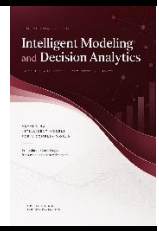


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Entrepreneurship at the Provincial Level: A Profiling Framework via CODAS-Sort and Multidimensional Scaling

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ABSTRACT

Entrepreneurship has positive effects on reducing unemployment and promoting economic growth. In this context, countries are developing policies to support entrepreneurship. This study aims to examine newly created startups in Türkiye at the provincial level, classify provinces based on the number of new startups, and identify the key characteristics of these classes. Data obtained from TÜİK for the 2017–2019 period were analysed using Multidimensional Scaling (MDS) and the Combinative Distance-based Assessment Sort (CODAS-Sort) methods. The analyses revealed that Istanbul differs significantly from other provinces. In the four-class approach, Istanbul alone constituted the first class, while Ankara and Izmir formed the second class. Fifty-nine provinces were classified in the third class, and nineteen were classified in the fourth. When the results are evaluated for Türkiye, an entrepreneurial profile centred on Istanbul and dominated by the service sectors emerges. In this regard, it is considered appropriate to prioritize subsectors within the high-value-added, technology, and manufacturing sectors and for the government to establish cluster-like initiatives that facilitate access to resources for these sectors.

1. Introduction

The impact of entrepreneurship on countries' economic development and sustainable welfare levels is frequently emphasized in the literature. While entrepreneurship has various definitions in the social sciences, from a business perspective, it is fundamentally associated with the creation of new organizations or businesses to capitalize on economic opportunities. The entrepreneur, generally perceived as an individual, is defined as someone who identifies opportunities, takes risks, creates innovations or improvements, and ultimately establishes an organization by bringing together the appropriate factors. On the other hand, it is a well-known fact that conditions for entrepreneurship are not equal at the local, national, and global levels. Specifically in Türkiye, regions or provinces differ from one another in terms of levels of development, physical conditions, and demographic structures [1, 2]. In this context, this study will classify 81 provinces based on the varying numbers of entrepreneurs across sectors, using the second-level classification of the Statistical

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Classification of Economic Activities in the European Community (NACE; Nomenclature statistique des Activités économiques dans la Communauté Européenne). The aim is to identify and evaluate provinces with similar entrepreneurial structures. MDS (Multidimensional Scaling) and CODAS-Sort (COmbinative Distance-based Assessment-Sort) methods will be utilized to conduct these analyses.

While classical multi-criteria decision analysis (MCDA/MCDM) approaches primarily focus on ranking or selecting alternatives, multi-criteria sorting methods, which assign alternatives to predefined classes, have garnered increasing attention in the literature in recent years. By accounting for the flexible preferences of decision-makers and dominance relationships between classes, these methods are successfully applied in various fields, such as the evaluation of international logistics performance and global or sectoral supplier classification. Furthermore, these methods emerge as extensions of techniques originally developed for ranking and selection [3]. Extensions of frequently used ranking and selection methods, such as TOPSIS, VIKOR, AHP, ELECTRE, PROMETHEE, and CODAS, are evident in this context [4, 5]. For instance, methods based on outranking relations, such as ELECTRE TRI, employ a non-compensatory structure that prevents poor performance in one criterion from being offset by performance in others, thereby supporting realistic decision-making processes [6]. AHP-Sort is a multi-criteria sorting method that retains the pairwise comparison structure of classical AHP while assigning alternatives to predefined ordered classes [7]. Examples of reference- and distance-based methods include TOPSIS-Sort, VIKOR-Sort, REF-Sort, and CODAS-Sort [6, 8]. Among these, the CODAS-Sort method generates effective solutions for regional and sectoral clustering analyses by utilizing negative ideal solutions and class center profiles [9].

On the other hand, the MDS method visualizes the distance and similarity relationships between units/alternatives within high-dimensional, complex datasets on a geometric plane, thereby clearly revealing the structural connections and clustering tendencies of decision units [10, 11]. This spatial mapping capability provided by MDS offers a robust analytical foundation for validating results derived from classification models and for interpreting the qualitative relationships between alternatives in depth. Accordingly, this study employs an integrated approach combining the MDS and CODAS-SORT methods. The primary rationale for this choice is to merge the framework's consistency in defining class boundaries with MDS's ability to visualize complex data structures in a low-dimensional space within a single model. Thus, the aim was to enhance the classification accuracy of quantitative data while simultaneously ensuring the geometric validation of the resulting categorical outcomes, thereby bringing a multifaceted and holistic perspective to existing analyses in the literature.

The second section of the study will present a brief review of the literature on entrepreneurship. The study will then conclude with explanations of the methods used, followed by the findings and conclusions sections, in that order.

2. Entrepreneurship in Türkiye

Since the proclamation of the Republic, Türkiye has sought to implement policies that encourage private-sector entrepreneurship. In this context, particularly since the 1980s, regulations aimed at entrepreneurship have been included in development plans, strategic action plans, and support and incentive programs. However, the expected level of success has not been achieved [12, 13].

It is well known that businesses in Türkiye are predominantly concentrated in Istanbul. On the other hand, determining in which sectors entrepreneurship is more prevalent at the provincial level and whether there are provinces with similar characteristics are topics worthy of research. In this context, the following section will present brief summaries of studies examining the geographic and sectoral distribution of entrepreneurship in Türkiye over the past decade. It is helpful to explain the concept of clustering, which is frequently addressed alongside entrepreneurship in these studies.

Clustering refers to geographic concentrations of interconnected entities, such as companies, suppliers, service providers, firms in related sectors, universities, and trade associations, operating in specific fields characterized by both competition and collaboration. The concept of clustering is associated with regional development and the efficient use of resources [14].

Yelkikalan *et al.*, [15] defined Internet entrepreneurship as a project created and offered to customers in a virtual (online) environment with the aim of generating financial returns. Furthermore, an Internet entrepreneur is described as an individual who possesses software knowledge, is proficient in using electronic devices, is creative, has leadership qualities, creates their own opportunities, and seeks to sell the final product or service over the Internet. The authors also evaluated entrepreneurship through the lens of Generations X, Y, M, and Z. In this context, it was noted that while Generation X, which advocates for a structured and balanced lifestyle, held managerial positions, and Generation Y, which rejects authority and seeks flexible work arrangements, served as employees, the rise of the Internet led to an increase in Internet-based entrepreneurship among Generation Y. It was stated that Generation M, following Generation Y, has placed social networks and technology at the center of their lives. It was also noted that Generation M is more fortunate than previous generations in terms of entrepreneurship education and incentives and is poised to become Internet entrepreneurs. As for Generation Z, it was noted that they have grown up under conditions quite different from those of previous generations and will possess distinct entrepreneurial characteristics.

Durak [16] evaluated studies examining entrepreneurship under three headings within the frameworks of individual, environmental, and firm approaches. While the individual approach is based on the individual's characteristics and abilities, the environmental approach emphasizes the effects of the environment on the individual. The firm-level approach, also known as intrapreneurship, involves the renewal or development of business activities within the context of managerial practices. The author recommended that the Turkish education system and government policy be structured to support entrepreneurship, particularly by streamlining and increasing the transparency of bureaucratic procedures and taking steps toward the institutionalization of the rule of law and democracy.

Sönmez and Toksoy [13] emphasized the importance of entrepreneurship for Türkiye by highlighting its role in reducing unemployment and fostering economic growth through the creation of new jobs. In addition, the authors sought to identify the general profiles of entrepreneurs by administering a survey of 400 individuals who completed the KOSGEB (Small and Medium Enterprises Development Organization of Türkiye) Applied Entrepreneurship Training program in Istanbul in 2013. The majority of entrepreneurs wish to start a business in a region close to where they live and, in the service, or trade sectors. However, most entrepreneurs are not open to partnerships; among the obstacles they face, they cite a lack of startup capital, inability to obtain government support, and a lack of knowledge. Another important finding is that the proportion of entrepreneurs starting a business for the first time is as high as 90 percent.

Bozkurt *et al.*, [17] investigated the factors influencing entrepreneurs' sector selection. In their study, conducted in Düzce Province using survey forms, it was noted that sectoral foresight, level of knowledge, recommendations from friends, and the amount of capital were factors influencing entrepreneurs' sector selection.

İnce [18] emphasized that entrepreneurship is crucial for the development, progress, and survival of businesses, sectors, and the national economy. Additionally, the author aimed to identify the entrepreneurial characteristics of businesses by analyzing their mission and vision statements. In this context, the author examined the missions and visions of companies classified as the "second 500 largest" in Türkiye and sought to identify their entrepreneurial characteristics. The findings revealed

that companies frequently defined concepts such as success, innovation, competitiveness, and proactiveness in their missions, while concepts such as success, leadership, innovation, and competitiveness were defined in their visions.

Karahan and Kılvar [19] examined the maritime transportation cluster in Türkiye across six regions using the geographic concentration ratio and noted that the Istanbul region exhibits the characteristics of a full cluster. In this regard, the positive effects of Istanbul's proximity to markets and business partners from a maritime perspective, the presence of infrastructure, its hosting of the majority of the shipbuilding industry, and its relatively high quality of life were emphasized.

Yamaç [2] examined the cluster structure in the textile sector across twenty-six regions (Level 2 of the Turkish Statistical Regional Unit Classification). In analyses conducted in the context of the concentration coefficient for the textile sector, it was noted that clustering was very high in the TR21 Tekirdağ Sub-Region, the TR41 Bursa Sub-Region, and the TRC1 Gaziantep Sub-Region.

Esmer [20] states that ethical violations created by the capitalist mindset's greed for profit harm businesses' market and brand value. Furthermore, the concept of "ethical entrepreneurship," which emerges as a potential solution, is examined in its theoretical, global, and national dimensions. While the research findings indicate that unethical activities lead to financial losses in the long term, they also highlight the necessity of educational and academic awareness initiatives to enhance ethical awareness among entrepreneurs.

Durukan [21] evaluates KOSGEB's role in supporting women entrepreneurs within the framework of its "Entrepreneurship Support Programs," based on high-level policy documents and numerical data. It is stated that, despite the critical importance of women's entrepreneurship for economic development, the social and economic barriers encountered make the incentive and support mechanisms offered by institutions such as KOSGEB indispensable.

Güven [22] found that the Provincial Quality of Life Index, the proportion of the educated population, and population density significantly influenced the level of entrepreneurship. The findings reveal that robust infrastructure and modern social amenities are prerequisites for the development of an entrepreneurial ecosystem in a region or country.

Metin [23] states that Türkiye possesses strong potential, characterized by dynamic market conditions, technological aptitude, high-expectation businesses, and individual skill and self-confidence. However, it is emphasized that Türkiye has areas open to development, such as risk appetite, human capital, cultural support, process innovation, and internationalization.

Dinçay [24] adopted a holistic approach to the concept of entrepreneurship within the framework of domestic and international literature, examining the historical development of entrepreneurial culture and the global and Turkish implications of the industrial revolutions. Furthermore, by analyzing the institutions supporting entrepreneurship in Türkiye, its economic contributions, and the obstacles encountered, the study offers solutions for the future and development of the entrepreneurial ecosystem.

Kurtuluş and Büyükbacı [25] examined the effects of collaborations between established firms and technology startups on innovation performance and the factors contributing to their success through a systematic literature review and thematic analysis of 32 articles. Conducted within the framework of open innovation and strategic collaboration models, this study aims to draw attention to the gap in the literature on Türkiye's entrepreneurship ecosystem and to guide future research and collaboration strategies.

Saraç [26] examined women's transition processes from dependent employment to individual entrepreneurship, their roles in economic development, and the financial challenges they face in entrepreneurial activities. The research findings reveal the constraints women entrepreneurs face in

accessing financing due to reliance on equity capital, high interest rates, and inadequate equality policies, and offer recommendations for the sustainability of resources.

Korkmaz [27] examined the alignment of entrepreneurship activities carried out by development agencies in Türkiye with the policies of the 11th Development Plan and the role of their partnerships in regional development. The research findings reveal that the development agencies' practices, such as education, center establishment, and events, largely align with the plan's objectives and that the established partnerships contribute directly to regional development.

In summary, studies in the literature have examined entrepreneurship in Türkiye from a multidimensional perspective, focusing on conceptual and generational transformations, firm-level characteristics and institutional partnerships, public incentives and private entrepreneur profiles, as well as the macro-ecosystem and planning policies. On the other hand, studies addressing the geographic and spatial dimensions of the subject have primarily focused on sectoral preferences at the provincial level, macro-level dynamics of regional development, or cluster structures centered on a single sector, such as maritime transport and textiles. Despite this rich body of literature, a significant portion of existing studies limit their scope to either a single sector or a restricted geographic region. No study has been identified that simultaneously evaluates the number of new entrepreneurs across all 81 provinces in Türkiye based on all NACE Rev. 2 main sectors and derives a typology using multi-criteria decision-making/classification methods. This study holds unique value in that it classifies Türkiye's 81 provinces within the context of all major sectors, revealing province-level sectoral entrepreneurial profiles and groups of provinces with similar characteristics, thereby filling the sectoral and spatial data gap in the literature through an analytical and holistic approach.

3. Methodology

The study aims to evaluate provinces in terms of the number of new entrepreneurs by sector. To achieve this objective, the MDS and CODAS-Sort methods will be utilized. In this context, the general characteristics of MDS and CODAS-Sort will be discussed in the following subsections.

3.1 Multidimensional Scaling

MDS is one of the multivariate statistical methods and is used to obtain descriptive results in multi-criteria decision-making problems [28–31]. MDS represents the distances of m units determined based on n variables in a b -dimensional space, where $b < n$. In this regard, it serves as an alternative to methods such as PROMETHEE-GAIA and DEMATEL, which represent multi-criteria decision-making problems in a two-dimensional space.

MDS includes two different methods, metric and non-metric, depending on whether the data is quantitative/cardinal (measured on at least an equally-interval scale). In metric MDS, the data has a quantitative structure, and distance measures such as Euclidean, Squared Euclidean, Manhattan Block, Chebyshev, and Minkowski, which are appropriate for this data structure, are used to calculate the distances between units. In non-metric MDS, the data has a qualitative structure (measured on nominal or ordinal scales). In this context, depending on the number of categories in the data, one of the following distance measures is used in non-metric MDS: Binary Euclidean, Magnitude Difference, Lance-Williams, Spearman's Footrule, Chi-square, Phi-square, etc. Furthermore, in cases of mixed data, a common approach is to re-measure the qualitative data to convert it into quantitative form and then normalize the entire dataset [32, 33]. Since the data in this study is quantitative in nature, the Metric MDS will be used. In this regard, the general structure of the Metric MDS will be summarized in the following section.

In Metric MDS, first, the distances between the m units are calculated to form a distance matrix. Thus, the m units are represented by m points in an $(m-1)$ -dimensional Euclidean space. The primary

objective of the Metric MDS is to determine the number of dimensions that minimizes the proximity between the actual distances (d_{ik}) of the m units and their estimated distances ($\hat{d}_{ik}, f(\delta_{ik})$). In this context, the goal is to identify the dimension that minimizes Equation (1).

$$L = \sum (d_{ik} - \hat{d}_{ik})^2 \quad (1)$$

In the application of the MCDA method, whose general structure is summarized above, the following procedural steps are followed [11, 32, 33]:

Step 1. Creation of the decision matrix: A decision matrix is frequently used when seeking a solution using multi-criteria decision-making methods. The decision matrix presented in Equation (2) X , is a matrix of dimensions $m \times n$, containing n criteria and m distinct alternatives. X often shares the same characteristics as a data matrix used in multivariate statistical methods, where variables are listed in the columns, observations in the rows, and corresponding values in the cells. At this point, the fact that the relevant variable is used as a criterion constitutes the fundamental difference between the two concepts.

$$X = \begin{bmatrix} x_{11} & \dots & x_{1n} \\ \vdots & \ddots & \vdots \\ x_{m1} & \dots & x_{mn} \end{bmatrix} \quad \begin{matrix} i = 1, \dots, m \\ j = 1, \dots, n \end{matrix} \quad (2)$$

In Equation (2), it can be seen that the elements of the decision matrix are expressed as x_{ij} . Accordingly, x_{ij} represents the performance or outcome value of each alternative/observation i with respect to criterion/variable j .

Step 2. Construction of the distance matrix D : In metric MDS, the Euclidean distance measure is frequently used. In this context, the distances between the alternatives are calculated using Equation (3), and the D matrix given in Equation (4) is constructed.

$$d_{ik} = \sqrt{\sum (x_{ij} - x_{kj})^2} \quad (3)$$

$$D = \begin{bmatrix} 0 & \dots & \dots & \vdots \\ d_{21} & 0 & \ddots & \vdots \\ \vdots & \vdots & 0 & \vdots \\ d_{m1} & d_{m2} & \dots & 0 \end{bmatrix} \quad (4)$$

Step 3. Determining the appropriate number of dimensions: Stress statistics and goodness-of-fit values are used to determine the number of dimensions. In this context, the slope plot, which includes stress values and the number of dimensions, is also used for visual assessment. Generally, the number of dimensions with the lowest stress value is adopted. However, striking a balance between the number of dimensions and interpretability is an important criterion in MDS. Since structures with four or more dimensions are particularly difficult to interpret, two-dimensional structures are generally preferred, and three-dimensional structures are rarely used.

Step 4. Creation of the estimated distance matrix: Estimated (configuration) distance values ($\hat{d}_{ik}$) are obtained using one of the following regression methods: linear, polynomial, or monotonic. The scatter plot can be used to select the regression method.

Step 5. Examination of the fit between the true and estimated distance values: Goodness-of-fit values are used to assess the specified number of dimensions and the validity and reliability of the results. In this context, the stress statistics given in Equation (5) are used.

$$stress = \sqrt{\frac{\sum \sum (\hat{d}_{ik} - d_{ik})^2}{\sum \sum d_{ik}^2}} \quad (5)$$

A stress statistic value close to zero indicates a good fit between the actual distances and the distances estimated by the MDS method. A stress value equal to or greater than 0.20, however, indicates a poor fit. When using the R^2 value, the square of the correlation coefficient between the actual distances and the estimated distances, to determine goodness of fit, values close to one indicate a good fit.

Step 6. Graphical representation: The alternatives are plotted on a graph according to the specified number of dimensions. In this way, a graphical classification of the alternatives is obtained. Interpretations are made based on these classifications, the distances between the alternatives, and their positions on the graph.

3.2 CODAS-Sort

Reference-distance (target)-based methods hold an important place among multi-criteria decision-making methods. Among the methods in this group, CODAS is based on the premise that the worst values in the relevant criteria are taken as the reference, and the best solution will be the one farthest from that worst value (the negative ideal) [34]. CODAS-Sort, on the other hand, is a variant of CODAS proposed by Ouhibi and Frikha [9] for classification problems.

Among MCDA methods, there has recently been an increase in the number of methods aimed at solving classification problems. The main reasons for this include the fact that multi-criteria classification/sorting methods reflect the decision-maker's preferences and allow for classification where superiority relationships can be established between classes, as well as the fact that they involve fewer assumptions than multivariate statistical methods. At this point, it is important to note that multi-criteria classification methods are fundamentally divided into two main groups: nominal classification and ordinal classification [35–37]. Promethee-Sort, Electre-Tri, and Ref-Sort are among the examples of multi-criteria classification methods [7]. Among ordinal classification methods, CODAS-Sort requires the use of profiles (class references) to assign profiles to predefined classes. Class profiles are determined separately for each criterion within each class.

The following section provides a more detailed description of the processing steps of CODAS-Sort. Here, the approach generally follows the work of Ouhibi and Frikha [9]. However, adjustments have been made regarding normalization, weighting, and other related matters.

Step 1. Creation of the decision matrix: The decision matrix X , as given in Equation (1), is constructed.

Step 2. Determination of classes and creation of the profile matrix associated with the classes: In multi-criteria classification methods, alternatives are assigned to predefined classes. In this context, the decision-maker, an expert individual or group, or other scientific approaches/methods are used to determine the number of classes and their general characteristics. Accordingly, let the classes be $S = 1, \dots, p$; for each of the p classes, b profiles are determined for each of the j criteria.

Regarding the determination of profiles, Ouhibi and Frikha [9] state that either boundary profiles or center profiles can be used. Boundary profiles represent the threshold values between classes, while center profiles represent the general characteristics of the relevant class. When using boundary profiles, the relevant alternative is assigned to the class within which its overall evaluation score falls between the specified boundary profiles. When using center profiles, the relevant alternative is assigned to the class to which its overall evaluation score is closest. In this study, center profiles were utilized.

After the number of classes is determined, b profile values are defined for each criterion, where $b = 1, \dots, p$. In this context, the Y profile matrix of size $p \times n$, where y_{bj} represents the value associated with the b -th profile of the j -th criterion, is given in Equation (6).

$$Y = [y_{bj}]_{p \times n} = \begin{bmatrix} y_{11} & \cdots & y_{1n} \\ \vdots & \ddots & \vdots \\ x_{b1} & \cdots & x_{bn} \end{bmatrix} \quad \begin{matrix} b = 1, \dots, p \\ j = 1, \dots, n \end{matrix} \quad (6)$$

Step 3. Performing normalization: CODAS performs a linear normalization process based on the maximum and minimum values. On the other hand, Ouhibi and Frikha [9] did not include the normalization process in CODAS-Sort. Normalization produces comparable values in the same direction (typically the direction of utility optimization) by removing units from criteria with different structures. Furthermore, normalization reflects the decision-maker's preferences regarding the decision problem. In this regard, CODAS-Sort will utilize the linear normalization technique based on maximum and minimum values used in CODAS. In this context, the normalization processes are completed using Equation (7) for the X matrix and Equation (8) for the Y matrix.

$$f_{ij} = \begin{cases} \frac{x_{ij}}{\max_i x_{ij}} & \text{if } j \in J \\ \frac{\min_i x_{ij}}{x_{ij}} & \text{if } j \in J' \end{cases} \quad (7)$$

$$f_{bj} = \begin{cases} \frac{x_{ij}}{\max_b x_{bj}} & \text{if } j \in J \\ \frac{\min_b x_{bj}}{x_{ij}} & \text{if } j \in J' \end{cases} \quad (8)$$

In Equations (7–8), J denotes benefit-oriented criteria, J' represents cost-oriented criteria, f_{ij} represents the normalized values for alternatives, and f_{bj} represents the normalized values for profiles. However, if any of the criteria have negative or zero values, or if the issue of order (class) reversal is significant, it would be appropriate to use another normalization technique that better reflects the decision-maker's preferences.

Step 4. Performing the weighting process: Weighting is an important process that ensures the impact levels of the criteria on the decision-making problem and thus the decision-maker's preferences—are reflected. Ouhibi and Frikha [9] did not use the weighting process in CODAS-Sort. Therefore, the weighting process presented in Equations (9–10) has been included.

$$r_{ij} = w_j f_{ij} \quad (9)$$

$$r_{bj} = w_j f_{bj} \quad (10)$$

In Equations (9–10), w_j represents the weight value of criterion j and takes values in the range of 0–1. While subjective, objective, or mixed weighting techniques can be used to determine the weight values of the criteria, subjective judgments reflecting the preferences of the decision-maker or an expert can also be used directly.

Step 5. Determining the negative ideal solution values: Following the weighting process, the negative ideal solution values are determined for each criterion. In this context, the values of ns_j and ms_j are obtained using equations (11–12), based on the r_{ij} values and r_{bj} values.

$$ns_j = \min_i r_{ij} \quad (11)$$

$$ms_j = \min_b r_{bj} \quad (12)$$

Step 6. Calculation of Euclidean and Taxicab distances: The Euclidean and Taxicab distances between the alternatives and between the alternatives and the profiles are calculated. The negative ideal solution values are used for this purpose. Equations (13–14) are used to calculate the Euclidean (E_i) and Taxicab (T_i) distances of the alternatives from the negative ideal values, while equations

(15–16) are used to calculate the Euclidean (E_b) and Taxicab (T_b) distances of the profiles from the negative ideal values.

$$E_i = \sqrt{\sum_{j=1}^n (r_{ij} - ns_j)^2} \quad (13)$$

$$T_i = \sum_{j=1}^n |r_{ij} - ns_j| \quad (14)$$

$$E_b = \sqrt{\sum_{j=1}^n (r_{bj} - ms_j)^2} \quad (15)$$

$$T_b = \sum_{j=1}^n |r_{bj} - ms_j| \quad (16)$$

Step 7. Creation of the relative evaluation matrix: The values to be used in assigning alternatives to classes are obtained in this step. In this context, the relative evaluation (G) matrix is created using Euclidean and Taxicab distances. Equations (17–18) are used to derive this matrix.

$$G = [h_{ib}]_{m \times p} \quad (17)$$

$$h_{ib} = (E_i - E_b) + \left((\psi(E_i - E_b)) \times (T_i - T_b) \right) \quad (18)$$

In Equation (18), ψ represents the threshold function. The ψ function ensures that Taxicab distances are also taken into account by comparing the Euclidean distance value calculated using the b profile of alternative i with τ . Keshavarz Ghorabae *et al.*, [34] recommended setting the τ value between 0.01 and 0.05. Based on this value, a relative evaluation matrix is obtained using a ψ (psi) threshold function that incorporates both Euclidean and Taxicab distance measures. The ψ function is defined by Equation (19):

$$\psi(x) = \begin{cases} 1 & \text{if } |x| \geq \tau \\ 0 & \text{if } |x| < \tau \end{cases} \quad (19)$$

In Equation (19), τ represents whether the value of $|E_i - E_b|$ is below or above a certain threshold and is determined by the decision-maker. It is recommended that this value be set between 0.01 and 0.05 [34].

Step 8. Completion of the classification process: When using center profiles in the classification process, the alternatives are assigned to classes using Equation (20):

$$\begin{aligned} i \in S_1 & \text{ if } |h_{i1}| < |h_{ik}| \quad k = 2, \dots, p \\ i \in S_k & \text{ if } |h_{ik}| < |h_{i1}| \quad b = 1, \dots, k, \dots, p \end{aligned} \quad (20)$$

Using Equation (20), alternative i is assigned to the class associated with the smallest absolute value of h_{ib} . On the other hand, when boundary profiles are used in classification, Equation (21) is employed. At this point, the h_{ib} value used in the evaluation is the smallest absolute value in the G matrix, just as it is for central profiles.

$$\begin{aligned} i \in S_b & \quad \text{if } (h_{ib}) \geq 0 \quad b = 1, \dots, p \\ i \in S_{b-1} & \quad \text{if } (h_{ib}) < 0 \end{aligned} \quad (21)$$

Thus, using the CODAS-Sort method in the context of negative ideal and class profiles, the process of assigning alternatives to predefined classes is completed.

4. Findings

The number of new businesses established in each province in 2017, 2018, and 2019 was obtained from the TUIK database [38]. Within the context of NACE Rev. 2 main sectors, the average of the figures obtained for eighteen main sectors was used to classify the provinces in terms of

entrepreneurship. Additionally, SPSS 25.0 was used for MDS analyses, and MS Excel was used for CODAS-Sort analyses. Major sector groups were used as criteria/variables, and equal weight was assigned to each criterion.

First, the provinces were graphically positioned at different dimensions based on their number of new entrepreneurs using the MDS. Within the scope of the MDS, the number of dimensions was determined first. At this stage, care was taken to balance the number of dimensions with interpretability. Additionally, the dimension with a stress statistic close to zero yields the number of dimensions closest to the desired results. In this context, an analysis conducted in the MDS to determine the appropriate number of dimensions revealed that the lowest stress values were observed in a two-dimensional model (stress1 = 0.0306 for two dimensions). However, Figure 1 presents both two- and three-dimensional results.

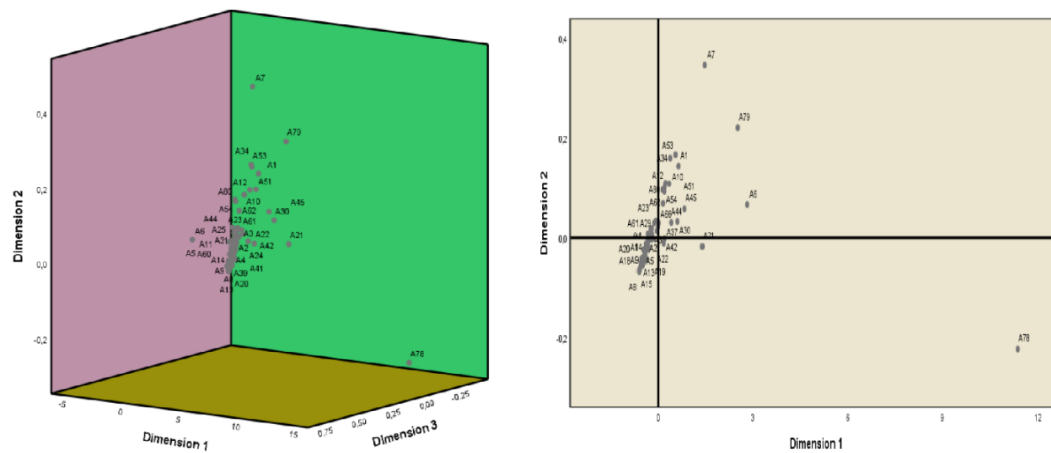


Fig. 1. Graphical representation for two and three dimensions

The results in Figure 1 show that A6 (Ankara), A7 (Antalya), A21 (Bursa), A78 (Istanbul), and A79 (Izmir) stand out from the other provinces. In both the two- and three-dimensional representations, the final coordinate values for these provinces also differ significantly from those of the other provinces. Another important point, as seen when examining Figure 1 and the matrix of differences, is that Istanbul is located far from all other provinces. Furthermore, it was determined that the agreement between configuration distances based on stress values and actual distances is at a high level (stress1 < 0.05 and R²= 0.99). However, the CODAS-Sort method will be used to evaluate the provinces within classes where dominance relationships can be established.

The results of the MDS were used to determine the number of classes into which the provinces would be classified. Accordingly, based on the four regions of the two dimensions included in the MDS, it was decided that the number of classes would be set at four. Equation (22) was used to determine the class profiles.

$$\begin{aligned}
 \text{Center profile for Class 1; } b_1 &= \frac{\sum_{i=1}^m x_{ij}}{m} + \left[\left(\max_i x_{ij} - \frac{\sum_{i=1}^m x_{ij}}{m} \right) \frac{1}{2} \right] \\
 \text{Center profile for Class 2; } b_2 &= \frac{\sum_{i=1}^m x_{ij}}{m} + \left[\left(\max_i x_{ij} - \frac{\sum_{i=1}^m x_{ij}}{m} \right) \frac{1}{4} \right] \\
 \text{Center profile for Class 3; } b_3 &= \frac{\sum_{i=1}^m x_{ij}}{m} - \left[\left(\frac{\sum_{i=1}^m x_{ij}}{m} - \min_i x_{ij} \right) \frac{1}{4} \right] \\
 \text{Center profile for Class 4; } b_4 &= \frac{\sum_{i=1}^m x_{ij}}{m} - \left[\left(\frac{\sum_{i=1}^m x_{ij}}{m} - \min_i x_{ij} \right) \frac{1}{2} \right]
 \end{aligned} \tag{22}$$

The class profiles created using Equation (22) and the average values for the criteria are presented in Table 1.

Table 1

Class profile values for the criteria

Criterion Code	NACE Rev. 2 Main Sector Name	Mean Value	Class Center Profiles			
			Class 1 b ₁	Class 2 b ₂	Class 3 b ₃	Class 4 b ₄
K1	A. Agriculture, Forestry, and Fishing	392.8	1,311.9	852.4	299.0	205.1
K2	B. Mining and Quarrying	78.9	574.1	326.5	59.7	40.6
K3	C. Manufacturing	5,440.5	681,361	36,788.3	4,123.1	2,805.7
K4	D. Production and Distribution of Electricity, Gas, Steam, and Air Conditioning	86.4	1,163.0	624.7	65.0	43.7
K5	E. Water Supply; Sewerage, Waste Management, and Remediation Activities	69.7	578.7	324.2	52.3	34.9
K6	F. Construction	3,395.3	36,428.5	19,911.9	2,578.1	1,760.8
K7	G. Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles	15,911.0	149,882.5	82,896.8	12,161.3	8,411.7
K8	H. Transportation and Storage	6,404.5	54,357.3	30,380.9	4,962.6	3,520.6
K9	I. Accommodation and Food Service Activities	4,210.1	36,458.2	20,334.2	3,233.9	2,257.7
K10	J. Information and Communication	563.1	10,654.6	5,608.8	426.9	290.7
K11	K. Financial and Insurance Activities	286.4	3,910.5	2,098.5	217.1	147.9
K12	L. Real Estate Activities	770.5	9,850.2	5,310.3	579.5	388.6
K13	M. Professional, Scientific, and Technical Activities	2,978.2	40,454.3	21,716.3	2,256.5	1,534.8
K14	Administrative and Support Services	834.0	12,016.2	6,425.1	630.3	426.7
K15	P. Education	334.6	4,399.5	2,367.0	252.5	170.5
K16	Q. Human Health and Social Services Activities	587.2	9,354.6	4,970.9	442.5	297.8
K17	R. Culture, Arts, Entertainment, Recreation, and Sports	678.1	7,541.9	4,110.0	525.5	373.0
K18	S. Other Service Activities	4,290.1	34,608.2	19,449.1	3,312.7	2,335.4

Table 1 shows that the largest number of businesses were established under the main sector “Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles.” The smallest number of businesses were established in the main sector group “Water Supply; Sewerage, Waste Management, and Remediation Activities.” The analysis conducted using CODAS-Sort yielded the classification results presented in Table 2.

Upon examining the classification results presented in Table 2, it is observed that only Istanbul is included in S1, Ankara and Izmir in S2, fifty-nine provinces in S3, and nineteen provinces in S4. These results align to a certain extent with the MDS findings. When provinces are ranked by the number of new startups during the 2017–2019 period, the top five are, in order: Istanbul, Ankara, Izmir, Antalya, and Bursa. The provinces with the fewest new startups during this period, from most to least, were Kilis, Gümüşhane, Ardahan, Tunceli, and Bayburt. It was determined that the provinces ranked at the top of the entrepreneur count list using CODAS-Sort were classified in classes S1, S2, and S3, while those in the bottom five were classified in class S4. Additionally, it was found that, with the exception of the provinces of Muş and Şırnak, the number of entrepreneurs showed an upward trend over the years in all other provinces during the 2017–2019 period.

In terms of the general characteristics of the classes, there is a correlation between the classes and the population per new business. While there is one business for every 299 people in Class S1, this figure is 349 in Class S2, 359 in Class S3, and 375 in Class S4. According to 2018 GDP per capita data, the provinces with the highest values are Kocaeli, Istanbul, and Çanakkale, while those with the lowest values are Van and Şanlıurfa. In this context, it can be noted that population and income play a significant role in creating a favorable environment for entrepreneurship.

Table 2
Classification results

Class	S1	S2	S3	S4
Provinces	Istanbul	Ankara, Izmir	Adana, Adıyaman, Afyonkarahisar, Aksaray, Amasya, Antalya, Artvin, Aydın, Balıkesir, Bolu, Burdur, Bursa, Denizli, Diyarbakır, Düzce, Edirne, Elazığ, Erzurum, Eskişehir, Gaziantep, Giresun, Hatay, Isparta, Kahramanmaraş, Karabük, Karaman, Kastamonu, Kayseri, Kocaeli, Konya, Kütahya, Kırklareli, Kırıkkale, Kırşehir, Malatya, Manisa, Mardin, Mersin, Muğla, Nevşehir, Niğde, Ordu, Osmaniye, Sakarya, Samsun, Sinop, Sivas, Tekirdağ, Tokat, Trabzon, Uşak, Van, Yalova, Yozgat, Zonguldak, Çanakkale, Çankırı, Çorum, Şanlıurfa	Ardahan, Ağrı, Bartın, Batman, Bayburt, Bilecik, Bingöl, Bitlis, Erzincan, Gümüşhane, Hakkâri, Iğdır, Kars, Kilis, Muş, Rize, Siirt, Tunceli, Şırnak
Total Number of Entrepreneurs in 2017	881,489	490,724	2,176,964	146,827
2017 Total Population	15,029,231	9,724,703	46,796,072	3,211,126
2017 GDP (Thousand TL)	972,491,829	471,917,028	1,557,104,751	109,136,547
2018 Total Number of Entrepreneurs	919,732	508,665	2,264,812	152,742
2018 Total Population	15,067,724	9,824,504	47,505,140	3,269,129
2018 GDP (Thousand TL)	1,155,254,285	563,346,041	1,874,071,636	131,715,974
2019 Total Number of Entrepreneurs	944,954	521,878	2,331,897	155,969
2019 Total Population	15,519,267	10,006,327	48,258,175	3,367,511
Population/New Entrepreneur Ratio (Avg.)	299	349	359	375
2017–18 Average GDP per Capita (TL)	70,696	52,957	36,385	37,167

In the S1 class, which includes Istanbul, and the S2 class, which includes Ankara and Izmir, the majority of new ventures took place in the “Restaurants and Mobile Food Service Activities” and “Construction of Residential and Non-Residential Buildings” subsectors. In S3, which includes a large number of provinces, the four sectors with the highest number of new businesses were, in order: “Freight Transportation by Road,” “Retail Trade in Food, Beverages, or Tobacco in Stores Not Dedicated to a Specific Commodity,” “Restaurants and Mobile Food Service Activities,” and “Activities of Other Member Organizations Not Classified Elsewhere.” In the last category, S4, the top three subsectors with the highest levels of entrepreneurship are, in order: “Retail Trade in Food, Beverages,

or Tobacco in Stores Not Dedicated to a Specific Commodity,” “Intra-city and Suburban Passenger Transportation by Land,” and “Activities of Other Member Organizations Not Classified Elsewhere.”

When examining the sectoral distribution of new businesses across Türkiye, the majority of new businesses established in 2019 were in the “Restaurants and Mobile Food Service Activities” subsector. This sector was followed, in order, by “Retail Trade in Food, Beverages, or Tobacco in Stores Not Dedicated to a Specific Commodity,” “Freight Transportation by Road,” “Activities of , and Other Member Organizations Not Classified Elsewhere,” and “Construction of Residential and Non-Residential Buildings.” The sub-sectors with the fewest new ventures were “Electricity Transmission,” “Intercity Passenger Transportation by Rail,” “Postal Services Under the Universal Service Obligation,” “Publication of Directories and Mailing Lists,” and “Central Bank Activities.” In general, it can be stated that entrepreneurship in Türkiye is concentrated within the service sector.

The findings obtained show significant parallels with theoretical and empirical studies in the literature. The analysis results, which show that new ventures are predominantly concentrated in areas such as “Restaurants and Mobile Food Services” and “Wholesale and Retail Trade,” align with the findings of Sönmez and Toksoy [13], who determined that entrepreneurs in Türkiye tend to establish businesses primarily in the trade and service sectors. The results of the MDS and CODAS-Sort analyses show that Istanbul (S1) stands out distinctly from all other provinces, forming a separate class, with Ankara and Izmir (S2) following closely behind; this confirms the findings of Karahan and Kırval [19] and Güven [22], who noted that market size, developed infrastructure, and quality of life advantages trigger geographic concentration and clustering. Furthermore, the positive relationship between population density and per capita GDP growth, on a class-by-class basis, and the number of entrepreneurs is fully consistent with the assessments by Güven [22] and Metin [23], who emphasize that population, income level, and social amenities are critical prerequisites for the development of the regional entrepreneurial ecosystem.

5. Conclusions

The positive effects of entrepreneurship on a country’s development, the reduction in unemployment, and the level of prosperity are undeniably significant. However, the likelihood of success for startups concentrated in certain sectors will be low. The analyses and examinations conducted within the scope of this study have shown that new ventures in Türkiye are concentrated in the service sector, particularly in the “Restaurants and Mobile Food Service Activities” subsector, and in Istanbul. Additionally, the study includes a classification of provinces based on the number of new ventures. In this context, the MDS and CODAS-Sort methods were utilized. The results obtained using MDS showed that Istanbul occupies a significantly different position from all other provinces. This result was consistent with the classification results obtained using CODAS-Sort. In the four-class classification, Istanbul alone constituted the first class, while Ankara and Izmir formed the second class.

When the results are evaluated across Türkiye, a profile of entrepreneurs centered in Istanbul and focused on the service sectors emerges. It can be stated that Istanbul’s growing population and easy access to most resources attract entrepreneurs. On the other hand, considering the devastating effects of the 1999 Marmara Earthquake, it is an indisputable reality that Istanbul-centered industrialization and urbanization pose high risks for Türkiye. Redirecting this concentration from Istanbul to the provinces in classes S3 and S4 and establishing sustainable, high-standard-of-living conditions in these provinces could be one potential solution. Furthermore, entrepreneurs evaluating opportunities focused on information technology and technology, or those involving innovations in production, rather than traditional sectors could increase their chances of success. In this regard, it is considered appropriate to prioritize sub-sectors within the high-value-added technology and

manufacturing sectors and for the government to establish cluster-like initiatives that facilitate access to resources for these sectors.

Accordingly, implementing agencies such as the Ministry of Industry and Technology, Development Agencies, and KOSGEB must prioritize technology transfer incubators and specialized organized industrial zones in provinces classified as S3 and S4. Redesigning the regional incentive system based on the NACE Rev. 2-based clustering potential of provinces will alleviate industrial pressure on Istanbul while ensuring the sustainability of the entrepreneurial ecosystem in Anatolia.

The fact that this study is limited to data from the 2017–2019 period and that sectors were weighted equally constitutes the study's main limitation. Future studies could utilize up-to-date and panel data covering the post-pandemic period. Additionally, hybrid models in which sectors are weighted using subjective/objective methods such as AHP, BWM, or CRITIC could be applied. Furthermore, various multi-criteria classification methods, such as Ref-Sort, Electre-Tri, and Promethee-Sort, could also be utilized. Comprehensive studies on entrepreneurship conducted by researchers could help identify the characteristics of successful startups, pinpoint the challenges entrepreneurs face during the process and potential solutions, and evaluate successful entrepreneurship projects from around the world within the Turkish context. In this way, different perspectives on entrepreneurship-related issues and proposed solutions in Türkiye could be brought to light.

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Conflicts of Interest

The author declares no conflicts of interest.

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