Identifying Entrepreneurial Patterns Among Women: A Cluster Analysis Approach

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Introduction – Female entrepreneurship has become an increasingly prominent topic in business research. Although women exhibit lower entrepreneurial activity across most countries, the underlying drivers remain poorly understood. The study examines determinants of women's entrepreneurial engagement. Methodology – Using Global Entrepreneurship Monitor (GEM) data from Hungary between 2021 and 2024 (n=4,080 women), an exploratory principal component analysis (PCA) was first conducted using 14 variables measuring entrepreneurial attitudes and perceptions, followed by Python-based K-means clustering. Results – Three distinct clusters emerged: (1) entrepreneurially engaged women with high perceived readiness and strong opportunity recognition; (2) proactive aspirants with high fear of failure despite positive attitudes; and (3) disengaged non-entrepreneurs with low proactivity and higher risk aversion. The clusters show clear separation in PCA space and significant differences across all attitudinal dimensions. Discussion – Results reveal heterogeneity in women's entrepreneurial attitudes. Entrepreneurship-related perceptions may change over time due to external factors, suggesting that targeted interventions can foster female entrepreneurial activity.

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1   Introduction

Women's participation in economic life is a topic of flourishing and growing interest in the social sciences. Research on women is driven by several factors. On the one hand, women's intensive participation in the economy has become an economic necessity, as sustainable growth and development are impossible without their active presence (Duflo, 2012). Research on women is also fueled by indices that reveal a significant gender gap (Behr & Xi, 2025). In addition to quantifiable reasons, soft factors also urge a deeper exploration of the topic, such as the recognition that old, traditionally established solutions do not always work. Proven differences in approach between the sexes may be the source of optimal solutions. Parallel to women's economic participation, female entrepreneurship has become an increasingly prominent topic in business research. Although empirical findings consistently show that women exhibit lower entrepreneurial activity across most countries, the underlying drivers of this gap remain poorly understood. This study contributes to the ongoing debate by examining the determinants of women's decisions to engage in entrepreneurial activity.

In our work, we seek to determine whether entrepreneurial attitudes, mindsets, and social perceptions are associated with entrepreneurship among adult women in Hungary. We also aim to identify differences between the characteristics of female entrepreneurs, women with entrepreneurial intentions, and non-entrepreneurs.

2   Literature review

The scholarly discourse surrounding women entrepreneurs emerged within the broader domain of entrepreneurship in the late 1970s, gaining significant momentum during the late 1990s and early 2000s. This period marked a pivotal shift as researchers began to challenge the prevailing assumption that entrepreneurial activity was gender-neutral, arguing instead that the distinct characteristics of female entrepreneurship warranted separate investigation (Yadav & Unni, 2016). This finding was confirmed by the 2025 GEM report which finds that women's entrepreneurial activity is lower than men's in most economies, regardless of the phase of entrepreneurship or a country's income level (GEM, 2025). Furthermore, women who intend to start a new business tend to realise it is less likely than men do. The case of Hungary aligns with this very international trend.

While the majority of foundational publications in this field originate from the United States and the United Kingdom (Deng et al., 2024), international studies have gradually expanded into six key thematic areas: the barriers to women's entrepreneurial activity; the role of human and social capital in business growth; culture and gender differences; family support and motherhood; the intersection of social entrepreneurship; and feminist perspectives (Cardella et al., 2020).

As the field has matured, research has increasingly focused on the embeddedness of female entrepreneurial activity, its environmental drivers, and its varied impacts across regions (Deng et al., 2020). A contextual nuance is required when examining Central and Eastern Europe (CEE). Rugina and Ahl (2023) suggest that because entrepreneurial activity was severely restricted during the socialist era, research in this region remains relatively young on the international stage. Despite this unique historical and economic trajectory, the normative assumptions of Western literature still permeate CEE studies. While women entrepreneurs in this region are recognized as vital contributors to economic growth and social problem-solving, research highlights a persistent need for skill development and support to increase their participation in entrepreneurship.

The decision to enter entrepreneurship is often mediated by psychological factors, most notably the fear of failure. In a cross-national study of 17 countries, Koellinger et al. (2013) found that women exhibit lower levels of entrepreneurial activity primarily due to this heightened anxiety, which acts as a critical barrier even when the necessary skills and resources are present. Furthermore, gender-specific dynamics influence how entrepreneurs access networks and their motivation; for instance, although human capital levels may be similar, significant differences exist between men and women in psychological drivers and social capital dimensions (Širec & Močnik, 2012).

Understanding these decision-making processes requires examining the "push" and "pull" factors that define the entrepreneurial continuum. Pull factors include positive motivations such as personal fulfillment, independence, and financial gain, while push factors include external constraints such as unemployment, job dissatisfaction, or family responsibilities (Uhlaner & Thurik, 2007; Verheul et al., 2006). Lingappa and Rodrigues (2023) argue that these motivations are rarely mutually exclusive; rather, women's entrepreneurial entry typically emerges from a nuanced

combination of personal aspirations and external necessity. This complexity is further addressed by Human Capital Theory, which posits that education and experience are key predictors of success (Becker, 1994), and the expanded "5M" model. By adding "Motherhood" and the "Meso/Macro environment" to the traditional 3Ms (Market, Money, Management), Brush et al. (2009) provided a holistic framework that accounts for the family context and societal expectations that disproportionately shape female ventures.

These external and internal pressures are deeply intertwined with women's life-course trajectories. Role transitions, such as becoming a mother or taking on caregiving duties, often lead to nonlinear entrepreneurial paths (Jennings & McDougald, 2007). This persistent dilemma between professional and familial commitments can act as both a catalyst for seeking the flexibility of self-employment and a primary challenge in daily operations (Santos et al., 2018; Zhang & Zhou, 2021). Social cognitive career theory further explains these variations, suggesting that confidence levels and perceived barriers—such as the "glass ceiling," "glass cliff," or the "career labyrinth"—significantly dictate whether a woman pursues an entrepreneurial path (Carli, 2018; Glass & Cook, 2018; Mattis, 2004; Wilson et al., 2007).

Ultimately, the literature underscores that women entrepreneurs are not a homogeneous group (Sarri & Trihopoulou, 2005). Their decisions are influenced by a multifaceted array of attitudes, social perceptions, and life stages. Recognizing this diversity is vital for advancing the field, as it allows for a deeper understanding of the specific patterns and mindsets that characterize different segments of female entrepreneurs.

3   Methodology

Our study adopts a quantitative approach using Global Entrepreneurship Monitor (GEM) Adult Population Survey (APS) data from Hungary for the years 2021–2024. GEM is an international research consortium that collects harmonized entrepreneurship data using a standardized methodology, ensuring cross-country comparability and high data quality (Reynolds et al., 2005; GEM, 2023).

M. Krankovits, J. Csákné Filep, Á. Szennay: Identifying Entrepreneurial Patterns Among Women:
A Cluster Analysis Approach

363

The APS is a representative survey of the active-age population, with at least 2,000 respondents per country per year. As the focus of this study is female entrepreneurship, only female respondents were included, yielding approximately 1,000 observations per year. To increase statistical power, the datasets were merged across years, resulting in a final sample of 4,080 Hungarian women. Since the analysis relies on attitudinal and perceptual variables that tend to change slowly over time, this pooling is expected to introduce minimal bias.

The analysis proceeded in two steps. First, exploratory principal component analysis (PCA) was used to identify latent dimensions of entrepreneurial attitudes and perceptions. Second, a Python-based clustering procedure was applied using 14 attitudinal variables and one dummy variable distinguishing non-entrepreneurs, nascent entrepreneurs, and current entrepreneurs. Cluster Optimization K-means clustering was employed to identify distinct groups within the female population based on their entrepreneurial attitudes and perceptions. The optimal number of clusters was determined using the elbow method, which examines the Within-Cluster Sum of Squares (WCSS) for cluster solutions ranging from k=2 to k=9. The elbow curve analysis indicated that k=3 provides the optimal balance between model complexity and explanatory power, as the rate of WCSS reduction substantially decreased beyond three clusters. Clusters were interpreted using descriptive statistics and visualized through PCA plots to characterize distinct attitudinal profiles.

The analysis incorporates 14 variables capturing multiple dimensions of entrepreneurial attitudes and perceptions (see Table 1). The respondents' actual entrepreneurial status (FEMENT) was categorized using two dichotomous variables, namely whether actively involved in a business (ANYBUSOW) and intents to start a new venture (FUTSUP), following the following pattern: (0) non-entrepreneurs with no entrepreneurial intentions, (1) individuals expecting to start a business within three years, and (2) current entrepreneurs.

All analyses were conducted using Python 3.x with the scikit-learn library for machine learning procedures, pandas for data manipulation, and matplotlib and seaborn for visualization.

Table 1: Variables concerning entrepreneurial attitudes, mindsets, and social perceptions are associated with entrepreneurship analyzed

Variable name	Question text
knowentR	Personal knowledge of entrepreneurs
opportL	Perceived business opportunities in the local area
suskillL	Self-assessed skills and knowledge for starting a business
fearfailL	Fear of failure prevents startup a new business venture
easystartL	Perceived ease of starting a business
oppism	Opportunism and proactive opportunity seeking
proact	Proactivity in pursuing entrepreneurial activities
creativ	Self-perceived creativity
vision	Decisions are part of a long-term career plan
equalincL	Perception of equal income opportunities
nbgoodcL	Perception that most people consider starting a business as a good career choice
nbstatusL	Perception that successful entrepreneurs have high social status
nbmediaL	Perception of positive media attention for entrepreneurs
nbsocentL	Perception that entrepreneurship is valued in society

Source: Data compiled by the author, based on GEM definitions

4   Results

4.1   Cluster Identification and Distribution

The K-means clustering method is popular for segmentation because it is computationally efficient and scalable for large datasets, and it helps extract interpretable clusters that inform interventions. Multi-attribute or PCA+K-means implementations have reported large reductions in within-cluster error and easier interpretation (Proksch et al, 2018; Gosztonyi and Csákné Filep, 2022; Rijati 2108, Srikar, 2025)

The K-means clustering algorithm identified three distinct clusters within the sample of 4,080 women: (cluster 0) Entrepreneurially engaged (n=1,422, 34.9%); (cluster 1) Proactive aspirants (n=1,788, 43.8%); (cluster 2) Disengaged non-entrepreneurs (n=870, 21.3%). The two-component PCA solution explained a substantial portion of variance in the standardized data. Visual inspection of the PCA scatter plot revealed clear separation between clusters, particularly between disengaged non-entrepreneurs (positioned predominantly in the left portion of the plot) and the two other clusters (positioned more centrally and to the right). While some overlap exists between non-entrepreneurs and proactive aspirants, they occupy distinct regions of

M. Krankovits, J. Csákné Filep, Á. Szennay: Identifying Entrepreneurial Patterns Among Women: A Cluster Analysis Approach

365

the PCA space, with entrepreneurially engaged individuals showing greater dispersion along both principal components.
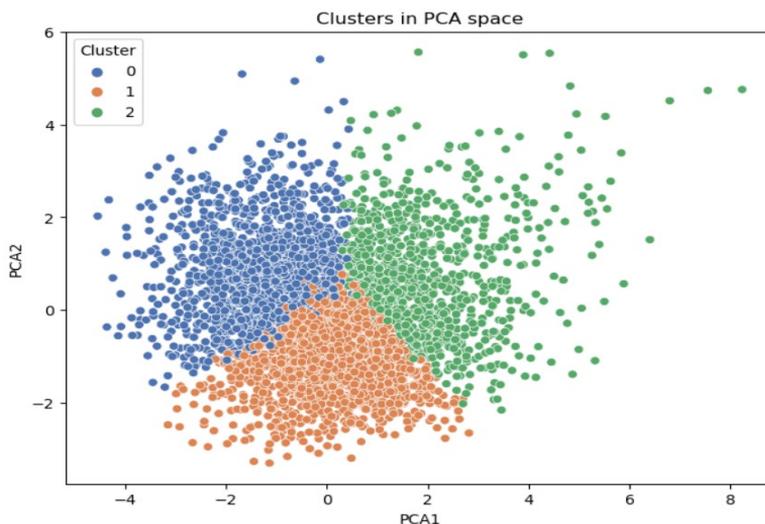

Figure 1: Clusters in PCA space
Source: Own elaboration

The elbow curve analysis confirmed that three clusters represent an optimal solution, with the WCSS decreasing from approximately 51.000 at k=2 to 47.600 at k=3, followed by diminishing returns for additional clusters.

4.2   Cluster Characteristics

Analysis of cluster means revealed distinct attitudinal profiles for each group (see Table 2).

Entrepreneurially engaged individuals are typically either entrepreneurs or have strong entrepreneurial intentions, as the average FEMENT score is rather high (0.58). Cluster members assess their own skills, experiences, and knowledge as sufficient for starting a new business, know at least one person who started a new business in the last 2 years, and consider starting a business to be easy. They show strong opportunity recognition and relatively low fear of failure. Furthermore, group members are considered creative by others, and their steps are part of a long-term

career plan. They have positive perceptions of entrepreneurs' social status and media attention.

Table 2: Cluster means

feature	Cluster 0	Cluster 1	Cluster 2	feature	Cluster 0	Cluster 1	Cluster 2
knowentR	1.39	0.46	0.5	creativ	3.29	2.31	1.39
opportL	2.65	1.91	0.72	vision	3.89	3.22	2.6
suskillL	3.52	1.57	1.72	equalincL	3.38	3.75	2.76
fearfailL	2.25	3.91	2.54	nbgoodcL	3.49	3.48	1.66
easystartL	3.32	2.1	1.2	nbstatusL	3.45	3.48	1.85
oppism	2.88	3.86	2.48	nbmediaL	3.63	3.41	2.05
proact	3.05	4.2	3.1	nbsocentL	2.58	2.27	0.86

Source: Own elaboration

The cluster of proactive aspirants has the lowest proportion of current entrepreneurs, with an average FEMENT score of 0.11, suggesting that cluster members are primarily non-entrepreneurs. However, they exhibit the highest proactivity and opportunism scores among all clusters. Paradoxically, this group shows the highest fear of failure and relatively low self-assessed skills, experiences, and knowledge in entrepreneurship. Their perceptions of entrepreneurs are rather positive, but they lack confidence in their own capabilities.

Disengaged non-entrepreneurs have, similarly, rather low but somehow higher entrepreneurial engagement (FEMENT=0.19) than aspirants, and are characterized by consistently low scores across most dimensions. Members exhibit minimal opportunity perception, low self-assessed skills, experiences, and knowledge, very low perceived ease of starting a new business, and do not consider their decisions part of a long-term career plan, while their peers do not consider them creative. Critically, this group demonstrates the most negative perceptions of entrepreneurship's social value, with particularly low scores for career desirability , social status, and societal appreciation.

These findings suggest that entrepreneurial attitudes cluster in ways that partially, but not perfectly, align with actual entrepreneurial behavior, indicating that the transition from non-entrepreneur to entrepreneur involves complex attitudinal shifts that may occur gradually over time.

M. Krankovits, J. Csákné Filep, Á. Szennay: *Identifying Entrepreneurial Patterns Among Women: A Cluster Analysis Approach*

367

5   Discussion & Conclusion

This study investigated the determinants influencing women's entrepreneurial activity in Hungary using GEM data from 2021-2024. Scholarly discourse emphasizes that the fear of failure acts as a critical barrier to women's entrepreneurial entry, even when the necessary skills are present (Koellinger et al., 2013). Our results confirm these findings: the proactive aspirants cluster exhibited the highest fear of failure, which explains why, despite their high proactivity, this group has the lowest proportion of actual entrepreneurs. Conversely, the members of the entrepreneurially engaged cluster possess high self-assessed skills, aligning with Human Capital Theory, which posits that education and experience are key predictors of success (Becker, 1994).

The "5M" model highlights that female entrepreneurial activity is disproportionately shaped by the family context and societal expectations - specifically "motherhood" and the "meso/macro environment" (Brush et al., 2009). In our study, the cluster of disengaged non-entrepreneurs showed the most negative social perceptions, reporting the lowest scores for entrepreneurs' social status and societal appreciation. This confirms that a lack of social recognition is a major deterrent, while the positive social perceptions in Cluster 0 correlate with actual entrepreneurial activity.

The literature distinguishes between "pull" factors, such as the desire for independence, and "push" factors, such as job dissatisfaction or unemployment (Uhlaner & Thurik, 2007; Verheul et al., 2006). Our findings indicate that opportunity recognition (*opportL*) is highest among current and intentional entrepreneurs. Members of Cluster 0 are clearly driven by "pull" factors, such as opportunism and vision, whereas the "aspirants" in Cluster 1 recognize opportunities but are often held back by a lack of confidence and high perceived risk.

Due to the unique historical trajectory of the Central and Eastern European (CEE) region, research highlights a persistent need for skill development and encouragement to bolster women's participation (Rugina & Ahl, 2023). Our cluster analysis of the Hungarian sample reinforces the 2025 GEM report's findings: women's entrepreneurial activity remains lower than men's. The extremely low "perceived ease of starting" observed in Cluster 2 suggests that environmental

barriers and the perceived difficulty of bureaucracy represent significant entry hurdles for Hungarian women.

The findings of this research offer policymakers vital insights. When designing policy interventions, it is essential to develop programs that support women's entrepreneurship by accounting for the complexity and interdependence of these identified factors. Providing financial resources alone is insufficient; programs must simultaneously address psychological barriers (such as confidence-building and failure management) and social and familial challenges (such as flexible childcare systems and mentoring).

Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the authors used Grammarly, ChatGPT 4.0, and Google Gemini as writing assistants to contextually supplement the existing text, improve readability and style, and provide translation services. After using these tools, the authors reviewed and edited the content as needed and took full responsibility for the publication's content. The authors certify that the use of these AI tools had no influence on the research results, data interpretation, or the final conclusions of the article.

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M. Krankovits, J. Csákné Filep, Á. Szennay: Identifying Entrepreneurial Patterns Among Women:
A Cluster Analysis Approach

369

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