of significant factors influencing the phenomena under study that were not included in the models, which limited the possibility of fully understanding the complex relationships between entrepreneurship and the state of the natural environment. In addition, the lack of statistical significance observed in 2010 suggested that these relationships were either more complex or characterized by weaker correlations during that period. Therefore, the findings remained exploratory in nature and required cautious interpretation. Alternative factors that may have influenced the observed relationships

were also considered, such as the implementation of national environmental regulations related to Poland's accession to European Union funds and the effects of the COVID-19 pandemic, which may have significantly modulated the dynamics of the relationship between entrepreneurship and the state of the natural environment.

Table 6. Non-linear regression results for synthetic measures of entrepreneurship and the natural environment and selected diagnostic variables in municipalities of the Świętokrzyskie Region in Poland

2022_Final value: .55047349; Share of variance explained: .38227979 R =.61828779						
	Evaluation	Error (stand.)	Value t (df = 93)	p	Lower uf (Limit)	Upper uf (Limit)
b1	−0.410172	0.149720	−2.73960	0.007374	−0.707486	−0.112859
b2	0.028880	0.037020	0.78012	0.437304	−0.044635	0.102395
b3	0.047060	0.029915	1.57314	0.119082	−0.012345	0.106465
b4	0.499456	0.134495	3.71356	0.000348	0.232375	0.766536
b5	0.013451	0.017228	0.78077	0.436920	−0.020761	0.047663
b6	−0.016450	0.010153	−1.62013	0.108590	−0.036612	0.003713
b7	−0.053392	0.023514	−2.27066	0.025476	−0.100086	−0.006698
b8	−0.143627	0.134509	−1.06779	0.288379	−0.410734	0.123480
b0	0.942505	0.876313	1.07553	0.284918	−0.797680	2.682689
2019_Final value: . 63501266; Share of variance explained: .30154278 R =.54912911						
	Evaluation	Error (stand.)	Value t (df = 93)	p	Lower uf (Limit)	Upper uf (Limit)
b1	−0.386200	0.174450	−2.21381	0.029286	−0.732623	−0.039777
b2	−0.001045	0.047166	−0.02215	0.982378	−0.094706	0.092617
b3	0.121858	0.033987	3.58543	0.000539	0.054367	0.189350
b4	0.328981	0.150822	2.18125	0.031687	0.029478	0.628484
b5	0.002602	0.020670	0.12587	0.900110	−0.038445	0.043649
b6	0.007901	0.010811	0.73079	0.466743	−0.013568	0.029369
b7	−0.085705	0.028106	−3.04934	0.002987	−0.141518	−0.029892
b8	0.011239	0.019882	0.56528	0.573242	−0.028243	0.050721
b0	0.617107	0.218301	2.82686	0.005755	0.183604	1.050609
2010_Final value: .59166792; Share of variance explained: .20480295 R =.4525516						
	Evaluation	Error (stand.)	Value t (df = 93)	p	Lower uf (Limit)	Upper uf (Limit)
b1	−0.299987	0.190678	−1.57326	0.119054	−0.678636	0.078663
b2	0.061397	0.038740	1.58486	0.116392	−0.015532	0.138327
b3	0.044441	0.028176	1.57729	0.118124	−0.011510	0.100393
b4	0.270083	0.162538	1.66166	0.099949	−0.052686	0.592852
b5	0.006435	0.020329	0.31653	0.752312	−0.033934	0.046803
b6	0.004001	0.010257	0.39005	0.697392	−0.016368	0.024370
b7	−0.037129	0.033017	−1.12454	0.263677	−0.102696	0.028437
b8	−0.016536	0.022784	−0.72576	0.469807	−0.061780	0.028708
b0	0.398021	0.195480	2.03612	0.044582	0.009837	0.786204

Source: own compilation based on Statistics Poland data

Discussion

The state of the environment in Poland was territorially diverse and depended on many factors, both natural and human. Environmental degradation, especially in highly industrialised regions such as the Silesian and Mazowieckie provinces, was mainly due to industrial activities, including chemical and metallurgical industries and raw materials extraction, which caused air, water and soil pollution. In Mazowieckie, pollution was exacerbated by a variety of industries and heavy traffic. According to a study by Jaworska and Rusin (2011), environmental degradation was most severe in these two provinces. In turn, the development of entrepreneurship in rural areas of Świętokrzyskie depended on natural, social, economic and institutional conditions. The best conditions were found in municipalities within reach of urban centres, such as Kielce, and where regionally important enterprises were located. Peripheral, agricultural municipalities had more difficult conditions for entrepreneurial development, as noted by Gąsiorowska-Mącznik (2017).

As Poplawski, Grzelak and Dziekański (2024) indicated, the relationship of waste management with the environment was not yet synergistic or consensual. No statistically significant regularities were found in this regard. Low levels of waste management had a negative impact on the environment, so it was important to improve waste management towards a closed-loop economy model. Dziekański (2018) emphasized that recognizing the extent of social, economic and spatial development at the local scale became particularly difficult, as counties functioned and developed as an integral part of a larger whole. Infrastructure and environment could determine the competitive advantage of an entity, the differentiation of a region, and the creation of opportunities or barriers to development. The needs in this area were still very high. Strong local differentiation in terms of infrastructure was primarily related to the financial situation and activity of local authorities.

As Dhahri and Omri (2018), and Sreenivasan and Suresh (2023) indicated, modern entrepreneurship played a key role in sustainable development, combining environmental, economic, and social goals. Through innovation and responsible solutions, entrepreneurs could contribute to improving the quality of the natural environment while minimizing negative impacts on ecosystems. Furthermore, Zhang et al. (2025) and Fratesi and Perucca (2019) emphasized that regions with developed territorial capital could effectively manage resources and support a sustainable economy. Regional cooperation promoted equity, enabling equitable development that minimized negative environmental impacts while promoting economic growth. Increased business activity was associated with greater demand for natural resources, which could lead to negative environmental impacts such as increased water consumption and emissions. Over time, however, companies adapted to changing conditions by adopting more sustainable practices, which could reduce negative environmental impacts. It was crucial

to continue investing in green technologies and supporting green innovation, which could create new jobs in the green economy.

The limitations of the study stemmed primarily from the availability of data and the adopted time horizon, covering the years 2010–2022. Although the examined period was relatively short and did not permit a comprehensive assessment of long-term trends and the effects of the observed processes, it was deliberately selected to encompass key events of the past decade. These included the financial crisis, the pre-pandemic period, the impact of the COVID-19 pandemic, and the initial phase of the European Union's green transition. It allowed for capturing specific trends in the region, such as the stabilization of entrepreneurship in the absence of environmental degradation. In addition, the approach used focused on the analysis of aggregate indicators, which may have limited the ability to capture the specifics of individual sectors and local conditions for the implementation of pro-environmental solutions. Therefore, further research should focus on an in-depth analysis of the mechanisms behind the observed non-linearity, including threshold effects, tipping points, and interactions with other socio-economic factors, considering their evolution over time and space.

Further research into the non-linear relationships between entrepreneurship and the environment was essential to better understand the mechanisms that allowed for simultaneous support of economic growth and environmental protection. In practice, it was important to continue supporting young entrepreneurs and investing in green technologies, especially in less developed regions, in order to reduce inequalities and promote sustainable development. Future analyses should consider the long-term effects of pro-environmental solutions, the effectiveness of technological innovations, and their adaptation to local conditions. It was also important to examine public policies and financing mechanisms that support the transformation of enterprises towards more sustainable business models.

Conclusions

An analysis of data from 2010, 2019, and 2022 for the Świętokrzyskie Province indicated a complex and non-linear relationship between entrepreneurship and the state of the natural environment at the municipal level. In the area of entrepreneurship, a gradual decrease in spatial diversity was observed. At the same time, an increase in economic activity and a decrease in unemployment were recorded. A synthetic measure of the natural environment showed an overall improvement trend.

The analyses indicated the presence of weak, predominantly positive correlations between the level of entrepreneurship and the condition of the natural environment at the municipal level. Furthermore, there was a simultaneous tendency for these correlations to weaken over time. This may have suggested that enterprises were adapting

to environmental protection requirements and institutional conditions, but further research was needed due to the nature of the data and methods. This pattern did not indicate a clear conflict between the development of entrepreneurship and the state of the environment.

The conclusions of the study referred primarily to the specific characteristics of the Świętokrzyskie Province as a peripheral region of Eastern Poland, characterized by unique local conditions, low business density, and specific socio-economic processes in the years 2010–2022. Therefore, the results should not have been directly extrapolated to other regions with different characteristics. Although the study provided valuable empirical evidence of non-linear and evolving relationships between entrepreneurship and the state of the natural environment over time, further research in other regional contexts and using different methodologies was necessary to fully understand these phenomena. The conclusions presented were guidelines and working hypotheses that could serve as a starting point for comparative studies and broader analyses in Poland and the European Union.

Spatial analysis revealed persistent regional disparities. Changing clustering patterns in entrepreneurship and the natural environment were also noted. The results confirmed the important role of local conditions and public policies. In this context, the results pointed to the need for a more targeted approach in regional policy, particularly with regard to municipalities with low levels of both synthetic measures, especially in the south-eastern part of the region. It was also important to systematically monitor the effects of regional policy in the area of green transition, considering spatial diversity. The greatest disparities were found in south-eastern municipalities, which is why support for these areas should have been a priority. At the same time, it was necessary to systematically monitor the effects of local programs, especially in light of the observed weakening of the correlation between the phenomena studied, which decreased from r = 0.2665 in 2022 to insignificant in 2010.

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Aims & Scope

Urban and regional questions are crucial in understanding the present territorial conditions. From the World Bank's 'rediscovery' in its 2009 Report of the potential of cities in encouraging economic growth, to the multiple ways in which cities are being drawn into the processes of neoliberalism, to the dynamic growth of cities in the developing countries in Asia far out stripping the scale of cities in the older urbanized nations – everywhere there are signs of a rapidly changing urban condition. The same is true for the regions where 'old questions' of regional economic disparity and uneven development are being given a new twist as economic globalization impacts the national and local arenas.

JURA, the Journal of Urban and Regional Analysis, working as an Open-access journal (with two issues/year, in **April and in October** - starting with 2023; previously annually publishing in June and in December, for the period 2009-2019), was launched as a response to the exciting world of urban and regional research emerging in reaction to these changes happening in the real world.

JURA represents the initiative of the Interdisciplinary Center for Advanced Research on Territorial Dynamics (CICADIT) at the University of Bucharest working in collaboration with Ronan Paddison at the University of Glasgow, for the period 2009-2020. Starting with 2021, JURA is also supported by the Professional Association of Romanian Geographers (APGR). While the intention is that articles published by JURA will draw on examples throughout the world, particular emphasis will be given to urban and regional change as it is being experienced in Eastern Europe.

Transitional economies, and urban and regional shifts in the region since the end of the socialist regimes have been profound. The socialist regime had its particular effects on the regional economy and the cities, linked with structures that, in many ways, were very different from the trends apparent in Western Europe in the post-World War II period. Since 1990, change has been swift, challenging our theoretical understanding of the processes; for example, it is plausible to transport theories of contemporary urban change under neoliberalism developed in the advanced economies to the transitional economy. The legacy of the socialist regime, its imprint on the city physically and socially, provides further reason to suppose that urban (and regional) development in transitional economies is distinctive. These differences re-emphasise a consistent axiom underpinning the study of cities and regions: that if it is possible to point to broad theories that apply across different regions of the world, they often need to be modified taking into consideration the local conditions.

Though JURA is primarily concerned with looking at urban and regional change in the transitional East European economies, case studies exploring similar problems but in other parts of the world are certainly parts of the journal's agenda. The remit of the journal is emphatically interdisciplinary. The analysis of the urban and regional conditions needs to be interdisciplinary. Urban and regional researchers usually tend to belong to a discipline reflecting their training whether as sociologists, geographers, urban planners or any number of subjects concerned with the study of space and place. Our training very often endorses an appreciation of how other disciplines explore the city and the region. For the journal, the acknowledgement of the many disciplines that are concerned with understanding cities and regions will be indicated by the different disciplinary backgrounds reflected in the published papers. Articles will be published by geographers, sociologists, urban planners, economists, political scientists, to mention just a few of the scholars involved in the urban and regional study.

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