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ORIGINAL SCIENTIFIC PAPER

Institutional Quality, Entrepreneurial Perceptions, and Women's Entrepreneurship: A Comparative Cluster Analysis



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A B S T R A C T

This study examines patterns of female entrepreneurship within a comparative framework through an integrated analytical approach linking institutional quality and entrepreneurial perceptions at the national level. Indicators related to female entrepreneurship are treated as manifest expressions of gendered entrepreneurial activity. The analysis covers 25 countries in Europe and North America, selected based on data availability in the Global Entrepreneurship Monitor (GEM), the World Bank (WB), and the Worldwide Governance Indicators (WGI) databases for 2024. The methodological framework combines hierarchical cluster analysis (Ward's method) and the K-means algorithm, with multidimensional scaling (MDS) applied as a complementary technique for the spatial representation of inter-country similarities. The results of both hierarchical and K-means clustering indicate a stable four-cluster structure, showing systematic grouping of countries based on similarities across institutional and perceptual indicators. These

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groupings reflect differences in the observed configuration of variables across countries. Lower institutional quality is observed alongside higher levels of female self-employment, while more developed economies tend to exhibit lower levels of female self-employment. These patterns describe structural differences in labor market characteristics and the relative presence of necessity- and opportunity-related entrepreneurial activity. The findings highlight cross-country variation in entrepreneurial indicators and the role of institutional and perceptual measures in describing these differences.

KEYWORDS: *female entrepreneurship, institutional quality, cluster analysis, multidimensional scaling, entrepreneurial ecosystem*

Introduction

Although numerous studies have separately examined institutions and entrepreneurial perceptions, less attention has been devoted to their joint role in explaining cross-country patterns of entrepreneurship at the national level. In particular, empirical evidence remains fragmented regarding the ways in which institutional quality and entrepreneurial perceptions are interconnected in forming different patterns of entrepreneurship, as well as how these patterns can be systematically grouped across countries. This limits the development of coherent comparative typologies and deeper macro-level insights. In this context, entrepreneurship is embedded within a broader institutional and social framework, in which conditions do not operate in isolation but jointly shape entrepreneurial patterns and perceptions (Welter, 2011).

The study focuses on a selected group of countries from Europe and North America, allowing comparison within a relatively homogeneous macro-regional context and reducing global heterogeneity. This sample selection is constrained by the availability of complete and comparable data in the GEM, World Bank (WB), and Worldwide Governance Indicators (WGI) databases for the observed period. Accordingly, the analysis is directed toward identifying structural patterns rather than testing causal relationships between the observed variables. The study addresses two research questions: (1) how countries are positioned within a multidimensional space defined by institutional quality, entrepreneurial perceptions, and indicators of women's entrepreneurship, and (2) whether these differences form stable and interpretable country groupings.

The main contribution of the paper lies in integrating institutional and perceptual dimensions into a unified macro-level framework of entrepreneurship, with the explicit inclusion of the gender dimension, thereby extending fragmented literature and contributing to comparative research on entrepreneurial ecosystems.

Theoretical Background

This study adopts the National Systems of Entrepreneurship (NSE) framework proposed by Acs et al. (2014), which conceptualizes entrepreneurship as a systemic phenomenon emerging from the interaction between individual-level entrepreneurial characteristics and the institutional environment. Unlike approaches that examine institutional or individual determinants separately, the NSE framework argues that entrepreneurial outcomes arise from the configuration and interplay of these complementary components within a broader entrepreneurial system. This systemic perspective provides the theoretical rationale for jointly examining institutional quality, entrepreneurial perceptions, and indicators of women's entrepreneurship in a comparative cross-country context.

Within this perspective, entrepreneurship is conceptualized as the outcome of interactions among entrepreneurs, institutions, networks, resources, and market conditions rather than the result of isolated determinants. Institutional conditions constitute a fundamental component of the ecosystem because they shape the environment in which entrepreneurial activity develops. Consequently, the focus of entrepreneurship policy should shift from increasing the quantity of entrepreneurial activity toward creating institutional conditions that support productive entrepreneurship and long-term value creation (Stam, 2015).

Acs et al. (2017) argue that entrepreneurial ecosystems are inherently heterogeneous and that this heterogeneity should be explicitly considered in empirical research. This perspective supports comparative analyses aimed at identifying distinct ecosystem configurations rather than assuming a uniform pattern of entrepreneurial development.

Welter et al. (2017) emphasize that entrepreneurship is an inherently heterogeneous and widely distributed social phenomenon that extends beyond the Silicon Valley model of entrepreneurship. Entrepreneurship encompasses diverse forms that emerge across different social, economic,

and local contexts, making it impossible to explain through a single model or an ideal type.

Jennings and Brush (2013) argue that research on women's entrepreneurship has contributed to the development of general entrepreneurship theory by demonstrating that entrepreneurship is a gendered phenomenon, that entrepreneurial activity is shaped by the broader social context, and that entrepreneurial motivations extend beyond purely economic objectives. The authors further suggest that future research should move beyond simple comparisons between female and male entrepreneurs and instead focus on a broader understanding of the factors shaping the development of women's entrepreneurship.

Building on the systemic perspective outlined above, the present study jointly examines institutional quality, entrepreneurial perceptions, and indicators of female entrepreneurship in a comparative cross-country context. From this perspective, differences in entrepreneurial behavior between women and men are understood as emerging from the interaction of individual and contextual factors, including subjective perceptions and motivational dimensions (Langowitz & Minniti, 2007).

Recent comparative evidence further suggests that perceptual and expectation-based indicators do not necessarily correspond to realized entrepreneurial outcomes, indicating that they may capture distinct empirical dimensions of entrepreneurship rather than a unified construct (Kleinhempel & Estrin, 2025). At the individual level, recent evidence among female higher education students in Serbia similarly indicates that perceived and objectively demonstrated entrepreneurial competencies may diverge, with female students showing a tendency to systematically overestimate their digital entrepreneurial competence (Veselinović et al., 2026). This distinction is particularly relevant in cross-country analyses, where aggregated perceptions may diverge from realized entrepreneurial activity due to structural and institutional constraints.

Entrepreneurship literature commonly distinguishes between opportunity-driven and necessity-driven entrepreneurship. Opportunity-driven entrepreneurship refers to entrepreneurial activity motivated by the exploitation of perceived business opportunities, whereas necessity-driven entrepreneurship reflects business creation undertaken because individuals lack better employment alternatives (Global Entrepreneurship Monitor, 2019). Recent evidence further suggests that institutional conditions influence these entrepreneurial motivations, with regulatory efficiency

affecting the balance between opportunity- and necessity-driven entrepreneurship (Darnihamedani & Murphy, 2026).

The literature on female entrepreneurship has increasingly adopted multidimensional approaches, recognizing its importance for economic development, innovation, and social inclusion. Women entrepreneurs contribute to national economies and the development of sustainable business models (Radović-Marković, 2026). Access to financial services represents another important component of the broader enabling environment for women entrepreneurs. Recent evidence from the Western Balkans and comparative evidence from the Gulf and Western Balkan regions indicate that women's financial inclusion varies systematically according to socio-demographic characteristics, particularly education, employment status, income, and age, highlighting financial inclusion as a relevant enabling condition for women's entrepreneurship (Abdallah et al., 2025; Antonijević et al., 2024).

Recent literature emphasizes that entrepreneurship cannot be analyzed independently of its context (Welter et al., 2017). Female entrepreneurial behavior emerges from the interaction of individual attitudes, systemic constraints, and institutional conditions. This integrated perspective is reflected in studies highlighting socio-economic context and gender-specific barriers in shaping entrepreneurial outcomes (Radović-Marković, 2018; Radović-Marković & Salamzadeh, 2019). Recent evidence from Serbia further shows that women entrepreneurs continue to face institutional barriers related to access to finance, education, and mentoring, underscoring the importance of gender-sensitive national and local support policies (Đuričin & Beraha, 2024). In this sense, context is not merely a passive backdrop, but a structuring environment that shapes how entrepreneurial opportunities are perceived and interpreted. This aligns with systemic perspectives on entrepreneurship as a multidimensional and interdependent phenomenon (Acs et al., 2018).

Entrepreneurial ecosystems can be operationalized through three macro-level dimensions—attitudes, abilities, and aspirations—representing aggregate components of entrepreneurial activity (Acs et al., 2016).

Regarding institutional context, studies suggest that lower levels of particularism, defined as weaker reliance on personal relationships relative to universal rules, are associated with lower corruption. Empirical evidence indicates a systematic relationship between particularism and corrupt behavior at the individual level (Rotondi & Stanca, 2015).

The selection of corruption indicators is based on reducing model complexity while preserving informational value, given the high intercorrelation among governance dimensions. For example, political stability may support policy implementation, while regulatory quality is associated with institutional impartiality. Governance indicators are therefore positively correlated, suggesting a latent institutional structure (World Bank, 2025).

Hypotheses

Based on the theoretical framework and relevant literature, the following research hypotheses are formulated:

H1: Institutional quality differentiates countries in terms of entrepreneurship.

H2: Entrepreneurial perceptions differentiate countries.

H3: Manifest indicators of female entrepreneurship do not indicate a uniform pattern across countries.

The formulation of the hypotheses is directed toward examining patterns of differentiation in a multidimensional analytical space, rather than identifying isolated linear effects of individual variables.

Methodology

The analysis covers 25 countries from Europe and North America: Austria, Belarus, Bosnia and Herzegovina, Canada, Croatia, Cyprus, Estonia, France, Germany, Greece, Hungary, Italy, Latvia, Lithuania, Luxembourg, Norway, Poland, Romania, Serbia, Slovakia, Slovenia, Spain, Switzerland, the United Kingdom, and the United States.

All data used in this study refer to the year 2024 and are drawn from the Global Entrepreneurship Monitor (GEM), the World Bank (WB), and the Worldwide Governance Indicators (WGI) databases.

The GEM indicators included in the analysis comprise Perceived Opportunities, Perceived Capabilities, Fear of Failure Rate, and Entrepreneurship as a Good Career Choice. Female entrepreneurship is captured through the Female/Male TEA ratio (total early-stage entrepreneurial activity of women relative to men; GEM) and the Self-employed female indicator (ILO estimate; World Bank database), which

reflect gender differences in entrepreneurial activity. In this regard, GEM indicators play a differentiated role in the study: perceptual indicators are used as proxies for entrepreneurial propensity, while TEA and self-employment indicators refer to manifest forms of entrepreneurial activity.

In this study, the empirical variables are interpreted as belonging to three distinct but interrelated levels: institutional conditions (WGI indicators), population-level entrepreneurial perceptions (GEM perceptual indicators), and realized entrepreneurial outcomes (TEA and self-employment). Accordingly, the analysis does not treat perceptions as cognitive traits or behavioral outcomes, but as aggregated socio-cognitive representations shaped by institutional environments. GEM indicators are interpreted as context-dependent, aggregated perceptions rather than cognitive traits, reflecting how institutional environments shape the distribution of entrepreneurial attitudes at the population level.

The WGI dataset includes six dimensions of governance (Voice and Accountability, Political Stability, Government Effectiveness, Regulatory Quality, Rule of Law, and Control of Corruption). In this study, only the Control of Corruption (CC) indicator is used, which measures the extent to which public power is exercised for private gain, including both petty and grand corruption, as well as "state capture" by elites and private interests. These dimensions are conceptually distinct but empirically interrelated and tend to be positively correlated across countries (World Bank, 2025). Given this interrelatedness, CC was selected as a representative indicator of institutional quality to reduce redundancy arising from overlapping information among governance dimensions, while retaining a theoretically relevant measure of institutional constraints on the exercise of public power.

Aidt (2009) suggests that empirical findings do not provide strong support for the "grease the wheels" hypothesis of corruption, but rather indicate a predominantly negative association with long-term economic growth and sustainable development.

In the empirical section, variables are standardized and analyzed using hierarchical and K-means cluster analysis in order to identify patterns of country grouping based on similarities in institutional and perceptual characteristics of female entrepreneurship.

The results of the hierarchical cluster analysis are used as the basis for initializing the K-means algorithm with a predefined number of clusters, thereby ensuring more stable centroid initialization and a clearer separation of clusters.

Consistent with the theoretical framework, the empirical analysis integrates institutional factors, population-level entrepreneurial perceptions, and realized entrepreneurial outcomes, with particular attention given to patterns of female entrepreneurship as a dimension of cross-country differentiation.

Table 1: Descriptive Statistics of the Study Variables (Original Data)

Statistic	Variable 1	Variable 2	Variable 3	Variable 4	Variable 5	Variable 6	Variable 7
Mean	48.589	53.675	46.730	0.717	63.180	11.368	64.231
Std. Deviation	10.802	8.821	6.300	0.160	13.691	5.790	16.030
Min	29.300	35.830	36.370	0.450	35.910	3.400	36.150
Max	73.65	73.81	67.4	1.00	87.18	26.000	88.66

Source: Authors' calculation

Cluster analysis was performed on standardized values (z-scores), enabling the formation of homogeneous groups based on multivariate similarity. For the purpose of additional spatial interpretation of inter-country relationships, a Euclidean distance matrix was constructed from the same set of standardized variables and used as input for the multidimensional scaling (MDS) analysis based on the PROXSCAL algorithm.

A particular analytical focus is placed on the simultaneous consideration of institutional and psychological factors at the population level, as their combination allows for the identification of differentiated cross-country patterns. Differentiation among countries is observed through their overall configuration rather than through isolated effects of individual indicators.

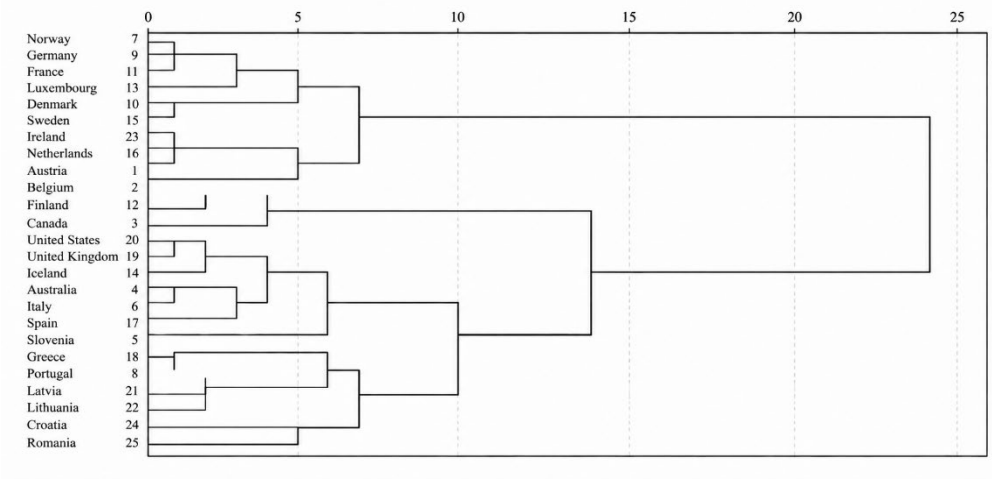
Hierarchical cluster analysis was applied as a preliminary method for identifying the potential number of clusters, with the decision based on the examination of a sharp increase in

the agglomeration coefficient, in line with Hair et al. (2010). In such cases, the analytical approach is based on defining an appropriate distance metric between objects using standardized values of the observed variables, which then serve as the basis for defining measures of dissimilarity between observational units (Everitt et al., 2011).

The decision regarding the optimal number of clusters is further supported by the recommendations of Milligan and Cooper (1985), who discuss various methods for determining the optimal number of clusters in multivariate datasets. The use of hierarchical analysis as an initialization step for the K-means algorithm is consistent with the guidelines of Ketchen and Shook (1996), thereby supporting its methodological appropriateness and the interpretability of the final results.

The empirical analysis was conducted in SPSS using hierarchical cluster analysis (Ward's method, squared Euclidean distance), followed by K-means clustering based on the resulting four-cluster solution. Cluster identification was supported by the Proximity Matrix and dendrogram.

Figure 1: Dendrogram of hierarchical cluster analysis (Ward method, squared Euclidean distance)



Note: The dendrogram presents the results of hierarchical cluster analysis using Ward's method with squared Euclidean distance. Clusters were further validated using K-means analysis to ensure stability and consistency of the solution.

Source: Authors

The Agglomeration Schedule was used to monitor the values of agglomeration coefficients at each merging stage, allowing the identification of potential cut-off points for determining the optimal number of clusters. The agglomeration coefficient represents a measure of the increase in within-cluster heterogeneity at each clustering step. Its gradual increase

indicates the merging of relatively similar groups, whereas a sharp increase signals the combination of structurally distinct clusters.

The analysis of the agglomeration schedule shows a relatively gradual increase in coefficients up to stage 21 (90.690), followed by a more pronounced increase at stage 22 (106.484), as well as further increases at stages 23 (128.900) and 24 (168.000).

This discontinuity indicates a transition from the merging of relatively homogeneous groups to the aggregation of more heterogeneous clusters, which may lead to a reduction in the internal homogeneity of previously formed groups. Since stage 21 corresponds to a four-cluster solution (25 − 21 = 4), the four-cluster solution is considered methodologically appropriate, as it provides a balance between internal coherence and inter-cluster differentiation.

The resulting structure derives exclusively from multivariate similarity among the observed indicators rather than from a priori geographic or political criteria. The identified four-cluster solution is used as the basis for determining the number of clusters (K = 4) in the subsequent K-means analysis, thereby enabling further optimization and stabilization of centroids.

Consistent results obtained from the agglomeration schedule and dendrogram indicate a pronounced structural discontinuity after the formation of the four-cluster solution, which further suggests its stability and methodological appropriateness.

Results – Clustering

Hierarchical clustering and cluster validation procedures were conducted using JASP statistical software. The value of the silhouette coefficient was interpreted in accordance with Rousseeuw (1987) as an indicator of cluster separation and overlap. The hierarchical clustering analysis identified a four-cluster solution across 25 countries, with the model explaining 46.0% of the total variance ($R^2 = 0.460$), indicating a moderate level of structural differentiation among institutional and entrepreneurial indicators. The silhouette coefficient (0.180) indicates limited cluster separation and partial overlap between clusters, which is consistent with findings in complex socio-economic datasets where variables tend to form continuous rather than clearly separable structures. According to Rhomadhona et al. (2025), low and near-zero silhouette values

typically reflect observations located near cluster boundaries, while negative values indicate potential weak assignments.

Despite the relatively low silhouette value, such magnitudes are not uncommon in real-world clustering applications. Empirical studies report comparable values in the range of approximately 0.17–0.18 in complex unsupervised learning contexts, where such results are interpreted as evidence of moderate but meaningful cluster structure accompanied by partial overlap between groups (e.g., Trapanese et al., 2025). In line with this interpretation, the obtained silhouette score suggests the presence of weak but structurally relevant clustering patterns in the observed data.

Cluster sizes are unevenly distributed (Cluster 1: n = 7, Cluster 2: n = 3, Cluster 3: n = 5, Cluster 4: n = 10), reflecting heterogeneity in institutional quality and entrepreneurial profiles across countries. Furthermore, additional validation metrics provide complementary evidence on the structure of the solution (Dunn index = 0.384; Calinski–Harabasz index = 5.967; Pearson's γ = 0.475), indicating that despite moderate overlap between cluster boundaries, the four-cluster structure captures meaningful patterns of differentiation in the multidimensional space of institutional and entrepreneurial indicators.

Results of K-means Clustering

Cluster 1: Moderately Institutionally Stable EU Economies

This cluster includes France, Hungary, Latvia, Slovakia, and Spain and is characterized by a moderate level of institutional quality combined with heterogeneous entrepreneurial perceptions.

Perceived entrepreneurial opportunities vary considerably, ranging from 29.30 in Spain to 42.79 in France, while perceived capabilities range from 35.83 in Hungary to 54.00 in Latvia. Slovakia occupies an intermediate position, with perceived opportunities of 38.75 and perceived capabilities of 52.43. Fear of failure remains moderate across the cluster, ranging from 36.37 in Hungary to 47.91 in Latvia, while Slovakia records 44.10. Entrepreneurship as a good career choice also differs across countries, ranging from 37.74 in Slovakia and 44.10 in Spain to 68.87 in France**.** Female self-employment remains generally moderate, ranging from 7.9% in Slovakia to 11.5% in Latvia, whereas institutional quality and

control of corruption occupy intermediate positions compared with the remaining clusters.

Cluster 2: Highly institutionally developed economies

This cluster includes Estonia, Germany, Luxembourg, Norway, and Switzerland and is characterized by high institutional quality and strong control of corruption.

Female self-employment is generally low (Norway 3.4%; Germany 5.9%; Estonia 7.6%**),** although Switzerland (15.0%) represents an exception. Entrepreneurial perceptions (perceived opportunities, perceived capabilities, and fear of failure) remain within relatively moderate ranges, suggesting a stable entrepreneurial environment. The Female/Male TEA indicator shows some variation but does not represent a major source of differentiation within the cluster.

Cluster 3: Structurally Constrained Systems

This cluster comprises Belarus, Bosnia and Herzegovina, Cyprus, Greece, Italy, Romania, and Serbia and is characterized by lower institutional quality and weaker control of corruption.

Several countries report relatively high perceived capabilities **(**Bosnia and Herzegovina 73.34; Serbia 62.72) despite only moderate perceived opportunities, indicating a discrepancy between individual confidence and the external entrepreneurial environment. Fear of failure reaches particularly high levels in Romania (67.40) and Greece (54.07). Female self-employment is comparatively high (Bosnia and Herzegovina 26.0%; Greece 24.8%; Serbia 24.3%), a pattern frequently associated in the literature with necessity-driven entrepreneurship.

Cluster 4: Mixed Institutional–Entrepreneurial Profile

This cluster includes Austria, Canada, Croatia, Lithuania, Poland, Slovenia, the United Kingdom, and the United States and combines relatively strong institutional conditions with heterogeneous entrepreneurial perceptions.

Perceived entrepreneurial opportunities range from 45.96 in Austria to 73.65 in Poland, while perceived capabilities remain relatively stable (approximately 55–66%). Fear of failure varies across countries, reaching

57.0 in the United Kingdom**,** compared with 44.76 in Austria and 44.41 in the United States**.** Entrepreneurship as a good career choice receives consistently high evaluations **(**United States 82.26; Canada 75.89; United Kingdom 70.49). Female self-employment is generally moderate (8–13%), although it ranges from 3.9% in the United States to 13.7% in Poland. Despite differences in institutional quality (Canada 80.89 vs. Croatia 50.86**),** the cluster exhibits similar entrepreneurial patterns, suggesting that different institutional configurations may lead to comparable entrepreneurial outcomes.

Additional Indicator Analysis

For additional interpretation of the cluster structure, ANOVA was performed in SPSS for descriptive purposes to assess the relative contribution of individual variables to cluster differentiation.

Figure 2: ANOVA results for cluster differentiation

Variable	Cluster Mean Square	df	Error Mean Square	df	F	Sig.
Z-score (Perceived opportunities)	4.018	3	.569	21	7.064	.002
Z-score (Perceived capabilities)	3.620	3	.626	21	5.786	.005
Z-score (Fear of failure rate)	2.647	3	.765	21	3.462	.035
Z-score (Female/Male TEA)	1.022	3	.997	21	1.025	.401
Z-score (Entrepreneurship as a Good Career Choice)	3.776	3	.603	21	6.258	.003
Z-score (Self-employed female, ILO estimate)	2.754	3	.749	21	3.676	.028
Z-score (Governance score, 0-100)	5.804	3	.314	21	18.503	.000

Note: The F tests should be used only for descriptive purposes because the clusters were chosen to maximize differences among cases in different clusters. The observed significance levels are not corrected for this and therefore cannot be interpreted as tests of the hypothesis that cluster means are equal.

Source: Authors' calculation

Stability of the Cluster Solution

Following the application of K-means cluster analysis, a procedure of multiple centroid re-initializations with different starting configurations was conducted, thereby simulating the effect of permutation-based changes in

the arrangement of observational units within the solution space. This approach was used to test the stability of the cluster structure and to reduce the risk of convergence to local optima, which is a well-known limitation of the K-means algorithm (Steinley, 2003, 2006).

The results indicate a relatively high level of stability of the four-cluster solution, with consistent inter-cluster distances and a generally stable grouping of key countries. Nevertheless, a limited degree of variability was observed in the cluster membership of certain countries, which, in a small number of runs, shifted between clusters depending on the initial conditions of the algorithm. This phenomenon is consistent with the presence of local optima characteristic of the K-means procedure. In particular, Serbia and Greece showed stable positioning across all configurations, consistently appearing within the same cluster, while Bosnia and Herzegovina and Croatia were frequently included in the same group.

The results of the ANOVA analysis indicate that cluster differentiation is predominantly determined by institutional quality (governance score), female self-employment rate, fear of failure, and perceived capabilities, which can be interpreted as structural and relatively stable predictors within the observed analytical space.

In contrast, the Female/Male TEA indicator exhibits pronounced sensitivity to initial algorithm conditions and variability in statistical significance across different cluster configurations, suggesting its unstable and configuration-dependent role in explaining the cluster structure. Perceptual indicators, as well as attitudes toward entrepreneurship as a desirable career choice, occupy an intermediate position, with variable discriminatory power depending on the specific configuration.

Anokhin and Schulze (2009) also report a statistically significant positive association between wealth and control of corruption, while the relationships between wealth and indicators of entrepreneurial and innovative activity, including TEA and innovation measures, vary in magnitude and direction.

Overall, these theoretical and empirical findings provide a basis for interpreting the stability and structural consistency of the obtained cluster solution. The observed patterns suggest the existence of two dominant profiles of economies. The first group consists of institutionally developed economies with lower rates of female self-employment, characterized by opportunity-driven entrepreneurship (e.g., Canada, the United Kingdom, and the United States). The second group includes economies with moderate

institutional quality and pronounced psychological barriers, where entrepreneurship more often takes an aspiration–risk-oriented character. A special case is Romania, which stands out as an extreme within the analyzed sample, with the highest recorded value of the fear of failure indicator (67.4%). This combination of high perceived opportunities and elevated fear of failure suggests the presence of a specific hybrid profile, in which entrepreneurial potential coexists with strong psychological constraints. Such a configuration may contribute to the variability of its positioning in the MDS space and cluster structure. In addition, Belarus occupies a relatively isolated position in the MDS configuration, rather than being clearly associated with a particular cluster. This finding reflects its specific combination of entrepreneurial indicators and institutional characteristics, suggesting that countries with similar levels of institutional quality may nevertheless display different entrepreneurial profiles. The obtained results provide empirical support for the choice of a four-cluster solution and suggest that country differentiation arises from a combination of institutional and psychological determinants, rather than solely from the level of economic development. In this context, indicators such as institutional quality, female self-employment rate, and fear of failure demonstrate greater robustness in explaining the cluster structure compared to relative measures such as Female/Male TEA.

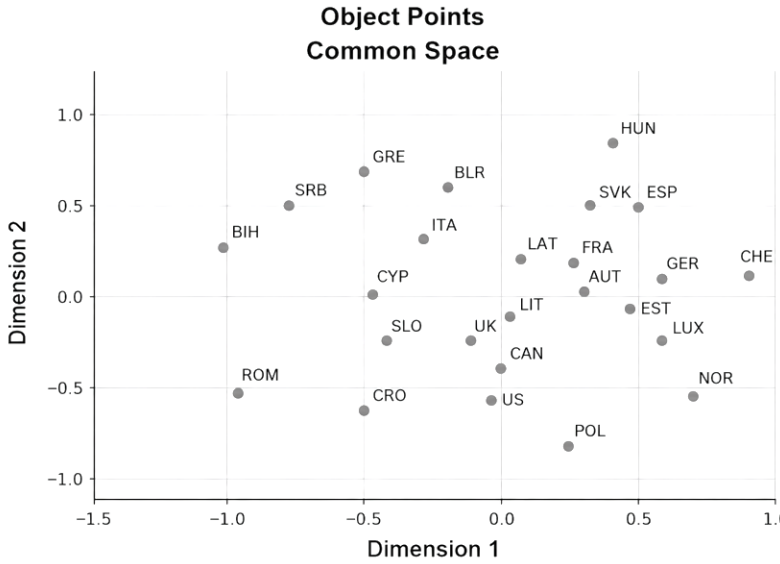
Multidimensional Scaling (MDS)

To provide an additional visual assessment of the consistency of the cluster structure and to interpret the relationships among countries, multidimensional scaling (MDS) was applied using the PROXSCAL algorithm on a dissimilarity matrix. The dissimilarity matrix was derived from the same set of standardized variables (z-scores) used in the cluster analysis, applying Euclidean distance. The analysis was conducted on a pre-constructed distance matrix among 25 countries, enabling the projection of a complex multidimensional space into a two-dimensional representation. Within the PROXSCAL procedure, a ratio transformation was applied, which is described in the literature as the most restrictive form of metric MDS, as it does not allow additive transformations and preserves proportional relationships between the original dissimilarities in the solution space (Borg et al., 2018). All included variables contribute to the construction of the distance matrix through standardized values, where

dissimilarities between countries are computed based on Euclidean distances in a multidimensional indicator space.

The results of the MDS analysis indicate a satisfactory level of model fit. The Normalized Raw Stress value is 0.053, which according to established criteria in the literature indicates a good model fit, while the Dispersion Accounted For (DAF = 0.947) and Tucker's congruence coefficient (0.973) suggest a high degree of structural preservation in the reduced space.

Figure 3: Multidimensional scaling (MDS) configuration of countries based on dissimilarity matrix



Note: The figure presents a two-dimensional MDS solution based on a dissimilarity matrix derived from standardized GEM indicators of entrepreneurial perceptions, institutional quality, and female entrepreneurship. Distances between points reflect the degree of similarity between countries.

Source: Authors' calculation

The graphical representation suggests that countries cluster in line with the previously identified cluster structure, with similar countries positioned closer in space, while structurally different economies are more distant.

The first dimension can be descriptively associated with variations in institutional quality, with more institutionally developed economies

positioned toward one end of the dimension, while countries with more pronounced institutional constraints are located at the opposite end.

The second dimension can be descriptively related to entrepreneurial perceptions, with countries differentiating according to their positioning within the multidimensional space of these indicators. This interpretation is strictly descriptive and indicative in nature and does not represent a formal confirmation of latent dimensions.

It is particularly notable that countries with higher rates of female self-employment (e.g., Serbia, Bosnia and Herzegovina, Greece) are clustered in the part of the space characterized by lower institutional quality. This pattern is consistent with findings in the literature, where higher levels of self-employment in such contexts are often associated with necessity-driven entrepreneurship. The interpretation of entrepreneurial perceptions requires additional caution due to the variability of individual indicators across countries.

In contrast, countries with developed institutional frameworks (e.g., Germany, Switzerland, Norway) are located in the region of the space characterized by stable institutional conditions and lower rates of female self-employment, which is often associated in the literature with opportunity-driven entrepreneurship patterns.

Discussion

Taken together, these findings are consistent with the National Systems of Entrepreneurship framework (Acs et al., 2014), according to which entrepreneurial outcomes emerge from the interaction between individual entrepreneurial characteristics and the institutional environment. They also support the entrepreneurial ecosystem perspective, which conceptualizes entrepreneurship as the outcome of interactions among institutional conditions, entrepreneurial perceptions, and entrepreneurial activity rather than as the consequence of isolated determinants (Stam, 2015; Acs et al., 2017). The identified country clusters further support the view that entrepreneurial environments are inherently heterogeneous (Welter et al., 2016), while the observed differences in female entrepreneurship are associated with broader contextual configurations rather than a single explanatory factor. The weaker discriminatory role of the Female/Male TEA indicator compared with female self-employment is also consistent with recent evidence suggesting that different entrepreneurial indicators capture

distinct empirical dimensions of entrepreneurship. Kleinhempel and Estrin (2024) demonstrate that expectation-based measures do not necessarily correspond to realized entrepreneurial outcomes, questioning the assumption that different entrepreneurial indicators reflect a single underlying construct.

However, the relationship between institutional quality and women's entrepreneurship is not necessarily uniform. Gaweł and Toikko (2024), using panel data for 27 EU member states, report mixed effects: weaknesses in some governance dimensions, including control of corruption, are associated with necessity-driven entrepreneurship, while other institutional conditions support opportunity-driven entrepreneurship. These findings are consistent with the differentiated configurations observed in the present study.

The multidimensional scaling (MDS) configuration provides an additional illustration of these findings. Countries with comparable levels of institutional quality may nevertheless occupy different positions in the multidimensional space, reflecting different configurations of entrepreneurial perceptions and female entrepreneurship indicators. A particularly illustrative example is provided by Serbia and Belarus, which exhibit almost identical governance scores (36.50 and 36.15, respectively) but markedly different profiles of female entrepreneurship. Belarus is characterized by a relatively high Female/Male TEA ratio (0.94) combined with low female self-employment (6.9%), whereas Serbia exhibits the opposite pattern, with a substantially lower Female/Male TEA ratio (0.59) but one of the highest levels of female self-employment (24.3%) in the sample. This pattern is consistent with the interpretation that Female/Male TEA and female self-employment represent complementary rather than interchangeable indicators of female entrepreneurship, capturing different empirical dimensions of entrepreneurial activity.

Discussion of Hypotheses

H1 is fully supported. The results show that institutional quality represents a key dimension in differentiating countries, with control of corruption standing out as the most important indicator that consistently separates countries with high and low institutional capacities.

H2 is also largely supported. Entrepreneurial perceptions (perceived opportunities, perceived capabilities, fear of failure, and entrepreneurship as a good career choice) contribute to country differentiation, but their effect

depends on the institutional context and is interpreted as an aggregated socio-cognitive pattern rather than an individual psychological trait.

H3 is partially supported. Manifest indicators of female entrepreneurship do not show a uniform contribution to differentiation, with female self-employment representing a more stable indicator than Female/Male TEA, which exhibits variability and weaker discriminatory power.

The results of multidimensional scaling provide additional visual evidence consistent with the cluster structure, as the spatial distribution of countries reflects similar patterns of institutional and perceptual characteristics, with a high degree of correspondence to the K-means solution.

Overall, the findings indicate a non-linear and context-dependent relationship between institutional quality, perceptions, and entrepreneurial outcomes.

Urbano et al. (2019), based on a systematic review of twenty-five years of research, conclude that institutional factors constitute one of the central determinants of entrepreneurial activity and represent the dominant theoretical perspective for explaining cross-country differences in entrepreneurship. The observed differentiation of countries according to institutional quality in the present study is consistent with this broader body of evidence. In the context of women's entrepreneurship, similar conclusions have been reported by Radović-Marković (2020), who emphasizes the importance of institutional conditions, including the regulatory framework and access to finance, particularly in transition economies. This integrated perspective is further supported by studies emphasizing the importance of the broader socio-economic context and gender-specific barriers in shaping women's entrepreneurship (Radović-Marković, 2018; Radović-Marković & Salamzadeh, 2019). Recent literature further indicates that research on women's entrepreneurship has evolved from a predominant focus on entrepreneurial performance toward broader multidimensional analyses encompassing institutional, socio-economic, and gender-specific factors. Within this perspective, women's entrepreneurship is increasingly recognized as an important contributor to economic development, innovation, and social inclusion. Women entrepreneurs are viewed not only as creators of new businesses but also as important actors in developing sustainable business models and strengthening national economies (Radović-Marković, 2026). This understanding of entrepreneurial

perceptions is consistent with the literature suggesting that perceptions and attitudes toward entrepreneurship are shaped by the broader social and institutional environment and constitute an important element in the process of engaging in entrepreneurial activity, particularly among women (Radović-Marković & Nelson-Porter, 2016).

Finally, the findings of the present study are further supported by the Global Entrepreneurship Monitor Global Report (2025), which highlights the importance of a high-quality regulatory framework, well-developed business support systems, and strong infrastructure as essential components of a favorable entrepreneurial environment. This broader international evidence reinforces the importance of institutional conditions for entrepreneurial perceptions and entrepreneurial activity, consistent with the conceptual framework adopted in the present study.

Conclusion

Overall, the findings support a systemic understanding of entrepreneurship, indicating that institutional quality, entrepreneurial perceptions, and realized entrepreneurial activity should be considered complementary and interdependent components of entrepreneurial systems, thereby contributing to the literature on entrepreneurial ecosystems and comparative entrepreneurship by demonstrating the importance of their joint consideration in cross-country analyses (Acs et al., 2014; Stam, 2015).

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