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COMPARISON OF ENTREPRENEURIAL CONDITIONS IN THE V4 COUNTRIES

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Abstract. This article assesses the entrepreneurial environment in the Visegrád Four (V4) countries by means of a newly proposed composite indicator, the Business Environment Indicator (BEI), constructed based on fuzzy logic principles. Its aim is to provide a methodologically consistent and empirically grounded tool for the comparative evaluation of entrepreneurial conditions in countries with similar historical and institutional development but differing current economic dynamics. The BEI was developed within a socio-economic conception of the entrepreneurial environment and based on expert input from managers of Czech companies experienced in establishing or managing foreign branches in the V4 countries, who identified key areas and selected relevant indicators. Using Eurostat data for 2020–2024, the BEI was applied to evaluate the V4 countries. The results show that the Czech Republic was the best-rated country, while the remaining V4 countries ranged from acceptable to partially acceptable conditions in the observed period. Comparison with the Prosperity and Financial Health Index confirmed the sufficient informational value of the proposed indicator. The procedure is applicable to other countries or regions and may support comparative research and managerial decision-making; its originality and value lie in combining empirical expert selection of indicators with a fuzzy-logic-based composite measure.

Keywords: entrepreneurial environment, V4 countries, entrepreneurship, fuzzy logic, Business Environment Indicator, managerial decision-making.

JEL Classification: C51, L26, M10, O10, P51.

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1. Introduction

In contemporary economic literature, the entrepreneurial environment is understood as one of the key frameworks shaping the scope, structure, and quality of entrepreneurial activity, and thus broader economic and societal development. Empirical research repeatedly shows that entrepreneurship contributes to economic growth, employment, innovation, and overall economic, social, and environmental welfare. However, the magnitude of these effects is significantly conditioned by the quality of the surrounding environment in which entrepreneurs operate (Neumann, 2021; Ndofirepi & Steyn, 2023; Scartozzi et al., 2025). At the same time, entrepreneurship is not merely the outcome of individual abilities and motivation; rather, it emerges through interaction with institutions, culture, access to finance, market opportunities, support organizations, educational infrastructure, and technological infrastructure—factors that together constitute the quality of the entrepreneurial environment or entrepreneurial

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ecosystem (Stam & van de Ven, 2021; Guerrero et al., 2021; Galindo-Martín et al., 2023; del Olmo-García et al., 2023).

This issue is particularly relevant in Central Europe and especially in the countries of the Visegrád Group (V4), because the Czech Republic, Hungary, Poland, and Slovakia share a similar experience of economic transformation, yet their current entrepreneurial conditions, institutional quality, and entrepreneurial dynamism have evolved in divergent ways. Comparative research shows that although the V4 countries have common historical and institutional roots, they differ in terms of individual-level determinants of entrepreneurship, the quality of the entrepreneurial environment, and the regional configurations of support for entrepreneurship (Dvouletý & Orel, 2020; Gajdosikova & Vojtekova, 2024). Furthermore, Europe-wide comparisons indicate that the V4 countries usually occupy a "middle" tier in terms of entrepreneurial environment quality: they do not exhibit the lowest levels of conditions for entrepreneurship, yet they lag behind the highest-performing European economies, particularly in the areas of innovation, institutional quality, digitalization, and transparency (Gajdosikova & Vojtekova, 2024; Komlósi et al., 2025; Galindo-Martín et al., 2023).

From a conceptual perspective, the entrepreneurial environment is not a monolithic construct. The literature indicates that it encompasses both "hard" structural factors—such as the quality of regulations, access to finance, innovation infrastructure, university and knowledge support, or physical and digital resources—and "soft" dimensions, such as culture, social norms, the legitimacy of entrepreneurship, entrepreneurial self-efficacy, entrepreneurial mindset, and the perceived availability of support (Stam & van de Ven, 2021; Tetteh et al., 2024; Patrício & Ferreira, 2024; Pita et al., 2021). Moreover, both European and global studies show a clear shift from a linear understanding of the entrepreneurial environment toward viewing the entrepreneurial ecosystem as a multi-level, interdependent, and dynamic system in which entrepreneurial outcomes result from the configuration and mutual interdependence of multiple dimensions, rather than the influence of any single variable (Cantner et al., 2021; Komlósi et al., 2025; Schrijvers et al., 2024; Lado et al., 2024).

This multi-level, configurational nature presents a fundamental methodological challenge for measuring the quality of the entrepreneurial environment. Prior research has employed a wide range of approaches – from international indices such as the World Bank's Doing Business index, through multi-criteria models based on methods like TOPSIS, CPI, and GCI, to entrepreneurial ecosystem indices or approaches drawing on the Global Entrepreneurship Monitor (GEM) and the Regional Entrepreneurship and Development Index (REDI). Each of these tools captures only a limited portion of reality and differs in its level of aggregation, choice of indicators, and capacity for international comparison (Fabuš et al., 2021; Gajdosikova & Vojtekova, 2024; Stam & van de Ven, 2021; Komlósi et al., 2025; Zhu et al., 2022). Moreover, newer literature warns that traditional indices often fail to adequately capture the local and regional character of entrepreneurial environments, and that achieving more accurate measurement may require combining archival data with insights from entrepreneurs, company founders, and support organizations (Hess et al., 2025; Peterková et al., 2022; Guo et al., 2022).

Despite the growing number of studies focusing on individual V4 countries, regional innovation systems, or specific determinants of entrepreneurship, a comprehensive approach is still lacking that would enable the quality of the entrepreneurial environment across all four V4 countries to be compared on a unified basis using a single composite indicator. The

existing literature often concentrates either on individual national cases—for instance, Poland's regional innovativeness, the structure of the support infrastructure in the Czech–Polish border region, or the entrepreneurial demography of Slovakia—or on broader European comparisons in which the V4 appears only as one among many groups of countries (Brodny & Tutak, 2022; Peterková et al., 2022; Vojtková et al., 2024). As a result, the question remains how to capture the multiple dimensions of the entrepreneurial environments in the V4 in a way that allows not only comparison of their overall quality but also identification of their internal structural differences. This gap is all the more significant given that research shows that seemingly similar economies can achieve comparable entrepreneurial outcomes through different configurations of institutions, resources, and support mechanisms (Schrijvers et al., 2024; Komlósi et al., 2025; del Olmo-García et al., 2023).

2. Literature review

2.1. Conceptualizing the quality of the entrepreneurial environment

Contemporary literature conceptualizes the quality of the entrepreneurial environment as a multidimensional set of conditions that shape the emergence, survival, and growth of entrepreneurial activity, rather than as a narrow matter of regulation or "ease of doing business." The entrepreneurial ecosystem perspective captures this complexity by treating the environment as an interdependent system of actors and factors supporting productive entrepreneurship (Stam & van de Ven, 2021; Guerrero et al., 2021). Its core dimensions include institutions, culture, finance, markets, talent, knowledge, support services, educational institutions, and infrastructure, and the literature stresses that outcomes depend not merely on their separate presence but on their interconnections and complementarities (Stam & van de Ven, 2021; Queissner et al., 2025; Patrício & Ferreira, 2024). Recent work also distinguishes traditional from digital entrepreneurial ecosystems, reflecting differences in networks, support structures, and the roles of public and private actors (Lado et al., 2024).

A systemic view also implies that entrepreneurial environments evolve over time and cannot be understood as closed territorial units. Ecosystems develop through changing configurations of resources, relationships, coordination mechanisms, and digital or cross-regional connections (Cantner et al., 2021; Hruskova, 2024; Muldoon et al., 2023; Mazzoni et al., 2025). This perspective is particularly relevant for the V4 countries, whose entrepreneurial environments emerged from a shared post-socialist transformation but now differ in institutional quality, entrepreneurial dynamism, and regional innovation infrastructure (Dvouletý & Orel, 2020; Gawel & Głodowska, 2021; Peterková et al., 2022). Hence, in the V4 context it is more appropriate to conceptualize entrepreneurial conditions as a configuration of institutional, innovation, digital, educational, and support factors than as an isolated set of macroeconomic indicators (Schrijvers et al., 2024; Komlósi et al., 2025; Pita et al., 2021).

The authors of this study raise the question of whether an attempt to incorporate the maximum possible number of factors (on the order of several dozen, or possibly more than one hundred) may be counterproductive, in the sense that marginal factors could exert a decisive influence on the final evaluation if the weights assigned to individual factors or other parameters are not set optimally. However, determining an optimal weighting scheme for fifty, one hundred, or more factors is itself highly debatable.

2.2. Approaches to measuring the quality of the entrepreneurial environment

The literature measures the entrepreneurial environment through several complementary approaches that differ in focus, aggregation, and index construction. International indicators, including the World Bank's Doing Business framework and related institutional measures, emphasize formal regulation, administrative burden, and legal conditions for entrepreneurship; while they enable cross-country comparison, they capture only part of the broader ecosystem and tend to underrepresent innovation, culture, digitalization, education, and support infrastructure (Fabuš et al., 2021; Hess et al., 2025; Guerrero et al., 2021; Galindo-Martín et al., 2023).

A second approach employs multi-criteria or composite models that combine economic, institutional, innovation, digital, competitiveness, educational, and social variables into a single assessment. Studies using methods such as TOPSIS, CPI, GCI, or grey relational analysis illustrate the analytical value of such aggregation for Central and Eastern European or cross-country comparisons (Gajdosikova & Vojtekova, 2024; Zhu et al., 2022; Patrício & Ferreira, 2024). However, these approaches also remain sensitive to indicator selection, weighting schemes, aggregation methods, and information loss when heterogeneous data are compressed into a single index (Gajdosikova & Vojtekova, 2024; Hess et al., 2025).

A third stream draws directly on entrepreneurial ecosystem theory, including dedicated ecosystem indices and tools such as REDI. This perspective emphasizes finance, talent, knowledge, markets, culture, support services, and inter-organizational linkages, interpreting ecosystem performance as a configuration rather than a linear sum of components (Stam & van de Ven, 2021; Komlósi et al., 2025; Schrijvers et al., 2024). More recent work therefore argues for measurement at finer territorial levels and for combining archival indicators with information from founders, firms, and support organizations, especially where national averages obscure intra-country variation (Hess et al., 2025; Peterková et al., 2022; Hruskova, 2024).

2.3. Empirical findings from the V4 countries

The V4 countries share a common transformation legacy, but the empirical literature shows that their current entrepreneurial environments have diverged. Comparative studies examine competitiveness, resilience, regional disparities, and NUTS 3 growth dynamics across the group, indicating that similar historical conditions have produced different structural and regional trajectories (Svoboda et al., 2024; Zdražil & Applová, 2016; Szakálné Kanó & Lengyel, 2021). GEM-based evidence further shows that entrepreneurial self-efficacy is the most stable determinant of established entrepreneurship in the V4, whereas the effects of gender, age, and education vary by country and entrepreneurial type (Dvouletý & Orel, 2020). Similarly, the relationship between macroeconomic dynamics and female entrepreneurship appears country-specific and more visible in long-term trends than in short-term fluctuations (Gawel & Głodowska, 2021). Taken together, these findings suggest that the same regional background does not generate uniform entrepreneurial effects; different groups and types of entrepreneurial activity are influenced by distinct combinations of individual, institutional, and macroeconomic conditions. Broader European evidence also points to digitalization and

its links to competitiveness as relevant factors for interpreting V4 differences (Galindo-Martín et al., 2023; del Olmo-García et al., 2023).

Poland illustrates the importance of subnational differentiation and institutional support. Regional analyses identify marked disparities in innovation levels and dynamics, confirming that entrepreneurial environment quality has a strong regional dimension (Brodny & Tutak, 2022). Studies of Polish business environment institutions further show that digitalized support services, including e-government and mobile services, can strengthen SME support infrastructure (Fabińska, 2023). In technology firms, capital-structure choices also reflect firm liquidity, age, and the mode of innovation investment, illustrating the relevance of financial conditions within the entrepreneurial environment (Kędzior et al., 2020). Research on Polish SMEs also indicates that innovative performance under resource constraints depends on leadership, entrepreneurial bricolage, and knowledge diversity, adding a firm-level dimension of adaptive capacity (Iqbal et al., 2025).

The Slovak literature emphasizes the interaction between formal business conditions, macroeconomic factors, and firm demographics. Doing Business-based evidence suggests that improvements in Slovakia's entrepreneurial environment have been uneven and must be interpreted cautiously in relation to actual entrepreneurial behavior (Fabuš et al., 2021). Enterprise-demography research shows that dissolution is associated with legal form, firm size, industry, and region, with smaller firms and service-sector firms in eastern regions being particularly vulnerable (Vojtková et al., 2024). Additional euro-area evidence links entrepreneurial activity to GDP per capita, regulatory quality, digitalization, and stock market capitalization, underscoring the connection between entrepreneurship and the macro-institutional context (Vyrostková & Kádárová, 2023; del Olmo-García et al., 2023).

In the Czech context, recent work focuses mainly on regional support infrastructure and investment conditions. Peterková et al. (2022) show that both the Czech Republic and Poland lack precise official statistics on start-ups, spin-offs, and support organizations, which means that innovative entrepreneurship must often be assessed indirectly through incubators, science parks, coworking centers, and related support actors. Their findings also show that regions with comparable socio-economic development may differ substantially in ownership, services, and collaboration among support organizations, confirming the importance of regional institutional configuration (Peterková et al., 2022; Pita et al., 2021). From an investment perspective, evidence on tax incentives for FDI firms suggests that incentives alone do not determine profit-repatriation behavior; investment opportunities, leverage, and firm size are more significant factors (Vu et al., 2023).

2.4. The broader European and global literature focusing on the quality of the business environment

The wider European and global literature reinforces the view that entrepreneurial environment quality is configurational rather than linear and therefore cannot be captured by regulation alone. European studies show that high entrepreneurial performance can arise from different ecosystem structures, so composite indicators should be interpreted not merely as rankings but as tools for identifying distinct profiles of entrepreneurial environment quality (Komlósi et al., 2025; Schrijvers et al., 2024). In addition to classic ecosystem elements,

collective action, specialization, and the connection between traditional and digital actors are relevant (Hruskova, 2024; Lado et al., 2024). European research also emphasizes universities, alumni networks, entrepreneurship education, entrepreneurial mindset, and talent mobility, suggesting that knowledge infrastructure and the ability to attract or retain talent should be reflected in assessing entrepreneurial environments (Abreu & Grinevich, 2024; Politis et al., 2024; Mazzoni et al., 2025; Patrício & Ferreira, 2024).

Global studies similarly identify digital technologies, finance, education, and institutional quality as core components of entrepreneurship-supporting environments, while also showing that their importance varies by entrepreneurial stage, actor group, and economic context (Zhang et al., 2023; Queissner et al., 2025; Guo et al., 2022; Alvarez et al., 2025; Guerrero et al., 2021). Research on students and nascent entrepreneurs highlights the relevance of self-efficacy, perceived entrepreneurial environment, creativity, digital capabilities, and financial literacy for entrepreneurial intentions and start-up readiness (Adeniyi, 2023; Kang et al., 2024; Lin et al., 2024). These findings indicate that even macro-level composite measurement should not disregard actor-level mechanisms through which the environment affects entrepreneurial behavior (Jiang et al., 2022; Xanthopoulou & Sahinidis, 2024).

At the macro- and meso-level, entrepreneurial environment quality is linked to regional financial services, innovation climate, resilience, and the capacity of actors to mobilize resources collectively. Evidence from China highlights the role of business environment and financial services in high-quality regional development (Guo et al., 2022), while ecosystem studies show that entrepreneurial environments may evolve from initial opportunity exploitation toward more innovation-oriented and coordinated collaboration (Hong et al., 2023). In peripheral or developing regions, enabling factors such as infrastructure, local markets, government support, and entrepreneurship training become especially salient, and crisis periods increase the need for adaptive public support mechanisms (Shongwe et al., 2024; Leiva-Lugo et al., 2024; Meng et al., 2022).

2.5. Synthesis of findings and delineation of the research direction

It cannot be denied that, in addition to macroeconomic factors, a wide range of other factors influence the quality of the business environment (see, for example, Stam & van de Ven, 2021; Guerrero et al., 2021; Galindo-Martín et al., 2023; del Olmo-García et al., 2023, among others). At the same time, based on the findings of the preceding literature review, it is necessary to acknowledge that:

- **a)** The aforementioned access to finance, regulatory framework, corruption, requirements for technological infrastructure, and similar factors affect individual firms differently, particularly across different industries and depending on their specific needs.
- **b)** The perceived importance and intensity of other factors vary among individual entrepreneurs.
- **c)** The effects of additional factors may also differ regionally within a country.
- **d)** Methods for measuring other, especially qualitative, factors are often contested, with methodologies being inconsistent or debatable.
- **e)** A potential weakness lies in the aggregation of a large number of heterogeneous factors into a single synthetic indicator.

f) As the number of assessed factors increases, the difficulty of determining the relative importance of individual factors grows, potentially reducing the objectivity of their evaluation.

g) With an increasing number of assessed factors, the likelihood also rises that marginal factors will receive greater weight in the overall assessment than key indicators.

h) The number of empirically confirmed factors influencing the business environment has, with high probability, already reached 100 or more. At this scale, objectively assigning weights to individual criteria is essentially impossible.

Based on these considerations, the authors of this study conclude that the quality of the business environment is influenced by a large number of factors that affect business entities in an individual and heterogeneous manner. However, what can be measured objectively are macroeconomic variables. These variables are clearly the outcome of the combined effects of all quantitative and qualitative factors influencing business activity in a given country. The remaining question, therefore, concerns which macroeconomic variables are key for the business sector and, within this set, how important individual indicators are relative to one another. The authors of this article have chosen to address this question through an empirical survey conducted within the business sector.

3. Methodology

This empirical research aimed to compare the entrepreneurial environments in the V4 countries, based on collaboration with managers of Czech companies who have experience in establishing or managing foreign branches in V4 countries. The study involved 45 respondents.

The survey was conducted between February 2025 and September 2025. Respondents were contacted primarily through personal networks, as well as through contacts obtained from members of the Association of Exporters. The respondents also cooperated with the Czech Chamber of Commerce and CzechInvest. In addition, personal contacts within the business sector were utilized. The specific nature of these organizations ensured that the contacted managers possessed comprehensive experience related to information and knowledge sharing both within their respective organizations and across different sectors, including an international dimension. In total, 62 respondents were approached. Due to their workload, it was possible to complete 45 interviews. All respondents had experience with business activities in V4 countries: 100% in the Czech Republic, more than 60% in Slovakia, 36% in Poland, and 25% in Hungary. A total of 62% of respondents had experience from multiple countries, although these were not limited exclusively to the V4 region. For the construction of the synthetic indicator, it was not essential whether the respondents operated branches in these countries, but rather whether they possessed the competence to conduct cross-country comparisons at the international level.

For the comparison of conditions suitable for establishing a business entity or a new branch, a socio-economic conception of the entrepreneurial environment was employed as the starting framework. Initially, it was necessary to determine the priority areas by which the entrepreneurial environment would be evaluated, and subsequently to propose a set of potential indicators for assessing these areas. In the next phase of the research, this set of indicators was presented to the managers for expert review and possible augmentation.

Respondents first chose the areas that, in their opinion, are essential when deciding whether to engage in business in the country under consideration. They independently rated each area in terms of importance using a Likert scale, where 5 represented the highest importance and 1 indicated an area of low importance. In the subsequent step, for each area they selected relevant indicators from the provided set, with the option to suggest additional indicators not included in the original list. Managers were also given the opportunity to comment on their selections. During the clarification of responses obtained in the empirical investigation, particular attention was paid to whether the respondents also considered knowledge and experience acquired from their international colleagues and business partners. The purpose of this clarification was to emphasize the importance of the international context in the selection of indicators.

The objective was to maximize the accuracy and reliability of the empirical investigation, given that the authors were aware that the study was based on a relatively small sample of respondents.

The selected set of indicators (see Section 3.1) formed the basis for evaluating the V4 countries. The required data were sourced from Eurostat databases.

The assessment of the entrepreneurial environment in each country was performed using the newly proposed BEI indicator, which was constructed employing fuzzy logic. The procedure for designing this indicator is detailed in the following text (see Section 3.2). The resulting BEI values are presented and compared for the individual countries in Section 4. To determine whether the proposed indicator can still have adequate explanatory power even when it includes a smaller number of sub-indicators, the results were compared with the Prosperity and Financial Health Index, which comprises more than 100 sub-indicators.

3.1. Selection of areas and evaluation indicators for assessing the entrepreneurial environment

For the selection, the following areas were chosen: state of the economy (macroeconomic perspective), business environment, labour market, state of society and its stability, standard of living of the population, state of digitalization and infrastructure, and environment. For each area, examples of indicators were delineated to further specify that area. These areas and indicators are shown in Table 1.

The chosen set of indicators was selected based on a review of the literature. A brief description of the proposed indicators served both to justify the initial selection and to provide respondents with guidance during their subsequent selection.

State of the economy:

1. Gross domestic product per capita – an indicator providing a comprehensive view of a country's economic performance and standard of living, which takes into account the size of the economy, population, and the relative price level in the country.
2. GDP growth rate – an indicator describing the growth or decline of the country's economy.
3. Public debt to GDP – an indicator reflecting fiscal responsibility; it can be linked to the stability of the country's economy.

4. Gross value added (GVA) – an indicator assessing the value created by production after subtracting intermediate inputs, considered an indicator of actual value creation.
5. Foreign direct investment – an indicator reflecting investors' interest in the country's market, but also increased competitive pressure in the business environment (investments in which a foreign investor must acquire at least a 10% stake in the target company).
6. Inflation – an indicator measuring the rise in the price level.

Table 1. Selection of areas for evaluating the entrepreneurial environment in the V4 countries (source: own elaboration)

Area	Indicators
State of the economy	Gross domestic product per capita; GDP growth rate; public debt to GDP; gross value added (GVA); foreign direct investment; inflation
Business environment	Number of business entities; corporate tax; business start-ups; investment in intellectual property (research and development)
Labour market	Unemployment; labour productivity; job vacancy rate; average working hours; average wage
State of society and stability	Trust in government; press freedom; corruption; support for migration; expenditures on education and research
Standard of living	Financial affordability of housing; household expenditures; number of dwellings per 1,000 inhabitants; average wage in purchasing power parity; share of low-income households without financial reserves
Digitalization and infrastructure	Digitalization level of public administration; road density; government expenditures on transport
Environment	Greenhouse gas emissions per capita; urban air pollution; renewable resources; government investment in environmental protection

Business environment:

1. Number of business entities – an indicator expressing the number of firms with ten or more employees, allowing assessment of market saturation by business entities; the number of firms in each EU country is normalized per one million inhabitants.
2. Corporate tax – indicates the rate of corporate income tax; given differences across countries, this can serve as an informative indicator.
3. Business start-ups – the share of new firms relative to the total number of firms, demonstrating the interest of new entities to enter the market; it usually also relates to the ease of starting a company in terms of time, cost, and necessary steps.
4. Investment in intellectual property – the share of investment in intellectual property in total gross fixed capital formation, which demonstrates the innovation potential of the given country.

Labour market:

1. Unemployment – an indicator expressing what percentage of the working-age population (20–64 years, per Eurostat) is without a job and actively seeking work in each assessed country.

2. Labour productivity – an indicator calculated per hour worked, typically assessed as a percentage relative to the EU average; it evaluates the use of production factors, where a higher value indicates higher labour productivity.
3. Job vacancies (job vacancy rate) – an indicator that compares the number of unfilled jobs to the total number of jobs (filled and unfilled), usually expressed as a percentage. A vacancy is defined as a newly created position, one vacated by an employee's departure, or one that is expected to become vacant soon, provided the employer is taking active steps to find a suitable candidate.
4. Average working hours – an indicator evaluating the average weekly working time in each country; it relates to the utilization of human resources and production capacity.
5. Average wage – indicator of the general income level for a particular demographic or labour market segment.

State of society and stability:

1. Trust in government – this indicator is assessed annually through an EU-wide opinion survey; it reflects the stability of the government as an institution from the perspective of residents.
2. Press freedom – an indicator associated with the expression of freedom not only in the press (as it is evaluated based on violations of journalistic standards and reporters' rights) but in society as a whole.
3. Corruption – an indicator of perceived corruption that evaluates, for example, a country's legislation in relation to conflict of interest and lobbying regulation; it is assessed, for instance, by Transparency International's Corruption Perceptions Index (CPI).
4. Support for migration – focuses on state policies and approaches toward people coming from abroad; comparisons include human rights, employment opportunities, integration of immigrants into society, and more.
5. Expenditures on education and research – an indicator associated with a country's innovation potential, expressed as a percentage of the country's GDP.

Standard of living of the population:

1. Financial affordability of housing – evaluates the difficulty of acquiring and maintaining housing relative to household incomes, which significantly influences the population's purchasing power.
2. Household expenditures – describes the share of household spending related to running the household (housing costs, water or energy expenses, etc., related to financially sustainable living), which again affects the population's purchasing power.
3. Number of dwellings per 1,000 inhabitants – serves to assess the level of housing; the higher this number, the more positively the quality of life in the country is evaluated.
4. Share of low-income households without financial reserves – connected to the assessment of poverty levels; from a business perspective, it is reflected negatively in demand for products.
5. Average wage in purchasing power parity – comparing wages in terms of purchasing power parity is used to evaluate the living standard of employees earning the average wage, based on assessing how many goods and services can be purchased for the same amount in different countries.

Digitalization and infrastructure:

1. Digitalization level of public administration – an indicator tracking the progress of EU member states in the digitalization of public administration; it encompasses areas such as digital skills and education, development of digital infrastructure, digital transformation of businesses, and digitalization of public services.
2. Road density – an important indicator given the prevalence of road transport in all the assessed countries (approximately 90%); it is expressed as the number of kilometers of roads per thousand square kilometers.
3. Government expenditures on transport – an indicator assessing the development of transportation infrastructure through government spending on all types of transport, usually expressed as a share of GDP.

Environment:

1. Greenhouse gas emissions per capita – assesses the impact of economic activities (emission sources. in terms of their effect on the population, usually measured in tons of CO_2 equivalent).
2. Urban air pollution – an indicator assessing the impact of emissions on air quality in large cities for health protection reasons, which is linked to employee illness in the business sector.
3. Renewable resources – expresses the share of renewable sources in energy production in each country.
4. Government investment in environmental protection – an indicator evaluating national investments in environmental protection, usually expressed as a percentage of the country's GDP.

Most respondents, in their decision-making, took into account the overall state of the country's economy and also considered the state of the business environment. However, the respondents regarded the situation in the labour market as crucial for their decision-making. The evaluation of the selected areas is presented in Table 2.

Environmental issues were not considered marginal, but respondents did not pay heightened attention to them, because they assume that the EU's efforts to improve the environment exert similar legislative pressure on all the assessed countries. A somewhat different assessment applied only to the situation in Hungary, where three of the respondents mentioned in their comments a more lax approach to environmental protection and a prioritization of the economy over sustainability.

Table 2. Definition of key areas for entrepreneurship according to the survey results (source: own elaboration)

Area	Significance – median	Significance – mean	St. deviation
State of the economy	4	4.1	0.59
Business environment	4	3.6	0.59
Labour market	5	4.9	0.24
State of society and stability	3	3.5	0.78
Standard of living	3	2.9	0.24
Digitalization and infrastructure	3	3.2	0.52
Environment	1	1.2	0.39

The evaluation of individual areas was subsequently reflected in the selection of indicators. The selection of categories was based on the preferences expressed by the respondents.

In Table 3, the indicators with the highest frequency of selection by respondents are presented. It was surprising to find that respondents did not include the average wage among their priorities, even though it is very often mentioned in the literature as a significant factor.

For greater explanatory power, Table 3 includes not only the selected areas and indicators but also those areas that were evaluated (see Table 2) as relatively significant, yet no sub-indicators were selected from them for the BEI. The absolute frequencies of the individual indicators demonstrate that these sub-indicators within the respective areas were not considered essential by the respondents (none of the sub-indicators reached frequencies comparable to those reported in the categories *State of the economy* and *Labour market*). The selected areas and indicators used for the construction of the BEI are highlighted in Table 3.

For the evaluation, the following indicators were selected:

1. GDP per capita in PPS (GDP) – as a volume index of GDP per capita in purchasing power standards (PPS) relative to the EU average, which is set to 100.
2. Inflation (I) – an indicator that allows consideration of the impact of increased costs of inputs (raw materials and labour) on profit margins, employment, or investment, expressed as a percentage.

Table 3. Selection of indicators for assessing the entrepreneurial environment (source: own elaboration)

Area	Indicators	Abs. frequency
State of the economy	**GDP per capita in PPS (GDP)**	**33**
	Inflation	**42**
	GDP growth rate	33
	Public debt to GDP	24
	Gross value added (GVA)	15
	Foreign direct investment	17
Labour market	**Unemployment rate**	**39**
	Job vacancies (Number of vacant jobs per 1,000 inhabitants)	**36**
	Labour productivity	**42**
	Average working hours	22
	Average wage	20
Business environment	Number of business entities	19
	Corporate tax	15
	Business start-ups	17
	Investment in intellectual property (research and development)	21
State of society and stability	Trust in government	23
	Press freedom	11
	Corruption	20
	Support for migration	18
	Expenditures on education and research	17

3. Unemployment rate (UR) – defined as the share of unemployed persons aged 20–64 (according to Eurostat) in the total population of that age group actively seeking work, expressed as a percentage, indicating the demand for labour.
4. Number of vacant jobs relative to all jobs (NVJ) – an indicator of labour supply which, together with the unemployment rate, helps evaluate labour market balance, expressed as a percentage.
5. Labour productivity (LP) – an indicator of workforce productivity, expressed relative to the EU average (EU = 100).

The aim of the empirical investigation was to identify appropriate indicators for assessing the business environment while ensuring that the resulting synthetic indicator remained sufficiently informative without incorporating an excessive number of partial indicators. The theoretical foundations, which suggested a broad range of potential indicators, were reflected in the survey design by allowing respondents to express their views on the areas they considered most representative of the business environment.

The authors were aware that theoretical considerations do not always lead to unequivocal conclusions. The fact that the respondents primarily selected macroeconomic indicators for inclusion in the synthetic indicator was somewhat surprising. Nevertheless, the authors respect the opinions of practitioners whose assessments reflect the current conditions prevailing in the Visegrád Group (V4) countries.

3.2. Design of the indicator for evaluating the entrepreneurial environment in selected countries

The construction of the BEI indicator for evaluating entrepreneurial conditions in selected countries using fuzzy logic is divided into the following steps:

1. Basic variable – According to the nature of the system, the basic variable E is chosen whose value is to be found using the fuzzy process. The basic variable is the BEI indicator.

2. Attributes of the basic variable – m attributes (levels) of the basic variable are defined. The following BEI attributes are selected:

VG – Very Good Business Environment,
G – Good Business Environment,
A – Acceptable Business Environment,
PA – Partially Acceptable Business Environment,
U – Unsatisfactory Business Environment,
thus:

$$m = 5. \tag{1}$$

3. Sub-variables – *n* sub-variables of the system are defined, whose values influence the resulting value of the system's main variable. In the BEI indicator, the included indicators are: GDP per capita in PPS (GDP), average annual inflation (I), average unemployment rate (UR), number of vacant jobs in % (NVJ), and labour productivity per employee in % relative to the EU average (LP). Based on the GDP, I, UR, NVJ, and LP indicators, sub-variables G, I, U, N, L (in that order) are defined, whose values are given in Table 4 for the selected years 2020 to 2024

for the V4 countries: the Czech Republic, Slovakia, Poland, and Hungary. Sub-variables G and L are expressed as a percentage relative to the values achieved in the EU (EU average = 100%).

4. Attributes of sub-variables – The attributes of the sub-variables correspond to the attributes (1) of the system's main variable.

5. Transformation matrix of sub-variables T – The transformation matrix of sub-variables is an $m \times n$ matrix whose elements (t {i, j}) for (i = 1, 2, ..., m) and (j = 1, 2, ..., n) are numbers corresponding to the threshold intervals of each attribute of the sub-variables of the problem under consideration. The threshold intervals of sub-variable attributes G and L were set such that each threshold expresses the difference from the average value in the EU (which represents 100%) in the case of below-average values. If these variables achieved values exceeding 100%, they are considered to fall into the interval corresponding to the VG state (see step 6). These interval thresholds were determined based on estimates by the expert group. An overview of the specific interval thresholds for the attributes of sub-variables is provided in Table 5. The mathematical representation of these thresholds (the grey-shaded portion of Table 5) is precisely the transformation matrix T.

Table 4. Values of sub-variables in selected countries (source: Eurostat, 2026)

Country	Year	G (%)	I (%)	U (%)	N (%)	L (%)
Czechia	2020	96	3.2	2.5	7.6	106.6
	2021	92	3.8	2.8	9,6	107
	2022	90	15.1	2.2	9.7	104.7
	2023	91	10.7	2.5	9.2	103.8
	2024	91	2.4	2.5	10.1	102,8
Slovakia	2020	74	1.9	6.5	4.8	85.1
	2021	74	3.2	6.7	4.5	84.3
	2022	71	12.8	6.0	5.1	83.9
	2023	74	10.5	5.7	5.4	84.7
	2024	75	2.8	5.1	5.6	85.2
Poland	2020	79	3.7	3.2	5.5	84.2
	2021	79	5.1	3.4	5.2	85.7
	2022	78	14.4	2.8	6.0	87.1
	2023	79	11.4	2.8	6.3	88.6
	2024	79	3.9	2.8	6.5	89.8
Hungary	2020	75	3.4	4.0	2.07	89.3
	2021	75	5.3	3.9	2.15	89.7
	2022	76	15.3	3.5	2.66	90.2
	2023	76	17.0	4.0	2.66	91.0
	2024	76	4.8	4.3	2.76	91.5
EU	2020	100	0.7	7.0	1.9	100
	2021	100	2.9	6.9	2.2	100
	2022	100	9.2	6.0	2.5	100
	2023	100	6.4	5.8	2.3	100
	2024	100	2.7	5.7	2.4	100

Table 5. Threshold intervals of sub-variable attributes (source: own elaboration)

	G	I	U	N	L
U	25	10	9	1	25
PA	15	6	7.5	1.5	15
A	10	4.5	6	3.2	10
G	5	3	5	3.5	5
VG	0	2	4	4	0

6. State matrix of sub-variables – The state matrix of sub-variables is an $m \times n$ matrix that is the mathematical representation of the actual state of the system described by the sub-variables. The elements ($s_\{i, j\}$) for (i = 1, 2, ..., m) and (j = 1, 2, ..., n) of matrix S are truth values of 0 (if the specific sub-variable value does not lie in the tested interval) or 1 (if the specific sub-variable value lies in the tested interval). The testing proceeds as follows (illustrated for variable G with threshold values from Table 5):

if (G \leq 5), then variable G is in the state Very Good Business Environment (VG);
if (10 \geq G > 5), then G is in Good Business Environment (G);
if (15 \geq G > 10), then G is in Acceptable Business Environment (A);
if (25 \geq G > 15), then G is in Partially Acceptable Business Environment (PA);
if (G > 25), then G is in Unsatisfactory Business Environment (U).

Specifically for the Czech Republic in 2024, we obtain the following sub-variable states:

G ... G, I ... VG, U ... VG, N ... G, L ... VG,

which is summarized in Table 6, whose grey-shaded portion is the state matrix S.

Table 6. Truth values of sub-variables for the Czech Republic – 2024 (source: own elaboration)

	G	I	U	N	L
U	0	0	0	0	0
PA	0	0	0	0	0
A	0	0	0	0	0
G	1	0	0	1	0
VG	0	1	1	0	1

7. Value of the main variable – This is the numerical value of the main variable E, which is calculated as the scalar product of the transformation matrix and the state matrix:

$$E = T \cdot S = \sum_{i=1}^{m} \sum_{j=1}^{n} t_{i,j} s_{i,j}, \tag{2}$$

for example:

$$BEI\,CR\,2024 = \begin{pmatrix} 25 & 10 & 9 & 1 & 25 \\ 15 & 6 & 7.5 & 1.5 & 15 \\ 10 & 4.5 & 6 & 3.2 & 10 \\ 5 & 3 & 5 & 3.5 & 5 \\ 0 & 2 & 4 & 4 & 0 \end{pmatrix} \cdot \begin{pmatrix} 1 & 1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 1 & 0 \\ 0 & 1 & 1 & 0 & 1 \end{pmatrix} = 14.5. \tag{3}$$

In our case, the BEI value for the Czech Republic in 2024 equals 14.5 (rounded to 15).

8. Threshold intervals of the main variable's attributes – Determining the threshold intervals of the main variable's attributes falls fully under the expert's competence in the given field. The maximum value of the main variable, which we determine using the transformation matrix T, defines the upper limit...

$$E_{\max} = \sum_{j=1}^{n} \max\left(t_{i,j}\right)_{i=1}^{m}. \tag{4}$$

The threshold intervals of the BEI attributes, chosen according to expert recommendations, are given in Table 7.

Table 7. Threshold intervals of main variable attributes (source: own elaboration)

Attributes in words	Attribute codes	BEI limits
Very Good Business Environment	VG	10
Good Business Environment	G	18
Acceptable Business Environment	A	36
Partially Acceptable Business Environment	PA	48
Unacceptable Business Environment	U	60

9. Retransformation of the main variable – Retransformation assigns the computed numerical value of the main variable to a corresponding attribute of the main variable based on a retransformation table, which is represented by Table 8. The retranslation conditions use the threshold intervals of the main variable's attributes from Table 7.

Table 8. Main variable retransformation table (source: own elaboration)

VG	G	A	PA	U
$10 \geq BEI < 18$	$18 \leq BEI < 36$	$36 \leq BEI < 48$	$48 \leq BEI < 60$	$60 \leq BEI < 70$

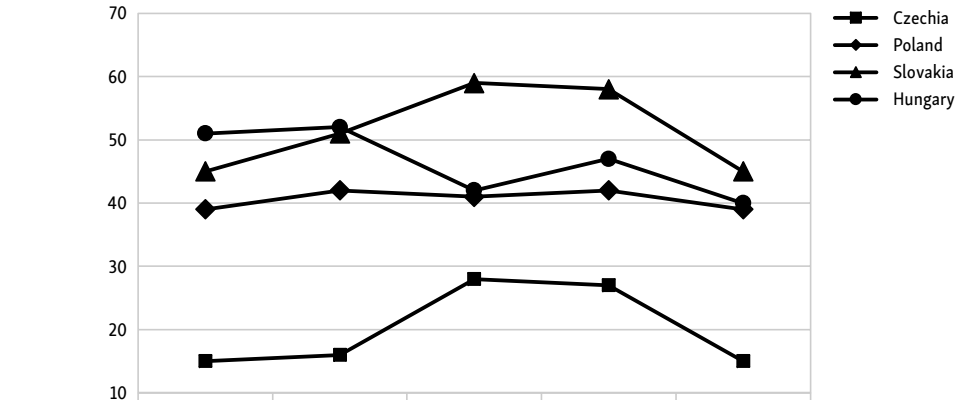
If we assign an attribute to the value BEI = 15, it is evident that in that year the entrepreneurial environment in the Czech Republic was very good.

4. Results and discussion

Based on the collected data and the application of the above procedure, the V4 countries were evaluated for the period 2020–2024. The achieved BEI values, rounded to whole numbers, for 2020–2024 are shown in Figure 1. The lower the BEI values a given country achieves in a particular year, the better its entrepreneurial environment.

After assigning attributes to the BEI variable, the evaluation of the entrepreneurial environment in the observed countries ranges from Very Good to Partially Acceptable Business Environment (see Table 9 for details).

In the period under review, the best-rated country is the Czech Republic. In particular, in terms of GDP per capita it is the highest performing country among those examined, whereas Slovakia and Hungary show significantly lower values compared to the EU average. In both of these countries, there was no significant economic growth after the COVID-19 pandemic,



	2020	2021	2022	2023	2024
Czechia	15	16	28	27	15
Poland	39	42	41	42	39
Slovakia	45	51	59	58	45
Hungary	51	52	42	47	40

Figure 1. BEI indicator values in 2020–2024 for the V4 countries (source: own elaboration)

Table 9. Entrepreneurial environment ratings in V4 countries, 2020–2024 (source: own elaboration)

	Czechia	Poland	Slovakia	Hungary
2020	VG – Very Good	A – Acceptable	A – Acceptable	PA – Partially Acceptable
2021	VG – Very Good	A – Acceptable	PA – Partially Acceptable	PA – Partially Acceptable
2022	G – Good	A – Acceptable	PA – Partially Acceptable	A – Acceptable
2023	G – Good	A – Acceptable	PA – Partially acceptable	A – Acceptable
2024	VG – Very Good	A – Acceptable	A – Acceptable	A – Acceptable

and the situation is associated with a lower level of investment— in the case of Hungary also with insufficient absorption of European funds. By contrast, Poland makes the best use of European Union resources.

However, the GDP per capita indicator cannot be considered the only evaluation criterion. For example, growing labour productivity in Poland, with unemployment comparable to that of the Czech Republic, indicates growth in the Polish economy. This is also evidenced by studies focusing on the quality of life in individual countries (Česká tisková kancelář, 2025), which point out the slowdown of economic growth in the Czech economy and the growth potential of Poland.

In 2022 and 2023, all the countries struggled with a high rate of inflation; in 2024 the situation is significantly better, although in Hungary it still considerably exceeds the EU average and the inflation target of around 2%. All countries have low unemployment; on the other hand, they have a higher number of job vacancies compared to the EU average.

The achieved results correspond with the results of a joint research by Česká spořitelna, the data portal "Evropa v datech" ("Europe in Data"), and the Institute of Sociology of the Czech Academy of Sciences, presented through the Index of Prosperity and Financial Health (Index prosperity a finančního zdraví, 2026). This research assessed the prosperity of the

Czech Republic in comparison with other EU countries using more than one hundred sub-indicators; the first results were presented for 2022. Each indicator included in the Index of Prosperity and Financial Health is evaluated with the same weight, so this setup is suitable for comparison with our proposed indicator. The overall result is presented not only as a score but also as a ranking of countries within the European Union, and this ranking enabled a clear comparison of the two studies. In Figure 2, the Y-axis shows the ranking of the V4 countries in the period 2022–2026.

It is apparent that the results presented in Figure 1 correspond with the ranking of countries shown in Figure 2, and that the informational value of the BEI indicator is sufficient even with the selection of five sub-indicators. These sub-indicators, defined based on the empirical research, were: GDP per capita in PPS (GDP), average annual inflation (I), average unemployment rate (UR), number of vacant jobs in % (NVJ), and labour productivity per employee in % relative to the EU average (LP).

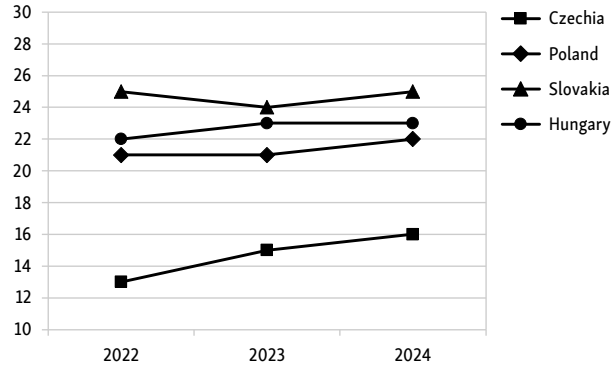


Figure 2. Ranking of V4 countries according to the Prosperity and Financial Health Index (source: own elaboration based on the Index prosperity a finančního zdraví, 2026)

Since the construction of the indicator relies on predefined value intervals for evaluating individual sub-indicators, the interval thresholds can be adjusted on the basis of expert judgment to reflect changing business conditions. This flexibility contributes to the robustness and explanatory power of the resulting indicator.

The results of the empirical investigation assess the V4 countries at the national level and do not account for differences among smaller territorial units, such as regions. The authors acknowledge that individual regions within each country may differ substantially in terms of economic, social, cultural, and other relevant conditions.

If the indicator were to be applied for the comparison of specific regions, for example in the context of selecting a location for a business operation, it could be modified through the selection of appropriate sub-indicators and calculated using regional-level data.

5. Conclusions

This article presents a newly created composite indicator, the Business Environment Indicator (BEI), designed to assess the entrepreneurial environment in selected countries. It was developed on the basis of insights from an original empirical study, and fuzzy logic was used in its construction.

In the design of the composite indicator, it was not essential whether the respondents represented companies with branches in the V4 countries; rather, the key factor was that their experience provided a sufficient basis for competent cross-country comparison at the international level. Although the evaluation may be subjective, the respondents made an effort to ensure objectivity in their assessments.

The proposed BEI for evaluating the entrepreneurial environment in the V4 countries can be applied not only to other countries but also to regions. For assessing a specific region within a country, the indicators included in this index can be directly used, because the data needed for its calculation (e.g., GDP per capita, labour productivity per employee) can be obtained at the regional level from the relevant national statistical offices. From this perspective, the selection of these quantitative sub-indicators is advantageous.

The authors acknowledge that the research is limited by the number of respondents who took part in selecting the areas and indicators for country evaluation. The accuracy of the set threshold intervals for the BEI attributes can also be debated, since it relies on subjective expert judgment; however, in this research the authors fully respected the practitioners' recommendations.

On the other hand, the presented results show that the proposed indicator is informative and corresponds both to individual expert assessments of the V4 countries and to the results obtained from the Prosperity and Financial Health Index.

The contribution of this article lies in the general applicability of the procedure for constructing the BEI. The approach can be used to create other indicators suitable for evaluating any areas of interest. One possibility for further research is to consider including the average wage, which was not chosen by respondents among the sub-indicators in our empirical survey. Another avenue is to conduct evaluations within a selected sector – for example, the economic performance of both the Czech Republic and Hungary is strongly dependent on the automotive industry, so a comparison focused on that sector is suggested.

Given that fuzzy logic is used in setting the threshold intervals of the indicator's attributes, these thresholds make it possible to effectively account for the sensitivity of the resulting indicator to the input values of each sub-indicator. This setup enables the significance of a given indicator to be reflected by tightening or, conversely, loosening the respective thresholds. In this sense, the presented procedure can be applied not only in further empirical research but also in modeling various future scenarios.

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