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"If you want something said, ask a man; if you want something done, ask a woman."
Margaret Thatcher

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Note of Editor in Chief



Dear Authors,

It is my pleasure to share the latest achievements of the *Journal of Women's Entrepreneurship and Education* (JWEE), which continues to strengthen its international visibility and academic standing. According to the available journal metrics for 2025, JWEE has achieved Q1 status in the Scopus subject area of Gender Studies and a CiteScore of 4.3. These achievements reflect the journal's growing relevance to international research on women's entrepreneurship, gender equality, entrepreneurial education, and related areas of economic and social development.

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Thank you for your continued support and contribution to the development of JWEE as an international platform for high-quality scholarship.

November 2026

Yours faithfully,
Prof. Dr. Mirjana Radović-Marković
Editor-in-Chief
Journal of Women's Entrepreneurship and Education (JWEE)



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ORIGINAL SCIENTIFIC PAPER

Determinants of the Establishment of Women-Owned Agricultural Entities: Evidence from Municipal Panel Data in the Republic of Srpska



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A B S T R A C T

This paper examines the determinants of the establishment of women-owned agricultural entities in the Republic of Srpska. The analysis uses municipal-level panel data for 2015-2024 and employs conditional fixed-effects Poisson panel specifications with municipality-clustered robust standard errors and estimated female population as an exposure term. The broader dataset covers 63 municipalities, while the preferred specification is estimated on 434 municipality-year observations from 47 municipalities. The results indicate that the effect of grants allocated to women through the agricultural payment agency on the rate of newly registered women-owned agricultural holdings depends on the municipality's level of development. Grants have a significantly stronger positive effect in highly underdeveloped and underdeveloped municipalities than in developed municipalities, but no significant effect in medium-developed municipalities. Female unemployment is negative and statistically significant in the preferred Poisson specifications, suggesting that weaker local labor market

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conditions are associated with lower rates of newly registered women-owned agricultural holdings. Descriptive evidence also shows that the share of support allocated to women in total agricultural payment agency support increased from 5.45% in 2014 to 7.50% in 2024, although it remains relatively modest. The findings suggest that public support matters, but that its effectiveness depends on local development conditions.

KEYWORDS: *women's entrepreneurship, agricultural entrepreneurship, women-owned agricultural entities, public support, municipal development, rural development, Poisson panel-data model, Republic of Srpska*

Introduction

Agriculture remains central to economic development because it supports food security, income generation, and rural livelihoods, while women make substantial contributions to agrifood systems and agricultural labor worldwide (FAO, 2002; Doss, 2011; FAO, 2023). At the same time, the growing importance of gender in economics has expanded scholarly attention from labor market participation to women's entrepreneurship and development more broadly (Olivetti et al., 2024; Goldin, 2014). In rural areas, women's entrepreneurship is increasingly recognized as important for local economic vitality, household income, innovation, and sustainability, despite persistent structural barriers and unequal access to resources (Anthopoulou, 2010; Li et al., 2026; Ge et al., 2022; Vuciterna et al., 2024). Women's entrepreneurial activity in agriculture is strongly shaped by local context. Poor infrastructure, distance, and limited accessibility can constrain access to essential agricultural services, while broader institutional barriers, weak access to finance, technology, advisory support, and social resources continue to limit women's participation in agrifood systems (Anang & Asante, 2020; Muhammad & Ximei, 2022; Hidrobo et al., 2024). This means that the establishment of agricultural entities depends not only on individual motivation and capabilities but also on local development conditions, service availability, and institutional support (Turlakova, 2023; Petrović, 2024). Rural development policy reflects this logic, as less developed and naturally constrained areas often receive more favorable treatment through higher aid intensity and compensatory support, including within the EU framework (Regulation (EU) No 1305/2013, 2013; Regulation (EU) 2021/2115, 2021; European Commission, 2023). Recent evidence likewise underlines the importance of institutional support,

finance, education, training, and targeted programs for women's economic empowerment and entrepreneurial participation in rural settings (Kademani et al., 2024; Allahmoradi et al., 2024; Vujadinović & Marjanović, 2025; Radović-Marković & Achakpa, 2018). Related evidence from the Western Balkans also highlights women's financial inclusion as an important factor for the advancement of women's entrepreneurship, with education, employment status, and income identified as significant positive determinants of financial inclusion (Antonijević et al., 2024). Previous studies have examined women's entrepreneurship mainly through national, regional, and sectoral indicators, while municipal-level formal agricultural entry by women remains insufficiently explored. Moreover, public support is usually treated as having an average effect, with limited evidence on whether grant effectiveness differs across local development contexts. This study addresses these gaps by examining newly registered women-owned agricultural holdings and testing whether grant effects vary across municipal development categories.

In the Republic of Srpska, the Agency for Agrarian Payments is a central institution supporting agriculture. Before 2019, support for women existed through rural development measures. A clear policy shift occurred in 2019: women-owned agricultural entities received additional points in evaluations and rankings. This step strengthened their position in the support system (Rulebook on the conditions and manner of obtaining financial incentives for the development of agriculture and rural areas in 2018; Rulebook on the conditions and manner of obtaining financial incentives for capital investments in agricultural production in 2019, 2019). This issue is also strategically relevant because the Strategy for the Development of Agriculture and Rural Areas of the Republic of Srpska 2021–2027 identifies gender equality and the improvement of women's position in rural areas as cross-cutting priorities, while rural-development measures are expected to support rural revitalization, employment opportunities, and stronger local development (Ministry of Agriculture, Forestry and Water Management of the Republic of Srpska, 2021). The importance of the topic is further supported by the Strategy for the Development of Women's Entrepreneurship of the Republic of Srpska 2025–2031, which shows that women-owned or co-owned business entities accounted for 27.95% of all business entities in 2023, while barriers to women owners and managers still remain (Government of the Republic of Srpska, 2025). This paper examines whether the creation of women-owned agricultural entities in the Republic of Srpska is influenced not only by

institutional support but also by local development differences across municipalities. This question is particularly relevant in the Republic of Srpska because agricultural support is implemented through a common institutional framework, while municipalities differ markedly in official development status, fiscal capacity, unemployment, demographic conditions, business activity, and infrastructure constraints (Decision on Criteria for Evaluating the Development Level of Local Self-Government Units in the Republic of Srpska, 2023; Ministry of Administration and Local Self-Government of the Republic of Srpska, 2023). This setting therefore allows the study to examine whether the same policy instrument produces different effects across local development contexts and whether public funds can be more effectively targeted toward municipalities where support is more likely to stimulate women's formal entry into agriculture. The paper contributes to the literature by using municipal-level administrative data on newly registered women-owned agricultural holdings and grants allocated to women, and by explicitly testing whether grant effects vary across municipal development categories. In doing so, it links women's agricultural entrepreneurship with place-sensitive rural development policy. Although the analysis is based on one institutional setting, the findings may be informative for similar rural and post-transition contexts where centrally designed agricultural support operates across territorially uneven local economies.

Literature Review

A considerable body of recent literature uses panel-data approaches to examine factors shaping women's entrepreneurship (Mirza, 2024; Hechavarría & Ingram, 2019; Mroczek-Dąbrowska & Gaweł, 2020; Kraska & Kot, 2021; Martínez-Rodríguez et al., 2022; Alam et al., 2024; Gaies et al., 2023; Williams, 2012; Bjuggren & Henrekson, 2022; Semykina, 2018; Georgellis & Wall, 2005). This approach is also widely used in studies of individual national settings. Analyses have been conducted at the country, municipal, and regional levels (Lo et al., 2020; Falavigna et al., 2024; Daymard, 2015; Ghani et al., 2014; Noguera et al., 2015; Li et al., 2026; Conroy & Rupasingha, 2025; Ghani et al., 2013). Within this literature, women's entrepreneurship is measured through related but distinct indicators. These include women's shares in self-employment and among employers (Mirza, 2024), GEM-based gender-specific entrepreneurship

rates (Hechavarría & Ingram, 2019), industry-level measures of female entrepreneurship (Mroczek-Dąbrowska & Gaweł, 2020; Gaweł & Mroczek-Dąbrowska, 2022), and female self-employment rates (Kraska & Kot, 2021). These differences reflect both data availability and the analytical level of each study. They are important because broad indicators capture general entrepreneurial participation, whereas registered agricultural holdings capture a more specific and policy-relevant form of formal entrepreneurial entry in rural areas.

Panel-data studies also identify several groups of determinants. Public policy, government support, and access to finance are used to capture whether targeted instruments reduce barriers to entry. This includes institutional and policy conditions (Hechavarría & Ingram, 2019), public grants for women entrepreneurs (Srhoj et al., 2022), public policy and support programs (Alam et al., 2024; Martínez-Rodríguez et al., 2022; Daymard, 2015; Kaya, 2018), and start-up subsidies for unemployed women (Caliendo & Künn, 2015). Evidence from Serbia similarly shows the relevance of institutionally sponsored entrepreneurship programs: women accounted for almost half of entrepreneurship-training participants and, in 2021 and 2022, received more than half of all subsidies for entrepreneurs (Ognjenović, 2023). Another group of studies uses indicators of economic development and income conditions, including GDP, GDP per capita, and regional income levels (Kraska & Kot, 2021; Martínez-Rodríguez et al., 2022; Gaweł & Głodowska, 2021; Gaies et al., 2023; Lo et al., 2020; Noguera et al., 2015; Li et al., 2026), wage and earnings-related measures (Kraska & Kot, 2021; Georgellis & Wall, 2005; Williams, 2012; Bjuggren & Henrekson, 2022), and income differences or income security within the household (Noguera et al., 2015; Bjuggren & Henrekson, 2022). These variables are used to capture market opportunities, expected returns from self-employment, and the attractiveness of entrepreneurship relative to paid employment. Labor-market conditions, particularly unemployment, are also widely used, but their expected effect is theoretically ambiguous. Unemployment may push women into self-employment when wage jobs are limited (Kraska & Kot, 2021; Martínez-Rodríguez et al., 2022), but it may also reduce women's entrepreneurial entry by signaling weaker business opportunities, lower household resources, and poorer local demand conditions (Mirza, 2024; Gaweł & Głodowska, 2021; Gaies et al., 2023). Previous studies also include childcare availability (Conroy & Rupasingha, 2025; Li et al., 2026; Semykina, 2018), household characteristics, family structure, and life-course factors (Romeu Gordo et al., 2022; Sałach-Dróżdż

& Goraus-Tańska, 2025; Semykina, 2018), infrastructure and access to services (Daymard, 2015; Ghani et al., 2013; Li et al., 2026), education and human capital (Daymard, 2015; Li et al., 2026), and demographic controls such as population density, age structure, fertility, and sex ratio (Daymard, 2015; Ghani et al., 2013), all of which are especially relevant in rural areas where distance, care responsibilities, infrastructure, and service availability shape women's ability to formalize or expand entrepreneurial activity.

Overall, the reviewed literature shows that women's entrepreneurship is shaped by public support, local economic conditions, labor-market constraints, human capital, infrastructure, and demographic factors. However, several important gaps remain insufficiently investigated and provide the foundation for the present study. First, municipal-level formal agricultural entry is less examined than broader national, regional, or sectoral indicators. Second, public support is often treated as an average effect, although its effectiveness may differ across local development contexts. Third, the effect of unemployment remains mixed, especially in rural and agricultural settings. This study addresses these gaps by examining whether grants allocated to women affect the rate of newly registered women-owned agricultural holdings and whether this effect differs across municipal development categories. Based on the above considerations, the following hypotheses are formulated:

H1: The effect of agricultural payment agency grants for women depends on the municipality's level of development.

H2: Agricultural payment agency grants for women have stronger positive effects in highly underdeveloped municipalities.

H3: Higher female unemployment negatively affects the rate of newly registered women-owned agricultural holdings.

Methodology

This study uses panel data for municipalities in the Republic of Srpska. Although data were initially collected for 2012–2024, the estimation period was restricted to 2015–2024 due to missing observations for several variables in earlier years. The broader dataset covers 63 municipalities. After applying the estimation-period restriction, constructing the lagged support variable, and excluding observations with missing values in the variables used in the model, the final estimation sample consists of 434

municipality-year observations. The preferred conditional fixed-effects Poisson specification is estimated on 47 municipalities. This reduction reflects the combined effect of lag construction, missing-value exclusions, and the requirements of the conditional fixed-effects Poisson estimator. The list of municipalities covered by the broader dataset and those included in the final estimation sample is reported in Appendix Table A1.

Given that the dependent variable measures the number of newly registered women-owned agricultural holdings, this study applies a conditional fixed-effects Poisson panel model. This specification is appropriate because the dependent variable is a non-negative count variable. At the same time, the fixed-effects structure allows the model to control for unobserved time-invariant municipal characteristics. These characteristics may include persistent geographic, institutional, demographic, cultural, and structural differences across municipalities. Controlling for them is important because they may influence both the establishment of women-owned agricultural holdings and the allocation or effectiveness of public support. A pooled Poisson model without municipality effects would not account for these time-invariant municipal differences. A random-effects Poisson model, on the other hand, would require the stronger assumption that unobserved municipal effects are uncorrelated with the explanatory variables. A population-averaged Poisson specification was not used as the main model because the objective is to control for municipality-specific unobserved heterogeneity through a conditional fixed-effects framework, rather than to estimate marginal average associations across municipalities. For this reason, the conditional fixed-effects Poisson model is used as the preferred specification. Year fixed effects are included to control for common shocks affecting all municipalities in a given year. Robust standard errors clustered at the municipality level are used to account for heteroskedasticity and within-municipality dependence. Accordingly, the empirical specification is defined as follows:

$$y_{it} \mid \alpha_i \sim Poisson\,(\mu_{it})$$

$$ln(\mu_{it}) = \alpha_i + \lambda_t + \ln(FemalePop_{it}) + \beta_1 Grants^{c}_{i,t-1} + \sum_{k=1}^{3}\delta_k D_{kit} + \sum_{k=1}^{3}\gamma_k\left(Grants^{c}_{i,t-1}\ x\ D_{kit}\right) + \theta' X_{it} \qquad (1)$$

where y_{it} denotes the number of newly registered women-owned agricultural holdings in municipality i and year t, and μ_{it} denotes the

expected number of registrations. α_i represents municipality fixed effects, while λ_t denotes year fixed effects, with 2015 used as the omitted reference year. $Grants^{c}_{i,t-1}$ denotes centered lagged grants allocated to women through the agricultural payment agency, expressed in units of 100,000 BAM. D_{kit} represents dummy variables for municipal development categories $k = 1,2,3$, with Category IV, developed municipalities, used as the reference category. The interaction term $Grants_{i,t-1}\ x\ D_{kit}$ allows the grant effect to differ across development categories. X_{it} is a vector of control variables, including female unemployment, average wage, kindergarten attendance rate, road length, and the combined education cycle variable. The estimated female population is included as an exposure term. In the Poisson model, this means that $\ln(FemalePop_{it})$ enters the specification as an offset with its coefficient constrained to one. This adjustment accounts for differences in the size of the population at risk across municipalities. Consequently, the model estimates the rate of newly registered women-owned agricultural holdings relative to the estimated female population, rather than only the absolute number of registrations. The coefficients should therefore be interpreted as effects on the expected registration rate, holding the population exposure constant.

Potential overdispersion and excess zeros were assessed as part of the count-data model selection. The descriptive statistics reported in Table 1 indicate that, in the broader available sample, the standard deviation of the dependent variable exceeds its mean, suggesting possible overdispersion under the strict Poisson variance assumption. Therefore, the share of zero outcomes was calculated in the final estimation sample, and overdispersion was evaluated using a Pearson goodness-of-fit diagnostic from an auxiliary Poisson model with municipality and year indicators. Alternative count-data specifications were also considered. Since zero outcomes were rare, a zero-inflated specification was not retained as the main alternative model. Given the possibility of overdispersion, the preferred conditional fixed-effects Poisson model is estimated with municipality-clustered robust standard errors, and a negative binomial model is estimated as an additional robustness check. To make this robustness check comparable to the preferred model, the negative binomial specification is estimated on the same estimation sample and includes municipality and year indicator variables, with the estimated female population included as an exposure term.

Data were compiled from several official sources. Information on women-owned agricultural holdings and grants allocated to women was obtained directly, upon request, from the Agency for Agrarian Payments of the Republic of Srpska. The remaining variables were collected from official municipal statistical bulletins and related publications. The municipal development category was based on annual decisions on the level of development of local self-government units in the Republic of Srpska. These were published in the Official Gazette of the Republic of Srpska for 2015-2024 (see References for the full list of decisions). For each estimation year, the official development classification referring to that year was used. These decisions are typically published in the Official Gazette in the preceding calendar year.

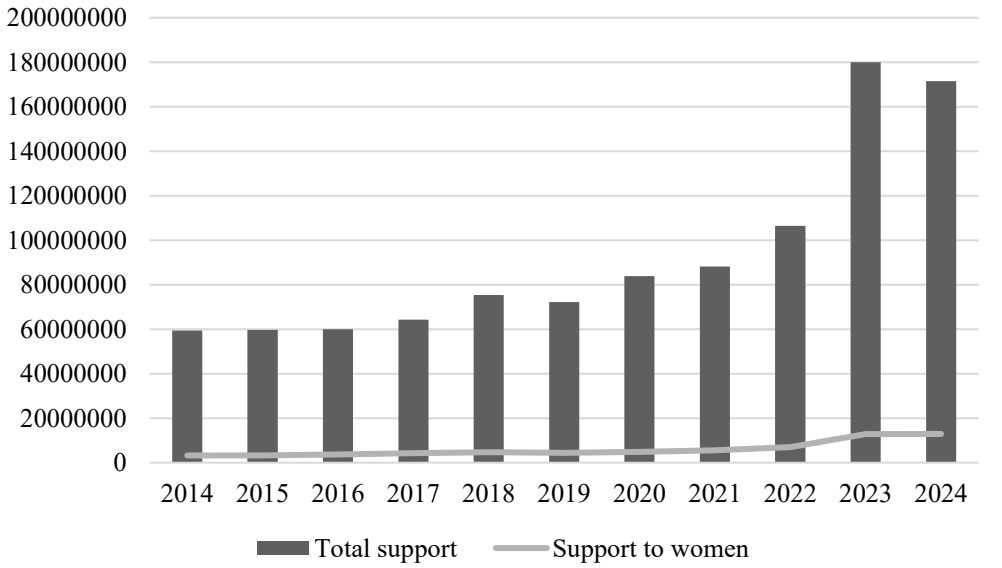
The dependent variable is the number of newly registered women-owned agricultural holdings. The main explanatory variable is centered lagged grants allocated to women through the agricultural payment agency, expressed in units of 100,000 BAM. The lagged specification is used because support approved or allocated in one year is expected to influence registration and investment decisions in the following year. The grant variable is interacted with the municipality development category, coded as 1 = highly underdeveloped, 2 = underdeveloped, 3 = medium-developed, and 4 = developed municipalities, with developed municipalities used as the reference category. Female unemployment and average net wage are included in logarithmic form. A robustness specification replaces average net wage with average gross wage, also in logarithmic form. The model also controls for the lagged kindergarten attendance rate, measured as the share of children enrolled in kindergartens in the total municipal population, road length, and the education variable, defined as the sum of first-, second-, and third-cycle female students per 1,000 estimated female population. In an additional robustness specification, the aggregate support variable is replaced with lagged support to current production for women, expressed in units of 100,000 BAM. As explained above, the estimated female population is included as an exposure term, so the estimated coefficients refer to registration rates relative to the female population rather than to absolute counts only. A negative binomial specification is also estimated as an additional robustness check for overdispersion and is reported in Appendix Table A2.

Results and Discussion

This section presents the study's main empirical results. First, it reports descriptive statistics, preliminary count-data diagnostics, and correlation coefficients for the main variables. Next, it discusses conditional fixed-effects Poisson estimates and the negative binomial robustness check. Because the model includes interaction terms, category-specific effects are reported to illustrate how grant impacts differ across municipal development categories.

Before discussing municipality-level statistics and econometric results, it is useful to briefly present broader trends in the support allocated by agricultural payment agencies to women. Figures 1 and 2 show the evolution of both the absolute support received by women and their share of total agency support over the observed period.

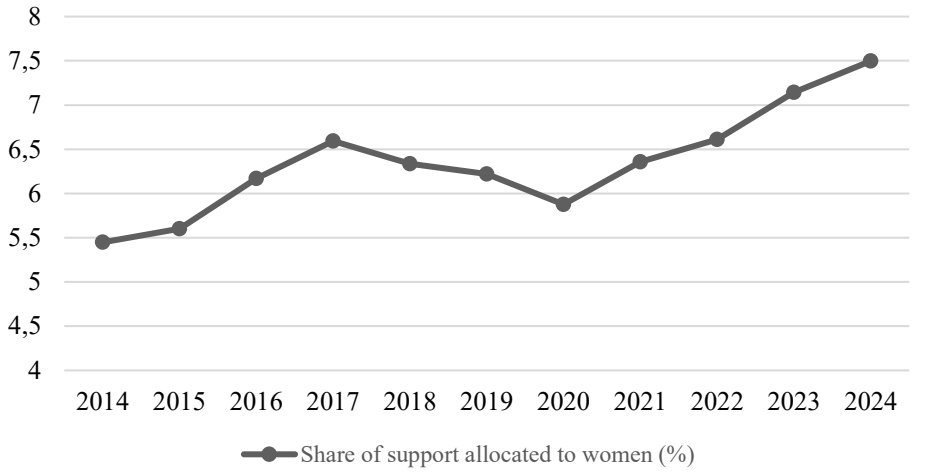
Figure 1: Total agricultural payment agency support and support allocated to women, 2014-2024



Note: Monetary values are expressed in BAM.

Source: Author's calculation

Figure 2: Women's share in total agricultural payment agency support, 2014-2024



Source: Author's calculation

Overall, the figures suggest that both the absolute amount of support allocated to women and their share in total agricultural payment agency support increased over time, despite some fluctuations across years. These aggregate trends provide useful descriptive background for the analysis, but they do not reveal how support is related to the number of women-owned agricultural entities across municipalities. To address this gap, Table 1 presents descriptive statistics for the variables used in the subsequent empirical analysis, including the number of women-owned entities.

Table 1: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Women-owned agricultural entities	945	8.044	17.972	0	394
Grants allocated to women through the agricultural payment agency	658	-.095	1.787	-1.113	18.737
Municipal development category	939	2.444	1.182	1	4
Female unemployment	733	6.286	1.013	3.610	9.123

Variable	Obs	Mean	Std. Dev.	Min	Max
Average net wage	879	6.798	.259	6.001	7.559
Average gross wage	876	7.250	.247	6.467	8.007
Kindergarten attendance rate	614	.924	.504	.135	2.959
Road length	816	158.840	90.267	5	376
Combined education cycle	629	27.287	32.625	0	480
Estimated female population	880	9303.723	14546.03	19	96925
Support to current production for women	652	.805	1.310	.0004	13.578

Notes: Monetary support variables used in the regression are expressed in units of 100,000 BAM. The main grant variable is centered before estimation.

Source: Author's calculation

The dependent variable has a standard deviation substantially above its mean, suggesting that overdispersion may be present. This issue was therefore examined more formally in the final estimation sample. Only 10 out of 434 observations have a zero value for the dependent variable, corresponding to 2.30% of the sample. Thus, excess zeros do not dominate the data. The Pearson goodness-of-fit diagnostic from an auxiliary Poisson model with municipality and year indicators produced a Pearson chi-square statistic of 745.95 with 366 degrees of freedom, corresponding to a dispersion ratio of approximately 2.04. This indicates overdispersion relative to the strict Poisson variance assumption and motivates the use of municipality-clustered robust standard errors and a negative binomial robustness check.

Table 2 reports the pairwise correlation matrix, which offers a preliminary indication of the direction and strength of associations among the variables included in the analysis before turning to the multivariate panel estimates.

Table 2: Correlation matrix of the main variables used in the analysis

Variables	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1. Women-owned agricultural holdings	1.000							
2. Grants allocated to women through the agricultural payment agency	0.568*	1.000						
3. Municipal development category	0.319*	0.335*	1.000					
4. Female unemployment	0.552*	0.318*	0.481*	1.000				
5. Average net wage	0.023	0.253*	0.131*	-0.131*	1.000			
6. Kindergarten attendance rate	0.130*	0.237*	0.297*	-0.055	0.481*	1.000		
7. Road length	0.267*	0.243*	0.096*	0.258*	0.056	0.017	1.000	
8. Combined education cycle rate	0.137*	-0.059	0.280*	0.270*	-0.109*	0.386*	0.082	1.000

Source: Author's calculation

The pairwise correlation matrix does not indicate serious multicollinearity, as the correlations among the explanatory variables are generally low to moderate and remain well below commonly used critical thresholds. This is further supported by the reported VIF values.

Table 3: Poisson panel estimates of women-owned agricultural holdings

Variables	**Model 1: Main specification**	**Model 2: Robustness check**	**Model 3: Robustness check**
Grants allocated to women through the agricultural payment agency	**-.046 *** (.013)**	**-.046*** (.013)**	
Support to current production for women			**-.054*** (.015)**
Municipal development category			
I	**-.524** (.264)**	**-.526** (.264)**	**-1.446*** (.303)**
II	**-.620 *** (.226)**	**-.625*** (.224)**	**-.969*** (.275)**
III	-.212 (.218)	-.217 (.216)	-.353 (.290)
Interaction between municipal development category and the respective support measure			
I	**.679*** (.124)**	**.679*** (.121)**	**1.242*** (.214)**
II	**.353***	**.353***	**.499***

Variables	Model 1: Main specification	Model 2: Robustness check	Model 3: Robustness check
	(.103)	**(.103)**	**(.120)**
III	.038	.037	.108
	(.040)	(.040)	(.072)
Female unemployment	**-.330***	**-.329***	**-.301***
	(.183)	**(.180)**	**(.175)**
Average net wage	-.603		-.247
	(.982)		(.932)
Average gross wage		-.656	
		(.964)	
Kindergarten attendance rate	.131	.131	.085
	(.168)	(.169)	(.174)
Road length	-.0005	-.0005	-.0003
	(.001)	(.001)	(.001)
Combined education cycle	.002	.002	.001
	(.013)	(.013)	(.013)
Exposure	Estimated female population	Estimated female population	Estimated female population
2016	-.120	-.122	-.122
	(.085)	(.086)	(.085)
2017	**-.290****	**-.294****	**-.283****
	(.121)	**(.120)**	**(.123)**
2018	**-.245***	**-.256***	**-.245***
	(.143)	**(.143)**	**(.147)**
2019	**-.693*****	**-.714*****	**-.718*****
	(.183)	**(.178)**	**(.184)**
2020	**-.569*****	**-.587*****	**-.607****
	(.188)	**(.171)**	**(.186)**
2021	**-.430****	**-.451****	**-.498****
	(.203)	**(.181)**	**(.199)**
2022	-.219	-.246	-.346
	(.319)	(.271)	(.305)
2023	-.153	-.171	-.292
	(.412)	(.361)	(.391)
2024	-.143	-.150	-.360
	(.527)	(.477)	(.489)
Number of observations:	434	434	431
Model significance:			
.	Wald $\chi^2(21)$ = 6524.90 Prob >χ^2 = 0.000	Wald $\chi^2(21)$ = 4933.91 Prob >χ^2 = 0.000	Wald $\chi^2(21)$ = 37257.39 Prob >χ^2 = 0.000
VIF:	2.87	2.70	2.60
Joint significance of time effects:			
	Wald $\chi^2(9)$ = 42.88, $p < 0.001$	Wald $\chi^2(9)$ = 42.20, $p < 0.001$	Wald $\chi^2(9)$ = 41.72, $p < 0.001$

*Notes: Robust standard errors are reported in parentheses. Category IV (developed municipalities) is the reference category. Year fixed effects are included in all specifications, with 2015 as the omitted reference year. The joint significance of year effects is tested using the Wald chi-square test. * p < 0.10, ** p < 0.05, *** p < 0.01.*
Source: Author's calculation

Table 3 reports the results of the conditional fixed-effects Poisson models for newly registered women-owned agricultural holdings. Most notably, the effect of grants allocated to women through the agricultural payment agency varies substantially across municipal development categories. This supports H1, indicating that the municipality's level of development shapes the effect of grants to women. Furthermore, the interaction terms in Models 1 and 2 indicate that the impact of lagged grants is significantly stronger in highly underdeveloped and underdeveloped municipalities than in developed municipalities. No significant difference emerges for medium-developed municipalities. Importantly, Model 3 reinforces these results: even when the aggregate support measure is replaced by lagged support to current production for women, the baseline negative effect in developed municipalities and the statistically significant positive interaction effects in highly underdeveloped and underdeveloped municipalities persist. The same grant-related pattern is also supported by the negative binomial robustness check reported in Appendix Table A2. The negative baseline coefficient in developed municipalities deserves particular attention because it refers to the reference category in the interaction framework. It should not be read as evidence that grants are generally harmful. Rather, it suggests that, in more developed local contexts, additional support may not translate into higher registration rates, possibly because a larger share of potential beneficiaries is already formally registered or able to register without additional support. This robustness to an alternative support measure and to an alternative count-data specification underlines the reliability of the main results.

The findings are consistent with Hechavarría and Ingram (2019), who show that women's entrepreneurship is shaped by entrepreneurial ecosystem conditions, including supportive government policy and barriers to entry. However, this study shifts the analysis to the municipal level and shows that the effectiveness of public support depends on local development conditions. The results also extend Srhoj et al. (2022), who find that grants targeted to women entrepreneurs improve several business outcomes, by showing that grant effects are not uniform across local contexts. Similarly, Martínez-Rodríguez et al. (2022) emphasize policy measures related to training and mentoring, access to finance, networks, entrepreneurship education, and reconciliation between business and family life, while the present study shows that such support may be most effective where local constraints are more binding. This interpretation is also consistent with Li et al. (2026), who show that rural entrepreneurial ecosystems are

heterogeneous and that financial services, infrastructure quality, childcare availability, and social capital may matter differently across rural places.

Across all three preferred specifications, female unemployment shows a negative and statistically significant effect, indicating that less favorable local labor-market conditions are associated with lower rates of newly registered women-owned agricultural holdings. This result supports H3 in the main Poisson specifications. However, this finding is less robust than the grant-related results, since female unemployment remains negative but is no longer statistically significant in the negative binomial robustness check. The finding aligns with Mirza (2024), Hechavarría and Ingram (2019), Gaies et al. (2023), and Noguera et al. (2015), who also report a negative and statistically significant unemployment effect in at least one specification. However, the broader literature remains mixed, with some studies identifying positive effects. This suggests that the unemployment effect should be interpreted in light of local labor-market conditions, rather than as a uniform relationship across settings. Conversely, the coefficients on the wage variables and remaining controls remain insignificant and lack robust individual effects. Overall, the model is statistically significant, as indicated by the Wald chi-square test, and the year effects are jointly significant, underscoring the role of time-specific shocks. Throughout, VIF values are low and well below commonly used cutoffs, including when the estimated female population is part of the collinearity check, confirming that multicollinearity is not a concern.

Given the evidence of overdispersion, the strict Poisson variance assumption may be restrictive. Therefore, a negative binomial specification was estimated as an additional robustness check. To ensure comparability with the preferred conditional fixed-effects Poisson model, the negative binomial specification was estimated on the same estimation sample, with municipality and year indicators and estimated female population as an exposure term. The results support the main grant-related pattern: the grant coefficient remains negative for developed municipalities, the interaction terms for highly underdeveloped and underdeveloped municipalities remain positive and statistically significant, and the interaction term for medium-developed municipalities remains statistically insignificant. This suggests that the main grant-related conclusion is not driven by the strict Poisson variance assumption. Female unemployment remains negative but is no longer statistically significant, indicating that this result is less stable than the grant-related findings.

Since the preferred Poisson model includes interaction terms, the category-specific grant effects are reported in Table 4 to illustrate how the effect of support differs across municipal development categories.

Table 4: Category-specific log-rate effects of lagged grants across municipal development categories (Model 1)

Municipal development category	Marginal effect of lagged grants allocated to women through the agricultural payment agency	Robust SE	Z	p-value
Category I	0.6326***	0.1311	4.83	0.000
Category II	0.3066***	0.1045	2.93	0.003
Category III	-0.0085	0.0480	-0.18	0.860
Category IV	-0.0466***	0.0136	-3.42	0.001

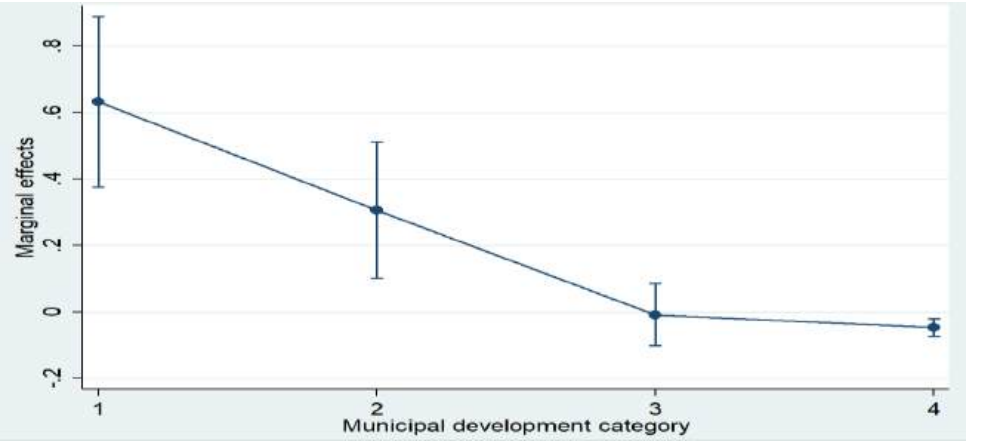
Source: Author's calculation

Table 4 presents the category-specific grant effects of lagged grants across municipal development categories. The results show that grants have the strongest positive effect in highly underdeveloped municipalities, followed by underdeveloped municipalities, while no statistically significant effect is found in medium-developed municipalities. The negative marginal effect in developed municipalities is consistent with the baseline coefficient discussed above. This pattern suggests that grants are most effective where public support relaxes stronger entry constraints, such as weaker access to finance, services, infrastructure, and institutional support. The insignificant effect in medium-developed municipalities may reflect their intermediate position: constraints are less severe than in highly underdeveloped areas, but local market and institutional capacity may still be insufficient to convert support into new registrations. Overall, these findings support hypothesis 2, which posits that agricultural payment agency grants for women have stronger positive effects in highly underdeveloped municipalities. However, some registrations may reflect the formalization of existing agricultural activities rather than entirely new ventures, so the results should be interpreted as evidence on formal entry into registered agricultural activity.

To facilitate interpretation, Figure 3 presents the graphical representation of the marginal effects reported in Table 4. The figure clearly illustrates that the effect of lagged grants is strongest and positive in highly underdeveloped municipalities, weaker but still positive in underdeveloped

municipalities, statistically insignificant in medium-developed municipalities, and negative in developed municipalities.

Figure 3: Category-specific grant effects across municipal development categories (Model 1)



Source: Author's calculation

The graphical pattern confirms the results from Table 4. It reinforces the conclusion that grant support is more effective in less developed municipalities. This finding provides additional support for H2. It also suggests that the local development context plays an important role in shaping the effectiveness of financial support for women's agricultural entrepreneurship.

Conclusion

This study examined the determinants of the establishment of women-owned agricultural entities in the Republic of Srpska using municipal panel data and Poisson panel-data models. The results show that the effect of agricultural payment agency grants for women depends on the local development context. More specifically, the impact of lagged grants is significantly stronger in highly underdeveloped and underdeveloped municipalities than in developed municipalities, whereas no significant effect is observed in medium-developed municipalities. Female unemployment is negatively associated with the rate of newly registered women-owned agricultural holdings in the preferred Poisson specifications,

indicating that less favorable labor-market conditions may represent an important barrier to women's entrepreneurial entry into agriculture. Overall, the findings confirm that both public support and local structural conditions matter for the establishment of women-owned agricultural entities. At the same time, the broader descriptive evidence shows that the share of total agricultural payment agency support allocated to women increased from 5.45% in 2014 to 7.50% in 2024, suggesting gradual improvement but also indicating that support directed to women still represents a relatively modest share of total agricultural support.

Despite these contributions, the study has several limitations. First, it examines only one institutional setting, which limits generalizability. Second, it focuses on establishing women-owned agricultural entities rather than on their survival or growth. Third, municipal data omit individual and household characteristics influencing women's entrepreneurial entry. Future research could examine other countries or regions to assess comparative policy and institutional contexts. It could also analyze post-entry outcomes and integrate municipal data with micro- or qualitative-level evidence. The study offers theoretical and practical insights, supporting the view that women's entrepreneurship in agriculture depends on institutional measures and local structural conditions. Practically, findings suggest that policies should be more place-sensitive, with greater emphasis on less developed municipalities where support is most effective. Agricultural payment agencies and local policymakers should supplement uniform financial support with targeted interventions, such as removing barriers to training, improving access to networks and resources, and addressing local labor-market and development constraints.

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Appendix

Table A1: Municipalities in the Broader Dataset and Final Fixed-Effects Poisson Estimation Sample

	Municipality / City				
1	City of Banja Luka	22	Kalinovik*	43	Petrovo
2	Berkovići	23	Kneževo	44	City of Prijedor
3	City of Bijeljina	24	Kozarska Dubica	45	Prnjavor
4	Bileća	25	Kostajnica	46	Ribnik
5	Bratunac	26	Kotor Varoš	47	Rogatica
6	Brod	27	Krupa na Uni*	48	Rudo
7	Višegrad	28	Kupres*	49	Sokolac
8	Vlasenica	29	Laktaši	50	Srbac
9	Vukosavlje*	30	Lopare	51	Srebrenica
10	Gacko	31	Ljubinje	52	Teslić
11	City of Gradiška	32	Milići	53	City of Trebinje
12	Derventa	33	Modriča	54	Trnovo*
13	City of Doboj	34	Mrkonjić Grad	55	Ugljevik
14	Donji Žabar*	35	Nevesinje	56	Foča
15	Zvornik	36	Novi Grad	57	Han Pijesak*
16	Istočna Ilidža	37	Novo Goražde*	58	Čajniče
17	Istočni Drvar*	38	Osmaci*	59	Čelinac
18	Istočni Mostar*	39	Oštra Luka*	60	Šamac
19	Istočni Stari Grad*	40	Pale	61	Šekovići
20	Istočno Novo Sarajevo	41	Pelagićevo*	62	Šipovo
21	Jezero*	42	Petrovac*	63	Stanari

Notes: Municipalities marked with an asterisk (*) are not included in the final conditional fixed-effects Poisson estimation sample.

Source: Author's compilation based on the study sample.

Table A2: Negative binomial robustness check of women-owned agricultural holdings

Variables	**Negative binomial robustness check**	**Year indicators**	**Negative binomial robustness check**
Grants allocated to women through the agricultural payment agency	-.050***(.018)	**2016**	-.098(.099)
Municipal development category		**2017**	-.323**(.131)
I	-.504*(.290)	**2018**	-.280*(.146)
II	-.590**(.246)	**2019**	-.725***(.175)
III	-.214(.235)	**2020**	-.645***(.185)
Interaction between municipal development category and grants allocated to women through the agricultural payment agency		**2021**	-.464**(.216)
I	.692***(.147)	**2022**	-.288(.339)
II	.355***(.127)	**2023**	-.261(.434)
III	.038(.045)	**2024**	-.281(.560)
Female unemployment	-.322(.216)	**Exposure**	Estimated female population
Average net wage	-.288(1.115)	Municipality indicators	Yes
Kindergarten attendance rate	.142(.179)	Year indicators	Yes
Road length	-.0008(.0015)	Number of clusters	47
Combined education cycle	.003(.015)	Log pseudolikelihood	-1133.19
Number of observations	434	Pseudo R^2	0.1837
Alpha	.0718		

*Notes: Municipality-clustered robust standard errors are reported in parentheses. Category IV, developed municipalities, is the reference category. Municipality and year indicator variables are included in the specification, with 2015 as the omitted reference year. Estimated female population is used as an exposure term. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.*

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ORIGINAL SCIENTIFIC PAPER

A Gender Analysis of Entrepreneurial Intention Among Postgraduate Students in Ecuador



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A B S T R A C T

This study aims to analyze the determinants of entrepreneurial intention among postgraduate students through a gender-comparative approach. The sample consists of 457 students from three Ecuadorian universities (244 women and 213 men). A quantitative methodology was adopted, employing covariance-based structural equation modeling (CB-SEM). The findings indicate that personal attitude exerts a stronger influence on women's entrepreneurial intention, whereas perceived behavioral control shows a greater effect among men. Additionally, the influence of entrepreneurial knowledge on both personal attitude and perceived behavioral control, as well as the effect of perceived access to finance on entrepreneurial intention, does not differ significantly between female and male students. These results provide empirical evidence on gender dynamics in the

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formation of entrepreneurial intention and highlight the importance of incorporating a gender perspective into the design of university entrepreneurship education and promotion programs.

KEYWORDS: *entrepreneurial intention, entrepreneurial knowledge, postgraduate education, gender*

Introduction

Over recent decades, entrepreneurship has consolidated itself as a field of growing academic interest and as a fundamental driver of socioeconomic development, particularly in emerging economies (Iddris et al., 2022). In Ecuador, this activity has gained strategic relevance as a mechanism for diversifying the productive structure and promoting social inclusion (Lasio et al., 2024). In a context characterized by limited availability of formal employment, a significant proportion of the population turns to entrepreneurship both as a pathway for innovation and as a strategy for income generation (Amaya et al., 2023). As a reflection of this dynamic, in 2025 Ecuador ranked as the country with the highest level of entrepreneurial activity in the region, recording a Total Early-Stage Entrepreneurial Activity (TEA) rate of 29.6% (GEM, 2026), indicating a highly entrepreneurial environment.

From a conceptual perspective, the entrepreneurial process encompasses multiple stages, ranging from the potential phase to business discontinuation (Lasio et al., 2024). Within this cycle, intention represents the strongest predictor of behavior (Fishbein & Ajzen, 1975). This decision is shaped by individual factors as well as environmental conditions (Shirokova et al., 2016). Consequently, intention emerges as a multidimensional construct in which endogenous and exogenous factors converge (Ajzen, 1991).

Gender analysis in the formation of intentions has become a research priority. Academic and governmental institutions seek to identify the drivers underlying this stage, given that intention explains differences in entrepreneurial propensity across social groups (Verheul et al., 2012). Particularly in Ecuador, higher education institutions have undertaken various efforts to understand students' entrepreneurial intention (Astudillo et al., 2024). Nevertheless, research focused specifically on the postgraduate level remains limited (Murudumbay et al., 2025).

In 2025, Ecuador reported a higher rate of female than male participation in early-stage entrepreneurial activity (GEM, 2026), raising important questions about how sociocultural and structural factors differentially shape entrepreneurial intention across genders. Addressing this issue among postgraduate students is particularly relevant, as they represent a theoretically significant group of population for analyzing entrepreneurial intention. Unlike undergraduate students, their intentions are formed under conditions that more closely reflect labor market realities, are subject to more clearly defined professional constraints, and typically involve greater work experience (Malebana & Mahlaole, 2023). These characteristics may alter the relative importance of the determinants of entrepreneurial intention, potentially leading to variations in the mechanisms proposed by the Theory of Planned Behavior (Ajzen, 1991).

Furthermore, from the perspective of Human Capital Theory, postgraduate students possess a higher level of accumulated knowledge, skills, and competencies acquired through advanced education, which enhances their ability to identify opportunities and develop successful business initiatives (Becker, 1964). In this sense, this group is not only theoretically relevant but also constitutes a potential driver of innovation and local economic development (Iddris et al., 2022).

Within this framework, the present study aims to analyze the determinants of entrepreneurial intention among postgraduate students and to conduct a comparative gender analysis. By doing so, it seeks to offer relevant evidence for the formulation of academic policies and strategies that foster high-impact entrepreneurship.

Theoretical Framework and Conceptual Development

Foundational Theory of Entrepreneurial Intention

The Theory of Planned Behavior (TPB) developed by Ajzen (1991) posits that a close relationship exists between the intention to perform a specific behavior and its actual execution. According to TPB, intentions are predicted by personal attitude (PA), subjective norms (SN), and perceived behavioral control (PBC).

Perceived behavioral control refers to an individual's perception of the ease or difficulty associated with performing a particular action. This concept is closely related to self-efficacy and perceived feasibility, as both

reflect an individual's judgment regarding their own capability to carry out a specific behavior (Krueger et al., 2000). In contrast, personal attitude represents the degree to which an individual holds a favorable or unfavorable evaluation of becoming an entrepreneur, encompassing both affective and evaluative dimensions (Ajzen, 1991; Liñán & Chen, 2009). Subjective norms, meanwhile, refer to perceived social pressure to engage or not engage in entrepreneurial behaviors, based on the approval or disapproval expressed by relevant reference groups (Ajzen, 1991, 2002).

The TPB has been widely applied in the study of entrepreneurial intention (EI), providing empirical evidence supporting the positive and significant influence of personal attitude and perceived behavioral control on the intention to start a business (Liñán et al., 2011; Padilla-Angulo, 2019). For example, the study by Drakpa et al. (2022) found that, among the three dimensions of the TPB, perceived behavioral control has the strongest influence on the entrepreneurial intentions of female business students in Bhutan. Similarly, Manjaly et al. (2022) demonstrated that individuals' favorable evaluations of their capacity for self-employment positively influence their intention to engage in entrepreneurial activities.

Although some studies have identified a positive and significant relationship between subjective norms and entrepreneurial intention (Carr & Sequeira, 2007; Galleguillos-Cortés et al., 2019), other research has failed to find statistically significant evidence supporting this association (Krueger et al., 2000; Liñán et al., 2011), leading certain authors to exclude this factor from their analytical models (Fitzsimmons & Douglas, 2011).

In line with this debate, the present study incorporates the social dimension through control variables that capture more structural forms of environmental influence. Prior literature has confirmed the positive influence of work experience (WE) and the presence of entrepreneurial family members (EFM) on entrepreneurial intention (Laguía et al., 2017). In particular, having relatives who own businesses facilitates access to social capital, professional networks, and opportunity recognition (Fragoso et al., 2020). Likewise, participation in associations (ASO) or close networks expands access to mentoring, support, and social legitimacy, elements that may foster entrepreneurial intention (Hindle et al., 2009).

The Role of Entrepreneurial Knowledge in Entrepreneurial Intention

Entrepreneurial knowledge (EK) constitutes a particularly relevant element in fostering entrepreneurial intention (Liñán & Chen, 2009). From

the perspective of Human Capital Theory (Becker, 1964), investment in education, experience, and skills enhances an individual's productivity and decision-making capacity. This accumulated capital contributes to more realistic perceptions of entrepreneurship, which in turn influence personal attitude, perceived behavioral control, and the intention to engage in entrepreneurial activities (Ajzen, 2002; Liñán & Chen, 2009).

Consistent with this perspective, several studies conducted in university contexts have demonstrated that entrepreneurship education exerts both direct and indirect effects on entrepreneurial intention (Aragón-Sánchez et al., 2017; Nowiński et al., 2019). In particular, the perception of a supportive educational environment, institutional support, and the acquisition of the knowledge required for venture creation are associated with a greater propensity to pursue entrepreneurial activities (Nguyen, 2020). Likewise, Karunambika and Arthi (2025) point out that incubator activities implemented by higher education institutions have a positive influence on entrepreneurial intention. However, Montes et al. (2023) find that entrepreneurship education does not maintain a direct and statistically significant relationship with the intention to start a business.

Perceived Access to Finance and Entrepreneurial Intention

The availability of financial resources is essential for business creation (Mohamad et al., 2015). Within the context of this study, perceived access to finance (PAF) refers to postgraduate students' perceptions regarding their ability to obtain or secure the financial resources required to engage in entrepreneurial activity.

According to Urban and Ratsimanetrimanana (2019), the capital needed to start a business may originate from personal savings, loans from family members or friends, formal credit institutions, or external investors. However, limited access to these funding sources constrains innovative initiatives and restricts students' entrepreneurial potential (Svotwa et al., 2022). In this regard, Nguyen (2020) argues that even when an individual possesses a strong entrepreneurial intention, the absence of sufficient financial resources may prevent the realization of entrepreneurial initiatives. Similarly, several studies have demonstrated that perceived access to finance exerts a positive and statistically significant effect on entrepreneurial intentions (Gentry & Hubbard, 2000; Peter et al., 2024).

Based on these theoretical and empirical foundations, the following relational hypotheses are proposed:

H1: PA, PBC, EK, and PAF exert a positive and significant influence on EI.

H2: EK exerts positive and significant influence on PA and PBC.

H3: PA and PBC significantly mediate the relationship between EK and EI.

H4: EFM, WE, and ASO exert a positive and significant influence on EI.

Entrepreneurial Intention and Gender

To understand how social constructions influence entrepreneurial intention, this study draws on two foundational gender theories. First, Social Role Theory, proposed by Eagly and Wood (1991), argues that the traditional division of labor assigns communal attributes to women, associated with caregiving and cooperation, while men are attributed agentic traits linked to authority and achievement.

Building on this perspective, Role Congruity Theory (Eagly & Karau, 2002) explains that prejudice emerges when the female gender role conflicts with the entrepreneurial role, which has historically been perceived as masculine. This perceived incongruity generates both external and internal barriers, including lower self-confidence and perceived competence (Barnir et al., 2011). Within this framework, the perception persists that entrepreneurship is a more suitable activity for men, who are socially viewed as more likely to engage in entrepreneurial initiatives and as possessing characteristics considered essential for entrepreneurial success (Shirokova et al., 2016).

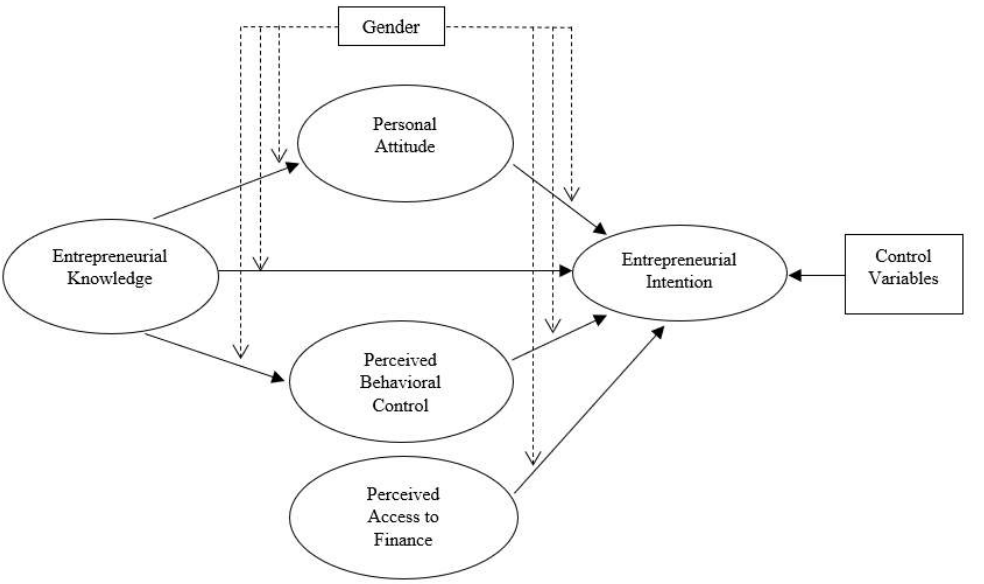
The relationship between gender and entrepreneurial intention shows heterogeneous results in the literature. Some studies report significant differences between men and women (Gomes et al., 2021; Zhao et al., 2005), whereas others find no statistically meaningful differences (Gupta et al., 2009; Santos et al., 2016). Consequently, the role of gender in entrepreneurship remains an unresolved area of academic debate. A meta-analysis conducted by Haus et al. (2013) indicates that men display, on average, higher levels of entrepreneurial intention than women; however, this difference is relatively weak and does not independently explain gender gaps in entrepreneurial participation. Similarly, Santos et al. (2016) report

that the effects of personal attitude and perceived behavioral control on entrepreneurial intention do not significantly differ by gender.

Conversely, Gomes et al. (2021) find that although personal attitude positively influences entrepreneurial intention for both men and women, its effect is weaker among women, whereas perceived behavioral control shows a stronger impact for female participants. In contrast, da Costa et al. (2023) report opposite findings, indicating that the effect of perceived behavioral control on entrepreneurial intention is significantly stronger among men. In the context of an emerging economy, Sam et al. (2025) find that personal attitude, perceived behavioral control, and access to capital exert a stronger influence among women.

More recent research has expanded gender-based analyses of entrepreneurial intention by incorporating additional constructs (Efendi et al., 2024; Sam et al., 2025). In educational contexts, Barron et al. (2022) found that gender does not moderate the effect of entrepreneurial knowledge on the entrepreneurial intention of academics in Mexico. Other studies suggest that entrepreneurship education reduces gender differences in personal attitude and perceived behavioral control, indicating a narrowing of gender gaps in key predictors of entrepreneurial intention (Lo et al., 2012).

Figure 1: Theoretical model



Source: Authors

Regarding perceived access to finance, the literature documents relevant gender inequalities associated with persistent stereotypes and discriminatory practices within financial systems, which may constrain female entrepreneurship (Zogning, 2023). Nevertheless, some studies nuance this evidence, suggesting that access to capital may exert an even stronger influence on women's entrepreneurial intention (Sam et al., 2025) and that, once the decision to start a business has been made or the firm has been established, women do not face greater financial barriers than men in obtaining resources (Bruhn, 2009).

Based on gender theory and existing empirical evidence, the following gender-related hypotheses are proposed. Figure 1 presents the conceptual model.

H5: Gender moderates the influence of PA, PBC, EK, and PAF on EI.

H6: Gender moderates the influence of EK on PA and PBC.

Research Methodology and Data

Sample and Procedure

This study adopted a quantitative approach using a cross-sectional design aimed at analyzing the relationships proposed in the research hypotheses. The study participants consisted of students enrolled in different postgraduate programs at 3 universities located in the city of Cuenca, Ecuador, selected through a stratified sampling procedure. Data collection was conducted in March 2025 through a structured survey administered anonymously and with prior informed consent from all participants. The sample comprised 457 students, of whom 244 were women and 213 were men. The average age of participants was 33 years. Approximately 66% of respondents were enrolled in private universities, while the remaining 33% attended a public higher education institution.

Measurement

The five constructs were measured using five-point Likert-scale items (1 = "strongly disagree"; 5 = "strongly agree"). Table 1 summarizes the bibliographic sources from which the measurement scales were obtained; some of these scales were adapted to the context of the present research.

Table 1: Scales employed

Construct	Sources	Items
Entrepreneurial Intention (EI)	Liñán and Chen (2009)	6
Personal Attitude (PA)	Liñán and Chen (2009)	5
Perceived Behavioral Control (PBC)	Liñán and Chen (2009)	6
Entrepreneurial Knowledge (EK)	Aragón-Sánchez et al. (2017)	4
Perceived Access to Finance (PAF)	Aragón-Sánchez et al. (2017)	4

Source: Authors

The moderating variable, gender, was coded as a dichotomous variable (0 = female; 1 = male). Additionally, the following control variables were included: work experience (WE) (0 = no professional experience; 1 = professional experience), entrepreneurial family members (EFM) (0 = no; 1 = yes), and association membership (ASO) (0 = no; 1 = yes), referring to participation in associations, groups, or professional networks.

Data Analysis

Data analysis was conducted using covariance-based structural equation modeling (CB-SEM) with Maximum Likelihood estimation, given the confirmatory nature of the study and the existence of a previously established theoretical framework (Kline, 2016; Hair et al., 2019). First, the measurement model was assessed by examining the reliability and validity of the indicators. Subsequently, the structural model was estimated, and the coefficients corresponding to the hypothesized relationships were evaluated. Parameter significance was estimated using bootstrapping with 5,000 resamples. Finally, the moderating effect of gender was analyzed through a multi-group analysis. All analyses were performed using AMOS 31.

Results

Measurement Model Evaluation

The validity and reliability of the constructs were assessed through Confirmatory Factor Analysis (CFA). Following the initial evaluation, two indicators from the perceived behavioral control (PBC) scale were removed due to factor loadings below the recommended threshold of 0.70 (Hair et al., 2019). The results obtained after item elimination are presented in Table 2.

Internal consistency was evaluated using Cronbach's alpha (α) and composite reliability (CR), both of which exceeded the recommended value of 0.70 across all constructs, indicating adequate levels of reliability. Furthermore, average variance extracted (AVE) values above 0.50, together with significant standardized factor loadings greater than 0.70, support the convergent validity of the measurement model (Hair et al., 2019).

Discriminant validity was assessed using the Fornell and Larcker (1981) criterion and the heterotrait–monotrait ratio (HTMT) proposed by Henseler et al. (2015). As shown in Table 3, the square root of the average variance extracted (AVE) (values on the diagonal) exceeds the inter-construct correlations (values below the diagonal), and the HTMT values (reported above the diagonal) are below the recommended threshold of 0.85 (Henseler et al., 2015), thereby confirming the discriminant validity of the measurement model. Model fit indices indicate CFI (0.961) and TLI (0.955) values above the recommended threshold of 0.95, together with an RMSEA value of 0.062. These results fall within the acceptable ranges suggested in the literature (Kline, 2016), demonstrating an adequate fit of the measurement model.

Table 2: Reliability of internal consistency and convergent validity

Construct	$\boldsymbol{\alpha}$	**CR**	**AVE**
Entrepreneurial Intention (EI)	0.960	0.961	0.806
Personal Attitude (PA)	0.939	0.941	0.762
Perceived Behavioral Control (PBC)	0.889	0.889	0.667
Entrepreneurial Knowledge (EK)	0.925	0.927	0.761
Perceived Access to Finance (PAF)	0.857	0.859	0.606

Source: Authors

Table 3: Discriminant validity

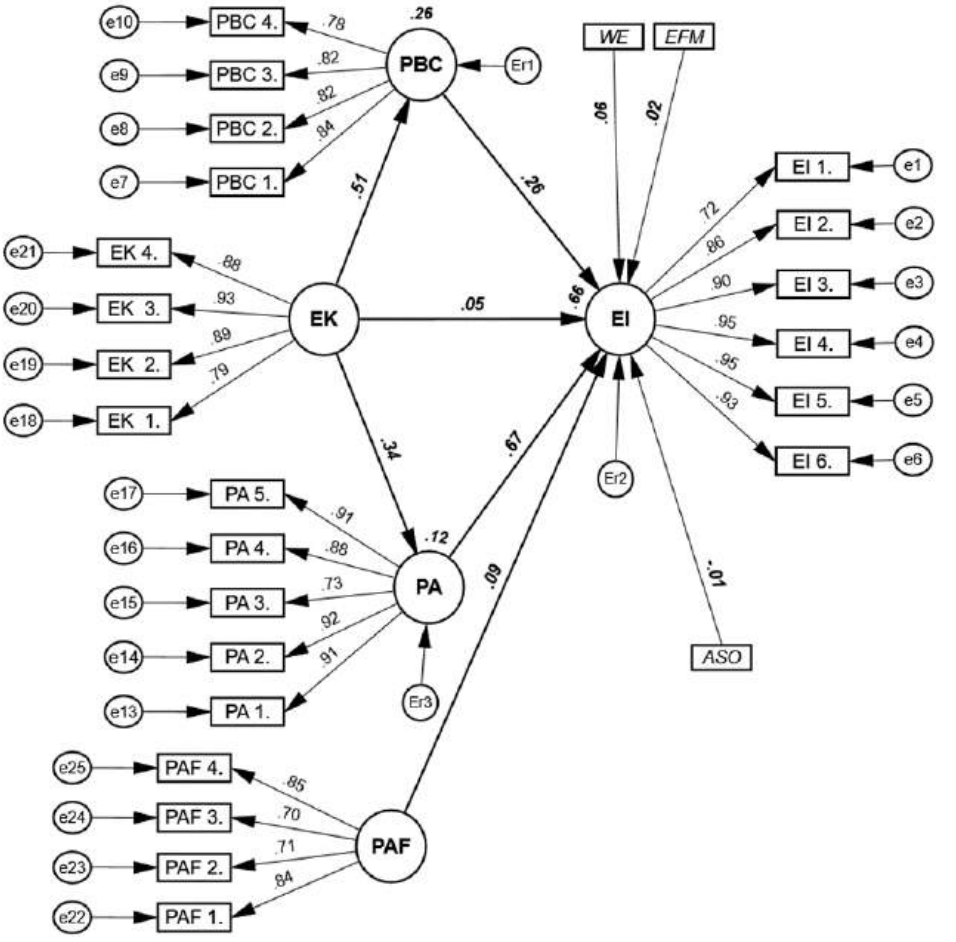
Construct	**EI**	**PA**	**PBC**	**EK**	**PAF**
EI	0.898	0.785	0.663	0.424	0.342
PA	0.784	0.872	0.543	0.328	0.164
PBC	0.651	0.546	0.817	0.488	0.456
EK	0.410	0.324	0.489	0.872	0.407
PAF	0.297	0.132	0.446	0.388	0.779

Source: Authors

Structural Model Estimation

Figure 2 and Table 4 present the results of the structural model estimated for the full sample of postgraduate students. Personal attitude, perceived behavioral control, and perceived access to finance exhibit positive and statistically significant effects on EI. Likewise, entrepreneurial knowledge positively and significantly influences both personal attitude and perceived behavioral control. However, it does not show a direct effect on EI, although it presents a positive and statistically significant indirect effect through these mediating variables.

Figure 2: Structural model



Source: Authors, AMOS software

Table 4: Values of structural model

Relationships	Stand β	T-value	P-value	Decision
PA → EI	0.672	14.453	***	Supported
PBC → EI	0.261	6.517	***	Supported
EFM → EI	0.023	0.780	0.436	Not supported
WE → EI	0.059	1.999	0.046	Supported
ASO → EI	-0.005	-0.185	0.853	Not supported
EK → EI	0.049	1.178	0.239	Not supported
EK →PA	0.339	6.938	***	Supported
EK → PBC	0.505	9.907	***	Supported
EK → PA → EI	0.227	5.161	***	Supported
EK → PBC → EI	0.136	4.318	***	Supported
PAF → EI	0.094	2.636	***	Supported

*Note. ***p-value < 0.01. EI's R^2 = 0.66. PA's R^2 = 0.12. PBC's R^2 = 0.26.*

Source: Authors

Regarding the control variables, work experience shows a positive effect on EI, whereas association membership and entrepreneurial family members are not statistically significant. With respect to the structural model fit indices, the RMSEA value (0.066) falls within the acceptable range, while the CFI (0.942) and TLI (0.936) indices exceed the recommended reference thresholds, supporting the overall adequacy of the structural model (Kline, 2016).

Multi-Group Analysis by Gender

Table 5 shows that the relationship between personal attitude and EI is positive and statistically significant for both men and women, with significant differences observed between the two groups. Likewise, PBC demonstrates a positive and significant effect on EI among men and women, with a marginally significant difference between groups. In contrast, perceived access to finance and entrepreneurial knowledge do not exhibit statistically significant differences across gender.

Table 5: Multigroup estimates of the structural model by gender

Relationships	Stand β		P-value	Decision
	Male	Female		
PA → EI	0.524***	0.760***	***	Supported
PBC → EI	0.355***	0.181***	0.088	Supported
EK → EI	0.016	0.081*	0.313	Not supported
EK →PA	0.411***	0.281***	0.468	Not supported
EK → PBC	0.524***	0.476***	0.542	Not supported
PAF → EI	0.099	0.106**	0.695	Not supported

*Note. ***p-value < 0.01; **p-value < 0.05; *p-value < 0.10.*
Source: Authors

Discussion

The findings derived from the overall analysis of postgraduate students indicate that EI largely depends on personal attitude toward entrepreneurship and perceived behavioral control—that is, how favorably students perceive the idea of entrepreneurship and how capable they feel of successfully undertaking it. This result is consistent with the findings reported by Liñán et al. (2011) and Drakpa et al. (2022).

Regarding entrepreneurial knowledge, the results indicate an indirect effect on EI through personal attitude and perceived behavioral control. Specifically, entrepreneurial knowledge may reduce the uncertainty associated with the entrepreneurial process, thereby strengthening postgraduate students' perceived capability to start a business. Likewise, it can enhance the evaluation of the potential benefits of entrepreneurship, positively influencing their personal attitude. These findings suggest that entrepreneurial education does not exert a direct effect on EI; rather, it functions as an exogenous factor whose impact is mediated by key cognitive variables. One possible explanation is that postgraduate programs in Ecuador tend to be predominantly theoretical, focusing on the transmission of knowledge in management and administration, with limited incorporation of practical experiences. In this context, entrepreneurial education primarily contributes to strengthening perceived capabilities and the evaluation of entrepreneurship, which in turn indirectly increases the predisposition to engage in entrepreneurial activities, in line with the findings of Montes et al. (2023) and Aragón-Sánchez et al. (2017).

Likewise, perceived access to finance emerges as a relevant factor in the decision to pursue entrepreneurship, as the availability of financial resources may facilitate the realization of entrepreneurial intentions (Nguyen, 2020; Peter et al., 2024). Similarly, work experience positively influences entrepreneurial intention by providing practical knowledge and a clearer understanding of business opportunities (Laguía et al., 2017). In contrast, variables traditionally associated with social capital—such as having family members who are entrepreneurs or belonging to professional associations—did not show significant effects, yielding results that are inconsistent with those reported by Fragoso et al. (2020) and Hindle et al. (2009). This may be explained by the characteristics of the postgraduate student sample, whose professional decisions tend to be more autonomous and are influenced more by individual factors than by their social environment. In particular, these students tend to base their entrepreneurial decisions primarily on their professional preparation and the availability of tangible resources.

With respect to the gender-based multi-group analysis, the results suggest that women exhibit a stronger effect of personal attitude on entrepreneurial intention compared to men. This finding is consistent with Sam et al. (2025), although it contrasts with Gomes et al. (2021) and Santos et al. (2016). One possible explanation is that women may perceive entrepreneurship as an alternative pathway for professional development and economic autonomy in response to limitations within traditional labor markets.

Gender differences were also identified in the relationship between perceived behavioral control and entrepreneurial intention, although this result should be interpreted cautiously due to its marginal statistical significance. This finding is consistent with da Costa et al. (2023) and supports evidence suggesting that gender may moderate the relationship between the primary predictors of entrepreneurial intention (Gomes et al., 2021; Zhao et al., 2005). Conversely, entrepreneurial knowledge does not present significant gender differences in its relationship with entrepreneurial intention or with its mediating variables. This result aligns with Lo et al. (2012) and Barron et al. (2022) and suggests that entrepreneurship education may contribute to reducing gender gaps by providing comparable skills and confidence levels for considering entrepreneurship as a viable career option.

Finally, no gender differences were identified in the relationship between perceived access to finance and entrepreneurial intention,

indicating that men and women perceive similar opportunities to access entrepreneurial resources. This finding is consistent with Bruhn (2009) and may be explained by the academic context of postgraduate students, where both groups possess comparable levels of information access and professional networks**.**

Conclusion

The objective of this article was to identify the determinants of EI among female and male graduate students enrolled in postgraduate programs in Ecuador. The findings of this study demonstrate a significant influence of personal attitude and perceived behavioral control on entrepreneurial intention for both men and women. However, personal attitude exerts a stronger effect among women, suggesting that a positive evaluation of entrepreneurship may contribute to challenging or reinterpreting traditional gender roles within the economic sphere. This finding reflects a high level of entrepreneurial motivation among female postgraduate students and points toward potential shifts in conventional gender patterns. In contrast, perceived behavioral control shows a more pronounced impact among men, which may reflect the persistence of social norms associating entrepreneurship with traditionally masculine attributes, consistent with Role Congruity Theory. Taken together, these results indicate that theoretical expectations are only partially supported within the analyzed context. Furthermore, no significant gender differences were observed in the effect of perceived access to finance on EI. Similarly, gender does not moderate the influence of entrepreneurial knowledge on personal attitude or perceived behavioral control, suggesting that these factors operate in a relatively gender-neutral manner within the entrepreneurial intention formation process.

In terms of practical implications, the findings suggest that higher education institutions and policymakers, such as the Ministry of Economy and Finance of Ecuador, should strengthen entrepreneurial support through technical training programs and the development of entrepreneurial competencies. In particular, given that entrepreneurial knowledge indirectly influences the intention to become an entrepreneur through attitude and perceived behavioral control, it is essential to direct these interventions toward strengthening postgraduate students' attitudinal dispositions and self-perceived capabilities.

Within this framework, universities should promote positive perceptions of entrepreneurship through mentorship, networking opportunities, and the dissemination of success stories within the Ecuadorian context, with particular attention to women, given the stronger influence of personal attitude on their entrepreneurial intention. Additionally, it is recommended to incorporate experiential methodologies—such as prototype development, applied problem-solving initiatives, participation in university incubators, and engagement with the professional environment—to enhance practical skills and perceived entrepreneurial capacity, particularly among men, considering the stronger effect of perceived behavioral control on their entrepreneurial disposition. Similarly, public and financial institutions, such as BanEcuador, should expand financing options for university-based startups by offering flexible requirements, preferential interest rates, and technical support, thereby reducing barriers to accessing capital in Ecuador. Finally, strengthening collaboration among universities, the public sector, and financial institutions is essential to consolidating a cooperative ecosystem that effectively supports entrepreneurship.

This study has certain limitations that should be considered when interpreting the findings. First, the sample is limited to postgraduate students from the city of Cuenca, which restricts the generalizability of the results to other geographical contexts and populations. Second, the cross-sectional design precludes the establishment of causal relationships among the variables, as the data were collected at a single point in time. Accordingly, the findings indicate significant associations but do not allow for definitive causal inferences. Likewise, the use of self-reported data may introduce biases. Additionally, it is important to distinguish between entrepreneurial intention and actual entrepreneurial behavior, as the former does not always translate into the creation of new ventures. Finally, although the model includes relevant variables, other potentially influential factors were not considered. Future research should incorporate these elements to provide a more comprehensive understanding of the phenomenon.

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ORIGINAL SCIENTIFIC PAPER

The Mediating Effect of Authentic Leadership on the Relationship between Self-leadership and Work-related Stress, Moderated by Gender



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A B S T R A C T

Leadership styles, self-leadership, work stress, and gender have received increasing attention in research due to their influence on individual performance; however, their impact on personal development processes has not yet been sufficiently explored. The objective of this study was to evaluate the mediating effect of authentic leadership and the moderating effect of gender on the relationship between self-leadership and work stress. To test the hypotheses, the partial least squares structural equation modeling (PLS-SEM) approach was employed in a sample of participants from a Latin American country (Peru). The results indicated that self-leadership had a significant negative effect on job stress and a significant positive effect on authentic leadership. Likewise, authentic leadership showed a significant negative effect on job stress. Moreover, it was found that authentic leadership partially mediated the relationship between self-leadership and work-related stress. Finally, the moderating role of gender was

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confirmed, revealing that the relationship between self-leadership and work-related stress was stronger among women than among men. These findings expand the literature on leadership and work-related stress by offering practical implications for designing organizational strategies to strengthen self-leadership, taking into account gender differences in their effectiveness.

KEYWORDS: *self-leadership, work-related stress, authentic leadership, gender*

Introduction

The current organizational environment is characterized by a growing demand for identifying elements that drive the achievement of institutional goals. As a result, organizations expect leaders with high levels of integrity, consistent with the values they promote, generating trust and fostering healthier work environments that have a direct impact on individual and organizational well-being (Pandey, 2025). Among these elements, we can identify self-leadership, authentic leadership, work-related stress, and the influence of gender on self-leadership and goal achievement.

In this process through which individuals self-regulate and motivate themselves to direct their behavior, emotions, and decision-making toward achieving goals, we identify self-leadership (Hukla & Shaheen, 2024). This construct goes beyond the traditional conception of leadership, which focuses exclusively on influencing others (Knotts et al., 2022). It is also important to note that self-efficacy is task-specific, with results varying across activities (Koca et al., 2024).

An important factor that emerges in the literature is authentic leadership, which, through an attitude of sincere acknowledgment of one's own weaknesses and mistakes and a pursuit of positive personal development, enhances interaction with members of the organization (Lho et al., 2026). However, employee performance is also influenced by a set of interrelated factors, such as stress, job satisfaction, motivation, leadership, commitment, and organizational culture (Czerw et al., 2025).

The literature indicates that self-leadership contributes to performance and the reduction of work-related stress primarily through the structuring function of goal-setting. Likewise, autonomy acts as a protective factor against stress, improving control over one's own decisions and helping to cope with work demands (Bäcklander et al., 2019). We found a study in Africa, in the academic setting, in which women face structural barriers and

demands that affect their professional development; in this regard, self-leadership emerges as a key resource for strengthening resilience and sustaining productivity in the face of such inequalities (Krampitz et al., 2023; Naveed et al., 2026).

The present study aims to contribute to the literature by conducting an integrated analysis of the mediating effect of authentic leadership on the relationship between self-leadership and work-related stress, and the moderating effect of gender on this relationship, taking into account the differential influence of gender on leadership experiences and behaviors. Grounded in social cognitive theory (Bandura, 1986), resource conservation theory (Hobfoll, 1989), and self-determination theory (Ryan & Deci, 2000a), the study articulates an explanatory framework that integrates cognitive, motivational, and stress management processes. Moreover, from an applied perspective, the research focuses on the Peruvian business context, characterized by specific social and cultural dynamics that shape leadership practices and workplace well-being.

Theoretical Framework and Conceptual Development

Theoretical Framework

The study explores the relationship between three key constructs: authentic leadership, self-leadership, and work-related stress. Self-leadership, through self-reflection and self-control, increases self-efficacy by strengthening self-regulation and intrinsic motivation, facilitating stress management, adaptation to change, and persistence in the face of challenges (Ndiango et al., 2023; Shafique et al., 2023; Khan et al., 2023). This relates to self-determination theory, which explains human motivation by exploring both intrinsic and extrinsic factors and identifying three basic psychological needs: autonomy, competence, and relatedness (Ryan & Deci, 2000b).

Authentic leadership, based on self-awareness, relational transparency, balanced processing, and an internalized moral perspective, contributes to the creation of positive organizational climates that foster employee engagement (Walumbwa et al., 2008). Studies show that authentic leadership and self-leadership foster self-regulation, authenticity, and personal development in educational and workplace contexts (Kringelum et al., 2023; Schoofs et al., 2024). These factors are linked to Bandura's theory

(1986), which posits that individuals can influence their own motivation and behavior.

Work-related stress arises when job demands exceed the worker's resources and capabilities, and it intensifies in the face of low levels of social support and limited control over work tasks (Goldsby et al., 2020). This argument is supported by Hobfoll's Conservation of Resources (COR) theory, which posits that stress occurs when individuals lack sufficient resources to meet environmental demands, whereas adequate resources help them cope more effectively with work-related challenges (Hobfoll, 1989).

According to Zhao and Wang (2025), self-leadership capabilities differ between men and women. The literature also notes that gender can affect decision-making, emotional regulation, and access to leadership positions, leading to persistent inequalities in the representation of women in senior management roles (Antonijević et al., 2022).

Although these constructs have been extensively analyzed in other contexts, either individually or in relation to other variables, their integrated effect remains insufficiently explored, particularly in Latin American countries. This section analyzes how the interaction between these constructs contributes to individual and organizational outcomes.

Relationships between Constructs and Hypotheses

Self-Leadership and Work Stress

Several studies suggest that self-leadership can help reduce stress levels by shaping how people evaluate stressful situations, though its impact on stress and performance is based on goal attainment (Bäcklander et al., 2019). Evidence suggests that when faced with high-pressure work situations, people may require more complex cognitive self-leadership strategies, and that these techniques may not be usable in such contexts (Goldsby et al., 2020).

According to Van Zyl (2008), when work-related stress reaches high levels, people tend to react more negatively and perceive stressors as threats, which hinders the effective use of their self-leadership skills and strategies. These authors highlight the need to expand research on self-leadership in order to better understand its potential across different professional and cultural contexts, as most research is currently based in the US and the UK.

Self-leadership enables people to orient themselves toward their own objectives through goals they consider meaningful and set for themselves,

helping them tackle necessary tasks even when they are unpleasant (Knotts et al., 2022). Therefore, future theoretical models should recognize the significant role of self-leadership in performance (Furtner, Liegl & Klösel, 2025); consequently, Hypothesis 1 was formulated as follows:

H1: Self-leadership and work stress have a significant negative relationship.

Self-Leadership and Authentic Leadership

As stated by Junça-Silva and Camaz (2023), self-leadership requires high levels of self-discipline for individuals to regulate and maintain their own motivation, which may carry potential risks of isolation or reduced collaboration. Moreover, its impact is shaped by cultural factors that influence its application across different contexts. Furthermore, this approach has gained greater relevance in relation to new leadership models, such as authentic, servant, emotional, participatory, and shared leadership. Authentic leadership, on the other hand, is grounded in transparency, ethical conduct, and alignment between personal values and organizational goals, thereby strengthening trust, commitment, and relationships within teams. However, this approach faces challenges in balancing transparency with strategic discretion and maintaining authenticity in changing environments (Heim et al., 2026).

Although the literature has not clearly defined this relationship, a study in South Africa's public sector found that self-leadership precedes authentic leadership in its four components, which are: self-awareness regarding strengths, weaknesses, and personal impact; relational transparency in expressing genuine emotions and thoughts; balanced processing in evaluating data objectively and considering divergent opinions; and internalized morality in acting according to one's own values in the face of external pressures (Kotze, 2016). This indicates that authentic leadership may not emerge in isolation, but rather as an extension of deeply internalized self-regulatory processes that shape how individuals interpret themselves and their interactions with others in organizational contexts.

Self-leadership fosters self-direction and motivation, which improves both individual and organizational performance. A study in the nursing field in China indicates that self-leadership and authentic leadership among managers are related to organizational culture and organizational silence. It also suggests that a broader review is still needed, considering work-related variables such as experience, work area, and work schedule, along with

personal, managerial, and organizational factors (Lho et al., 2026). From a theoretical perspective, self-leadership can be conceptualized as a higher-order self-regulatory capability that enables individuals to develop consistency among internal values, cognitions, and behaviors, thereby constituting a necessary psychological foundation for the enactment of authentic leadership. Therefore, Hypothesis 1 was formulated as follows:

H2*:* Self-leadership and authentic leadership have a positive and significant relationship.

Authentic Leadership and Work-related Stress

Czerw et al. (2025) argue that organizations that practice authentic leadership, as well as fair rewards as part of their organizational culture, foster an environment of trust across hierarchical levels, such as supervisors and coworkers, which influences job satisfaction and low stress levels among employees. Empirical evidence indicates that authentic leadership contributes to reducing work-related stress and burnout, but that there are also direct or indirect effects on stress and burnout reduction (Adil & Kamal, 2020). Despite advances in the understanding of authentic leadership, further research is still needed on how this style influences the management of work-related stress, and various authors note that this relationship still requires a more comprehensive theoretical and empirical analysis (Allssyah & Buntuang, 2025).

From a socio-psychological perspective, authentic leadership reduces work-related stress by enhancing psychological safety, reducing role ambiguity, and strengthening employees' perceived control over their work environment. Its emphasis on transparency and balanced processing may also mitigate uncertainty and cognitive overload, which are well-established antecedents of occupational stress. Therefore, Hypothesis 3 was formulated as follows:

H3*:* Authentic leadership and work-related stress have a significant negative relationship.

Mediating Effect of Authentic Leadership between Self-leadership and Work-related Stress

Czerw et al. (2025) noted that, based on a study conducted in the Kingdom of Saudi Arabia, there is a positive relationship between authentic leadership and employee performance, thereby enhancing organizational

performance. Likewise, the literature indicates that in other cultural contexts, such as Europe, China, Nigeria, and Turkey, authentic leadership has a positive and significant mediating effect on the relationship between employee training and performance (Czerw et al., 2025; Mira & Odeh, 2019).

The literature highlights the influence of authentic leadership on self-leadership by fostering environments of trust and empowerment, helping people take responsibility for their actions and self-regulate their behavior (Schoofs et al., 2024). It also notes that self-leadership is linked to various leadership styles, such as authentic, servant, emotional, participatory, and shared leadership. This suggests that self-leadership serves as an antecedent self-regulatory mechanism that shapes how individuals construct their leadership identity, which in turn influences how leadership is enacted in interpersonal and organizational contexts.

Regarding work-related stress, studies demonstrate its mediating effect in relation to leadership styles, such as toxic and ethical leadership, highlighting the distinct influence each style exerts on employee well-being (Uysal, 2019). However, studies on authentic leadership point to the need to expand the analysis of its mediating role to other organizational processes (Mira et al., 2019). What's more, it is evident that the interaction of these three constructs has not yet been explored in Latin American countries

Integrating these perspectives, this study proposes a sequential mediation mechanism grounded in self-regulation and resource-based theories of leadership, whereby self-leadership enhances individuals' capacity for self-awareness, behavioral regulation, and value congruence, which facilitates the emergence of authentic leadership behaviors. In turn, authentic leadership serves as a relational and organizational mechanism that reduces perceived work-related stress by increasing trust, psychological safety, and clarity in workplace interactions. Therefore, Hypothesis 4 was formulated as follows:

H4: Authentic leadership mediates the relationship between self-leadership and work-related stress.

Gender Differences in the Relationship Between Self-Leadership and Work Stress

Studies show that women tend to benefit more from leadership practices that foster empowerment and confidence (Paustian-Underdahl et al., 2024; Teja & Loza, 2025). However, other studies have demonstrated

that women face disadvantages in the labor market, particularly in income, access to employment, and educational opportunities (Abdulla et al., 2024). From a self-regulation and resource-based perspective, self-leadership can be understood as a set of cognitive and behavioral strategies that enhance individuals' ability to manage emotions, cognition, and motivation in response to workplace demands, suggesting that its effectiveness in reducing work-related stress may depend on the extent to which individuals rely on internal regulatory resources versus external structural support.

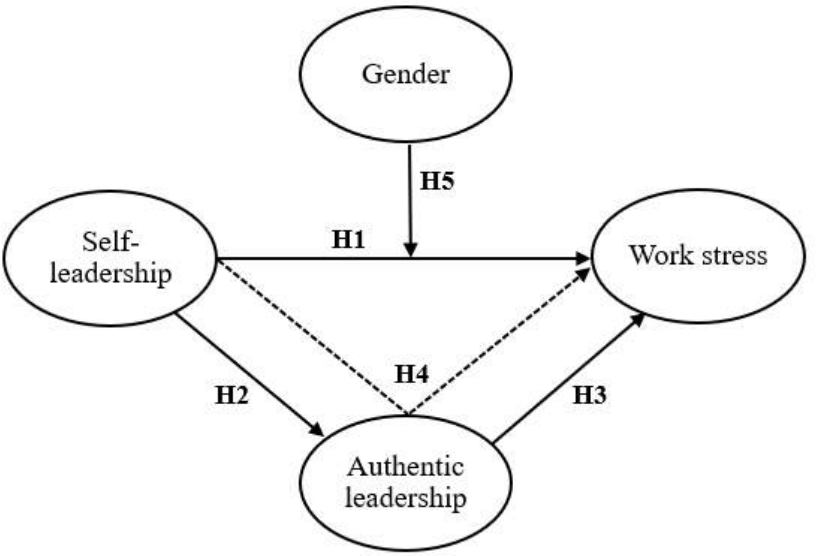
Ndiango (2025) argues that self-leadership capabilities can vary significantly between men and women. Moreover, a study conducted at public universities in Tanzania indicates that gender acts as a mediating factor between self-leadership and research productivity. There is also evidence in the field of education that women in leadership positions are more prone to work-related burnout. Similarly, Teja & Camino (2024) reported that the effects of psychological capital in reducing work stress are higher among women. In this sense, gender may operate as a critical boundary condition because men and women often experience different patterns of occupational stressors, role expectations, and access to organizational resources.

However, it is still unclear how gender differences affect the relationship with self-leadership (Ndiango, 2025). There is a need to expand studies on the moderating role of gender in high-stress contexts and other factors, such as geographic distribution. In contexts where women face greater role overload, emotional demands, and structural constraints in the labor market, self-leadership may serve as a more salient psychological coping mechanism that compensates for external resource limitations. Specifically, self-leadership may be more strongly associated with stress reduction among women because it enhances perceived control, self-efficacy, and cognitive reframing abilities, which are particularly relevant in environments characterized by unequal access to organizational support and higher exposure to work–family conflict. In the Peruvian labor context, such structural inequalities in employment conditions, income distribution, and occupational segregation may further intensify these gendered differences, making internal self-regulatory mechanisms such as self-leadership more influential for women's psychological adjustment in the workplace. Based on this evidence, the following hypothesis is proposed:

H5: Gender moderates the relationship between self-leadership and work-related stress.

Finally, Figure 1 shows the research hypotheses.

Figure 1: Theoretical model



Note: Solid arrows denote direct effects, dashed arrows denote mediating effects, and the arrow originating from Gender indicates a moderating effect on the proposed relationship.
Source: Prepared by the author.

Methodology

Data Collection

The study population consisted of 712 large and medium-sized Peruvian service companies identified from official business registries, using a non-probabilistic screening to ensure inclusion of firms meeting size and sector criteria. The sample comprised 101 valid responses, collected from firms that agreed to participate after initial contact via email and telephone invitations, with 53% from the service sector, 22% from manufacturing, and 25% from the commercial sector, reflecting a heterogeneous distribution across key economic sectors of the Peruvian economy. Of the respondents, 58% were men and 42% were women. The final response rate was approximately 14.2%.

To determine the minimum size of the probabilistic sample, two criteria were considered. The first was based on simple random sampling, with a confidence interval of 2.5 standard deviations (95.5%), the most unfavorable possible scenario (p=q=50), and a sampling error of ±5%. The second was determined using PLS-SEM, for which a sample size of 100 to 200 is sufficient (Hoyle, 1995). Therefore, the sample size is sufficient to validate the hypotheses and extrapolate the results. Data were collected through structured questionnaires administered to managers and employees with direct knowledge of organizational practices, who were recruited using a purposive contact strategy and invited to participate voluntarily.

Table 1: Sociodemographic characteristics of the sample

Characteristic	Frequency	Percentage
Gender		
Female	42	42
Male	59	58
Age		
20–30	15	14
31–40	49	49
41–50	29	29
51 and over	8	8
Role in the organization		
Senior management	12	12
Middle management/Supervisor	64	63
Non-managerial (Technician/Professional)	25	25
Sector		
Commercial	25	25
Manufacturing	22	22
Services	54	53
Type		
Private	94	93
Public	7	7
Total	101	100

Source: Prepared by the author

The research instrument consisted of a closed-ended questionnaire with 43 items reflecting individuals' perceptions of the research variables. To measure self-leadership, the nine-item questionnaire proposed by Houghton & Neck (2002) was used. Regarding work-related stress, the questionnaire

proposed by Cohen et al. (1983), consisting of 14 questions, was administered. For authentic leadership, the questionnaire by Walumbwa et al. (2008) was used, which includes four dimensions: self-awareness (5), relational transparency (5), balanced processing (5), and internalized moral perspective (5). All items were measured on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree).

Data Analysis

The study employed structural equation modeling using the partial least squares method (PLS-SEM) to test the research hypotheses. The choice of PLS-SEM, rather than a covariance-based approach (CB-SEM), is primarily based on methodological considerations related to sample size, the presence of formative constructs, and moderation effects (Hair et al., 2018). In particular, PLS-SEM is more suitable for moderate-sized samples, as it does not impose strict assumptions of multivariate normality. Furthermore, this approach is especially relevant when the model includes higher-order constructs and moderating effects, as is the case in the present study with authentic leadership and gender.

The application of PLS-SEM followed the procedure and methodological recommendations proposed by Hair et al. (2021), which involved the sequential evaluation of the measurement model and the estimation of the structural model. On the other hand, authentic leadership was conceptualized as a higher-order construct with a reflective-formative specification. For its estimation, the disjoint two-stage approach was applied, following the procedure established by Sarstedt et al. (2019). In analyzing the moderating effect of gender, a two-stage approach was used. This procedure reduces collinearity and improves the stability of the estimates by constructing the interaction term using the latent scores obtained in the first stage. Data analysis was conducted using SmartPLS 4 software.

Results

Evaluation of the Measurement Model

The first stage involved evaluating the measurement model, beginning with the reflective constructs. The initial model estimation, including all indicators, revealed that some indicators had external loadings below the

recommended threshold. In particular, indicators SA5 and IMP5 had loadings below 0.40 and were excluded from the model. Table 2 presents the results for indicator reliability, internal consistency, and convergent validity. In particular, the external loadings of the remaining indicators were above 0.70, meeting the commonly accepted criterion. Only item IMP2 showed a loading slightly below 0.70. However, it was decided to retain it in the model since its removal did not improve convergent validity. Regarding internal consistency reliability, both Cronbach's alpha and composite reliability exceeded the recommended minimum threshold of 0.70 for all constructs.

Finally, the average variance extracted (AVE) was above 0.50 in all cases, confirming the convergent validity of the measurement model.

Table 2: Reliability and Convergent Validity

Construct	Indicator	External loading	Cronbach's alpha	Composite reliability	AVE
Work-related stress	WS1	0.891	0.969	0.972	0.713
	WS2	0.891			
	WS3	0.705			
	WS4	0.870			
	WS5	0.829			
	WS6	0.886			
	WS7	0.835			
	WS8	0.783			
	WS9	0.793			
	WS10	0.882			
	WS11	0.845			
	WS12	0.882			
	WS13	0.863			
	WS14	0.846			
Self-Leadership	SL1	0.860	0.949	0.957	0.710
	SL2	0.844			
	SL3	0.855			
	SL4	0.879			
	SL5	0.752			
	SL6	0.850			
	SL7	0.812			
	SL8	0.873			
	SL9	0.853			
	SA1	0.792	0.785	0.860	0.607

Construct	Indicator	External loading	Cronbach's alpha	Composite reliability	AVE
Self-awareness	SA2	0.703			
	SA3	0.869			
	SA4	0.743			
	SA5	-			
Internalized moral perspective	IMP1	0.767	0.764	0.848	0.584
	IMP2	0.675			
	IMP3	0.760			
	IMP4	0.844			
	IMP5	-			
Balanced processing	BP1	0.773	0.832	0.881	0.597
	BP2	0.772			
	BP3	0.805			
	BP4	0.806			
	BP5	0.701			
Relational transparency	RT1	0.803	0.860	0.899	0.641
	RT2	0.752			
	RT3	0.873			
	RT4	0.716			
	RT5	0.848			

Source: Prepared by the author

Two complementary criteria were used to assess discriminant validity: the Fornell and Larcker criterion (1981) and the HTMT index (Henseler et al., 2019). Table 3 presents the corresponding results. The main diagonal reports the square roots of the AVE for each construct, while the values below the diagonal correspond to the correlations between constructs. The HTMT values are presented above the diagonal. According to Fornell and Larcker's criterion, discriminant validity is established when the square root of the AVE for each construct is greater than its correlations with the other constructs in the model. As shown in Table 3, in all cases, the diagonal values exceed the corresponding correlations. On the other hand, all HTMT values are below the 0.90 threshold. Taken together, the results obtained using both criteria confirm the discriminant validity of the measurement model.

Table 3: Discriminant validity

Construct	WS	SL	SA	IMP	BP	RT
WS	0.844*	0.562[b]	0.395[b]	0.130[b]	0.277[b]	0.380[b]
SL	0.550[a]	0.843*	0.339[b]	0.132[b]	0.151[b]	0.335[b]
SA	0.360[a]	0.306[a]	0.779*	0.542[b]	0.299[b]	0.525[b]
IMP	-0.087[a]	-0.102[a]	0.403[a]	0.764*	0.150[b]	0.343[b]
BP	0.257[a]	0.131[a]	0.230[a]	-0.007[a]	0.773*	0.217[b]
RT	0.367[a]	0.318[a]	0.431[a]	0.258[a]	0.163[a]	0.800*

Note: [a] correlation, [*]square root of AVE, [b] HTMT value.

Source: Prepared by the author

The next step in the analysis involved evaluating the second-order formative construct corresponding to authentic leadership. According to the disjoint two-stage approach, in the first stage, the first-order constructs were estimated, and their latent scores were extracted. In the second stage, these scores were incorporated as indicators of the second-order authentic leadership construct, allowing for its estimation under a formative specification.

Subsequently, the multicollinearity among the formative indicators was evaluated, as well as the significance and relevance of their external weights. Table 4 presents the corresponding results. First, the variance inflation factor (VIF) values were below the conservative threshold of 3, indicating no critical multicollinearity. Regarding the evaluation of the external weights, the results indicate that IMP, RT, and SA have positive and statistically significant weights, consistent with theoretical expectations. These findings confirm that these dimensions contribute substantially to the development of authentic leadership. However, the BP dimension had a non-significant external weight, suggesting that its contribution to the construct is not statistically significant. Nevertheless, its VIF values remain within acceptable levels, indicating that its inclusion does not introduce multicollinearity.

Overall, the results support the adequate psychometric quality of the reflective and formative constructs and allow us to proceed with estimating the structural model.

Table 4: Collinearity and significance

Variation	VIF	External weight	Std. Dev.	T-statistic	p-value
BP → AL	1.077	0.161	0.130	1.245	0.213
IMP→ AL	1.225	0.592	0.184	3.218	0.001
RT → AL	1.250	0.547	0.214	2.564	0.010
SA → AL	1.447	0.645	0.284	2.271	0.023

Source: Prepared by the author

Estimation of the Structural Model

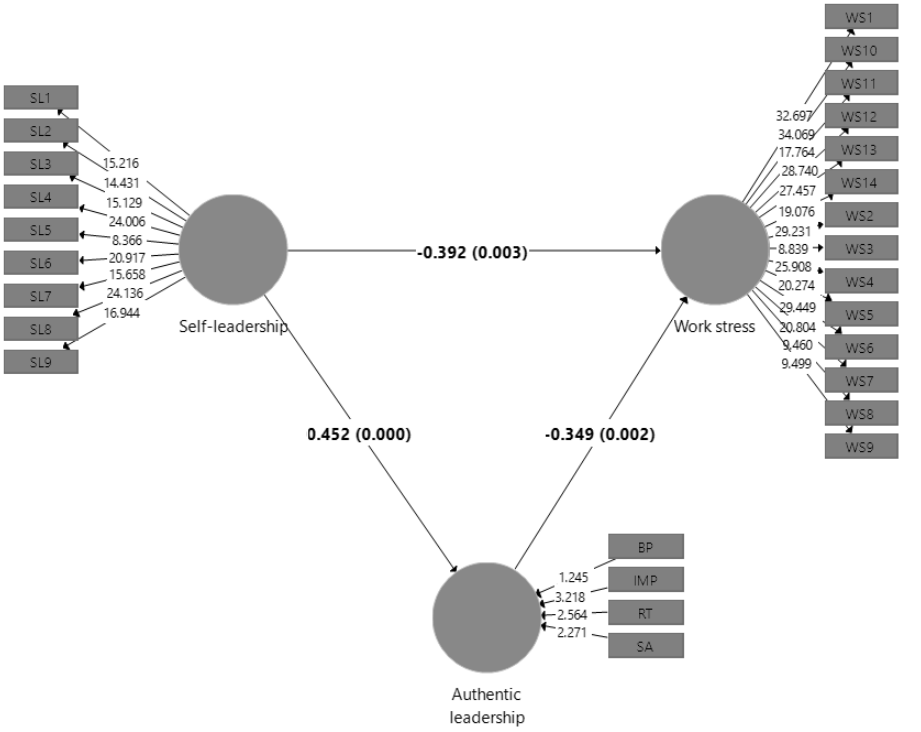
After evaluating the measurement model, we estimated the structural model to test the research hypotheses. We used a bootstrapping procedure with 10,000 repetitions, which yields robust standard error estimates. The results of the structural analysis are presented in Table 5. First, the relationship between self-leadership and work-related stress was negative and statistically significant ($\beta = -0.392$; $p = 0.003$), confirming the first research hypothesis. Second, the relationship between self-leadership and authentic leadership was also positive and significant ($\beta = 0.452$; $p < 0.001$), confirming the second research hypothesis. Likewise, the relationship between authentic leadership and job stress was negative and significant ($\beta = -0.349$; $p = 0.002$), confirming the third research hypothesis. Regarding the mediation analysis, the indirect relationship between self-leadership and job stress through authentic leadership was negative and significant ($\beta = -0.158$; $p = 0.018$), confirming the fourth research hypothesis. This result demonstrates the existence of a mediating mechanism, indicating that part of the relationship between self-leadership and job stress is mediated by authentic leadership. Finally, the gender interaction effect on the relationship between self-leadership and job stress was negative and statistically significant ($\beta = -0.190$; $p = 0.044$), confirming a moderating effect. This finding suggests that the magnitude of the relationship between self-leadership and job stress varies by gender. Figure 2 presents the estimation results obtained in SmartPLS.

Table 5: Bootstrapping results

Relationship	VIF	Path Coefficient	Std. Dev.	T-statistic	p-value
SL → WS	1.213	-0.392	0.133	2.961	0.003
SL→ AL	1.000	0.452	0.105	4.306	0.000
AL → WS	1.213	-0.349	0.111	3.154	0.002
SL→ AL → WS	-	-0.158	0.066	2.386	0.017
SL→ Gender→ WS	1.044	-0.190	0.095	2.011	0.044

Source: Prepared by the author

Figure 2: SmartPLS results

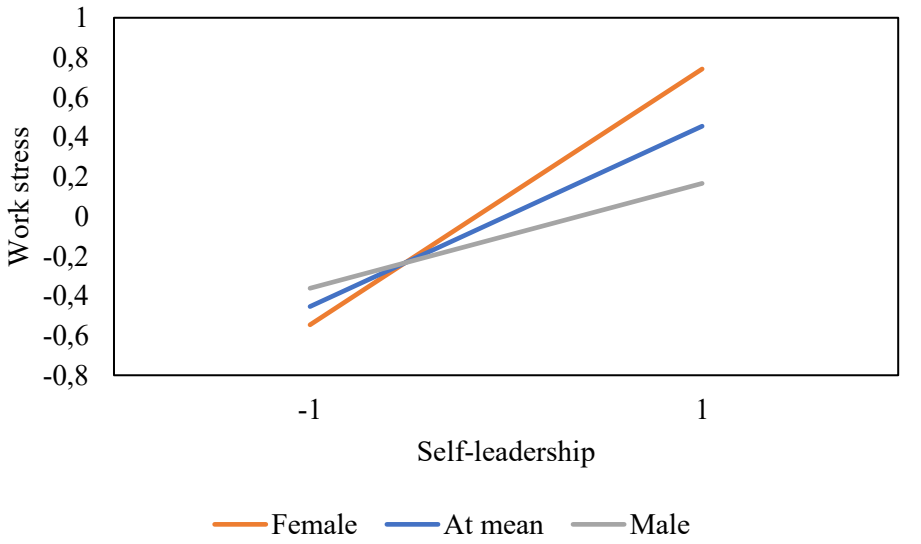


Source: Prepared by the author

Once the presence of the gender moderating effect has been established, the next step is to interpret the nature of this moderation. In the analysis of models with interaction effects, this evaluation is commonly performed using a simple slope plot, such as the one presented in Figure 3. Figure 3 shows the relationship between self-leadership and work-related

stress, differentiated by gender, with estimated slopes for each group. The horizontal axis shows the levels of self-leadership, while the vertical axis shows the levels of work-related stress. The lines corresponding to each group allow us to visualize how the strength of the relationship between the variables varies by gender. Upon analyzing the graph, it is observed that the slope for the group of women is steeper than that for men. This indicates that the relationship between self-leadership and work-related stress is stronger in women than in men. Therefore, these results confirm the fifth research hypothesis, demonstrating that the association between self-leadership and work-related stress is significantly greater among women. Overall, the results of the structural model empirically support the proposed hypotheses and confirm both the direct effects and the indirect and moderating effects proposed in the theoretical model.

Figure 3: Slope plot



Source: Prepared by the author

The final step of the analysis involved evaluating the model's explanatory and predictive power. Regarding explanatory power, the coefficient of determination was calculated. Specifically, the WS construct had a coefficient of determination of 0.438. This value can be considered moderate, suggesting that the model captures a significant proportion of the construct's variability. As for the model's predictive power, it was evaluated

using the Q-squared statistic, as well as the RMSE and MAE error metrics. The Q-squared statistic provides evidence of the out-of-sample predictive power of the endogenous constructs, with values greater than zero indicating significant predictive power. Meanwhile, RMSE and MAE are measures of discrepancy between observed and predicted values. Both are calculated using PLS and linear regression (LM). The results obtained are presented in Table 6. It can be seen that all Q-squared values are positive, confirming that the model possesses adequate predictive power for the indicators of work-related stress. Regarding RMSE and MAE, the values calculated for the PLS model are generally lower than those of LM, suggesting that estimation using PLS offers superior predictive power compared to the linear method. In conclusion, the results allow us to affirm that the model not only explains a significant proportion of the variance in work-related stress but also possesses out-of-sample predictive power, reinforcing the validity of the structural model and its utility for interpreting the relationships between the constructs.

Table 6: Predictive power

Indicator	Q-square	PLS		LM	
		RMSE	MAE	RMSE	MAE
WS1	0.189	0.858	0.708	0.895	0.723
WS2	0.166	0.825	0.691	0.860	0.727
WS3	0.188	0.785	0.657	0.815	0.681
WS4	0.245	0.806	0.658	0.831	0.673
WS5	0.208	0.855	0.678	0.937	0.736
WS6	0.177	0.800	0.688	0.779	0.656
WS7	0.193	0.818	0.676	0.852	0.693
WS8	0.138	0.884	0.713	0.912	0.736
WS9	0.153	0.900	0.712	0.907	0.702
WS10	0.160	0.887	0.726	0.873	0.694
WS11	0.253	0.815	0.679	0.810	0.683
WS12	0.141	0.790	0.654	0.768	0.634
WS13	0.145	0.831	0.689	0.831	0.675
WS14	0.150	0.834	0.697	0.870	0.705

Source: Prepared by the author

Discussion

The results from PLS-SEM provide relevant theoretical and empirical contributions to the literature on leadership and workplace well-being.

First, the findings reveal a significant negative relationship between self-leadership and work-related stress, which reinforces previous research highlighting self-leadership as a protective resource against stress (Bäcklander et al., 2019; Knotts et al., 2022) and linking it to self-determination theory (Ryan & Deci, 2000b). Second, the positive and significant relationship between self-leadership and authentic leadership is confirmed, supporting the notion that the processes of self-direction, self-awareness, and self-regulation constitute a fundamental basis for employee motivation and behavior modification, thereby strengthening their development and commitment (Kringelum et al., 2023; Schoofs et al., 2024), a finding that aligns with social cognitive theory (Bandura, 1986). Furthermore, the results show a significant negative relationship between authentic leadership and work-related stress, reinforcing previous studies on the negative effects of authentic leadership on stress and work-related burnout (Adil & Kamal, 2020). This result relates to resource conservation theory (Hobfoll, 1989) and highlights the need for further studies on the effect of authentic leadership (Allssyah & Buntuang, 2025).

A key contribution of the study is confirming the partial mediating effect of authentic leadership on the relationship between self-leadership and work-related stress. This finding indicates that self-leadership not only has a direct effect on stress but also influences it indirectly through the development of authentic leadership practices, expanding the role of authentic leadership as a mediator in other organizational processes (Mira et al., 2019).

Finally, the study confirms the moderating effect of gender on the relationship between self-leadership and work-related stress, showing that this relationship is stronger among women than among men. This finding aligns with research indicating that, due to limiting contexts, women may experience an intensified impact of self-leadership on stress (Antonijević et al., 2022; Ndiango, 2025) and highlights the need for further studies in other contexts.

Conclusion

The results offer relevant practical guidance for managing leadership and workplace well-being in organizations. The development of self-leadership competencies such as self-management, self-direction, and self-regulation can help reduce stress levels among employees, provided it is implemented in a structured manner. Organizations should foster environments that reinforce healthy practices of authentic leadership to reduce the impact of workplace stress and strengthen employee engagement. Finally, the moderating effect of gender highlights the importance of developing more inclusive and gender-sensitive leadership practices to enhance organizational effectiveness. The results indicate that the relationship between self-leadership and work stress is stronger for women than for men, suggesting potential gender differences in how self-leadership is associated with stress outcomes.

The study has some limitations stemming from the research design, sample selection, and inferential methods used, which entailed unavoidable methodological compromises. Moreover, the relatively small sample size may limit the generalizability of the findings, although it remains adequate for PLS-SEM analysis. Additionally, the use of retrospective measures based on managers' perceptions may have introduced bias in the responses, a common limitation in similar research. However, these limitations do not affect the achievement of the stated objectives, as the results obtained allow for a more comprehensive understanding of the relationships among the constructs analyzed. Future research should continue to incorporate gender as a relevant analytical variable, given its influence on employee performance, and expand the analysis to include other leadership styles across different organizational and cultural contexts.

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ORIGINAL SCIENTIFIC PAPER

Dynamic Capabilities and Performance of Indonesian Women Entrepreneurs: The Mediating Roles of Innovation and Digital Transformation



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A B S T R A C T

The success of women entrepreneurs in the current rapidly evolving business landscape increasingly depends on the group's ability to develop dynamic capabilities, particularly the capacities to sense, seize, and reconfigure opportunities, which enable innovation and digital transformation. Accordingly, this study aims to examine the relationship between dynamic capabilities and the performance of women entrepreneurs, both directly and indirectly, through the mediating roles of innovation and digital transformation. The study was conducted in East Java Province, Indonesia, between June and August 2025 and included 570 women entrepreneurs operating in the service, trade, and manufacturing sectors. Data were collected through questionnaires, and the analysis adopted Partial Least Squares Structural Equation Modeling (PLS-SEM) using SmartPLS software

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to assess the structural relationships among the proposed constructs. The obtained results showed that dynamic capabilities did not have a significant direct effect on the performance of women entrepreneurs. However, the factor reflected a significant indirect relationship with performance through innovation and digital transformation. In the service sector, digital transformation was the stronger mediating variable, while in the trade and manufacturing sectors, innovation showed a stronger association with entrepreneurial performance. These findings contribute to theory and practice by providing insights for women entrepreneurs on how to strengthen their respective strategic approaches and by offering guidance to policymakers in designing supportive interventions that promote innovation and digital transformation.

KEYWORDS: *dynamic capabilities, innovation, digital transformation, performance, women entrepreneurs*

Introduction

Women entrepreneurs continue to experience limited participation in entrepreneurial activities despite the growing recognition of their potential (Srividhya & Paramasivam, 2022). According to the Global Entrepreneurship Monitor (2024), only one in ten women initiates new businesses compared to one in eight men. Similarly, entrepreneurial intentions remain significantly lower among women, with an average of 16.9 percent compared to 20 percent for men. In the Indonesian context, these structural challenges are further compounded by unequal access to information technology, as women in both rural and urban areas encounter more obstacles than men (Central Bureau of Statistics, 2024).

Previous studies reported that dynamic capabilities, reflected in sensing, seizing, and reconfiguring capacities, were positively associated with innovation (Burton & Dickinger, 2025). These capabilities also facilitate the adoption of digital transformation in small and medium enterprises (SMEs) (Soluk et al., 2023). Moreover, SMEs have leveraged sensing, seizing, and reconfiguring capacities to mitigate the impact of the COVID-19 pandemic (Zahoor et al., 2022). Empirical evidence further showed that these capabilities contribute to organizational resilience and improved business performance in SMEs (Van Tran et al., 2024). Collectively, these findings suggest the need for further investigation into how dynamic capabilities relate to innovation and digital transformation as mechanisms for enhancing business performance.

Although the literature on this strategic approach is extensive, most studies have focused on large enterprises, offering limited insight into how SMEs utilize digitalization to enhance performance. The present study addresses this gap by examining the mediating roles of innovation and digital transformation in the relationship between dynamic capabilities and SME performance, particularly among women-led SMEs. Prior explorations have proposed performance models for SMEs across service, trade, and manufacturing sectors, as well as within specific sectors. However, comparative analyses across these sectors remain scarce. The present study contributes to the existing body of literature by acknowledging how each sector possesses distinct characteristics that shape entrepreneurial outcomes.

Against this background, the central question addressed in this study includes whether dynamic capabilities are associated with the performance of women entrepreneurs directly or indirectly through the mediating roles of innovation and digital transformation. In response to this question, the study develops a performance model for women entrepreneurs grounded in the dynamic capabilities perspective.

Literature Review

Dynamic Capabilities and Business Performance

The present study adopts the dynamic capabilities framework, drawing on the Dynamic Capabilities Theory developed by (Teece, 2009). Dynamic capabilities refer to a firm's capacity to effectively integrate, build, and reconfigure internal and external competencies in response to rapid environmental shifts. A growing body of evidence highlights the importance of dynamic capabilities in improving business performance. For instance, in Vietnam, learning, integration, and reconfiguration capabilities were found to enhance entrepreneurial outcomes (Van Tran et al., 2024). Similarly, SMEs in China were observed to depend on dynamic capabilities to strengthen competitiveness in the digital economy (Wang, Niu, et al., 2024; Wang, Mansor, et al., 2024). Among women entrepreneurs, dynamic capabilities such as education, managerial experience, and leadership contribute to financial growth in Ireland (Costin et al., 2021), while in Malaysia they support competitive advantage, business survival, and success in dynamic environments (Kanapathipillai et al., 2022). Based on these considerations, the first hypothesis is formulated as follows.

H1: Dynamic capabilities are positively associated with the performance of women entrepreneurs.

Dynamic Capabilities, Innovation, and Business Performance

Innovation is widely regarded as a cornerstone of economic activity and an essential driver of business performance. Fontana (2015) defined this concept as the social and economic success that originates from introducing new methods or novel combinations of existing methods for transforming inputs into outputs, thereby producing a substantial shift in the perceived value-to-price ratio for buyers and users. Previous studies have shown that dynamic capabilities are strongly associated with innovation outcomes across various sectors. For example, in the service sector, dynamic capabilities were reported to positively support innovation in banking (Abdurrahman et al., 2024) and hospitality industries (Burton & Dickinger, 2025). For international firms, these capabilities accelerated innovation and supported internationalization (Hadi & Ali, 2025; Hagen et al., 2024). Among women entrepreneurs in Sri Lanka, dynamic capabilities comprising sensing, learning, integration, reconfiguration, and knowledge sharing supported innovation in turbulent environments (Sriyani et al., 2022). Similarly, women entrepreneurs in India leveraged networking, resilience, and entrepreneurial orientation to develop innovative products during the COVID-19 crisis (Sahi et al., 2023). Based on the reviewed evidence, the second hypothesis is proposed as follows.

H2: Dynamic capabilities are positively associated with women entrepreneurs' innovation.

Innovation is strongly associated with business performance, particularly in increasingly competitive digital markets. Previous studies have shown that innovation enhances the growth of SMEs in Europe (Scuotto et al., 2021), while digital business model innovation improved performance in South Africa and the Netherlands through the adoption of digital technology (van Tonder et al., 2023). Within women-owned businesses, innovation was observed to be positively associated with entrepreneurial performance in China (Huang et al., 2022), entrepreneurial proactiveness and company performance in Greece (Karali et al., 2024), collaborative innovation practices in Vietnam (Lai, 2025), and internationalization among women entrepreneurs in Europe as well as

Central Asia (Machado et al., 2025). Based on these findings, the third and fourth hypotheses are proposed as follows.

H3: Innovation is positively associated with the performance of women entrepreneurs.

H4: Dynamic capabilities are indirectly associated with the performance of women entrepreneurs through innovation.

Dynamic Capabilities, Digital Transformation, and Business Performance

Digital transformation is reshaping economies and societies at an unprecedented scale. Bounfour (2016) defined digital transformation as a new phase in the application of digital artifacts, systems, and symbols within and around organizations. Dynamic capabilities play an important role in enabling digital transformation. Previous studies confirmed that these capabilities support digital transformation and digital adoption in SMEs across various industries (Matarazzo et al., 2021; Soluk et al., 2023; Prakasa & Jumani, 2024). In the context of women entrepreneurs, Kelly & McAdam (2022) found that women actively contributed to digital transformation through the development of new knowledge, skills, and relationships. Building on these insights, the fifth hypothesis is proposed as follows.

H5: Dynamic capabilities are positively associated with women entrepreneurs' digital transformation.

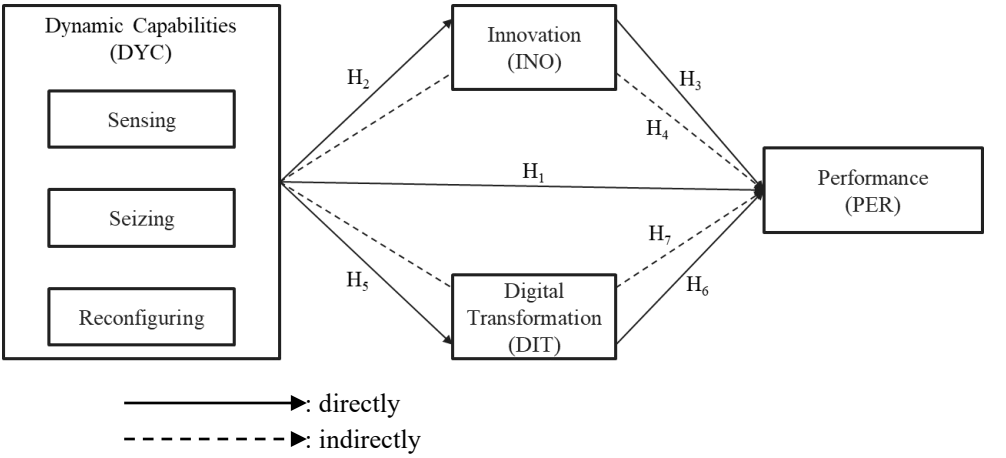
Previous studies have identified digital transformation as an important factor associated with SMEs' performance (Abdurrahman et al., 2024). By helping firms overcome resource constraints and adapt to market changes, digital transformation enhances resilience, flexibility, service quality, and financial performance (Prakasa & Jumani, 2024). Among women entrepreneurs, digital transformation has also been associated with improved entrepreneurial performance in China (Huang et al., 2025). A study conducted in the Czech Republic, Slovakia, Poland, and Hungary further found that digitalization-related knowledge capabilities serve as important indicators of digital transformation for the sustainable development of SMEs. (Belas et al., 2025). On the basis of these considerations, the sixth and seventh hypotheses are proposed as follows.

H6: Digital transformation is positively associated with the performance of women entrepreneurs**.**

H7: Dynamic capabilities are indirectly associated with the performance of women entrepreneurs through digital transformation.

Although dynamic capabilities, innovation, and digital transformation are conceptually related, each construct represents a distinct organizational phenomenon. In the present study, dynamic capabilities are positioned as higher-order strategic capacities that enable innovation and digital transformation to function as operational mechanisms associated with business performance. The conceptual model of this study, grounded in theoretical and empirical literature, is presented in Figure 1.

Figure 1: Conceptual framework model of the study



Source: processed by researchers (2025)

Methods

A quantitative study design was adopted in this study using an associative cross-sectional approach to examine the relationships among dynamic capabilities, innovation, digital transformation, and business performance. The study was conducted in East Java Province, Indonesia. The study focused on women entrepreneurs registered with the Department of Cooperatives and SMEs across thirty-eight regencies and cities in East Java Province. Purposive sampling was applied, and respondents were selected based on the criterion that they had implemented digital marketing in their businesses. Fifteen women entrepreneurs were selected from each

regency and city, representing the service, trade, and manufacturing sectors. This procedure resulted in a total sample of 570 respondents, comprising 190 participants from each sector. Considering the cross-sectional nature of the data, the findings should be interpreted as signifying associative rather than causal relationships.

Data were collected using a structured questionnaire based on a five-point Likert scale in which 1 represented strongly disagree and 5 represented strongly agree. The measurement items were adapted from previously validated studies and refined to suit the context of women entrepreneurs operating SMEs. Dynamic capabilities were treated as an exogenous variable and measured using indicators of sensing, seizing, and reconfiguring adapted from Teece (2009). Innovation, digital transformation, and business performance were specified as endogenous variables. Accordingly, innovation was measured using product, process, and organizational indicators adapted from Feranita et al. (2020). Digital transformation was measured using indicators of digitization, data utilization, networks, customer interfaces, and information exchange adapted from Malewska et al. (2024) while business performance was measured using market share, sales, and profit indicators adapted from Feranita et al. (2020). Several dimensions within the digital transformation and business performance constructs were measured using two-item indicators due to considerations related to questionnaire length and respondent accessibility. Table 1 presents the results of the validity and reliability tests for the study variables.

Table 1: The validity and reliability test results

Variable	**Indicator**	**No. of items**	**Cronbach alpha (α) coefficient**	**Item-total correlation ranges**
Dynamic Capabilities (DYC)	Sensing (DYC1)	4	0.898	0.864 – 0.904
	Seizing (DYC2)	5	0.933	0.843 – 0.935
	Reconfiguring (DYC3)	5	0.908	0.827 – 0.899
Innovation (INO)	Product (INO1)	4	0.923	0.883 – 0.917
	Process (INO2)	4	0.946	0.917 – 0.947
	Organizational (INO3)	4	0.966	0.909 – 0.980
Digital Transformation	Digitization (DIT1)	2	0.838	0.920 – 0.938
	Data (DIT2)	2	0.905	0.952 – 0.962

Variable	Indicator	No. of items	Cronbach alpha (α) coefficient	Item-total correlation ranges
(DIT)	Networks (DIT3)	2	0.898	0.949 – 0.957
	Customer interfaces (DIT4)	2	0.919	0.960 – 0.964
	Information exchange (DIT5)	2	0.872	0.938 – 0.946
Business Performance (PER)	Market share (PER1)	2	0.894	0.949 – 0.952
	Sales (PER2)	2	0.908	0.953 – 0.968
	Profits (PER3)	2	0.931	0.965 – 0.974

Source: processed by researchers (2025)

Instrument validity was assessed through correlation analysis by examining p-values for each item. The results confirmed that all items achieved correlation values with p-values below the significance threshold of 0.05, establishing the validity of each item. Reliability was subsequently assessed using Cronbach's alpha coefficient, with all indicators obtaining values above 0.70, thereby satisfying the recommended reliability threshold. Data collection was carried out between June and August 2025 through questionnaires distributed to respondents via local SME networks and business communities. The collected data were subsequently analyzed using PLS-SEM with SmartPLS 4.0 software.

Results

The present study adopted two forms of descriptive analysis, covering respondent characteristics and variable descriptions. The respondent characteristics examined included business subsector, marital status, entrepreneur age, highest level of education, company age, and business size, from which six primary observations were drawn. First, regarding business subsectors, the service sector was largely concentrated in beauty businesses at 24.7 percent, the trade sector was predominantly represented by grocery stores at 40 percent, and the manufacturing sector was dominated by food and soft drink enterprises at 43.2 percent. Second, married women constituted the overwhelming majority of respondents across all sectors, accounting for 86.8 percent of the sample. Third, most entrepreneurs were between 31 and 40 years of age, representing 29.8 percent of respondents.

Fourth, in terms of educational attainment, senior and vocational high school graduates dominated the sample at 57.7 percent. Fifth, more than a quarter of respondents (26.3 percent) had operated their respective businesses for four to six years. Sixth, micro-sized enterprises were the most prevalent, comprising 78.1 percent of the businesses surveyed. Variable descriptions were analyzed to present the mean scores of each construct. Innovation recorded a moderate mean value across all sectors, while the remaining variables recorded good mean values.

The study applied PLS-SEM to test the formulated hypotheses. Following the guidelines of Hair Jr. et al. (2022), the analysis required evaluation of both the outer model and the inner model. The outer model was assessed as a reflective measurement model, while the inner model was evaluated as a structural model. The reflective measurement model was assessed in four stages. The first stage examined indicator reliability through outer loading values. The second stage assessed internal consistency reliability using Cronbach's alpha and composite reliability. The third stage evaluated convergent validity through the average variance extracted. The fourth stage examined discriminant validity using the heterotrait-monotrait (HTMT) ratio, with the maximum shared squared variance and average shared squared variance compared against the average variance extracted values (Hair Jr. et al., 2022). The results of these assessments are presented in Table 2.

Table 2: Evaluation results of the reflective measurement model

Variable	Indicator	Outer loading	Cronbach's alpha	Composite reliability	AVE	MSV	ASV
Dynamic capabilities (DYC)	DYC1	0.875	0.883	0.885	0.810	0.468	0.435
	DYC2	0.927					
	DYC3	0.898					
Innovation (INO)	INO1	0.898	0.869	0.874	0.792	0.506	0.435
	INO2	0.914					
	INO3	0.857					
Digital transformation (DIT)	DIT1	0.859	0.913	0.913	0.741	0.507	0.436
	DIT2	0.871					
	DIT3	0.867					
	DIT4	0.864					
	DIT5	0.842					

Variable	Indicator	Outer loading	Cronbach's alpha	Composite reliability	AVE	MSV	ASV
Business performance (PER)	PER1	0.932	0.922	0.923	0.866	0.507	0.461
	PER2	0.936					
	PER3	0.923					

Source: processed by researchers (2025)

The evaluation of the reflective measurement model confirmed that all outer loading values exceeded 0.708, satisfying the required standard. Cronbach's alpha and composite reliability values both exceeded 0.70, indicating high levels of reliability as recommended by (Hair Jr. et al., 2022). Average variance extracted values above 0.50 further confirmed that each construct accounted for more than half of the variance in its indicators.

The recommended HTMT ratio threshold is 0.85 or below for acceptable discriminant validity (Hair Jr. et al., 2022). Discriminant validity was further assessed by comparing the maximum shared squared variance and average shared squared variance values against the average variance extracted, where shared variance is defined as the squared correlation coefficient of the latent variables (Fornell & Larcker, 1981). Discriminant validity is established when the average variance extracted exceeds both the maximum shared squared variance and the average shared squared variance (Hair Jr. et al., 2022). As presented in Table 2, the average variance extracted for all constructs exceeded both shared variance measures, and Table 3 confirms that all HTMT ratio values fell below the 0.85 threshold, satisfying the criterion for discriminant validity.

Table 3: Evaluation results of the discriminant validity

	DIT	DYC	INO	PER
DIT				
DYC	0.761			
INO	0.647	0.778		
PER	0.775	0.674	0.794	

Source: processed by researchers (2025)

The structural model was evaluated across four stages. The first stage examined collinearity using the variance inflation factor. As shown in Table 4, all variance inflation factor values were below 5, indicating that

collinearity did not present a significant concern in the model. The second stage assessed the relationships among constructs through estimated path coefficients and their corresponding significance levels. Standardized path coefficient values ranging from negative one to positive one reflected the strength and direction of the hypothesized relationships. Statistical significance was determined using empirical t values and p values, where results at the five percent significance level were considered significant when the empirical t value exceeded 1.96 or the p value fell below 0.05. The path coefficient estimates and their significance values are presented in Table 4.

Table 4: VIF, path coefficient values, and significance values

Hypothesis		VIF	Path coefficient value			Significance value (p)			Hypothesis testing
			Service	Trade	Manu-facturing	Service	Trade	Manu-facturing	
H1	DYC→PER	2.453	0.062	0.004	0.010	0.399	0.891	0.962	Rejected
H2	DYC→INO	1.000	0.611	0.702	0.720	0.000	0.000	0.000	Accepted
H3	INO→PER	1.957	0.425	0.420	0.522	0.000	0.000	0.000	Accepted
H4	DYC→INO → PER	-	0.260	0.295	0.376	0.000	0.000	0.000	Accepted
H5	DYC→DIT	1.000	0.697	0.685	0.677	0.000	0.000	0.000	Accepted
H6	DYC→PER	1.966	0.537	0.422	0.428	0.000	0.000	0.000	Accepted
H7	DYC→DIT → PER	-	0.374	0.289	0.289	0.000	0.000	0.000	Accepted

Source: processed by researchers (2025)

Based on the results in Table 4, all variables in the model recorded positive path coefficient values across the service, trade, and manufacturing sectors. The significance testing yielded consistent patterns across all three sectors, indicating that six of the seven proposed hypotheses were supported. The structural relationship analysis revealed that only the hypothesized direct relationship between dynamic capabilities and business performance was not statistically significant, resulting in the rejection of H1. The remaining direct hypotheses, H2, H3, H5, and H6, were all supported. The mediation analysis further confirmed that both proposed mediation pathways, H4 and H7, were statistically significant. These results indicate that dynamic capabilities are associated with business performance primarily through the mediating roles of innovation and digital transformation rather than through a direct relationship. The results of the total association analysis for each sector are presented in Table 5.

Table 5: Total association results

Sector	Association	DYC→PER	DYC→INO→PER	DYC→DIT→PER
Service	Direct	0.062		
	Indirect		0.260	0.374
	Total		0.322	0.436
	Percentage		32.2	43.6
Trade	Direct	0.004		
	Indirect		0.295	0.289
	Total		0.299	0.293
	Percentage		29.9	29.3
Manufacturing	Direct	0.010		
	Indirect		0.376	0.289
	Total		0.386	0.299
	Percentage		38.6	29.9

Source: processed by researchers (2025)

From a total-association perspective, digital transformation showed a relatively stronger mediating association than innovation in the service sector. However, in the trade and manufacturing sectors, innovation reflected a relatively stronger mediating association than digital transformation. Following confirmation that the model was free of collinearity issues and that the hypothesized paths were meaningful, the explanatory power of the model was assessed using the R^2, adjusted R^2, and F^2 values presented in Table 6.

Table 6: Evaluation results of the model's explanatory power

Construct	R^2	Adjusted R^2	f^2 effect size
DYC → PER			0.000
DYC → INO			0.873
INO → PER			0.302
DYC → DIT			0.881
DIT → PER			0.300
DIT	0.468	0.468	
INO	0.466	0.465	
PER	0.642	0.641	

Source: processed by researchers (2025)

The R^2 value measures the extent to which exogenous constructs explain the variance of endogenous constructs. According to Hair Jr. et al. (2022), R^2 values of 0.75, 0.50, and 0.25 indicate substantial, moderate, and weak explanatory power, respectively. In the present study, the R^2 values for digital transformation (0.468) and innovation (0.466) indicated moderate explanatory power, while the R2 value for performance (0.642) suggested relatively substantial explanatory power of the structural model. The close correspondence between the R^2 and adjusted R^2 values further indicated that the model demonstrated stable explanatory capability with minimal overfitting. The f-squared value assesses the contribution of each predictor to the variance of the endogenous construct, with effect sizes defined as 0.02 for small, 0.15 for medium, and 0.35 for large (Hair Jr. et al., 2022). The results indicated that dynamic capabilities demonstrated significant associations with innovation and digital transformation, while their association with performance was not statistically significant. Structurally, the relationship between dynamic capabilities and performance appeared to operate indirectly through innovation and digital transformation, which is consistent with H4 and H7.

Table 7: Evaluation results of the model's predictive power

Construct	Q^2 Predict	RMSE PLS-SEM	RMSE LM
INO	0.390	2.959	2.975
	0.412	3.029	3.040
	0.299	3.439	3.448
DIT	0.369	1.476	1.483
	0.381	1.533	1.540
	0.344	1.525	1.531
	0.329	1.380	1.384
	0.299	1.494	1.500
PER	0.325	1.437	1.439
	0.327	1.457	1.458
	0.304	1.508	1.512

Source: processed by researchers (2025)

The final step includes assessing the model's predictive power using the Q-squared value and comparing the root mean squared error of the PLS-SEM with that of the linear regression model (Hair Jr. et al., 2022). The Q-squared values for all endogenous constructs exceeded zero, confirming that the model possessed relevant predictive ability. The PLSpredict results were

further supported by comparing the root mean squared error values of both models, with Table 7 showing that the root mean squared error of the PLS-SEM across all indicators was lower than that of the linear regression model, which is consistent with strong predictive ability (Hair Jr. et al., 2022).

Model fit in PLS-SEM was evaluated using the standardized root mean squared residual, d_ULS, d_G, and the normed fit index (NFI) (Garson, 2016). A model is considered to have a good fit when the standardized root mean squared residual is below 0.08 and the NFI exceeds 0.90. The d_ULS and d_G values signal a significant difference between the covariance matrix of the empirical factor model and that of the composite factor model. As presented in Table 8, the standardized root mean squared residual, d_ULS, d_G, and NFI values collectively confirmed an acceptable model fit.

Table 8: Model fit values

Model Fit	Estimated Model
SRMR	0.053
d_ULS	0.293
d_G	0.139
NFI	0.926

Source: processed by researchers (2025)

Discussion

This study examined the associations between dynamic capabilities and the performance of women entrepreneurs through the mediating roles of innovation and digital transformation across the service, trade, and manufacturing sectors. The results showed that dynamic capabilities were not significantly associated directly with business performance but reflected significant indirect associations through innovation and digital transformation. These findings further suggested that dynamic capabilities functioned more as strategic capacities enabling women entrepreneurs to respond effectively to environmental changes through operational mechanisms such as innovation and digital transformation. It also strengthened the argument that dynamic capabilities often operate through mediating mechanisms, particularly processes, before producing measurable

performance outcomes. Conceptually, these results are consistent with the dynamic capabilities framework proposed by Teece (2009), which emphasized that the value of dynamic capabilities becomes evident when an organization translates sensing, seizing, and reconfiguring capacities into concrete activities.

The observations made in this study offer a different perspective from many previous studies that established a direct relationship between dynamic capabilities and business performance in SMEs. For example, a study of SMEs in Vietnam found that dynamic capabilities were positively associated with business performance by enabling organizations to learn and reconfigure resources (Van Tran et al., 2024). Another study conducted in China similarly showed that dynamic capabilities enhanced competitive advantage and impacted business performance (Wang et al., 2024). In the context of women entrepreneurs, however, this relationship was not direct, consistent with the results of the present study. This difference may be attributed to the nature of microenterprise-dominated businesses with limited resources, which rendered dynamic capabilities insufficient to generate performance impacts without the support of operational mechanisms.

The present study further strengthened the argument that dynamic capabilities were strongly associated with innovation, which in turn positively influenced business performance. Its findings are consistent with previous explorations showing that dynamic capabilities served as an organizational mechanism for identifying opportunities and fostering innovation. For instance, a study conducted in the European hospitality sector reported that sensing and seizing capabilities drove firms to develop innovative products and services (Burton & Dickinger, 2025). Another study of international companies additionally reported how dynamic capabilities accelerated innovation and enhanced organizational competitiveness (Hadi & Ali, 2025). The results of the present study confirmed that innovation represented one of the primary pathways connecting dynamic capabilities to improved business performance.

Beyond innovation, the study found that dynamic capabilities were significantly associated with digital transformation, which was also positively associated with improved business performance. This finding was consistent with prior studies, which observed that dynamic capabilities played an essential role in the adoption and implementation of digital transformation in SMEs. A study of SMEs in Italy reported that dynamic

capabilities supported by organizational learning accelerated digital transformation (Matarazzo et al., 2021). Another study equally found that an organization's ability to integrate resources and utilize digital technology contributed to increased flexibility and business performance (Prakasa & Jumani, 2024). The results of the present study, therefore, reinforced the view that digital transformation served as an important organizational mechanism through which firms leveraged dynamic capabilities in an increasingly digitalized business environment.

The cross-sector analysis provided additional insights into how the performance mechanisms of women entrepreneurs differed across sectors. In the service sector, digital transformation showed a stronger mediating role between dynamic capabilities and business performance, reflecting the sector's reliance on customer interaction, service experience, and digital technology to improve accessibility, efficiency, and customer value (Verhoef et al., 2021). Within this context, digital transformation functioned as a strategic mechanism connecting dynamic capabilities with business performance (Kraus et al., 2018). In the trade and manufacturing sectors, innovation showed a stronger mediating role than digital transformation. These sectors depended more heavily on product development, process efficiency, and adaptation of business models and production technologies to maintain competitiveness. Accordingly, innovation represented the primary mechanism through which dynamic capabilities were associated with business performance in the observed sectors (Nambisan et al., 2017).

From a gender perspective, the observations made an important contribution to the literature on women's entrepreneurship. As stated in a prior exploration, women entrepreneurs often faced various structural barriers such as limited access to capital, business networks, and digital technology Srividhya & Paramasivam, 2022). The present study expanded this perspective by showing how improving women's business performance depended not only on reducing structural barriers but also on the ability of women entrepreneurs to develop dynamic capabilities that enabled the group to effectively leverage innovation and digital transformation. Accordingly, the study positioned women not only as a group facing limitations in entrepreneurship but as strategic actors capable of developing dynamic capabilities to drive improved business performance.

Conclusion

In conclusion, this study examined the associations between dynamic capabilities and the performance of women entrepreneurs through the mediating roles of innovation and digital transformation across the service, trade, and manufacturing sectors in East Java Province, Indonesia. The obtained results showed that dynamic capabilities did not have a significant direct effect on business performance but were significantly associated with performance outcomes through innovation and digital transformation. These observations suggested that dynamic capabilities functioned as higher-order strategic capacities enabling women entrepreneurs to generate measurable performance improvements through operational mechanisms rather than through direct influence. The cross-sector analysis further reflected that digital transformation served as a stronger mediating pathway in the service sector, while innovation was found to be the stronger mediating mechanism in the trade and manufacturing sectors, signifying the distinct characteristics and competitive demands of each sector.

The findings carried several practical implications for women entrepreneurs and policymakers. For women entrepreneurs, strengthening both innovation and digital transformation was found to be important for improving business performance. Dynamic capabilities were associated with stronger innovation and digital transformation outcomes through the development of new business models, digital marketing strategies, and enhanced customer interaction. For policymakers, the findings emphasized the importance of designing sector-specific entrepreneurship policies. Given the stronger association between digital transformation and business performance in the service sector, supportive policies should prioritize the development of digital capabilities, improved access to digital technologies, and the effective utilization of digital platforms. In the trade and manufacturing sectors, where innovation showed stronger associations with performance, programs emphasizing product, process, and organizational innovation are needed to strengthen long-term competitiveness and business sustainability. These implications should primarily be interpreted within the context of women-owned SMEs in East Java, Indonesia.

The present study is subject to several limitations that should be acknowledged. First, including women entrepreneurs from diverse business subsectors may have introduced heterogeneity into the results. Second, the cross-sectional study design did not allow for the observation of long-term

changes in dynamic capabilities, innovation, and digital transformation, and the findings should hence be interpreted as reflecting associative rather than causal relationships. Third, the geographic focus on East Java Province limited the generalizability of the findings to other institutional, cultural, and economic contexts. Future studies are encouraged to examine specific sectors in greater depth, adopt longitudinal designs, and broaden the geographical scope through national or cross-country comparisons. Additionally, several constructs were measured using only two-item indicators, particularly within the digital transformation and business performance dimensions. Although all reliability and validity thresholds were satisfied, future studies should adopt broader multi-item measurement scales to enhance measurement stability and construct coverage.

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ORIGINAL SCIENTIFIC PAPER

Barriers to Accessing Entrepreneurial Support: Evidence from Rural Women Entrepreneurs in Morocco's INDH



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A B S T R A C T

For rural women in Morocco, entrepreneurship represents a hope of surviving for themselves and their families. In the majority of cases, these women are young, married with children and are in precarious conditions. This study aims to investigate the barriers preventing rural women from attending and completing a free entrepreneurship support program. This represents a paradoxical phenomenon that has not been studied in the existing literature. Semi-structured interviews and field observations were conducted to identify nine main barriers, which were subsequently statistically tested on a sample of 100 women who had registered in the INDH's entrepreneurial support program in a rural area of Morocco, using cross-tabulations, chi-square tests, Cramer's V, and binary logistic regression. The results revealed that inconvenient training schedules (B3) emerged as the factor most strongly associated with support status, with women reporting

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this problem showing markedly lower odds of accompaniment. The fear of wasting time and money without a guarantee of funding (B8) is negatively related to the likelihood of completing the training. Conversely, financial hardship (B9) is positively associated with support, women in precarious conditions being more strongly represented among the accompanied, a result that runs counter to the initial hypothesis and warrants cautious interpretation. Improving logistical and organizational arrangements and taking into consideration the economic and cultural specificities of the population could optimize the number of women gaining value from entrepreneurial support programs.

KEYWORDS: *female entrepreneurship, support entrepreneurship, necessity, barriers, Morocco, rural entrepreneurship, INDH, rural areas*

Introduction

Women are the cornerstones of society and make a major contribution to the sustainable development of civilizations. Today, female entrepreneurship is perceived as the foundation of an inclusive and non-discriminatory ecosystem (Rharzouz et al., 2024).

In Morocco, numerous programs have emerged over the years to support women with entrepreneurial projects, particularly in rural areas. Among these initiatives, the National Initiative for Human Development (INDH), especially through the third program of its third phase launched in 2019, stands out as one of the most comprehensive government-led accompaniment initiatives, offering not only free entrepreneurial training but also equipment funding and post-creation follow-up support (INDH, 2025).

Although the aim of entrepreneurial support is to help women strengthen their entrepreneurial capabilities through continuous monitoring and training, many women continue to face barriers that prevent them from fully benefiting from it. Existing research has extensively documented the barriers preventing women from starting businesses, including socio-cultural constraints, financial limitations, and lack of family support (Constantinidis et al., 2017; Panda, 2018).

However, a critical and largely overlooked question remains: what prevents rural women who have already registered for a free, government-funded entrepreneurial support program from attending and completing it effectively? Unlike prior studies that examine why women do not start businesses, this research investigates a more specific and paradoxical

phenomenon: the abandonment of a support program that removes the most commonly cited barriers in the literature, namely cost and access to funding. Despite the availability of such programs in Morocco, their uptake by women entrepreneurs remains significantly low (Bouarir et al., 2023).

This research addresses this issue by investigating the associations between categories of barriers and women's attendance at INDH training sessions in a rural area of Morocco. The survey helped identify respondents' training status and facilitated analysis of the challenges preventing rural women from attending entrepreneurial accompaniment sessions, despite having voluntarily enrolled in the program.

The dual contribution of this article is: providing a conceptual model of barriers across research hypotheses, and delivering a statistical validation of the significance and weight of each barrier through cross-tabulation, Chi^2 tests and logistic regression.

This paper begins with an overview of the relevant literature and the development of the research hypotheses, followed by a description of the methodological choices and data collection process. The results are then presented and discussed, and the paper concludes with a discussion of limitations and directions for future research.

Literature Review

From Barriers to Entrepreneurship to Barriers to Participation in Entrepreneurial Support

The literature on women's entrepreneurship in developing contexts overwhelmingly addresses the barriers that prevent women from becoming entrepreneurs, such as unequal access to education, restricted access to capital, and social norms that confine women to the domestic sphere (Constantinidis et al., 2017; Panda, 2018; Ramle & Mardikaningsih, 2024). These are barriers to entry into entrepreneurship, and they are extensively documented. A conceptually distinct question, however, concerns the barriers that prevent a woman already enrolled in a support program from actually attending it and completing it. This second question surfaces only at the margins of existing work. Studies on women's training address participation constraints without treating them as a distinct object of investigation. Azam Roomi and Harrison (2010) show how mobility and the organization of daily life shape women's effective attendance in training

programs, while Bullough et al. (2015) identify the contextual and human factors that determine whether a program reaches its objectives. Moreover, research on entrepreneurial training in emerging economies has primarily focused on the effects of training on performance (Bhardwaj, 2014) rather than on the obstacles to accessing it. More recently, Miković et al. (2026) observe that mentorship provision in emerging markets remains fragmented and insufficiently systematized, and call for greater accessibility for women in rural and underserved areas. Other recent studies have examined rural women's participation in entrepreneurial initiatives. Vujadinović and Marjanović (2025) identify limited access to finance and to training as the main obstacles faced by rural women in Serbia, while Kabir et al. (2022) show that engagement in agro-entrepreneurship improves their socio-economic status in Bangladesh. These studies shed light on rural women's entry into entrepreneurial activity or its effects, but not on the obstacles that prevent a woman already enrolled in a support program from actually participating.

This blind spot matters all the more because the phenomenon under study is paradoxical. The INDH program removes precisely the barrier that the entry literature identifies as decisive, the financial one, since participation is free and equipment funding is available. And yet women withdraw. This suggests that other obstacles exist, distinct from the barriers to entrepreneurship that precede any program. In the absence of a dedicated body of literature on barriers to participation, the hypotheses that follow are grounded in the broader empirical literature on barriers to women's entrepreneurship, mobilized here as a heuristic base rather than as an equivalence, and transposed to the specific context of entrepreneurial support programs.

Panda (2018) and Sukhija (2024) identify several categories of constraints faced by women entrepreneurs in developing countries, including infrastructure, work-family balance, and access to funding. Mersha and Sriram (2018) confirmed empirically that women entrepreneurs in emerging economies report lower business and entrepreneurial skill sets compared to their male counterparts, which may reduce their ability to fully engage with and benefit from structured training programs. Arab Muslim women entrepreneurs, particularly those in rural Morocco, may face a combination of socio-cultural and structural constraints that shape both their motivations and their trajectories. These constraints may stem from gender inequalities, geographic isolation, and poverty. In addition, community and

traditional norms greatly influence their decision-making and autonomy (Constantinidis et al., 2017; Tlaiss & McAdam, 2021). Giannella et al. (2025) showed that women in rural areas are, in most cases, necessity-driven entrepreneurs who did not choose entrepreneurship as a career opportunity. This has a significant impact on their attitude toward support programs and institutional assistance. However, no study has empirically tested which of these barriers specifically prevent enrolled women from completing a free government-funded program.

H1: Mobility issues remain a primary challenge preventing women from attending the training sessions.

H2: Lack of understanding the training language and limited entrepreneurial skills reduce women's engagement in the support initiative.

Program Offerings and Effective Access: A Noticeable Gap

Despite the proliferation of entrepreneurial support programs in Morocco, their uptake by women remains significantly low (Bouarir et al., 2023). Jabbouri et al. (2024) demonstrate that local entrepreneurial initiatives targeting rural women in Morocco can have a meaningful empowerment impact, but only when they successfully address the structural and cultural barriers that formal programs tend to overlook. Similarly, Bullough et al. (2015) stress that the design of a training program, its human factors and its contextual environment condition whether women can effectively benefit from it, suggesting that simply providing training free of charge does not guarantee effective participation or uptake.

Although most government support programs are technically free of charge, rural Moroccan women, especially those married with children, bear hidden costs such as transportation fees and childcare costs during sessions. The World Bank (2022) confirms, in its report, that these two constraints place a particularly heavy burden on women living in rural areas. So, the fact that a program is listed as free of charge does not reflect its actual cost to a woman who has to pay for transportation or find someone to look after her children when she is not available.

H3: Administrative and organizational planning is the major structural barrier that affects women's participation in the program.

H4: Family-related constraints, including patriarchal norms and childcare responsibilities, significantly affect women's attendance at training sessions.

Personal and Psychological Barriers: Decisive Factors in Commitment

Beyond structural constraints, individual and psychological factors significantly shape women's willingness to engage with support programs. Low self-confidence and fear of failure represent major obstacles to women's engagement with entrepreneurial accompaniment structures (Wieland et al., 2018). Minniti and Nardone (2007) highlight that fear of failure generates significant gender differences in entrepreneurial behavior, with women being systematically more risk-averse and more likely to disengage from entrepreneurial activities when outcomes are uncertain. In rural Moroccan communities, this psychological dimension is further amplified by the perception that training sessions are an investment of time and money with no guaranteed return, particularly for women whose entrepreneurial activity is primarily driven by economic and financial necessity rather than by aspirations for skill development (Giannella et al., 2025).

In addition, the literature links women's participation to psychological resources. Tejada and Camino (2024) show, in a different professional context, that psychological capital (self-efficacy, resilience, optimism, and hope) reduces stress, and that this effect is more pronounced among women than among men. Applied to entrepreneurial coaching, this finding suggests that a lack of these resources may weigh more heavily on women in a training setting that is perceived as challenging.

H5: Fear of failure combined with low self-confidence significantly reduces women's access to entrepreneurial accompaniment.

H6: Financial challenges such as poverty and the continuous need to generate income represent the foremost limitations preventing women's participation in support sessions.

Methodology

Research Design and Data Collection

This research is based on an exploratory sequential design combining qualitative and quantitative phases. The qualitative phase served to identify the barriers to attending entrepreneurial training through semi-structured interviews and direct field observation. On this basis, a quantitative phase was conducted to statistically test and validate the weight of each identified barrier.

Semi-structured interviews were conducted with three categories of women entrepreneurs enrolled in the INDH program in a rural area of Morocco. Participants were identified through purposive sampling, drawing on in-depth field knowledge to facilitate access to diverse profiles and foster a climate of trust.

According to the platform's staff, women represented approximately 15% of the accompanied persons, and among women who completed the training, more than 50% received material funding. These figures illustrate both the low female representation in this area and the central paradox of this study: despite the free accompaniment and the availability of funding, women's effective access to the program remains limited.

A sample of 100 women aged between 20 and 45 years was selected, ensuring the inclusion of women at different stages of engagement in the program in order to cover the full spectrum of possible trajectories, from enrollment to training completion. Interviews were conducted in person or by phone depending on each respondent's circumstances, and their duration ranged from 5 to 25 minutes. To preserve anonymity, each respondent was assigned the code Fx, where x is a randomly assigned number.

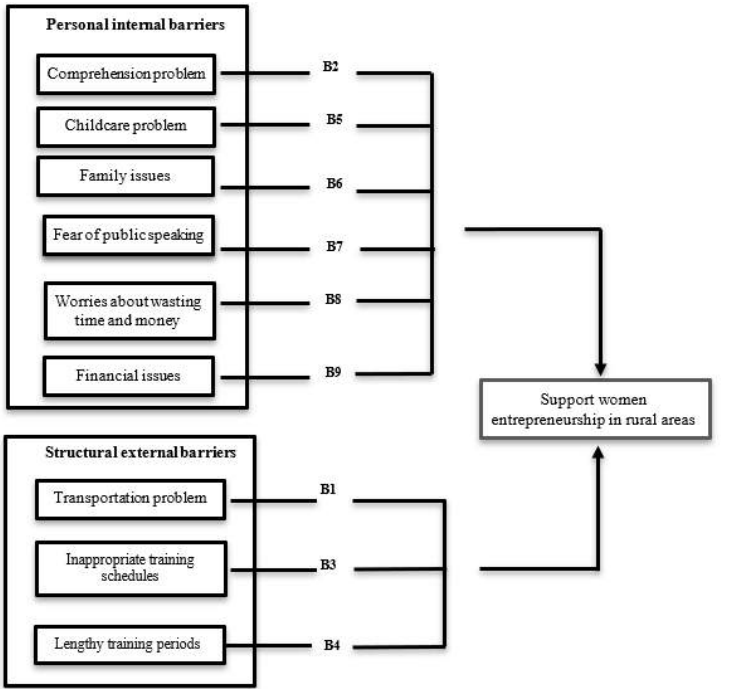
Respondents were divided into three groups according to their level of engagement in the program. The first group (G1) includes women who completed the entrepreneurial training and received INDH material funding. The second group (G2) includes women who attended training sessions but did not receive financial support. The third group (G3) includes women who enrolled in the program but did not attend part or all of the training sessions, in order to understand the real reasons for their disengagement.

We identified nine recurring barriers hindering effective access to entrepreneurial accompaniment in rural areas which are: transportation problem (B1), comprehension problem (B2), inappropriate training

schedules (B3), lengthy training periods (B4), childcare problem (B5), family issues (B6), fear of public speaking (B7), worries about wasting time and money (B8), and financial issues (B9). Based on these findings, a structured file was developed in which each barrier was operationalized as a binary variable (1 = problem present, 0 = problem absent). Figure 1 presents the analytical framework of the variables and their classification into personal internal barriers and structural external barriers.

Data Processing Approach

Figure1: Analytical Framework of Barrier Variables and Their Categorization



Source: Authors

Cross-tabulations first described the sociodemographic profile of the studied population and the occurrence of each barrier by group. Chi² tests were then performed using IBM SPSS to compare the three groups, and subsequently to compare women who attended all the training sessions (G1 and G2) with those who did not (G3). A p-value below 0.05 indicated a significant relationship between variables. Cramer's V was then calculated

to quantify the strength of association between each significant barrier and support status. Finally, a binary logistic regression was performed using two methods: Forward LR for predictor identification and Enter for confirmatory testing. The dependent variable was support status, defined based on training attendance: women who attended all sessions (G1 and G2) were coded as supported = 1, and those who did not (G3) as not supported = 0.

Results and Discussion

Sociodemographic Profile of Respondents

Table 1: Sociodemographic profile of respondents

Marital status/ Age group (years)	Single	Married	Divorced	Total
Under 25	13	3	0	16
25-35	12	33	4	49
35-45	3	28	4	35
Total	28	64	8	100

Source: Authors' calculations

Figure 2: Geographic proximity of respondents to the support platform location



Source: Authors

The sociodemographic profile of respondents shows that nearly half of the women interviewed were aged between 25 and 35 years old (49%), and the majority were married (64%), with most married and divorced women having children, as confirmed by the interviews. This profile is consistent with the literature on necessity-driven female entrepreneurship in developing countries, where women in this age bracket simultaneously face the highest concentration of domestic, parental, and professional

responsibilities (Giannella et al., 2025). Zakani (2024) similarly found that 80% of women entrepreneurs in Morocco fall within the 22 to 40 age bracket, confirming that this demographic represents the core population targeted by entrepreneurial support programs. The predominance of married women with children in the sample is not incidental. It directly shapes the nature and intensity of the barriers they encounter when attempting to engage with institutional support programs, as household and childcare obligations impose time constraints that are often not taken into account.

Equally significant is the geographic distribution of respondents. Three-quarters of the women surveyed (75%) reported living far from the training platform, while only 25% lived nearby. In rural Moroccan contexts, this distance translates into real financial and time costs. The World Bank (2022) highlights that inadequate transportation infrastructure disproportionately constrains rural women's economic participation, even when support programs are nominally free of charge. This territorial dimension introduces a form of differences in access linked to geographic proximity: women who happen to live closer to the platform enjoy a beneficial advantage that has nothing to do with their motivation or entrepreneurial capacity. This finding calls for reconsidering the geographic boundaries used to define coverage areas, since grouping women living one hour away with those living five minutes away creates artificial equality that does not reflect real access conditions.

Distribution of Barriers Across Groups

Table 2: Percentage of interviewees reporting each barrier by group

Barrier Group	B1	B2	B3	B4	B5	B6	B7	B8	B9
G1	16	6	17	18	6	0	4	7	10
G2	29	10	33	33	15	12	18	26	22
G3	30	7	34	30	18	7	14	25	11
Total*	**75**	**23**	**84**	**81**	**39**	**19**	**36**	**58**	**43**

Source: Authors' calculations

*Note: * Percentages are calculated on the total sample (N=100). The « Total » row is the overall proportion reporting each barrier*

The cross-tabulation of barriers across the three groups reveals several analytically significant patterns. Among women who successfully

completed training and received equipment funding (G1), barriers were present but did not constitute insurmountable obstacles. Inappropriate training schedules (B3: 17%) and lengthy training periods (B4: 18%) were also present among women in this group, suggesting that even motivated and ultimately successful participants acknowledged structural friction in the program design. The complete absence of family issues in G1 (B6: 0%) is particularly noteworthy: it suggests that women with stronger household support systems appear to be more represented among program completers. This suggests that women who benefit from stronger family support may be more likely to complete the training. It is also worth noting that women in G1 tended to present projects that stood out from the repetitive proposals commonly submitted in the same area. Attending training sessions gave them the opportunity to receive guidance and refine their projects. This likely increased their chances of being selected for equipment funding. Women who did not attend all sessions missed this kind of orientation and therefore had less opportunity to differentiate their projects.

Among women who attended training without receiving funding (G2), the barrier profile is noticeably more pronounced. In this group, training schedules and durations were the most frequently reported barriers (33%), alongside transportation difficulties (B1: 29%), worries about wasting time and money (B8: 26%), and financial issues (B9: 22%). This pattern suggests that the absence of material reward at the end of the accompaniment process may be associated with progressive disengagement. Women who invest time and resources without a guaranteed outcome may withdraw before reaching the funding stage.

Among women who were unable to attend the training sessions (G3), the barrier profile closely mirrors that of G2, with training schedules (B3: 34%), lengthy training periods (B4: 30%), transportation difficulties (B1: 30%), and worries about wasting time and money (B8: 25%) all exceeding or approaching the 30% mark. This convergence between G2 and G3 is one of the most analytically significant findings of this study. It suggests that the barriers preventing full engagement and the barriers causing complete disengagement are largely the same, differing in intensity rather than in nature. This observation implies that G2 are at high risk of becoming G3 in subsequent program cycles if structural interventions are not introduced early in the accompaniment process.

Although awareness campaigns were occasionally organized in remote areas, the training sessions remained centralized at the platforms, and

participants were sometimes notified a few days in advance, leaving insufficient time for organization. In addition, some women said that they had to take multiple forms of public transport or leave their homes very early in the morning to arrive on time. Repeating this several times in one or two months represents a high invisible cost that the program could not fully account for.

Overall, more than 80% of all respondents identified inappropriate training schedules (B3: 84%) and lengthy training periods (B4: 81%) as major obstacles, while 75% reported transportation difficulties (B1). These figures point to a fundamental misalignment between the training operational design and the daily realities of its target population. As Constantinidis et al. (2017) observed in their analysis of Moroccan rural women cooperatives, standardized accompaniment models that fail to account for the specific time and mobility constraints of rural women may be less effective regardless of their financial generosity.

The fact that 39% of the respondents reported childcare problems (B5) suggests that training sessions did not always accommodate women with young children, which is consistent with World Bank (2022) findings on rural Moroccan women's caregiving constraints.

Chi² Testing and Strength of Associations

Table 3: Chi² test summary chart

Barrier	Chi²	df	p-value	Significance
B1	3.514	2	0.173	Not significant
B2	0.406	2	0.816	Not significant
B3	6.923	2	**0.031**	**Significant**
B4	1.021	2	0.600	Not significant
B5	3.851	2	0.146	Not significant
B6	7.400	2	**0.025**	**Significant**
B7	3.916	2	0.141	Not significant
B8	8.889	2	**0.012**	**Significant**
B9	3.135	2	0.209	Not significant

Source: Authors' calculations

Table 4: Power of connection between each barrier and support category

Barrier	Chi² (df)	p-value	Cramer's V	Significance	Association strength
B1	3.297(1)	0.069	0.182	Not significant	Weak
B2	0.274(1)	0.601	0.052	Not significant	Very weak
B3	6.920(1)	**0.009**	0.263	**Significant**	Weak
B4	0.778(1)	0.378	0.088	Not significant	Very weak
B5	3.496(1)	0.062	0.187	Not significant	Weak
B6	0.035(1)	0.852	0.019	Not significant	Very weak
B7	0.374(1)	0.541	0.061	Not significant	Very weak
B8	3.986(1)	**0.046**	0.200	**Significant**	Weak
B9	2.942(1)	0.086	0.172	Not significant	Weak

Source: Authors' calculations

Chi² tests across the three groups identified three barriers with statistically significant associations with training status: inappropriate training schedules (B3: p=0.031), family issues (B6: p=0.025), and worries about wasting time and money (B8: p=0.012). After regrouping participants into trained and untrained categories, Cramer's V analysis confirmed that B3 and B8 maintained significant associations with support status, with weak effect sizes (V=0.263 and V=0.200, respectively).

In a small purposive sample, weak associations are statistically expected and do not diminish the practical significance of the findings (Kotrlik et al., 2011). The association between scheduling constraints and program dropout was consistently observed across the different analytical methods applied. This consistency across analytical methods strengthens the credibility of the finding.

The disappearance of B6 family issues in the trained/untrained analysis is particularly interesting. Although H4 was not confirmed as an independent predictor in the regression model, family issues were identified as significant in the three-group Chi² analysis (p=0.025). This can show that this barrier operates differently depending on the stage of engagement: real at the early stages, but potentially overcome when women perceive a genuine chance of being funded and focus on developing their projects.

While H1 and H2 were not statistically confirmed in the Chi² and regression analyses, their descriptive relevance remains significant. Transportation difficulties were reported by 75% of respondents and comprehension problems by 23%, suggesting that these barriers are widely

present but do not statistically differentiate trained from untrained women, as further discussed below.

The non-significance of transportation (B1) at this stage of the analysis as an apparent paradox can be explained by the fact that transportation difficulties, while widely shared, do not discriminate between trained and untrained women. In reality, they are a universal burden that all groups bear equally, and therefore do not explain the differential in outcomes between groups. This can be interpreted to mean that the decisive factor is not whether women face obstacles, but whether they can find enough flexibility to overcome them. This finding has direct policy implications: addressing transportation alone would not reduce the gap between G2 and G3, as it is not what statistically differentiates them.

These statistical findings are consistent with observations made in the field. Many participants reported that it was particularly difficult for them to attend all the sessions during the week, as other obligations made regular attendance practically impossible. In Morocco, for instance, Friday is a day of prayer and of the traditional family couscous meal, two cultural and religious observances that make it one of the busiest days of the week for rural women. Scheduling sessions on such a day can constitute a barrier itself. This scheduling choice reflects a broader trend already identified in the literature, namely that support programs are sometimes designed without taking into account the cultural and social specificities of their target population (Constantinidis et al., 2017; Tlaiss & McAdam, 2021). They therefore tend to create structural barriers that could be reduced through better anticipation.

Direct Effects of Barriers on Supporting Status: Binary Logistic Regression

Table 5: Forward logistic regression results (LR method)

Predictor	B	E. S	Wald	Df	p-value	Exp(B)	95%CI (Lower – Upper)
B3 Inappropriate training schedules	-2.322	1.056	4.833	1	**0.028**	0.098	0,012-0,777
Constant	2.708	1.033	6.875	1	0.009	15.000	

Source: Authors' calculations

Table 6: Confirmatory analysis results (Enter method)

Predictor	B	E. S	Wald	df	p-value	Exp(B)	Interpretation
B1 Transportation problem	-0.964	0.637	2.293	1	0.130	0.381	ot significant
B2 Comprehension problem	0.918	0.611	2.254	1	0.133	2.504	Not significant
B3 Inappropriate training schedules	-1.985	1.141	3.024	1	0.082	0.137	Not significant
B4 Lengthy training periods	0.266	0.699	0.144	1	0.704	1.304	Not significant
B5 Childcare problem	-0.733	0.507	2.091	1	0.148	0.480	Not significant
B6 Family issues	0.673	0.647	1.083	1	0.298	1.961	Not significant
B7 Fear of public speaking	-0.081	0.561	0.021	1	0.885	0.922	Not significant
B8 Worries about wasting time and money	-1.271	0.616	4.265	1	**0.039**	0.281	Negatively Significant
B9 Financial issues	1.420	0.562	6.389	1	**0.011**	4.137	Positively Significant
Constant	3.136	1.182	7.039	1	0.008	23.009	

Source: Authors' calculations

The Forward LR method identified inappropriate training schedules (B3) as the sole statistically significant predictor of support status (B = -2.322; p = 0.028; Exp(B) = 0.098). Pointing out scheduling conflicts is associated with approximately 90% lower odds of being classified as supported. This result is consistent with Hypothesis H3. In fact, according to these women, most training sessions were scheduled at times that conflicted directly with their daily obligations. In reality, some women are engaged in income-generating activities during these hours, others were helping their husbands at work, and many had no one to take care of their children or pick them up from school. The program's official cost is free, yet participants bear costs that are not taken into account (such as the journey to the platforms) and, above all, the opportunity cost borne by women who engage in income-generating activities or who must arrange childcare. For a woman

whose informal work supports her family, attending sessions at these times amounts to suspending the very source of income that formalization is supposed to guarantee, which turns the schedule itself into a barrier. This is consistent with the findings of the World Bank (2022), which highlights childcare and domestic obligations as major constraints on rural women's economic participation in Morocco.

The Enter method identified two other significant predictors, B8 and B9. B8, worries about wasting time and money (B=-1.271; p=0.039; Exp(B)=0.281), is negatively related to support status. A significant negative relationship emerges between apprehension about investing time and resources without guaranteed funding and the likelihood of accompaniment. Several respondents reported that they were aware from the beginning that funding was not guaranteed. For these women, the calculation is primarily economic rather than psychological: suspending a generative-income activity or paying for childcare in order to attend is only worthwhile if the funding at the end is reasonably assured. In the absence of such assurance, the anticipated loss of time and income outweighs the expected benefit. Being evaluated alongside participants from all sectors and backgrounds also amplified self-doubt among some women, and several of whom felt uncertain about their own legitimacy within such a diverse group, which further reduces their motivation to fully invest in the support process.

Regarding B9 financial issues (B=1.420; p=0.011; Exp(B)=4.137), financial difficulties are positively associated with support status, with odds more than four times higher. A possible reading is that women in financially precarious situations perceive the material support of the program as an incentive strong enough to outweigh other obstacles. For these women, the program may represent one of the few available routes to productive capital, which could account for a greater tolerance of scheduling and travel constraints. The only evidence available to support this reading is declarative: several participants facing financial difficulties indicated that their primary motivation was obtaining the funding rather than the training itself. This observation remains insufficient to establish the underlying mechanism, which would require dedicated investigation. Furthermore, this reading echoes a finding from a different context: Using municipal panel data from the Republic of Srpska, Stevandić et al. (2026) report that grants allocated to women have a significantly stronger positive effect in the most underdeveloped municipalities than in developed ones. Although their object concerns agricultural entrepreneurship and operates at an aggregate

level of analysis, this result converges with ours in suggesting that financial incentives weigh more heavily where precarity is most pronounced.

Field observations also revealed that women with genuine entrepreneurial intentions were the ones who attended the sessions most regularly, regardless of their financial difficulties. Several participants stated that their main motivation was to receive supplies rather than to benefit from training, and some would have preferred to receive material assistance first and participate in the support program afterward as a form of assistance. According to participants, this situation is largely due to a mismatch between the content of certain training sessions and the specific profile of some participants.

Summary of Hypothesis Testing Results

Table 7: Hypothesis testing results

Hypothesis	Description	Result
H1	Mobility issues prevent women from attending training sessions	Not supported
H2	Comprehension and skills barriers reduce engagement	Not supported
H3	Inappropriate training schedules affect participation	Supported
H4	Family issues affect attendance	Partially supported
H5	Fear of failure and low self-confidence reduce access	Not supported
H6	Financial challenges prevent participation	Not supported

Source: Authors' calculations

H5 is not supported, as the only strictly psychological indicator retained, fear of public speaking (B7), is not statistically significant in any of the tests. Although apprehension (B8) is associated with a lack of confidence, it primarily reflects an economic cost–benefit consideration and was therefore assigned to H6. H6 is also not supported, as financial hardship (B9) is positively, rather than negatively, associated with participation. This unexpected finding is discussed in more detail in the Results section.

Conclusion

This study set out to understand why rural women already enrolled in a free entrepreneurial support program nonetheless fail to attend and complete it. Among the nine barriers tested, inappropriate training schedules (B3) emerged as the factor most strongly associated with support status, women reporting this constraint showing roughly 90% lower odds of being classified as supported. Apprehension about wasting time and money without guaranteed funding (B8) was negatively related to support, reflecting a cost–benefit calculation rather than a purely psychological reluctance: women hesitate to suspend income-generating activities or to incur childcare costs without assurance of a return. Financial hardship (B9), against the initial hypothesis, was positively associated with participation, women in precarious conditions being more strongly represented among the accompanied. The convergence of barrier profiles between partially engaged women (G2) and non-attendees (G3) further indicates that both groups face obstacles identical in nature and differing only in intensity.

These findings carry specific implications for program design. Since scheduling (B3) is the single significant predictor of accompaniment, aligning session times with the daily and economic realities of rural women would address the most decisive barrier identified. Because the apprehension captured by B8 stems from the absence of any guarantee of funding, clearer signposting of the expected return on participation would reduce the perceived risk of investing time and forgoing income. And although transportation (B1) and childcare (B5) are not statistically significant, their descriptive prevalence is high. Since financial hardship (B9) draws the most precarious women into the program rather than deterring them, support structures should anticipate that this population, once enrolled, needs logistical accommodation, notably childcare and transport, to convert enrollment into completion.

Several methodological limitations must be acknowledged. The study relies on a cross-sectional design and on a sample of 100 women in a single rural area, which constrains both statistical power and the generalizability of the findings to other Moroccan territories or program types. Some G2 women may have been funded in later cycles, which the cross-sectional design does not capture. The binary logistic regression establishes associations, not causal relationships: the design does not permit inference about the direction or the mechanism linking barriers to disengagement, and

the correlational results should be read as such. The operationalization of barriers as binary variables, while necessary for statistical testing, flattens the intensity and the lived meaning of each obstacle, which the qualitative material only partially restores. Finally, the paradoxical result concerning financial hardship (B9) would warrant a dedicated longitudinal investigation, both to establish whether material precarity sustains participation over time or merely accelerates initial enrollment, and to disentangle what stems from participants' own motivation from other factors that the present cross-sectional, single-site design cannot isolate. By shifting the focus from barriers to entrepreneurship to barriers to entrepreneurial support, this study opens a research avenue that the existing literature had largely left aside.

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ORIGINAL SCIENTIFIC PAPER

Understanding Entrepreneurial Intentions among Female University Students: The Role of Self-Efficacy, Resilience, and University Environment



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A B S T R A C T

This study analyzes the factors associated with entrepreneurial intention among Colombian female university students, focusing on entrepreneurial self-efficacy, resilience, and the perceived university environment within an emerging economy. Based on the Theory of Planned Behavior and Institutional Theory, the research examines how psychological resources and contextual factors are associated with female entrepreneurial intention in Latin America. A quantitative cross-sectional design was employed with a final sample of 3,183 female university students. The effects were estimated using Ordinary Least Squares (OLS) multiple linear regression models, incorporating control variables and robust standard errors to correct for heteroskedasticity. The results show that entrepreneurial self-efficacy is the strongest predictor, followed by resilience. Regarding the university environment, there is limited evidence of a positive association, which is only marginally statistically significant ($p < 0.10$) after applying the robust standard error correction. These findings highlight the importance of strengthening developable psychological resources to foster favorable conditions for the

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development of female entrepreneurship, while suggesting that the effect of the institutional environment should be interpreted with caution.

KEYWORDS: *intentions, students, university, resilience, self-efficacy*

Introduction

Entrepreneurship has consolidated itself as a strategic pillar of economic and social development, fostering value creation, innovation, and inclusion in contexts characterized by structural and institutional constraints (Brush et al., 2018; Pinazo-Dallenbach & Castelló-Sirvent, 2024). Its relevance is particularly significant in emerging economies, where it operates as an adaptive mechanism in response to informal labor markets and highly volatile economic environments (Abuzaid, 2024; Tahir & Burki, 2023). In this sense, entrepreneurship not only reduces economic inequality but also reshapes young people's perceptions of their future by demonstrating that launching productive initiatives can generate positive, sustainable social impacts (Shabbir, 2025).

Within this framework, the literature has advanced toward a more nuanced understanding of entrepreneurship from a gender perspective, emphasizing that men and women face differentiated constraints when engaging in entrepreneurial activity (Cardella et al., 2020; Margaça et al., 2021), which may be associated with personal preferences or unequal access to resources (Bergmann et al., 2024). This analytical shift has shaped a dominant research stream in the field, highlighting that entrepreneurial decisions and trajectories are embedded in gendered social and cultural factors. Several studies indicate that women are affected by gender stereotypes that delegitimize their role as entrepreneurs by associating entrepreneurship with traditionally masculine attributes (Gupta et al., 2009; Langowitz & Minniti, 2007).

In Latin America, and particularly in developing countries such as Colombia, these inequalities are exacerbated by fragile institutional environments, low levels of state support, and high rates of labor informality (Gallegos et al., 2025; Monsalve-Castro et al., 2024). Although entrepreneurship has been promoted as a pathway to strengthen women's economic autonomy, its realization is often driven more by necessity than by the recognition of opportunities, which, in many cases, contributes to the

reproduction of precarious economic and labor conditions (Cano & Tabares, 2017; Jafari-Sadeghi et al., 2021).

In this context, the university emerges as a strategic space for reversing these dynamics by providing education, networks, and an institutional environment that may foster entrepreneurial intention (Çera et al., 2021; Bui et al., 2025). However, empirical literature suggests that this influence is neither direct nor automatic; rather, it is mediated by psychological and contextual variables associated with entrepreneurial intention (Pham & Le, 2023). Among these variables, entrepreneurial self-efficacy and resilience stand out as essential personal resources that may be associated with stronger entrepreneurial orientation and intention. Their effect is particularly salient in emerging economies, where adverse structural conditions and high levels of uncertainty require greater internal competencies to withstand failure and persist in creating business initiatives (Tahir & Burki, 2023; Bui et al., 2025).

Despite growing interest in female entrepreneurship, a significant gap persists in the literature on how variables such as the university environment, entrepreneurial self-efficacy, and resilience are associated with entrepreneurial intentions of female university students, particularly in Latin America (Kamran et al., 2025). Much of the available empirical evidence has been generated in advanced economies or based on mixed-gender samples, thereby privileging approaches centered on opportunity-driven entrepreneurship, innovation, and business growth, without adequately capturing the structural, institutional, and sociocultural challenges faced by women in emerging markets (Leiva et al., 2021; Arbulú Ballesteros et al., 2024). Accordingly, this article contributes to the literature by analyzing the factors that shape female entrepreneurial intention in the Colombian context.

The study draws on the Theory of Planned Behavior (TPB) and Institutional Theory to provide an analytical framework for explaining the processes leading up to entrepreneurial action, while considering structural characteristics that may influence business creation. The purpose of this study is to address the following research question: To what extent are factors such as the university environment, entrepreneurial self-efficacy, and resilience associated with the entrepreneurial intention of female university students in an emerging economy such as Colombia? Addressing this issue is essential to the design of gender-focused educational policies and to the

development of institutional strategies to strengthen entrepreneurship as a driver of economic development and social equity.

Theoretical Background

Entrepreneurship is understood not only as the creation of businesses but also as an innovative and adaptable mindset in uncertain contexts (Chen & Guo, 2024). Therefore, the literature has developed various theoretical perspectives to explain entrepreneurial intention and behavior, as well as the motivations for engaging in entrepreneurship, particularly among women, whose trajectories are shaped by distinct social, cultural, and institutional factors (Alfaro-García et al., 2022).

From the Theory of Planned Behavior (TPB), entrepreneurial intention is defined as the conscious disposition to undertake entrepreneurial activity and depends on attitudes toward entrepreneurship, subjective norms, and perceived behavioral control, the latter being closely related to entrepreneurial self-efficacy (Ajzen, 1991; Kautonen et al., 2015; Liñán & Fayolle, 2015). This approach is especially useful for analyzing the entrepreneurial intention of female university students, as it incorporates social and perceptual factors linked to gender gaps, such as stereotypes, perceived legitimacy, and confidence in one's own abilities, which significantly influence the formation of attitudes and the perception of control over entrepreneurial behavior (Chen & Guo, 2024).

However, the Theory of Planned Behavior (TPB), in its original formulation, implicitly assumes relatively stable and homogeneous contexts, which limits its explanatory power in environments characterized by institutional fragility, high levels of labor informality, and persistent gender inequalities, conditions frequently observed in many emerging economies. In this regard, Institutional Theory, proposed by North (1990), offers a complementary framework for analyzing how formal and informal rules establish the parameters that shape entrepreneurial opportunities, transaction costs, and relationships among actors within the entrepreneurial ecosystem. According to Gómez Araujo et al. (2025) and Amorós et al. (2019), the institutional environment plays a decisive role in entrepreneurship by establishing rules, norms, and incentives that shape both the objective viability of starting a business and the perceived desirability and feasibility of doing so. In the case of women, unfavorable institutional contexts may weaken essential psychological resources such as self-efficacy and

resilience due to barriers related to access to financing, support networks, and social legitimacy, as well as persistent discriminatory practices (Hossain et al., 2025; Rashid & Ratten, 2020; Llados-Masllorens & Ruiz-Dotras, 2022). In response, resilience emerges as a key resource for sustaining women's entrepreneurial intention. At the same time, the university serves as an institutional space that strengthens self-efficacy, supports networks, and legitimizes entrepreneurship. In this regard, the articulation between the Theory of Planned Behavior (TPB) and Institutional Theory enables a more contextually grounded understanding of women's entrepreneurial intention in emerging economies such as Colombia.

Entrepreneurial Intention

Entrepreneurial intention has become a central topic of interest in academic research, particularly within the university context, due to its role as a precursor of entrepreneurial behavior and its usefulness in understanding the factors that influence the decision to start a business (Pinazo-Dallenbach & Castelló-Sirvent, 2024; Barrera-Verdugo et al., 2024; Fayolle & Gailly, 2015; Paunović & Musial, 2024). From a conceptual perspective, entrepreneurial intention has been defined as a "cognitive state that immediately precedes the decision to engage in entrepreneurship and constitutes the foundation of the entrepreneurial process, due to its motivational and cognitive nature" (Leiva et al., 2021, p. 400). Complementarily, it is understood as an individual's conviction to initiate a new entrepreneurial activity and implement it in the future (Barrera-Verdugo et al., 2024), as well as an expression of the latent entrepreneurial spirit present within a given territory (Pinazo-Dallenbach & Castelló-Sirvent, 2024).

Entrepreneurial intention constitutes a key element for understanding the creation of new ventures, as it represents the first step in the entrepreneurial process (Pinazo-Dallenbach & Castelló-Sirvent, 2024). Women's entrepreneurial intention is of strategic importance for countries' economic growth, as it contributes significantly to job creation and the strengthening of the productive sector, especially in contexts where gender disparities in access to economic opportunities persist (Gallegos et al., 2025; Langowitz & Minniti, 2007). Furthermore, it generates positive effects on poverty reduction and social inclusion (Cardella et al., 2020).

Several studies conducted in different national contexts have consistently shown that female entrepreneurial intention in the university

setting is explained by the core constructs of the TPB, particularly attitudes toward entrepreneurship, subjective norms, and perceived behavioral control. For example, Drakpa et al. (2022), in Bhutan, found that all three TPB dimensions exert a positive influence on the entrepreneurial intention of female business students, although perceived behavioral control emerged as the strongest predictor, while subjective norms had the weakest effect. Similarly, Messikh (2021) reported that among Algerian female university students approaching graduation, entrepreneurial intention is high and is primarily associated with parental and governmental support. In contrast, self-efficacy, entrepreneurship education, and attitudes toward entrepreneurship also contribute, albeit to a lesser extent. Complementarily, Manjaly et al. (2022) found that among Indian female university students, entrepreneurial self-assessment is positively associated with entrepreneurial intention, and that this relationship is partially mediated by entrepreneurial passion, thereby reinforcing the importance of psychological resources in shaping young women's propensity to engage in entrepreneurship.

In line with these findings, it is suggested that women's entrepreneurial intention depends not only on general evaluations of entrepreneurship but also on confidence in one's own abilities and on perceived social and institutional support. According to Llados-Masllorens and Ruiz-Dotras (2022), women's intention to start a business extends beyond economic considerations. It is associated with the flexibility to manage their own time in order to achieve a balance between work and personal life. However, this intention may be hindered by a lack of competencies, insufficient support, and fear of failure.

Entrepreneurial Self-Efficacy and Entrepreneurial Intention

Self-efficacy has been widely recognized as a central determinant of entrepreneurial intention, as it influences individuals' willingness to initiate and sustain actions oriented toward venture creation. According to Abuzaid (2024), self-efficacy relates to how individuals approach their goals, the challenges these entail, and the confidence they have in their abilities to achieve positive outcomes. More broadly, self-efficacy refers to individuals' evaluation of their capacity to perform a specific activity, influencing goal setting, decision-making, the level of effort invested, emotional reactions, coping ability, and persistence in the face of difficulties (Nguyen & Phan, 2024).

Regarding studies focusing on women, the literature consistently reports a positive association between self-efficacy and entrepreneurial intention. Messikh (2021) found that, among Algerian female university students, entrepreneurial intention is significantly associated with self-efficacy, entrepreneurship education, family support, and government support programs. Zhang et al. (2024) argue that self-efficacy is fundamental for women to confront the inherent challenges of the entrepreneurial process and to mobilize resources effectively, thereby contributing to the success of their business initiatives. Similarly, Paunović and Musial (2024) contend that self-efficacy is a key motivational characteristic throughout the female entrepreneurial process. Gerke et al. (2023) identify self-efficacy as a critical success factor for women entrepreneurs, emphasizing its mediating role in the relationship between personal and contextual factors and the intention to create a business, as well as its potential to be strengthened through entrepreneurship training programs. Based on the foregoing, the following hypothesis is proposed:

H1. Entrepreneurial self-efficacy is positively associated with the entrepreneurial intention of female university students

Resilience and Entrepreneurial Intention

In a context characterized by uncertainty and limited access to the labor market, features typical of emerging economies such as Colombia, resilience emerges as a determining factor in the initiation of entrepreneurial ventures, as it motivates women to confront the adversities that arise during the early stages of business activity (Margaça et al., 2021). This competency enables successful adaptation to situations perceived as difficult or threatening in the venture creation process (Pérez-López et al., 2016). It may serve as a motivational force, strengthening self-confidence in effectively addressing the challenges of entrepreneurial activity (Bui et al., 2025).

From a theoretical perspective, resilience is conceptualized as a multidimensional construct that develops through a dynamic, evolutionary process, equipping women entrepreneurs to adapt to change, confront adverse contexts, and manage uncertain future scenarios (Barrera-Verdugo et al., 2024; González-López et al., 2019). Consistent with this view, empirical evidence suggests that women who exhibit higher levels of resilience demonstrate greater entrepreneurial intention (González-López et al., 2019), that is, a stronger willingness to achieve their goals, greater

flexibility in response to change, high levels of motivation and optimism, and an enhanced ability to identify and exploit opportunities related to their business projects (Margaça et al., 2021). Accordingly, the following hypothesis is proposed:

H2. Resilience is positively associated with female university students' entrepreneurial intention.

University Environment and Entrepreneurial Intention

The university environment has increasingly consolidated as a space committed to fostering entrepreneurial activities by providing students with support, guidance, and mentoring to help materialize their business ideas (Nguyen & Phan, 2024). In this context, women have recognized the university as a means to contribute to the social and economic development of emerging countries, achieve self-sufficiency, and improve their quality of life (Arbulú Ballesteros et al., 2024). In this regard, universities can significantly influence students' creativity, skill development, and entrepreneurial intentions through the business education they provide, the promotion of innovation, and the encouragement of an entrepreneurial mindset (Mustafa et al., 2023; Chen & Guo, 2024).

Empirical evidence indicates that students who perceive a supportive university environment exhibit higher levels of entrepreneurial intention than those who perceive it as less favorable (Çera et al., 2021). In this regard, recent studies show that the university environment strengthens women's entrepreneurial intention through incubation programs, mentoring, hands-on training, and support networks that foster the development of entrepreneurial capabilities and facilitate the transition from intention to entrepreneurial action (Karunambika & Arthi, 2025). Nevertheless, women's participation in entrepreneurial activities remains lower than that of men, and in some contexts, the gender gap may even widen as educational attainment increases (Llados-Masllorens & Ruiz-Dotras, 2022).

These findings suggest that entrepreneurial intention depends not only on individuals' perceptions of the university environment but also on the structural conditions under which women operate, as well as on the geographical and socioeconomic factors associated with the institutional context in which the university is embedded (Gallegos et al., 2025; Leiva et al., 2021). In this sense, creating a supportive institutional climate, supported by policies, programs, and mechanisms that promote

entrepreneurship, can play a key role in strengthening students' entrepreneurial intentions (Çera et al., 2021). Moreover, the evidence suggests that women benefit more than men from higher education in terms of self-reliance and confidence to engage in entrepreneurship, reinforcing the strategic role of the university environment in reducing gender disparities in entrepreneurship (Rotnitsky et al., 2023). Based on the foregoing, the following hypothesis is proposed:

H3. The university environment is positively associated with female students' entrepreneurial intention.

Research Methodology

Data Collection and Sample Size

The data were obtained from the 2023–2024 Colombia edition of the Global University Entrepreneurial Spirit Students' Survey (GUESSS), a large-scale international project that examines entrepreneurial intention among university students. The Colombian dataset includes 28 universities located across different regions of the country (Andean, Caribbean, Pacific, and Orinoquía regions), as well as cities such as Bogotá, Medellín, Cali, Barranquilla, and Bucaramanga, among others, which voluntarily participated in this edition. This enabled the collection of more than 13,296 surveys, ranking Colombia third among countries with the highest number of responses in this edition.

The initial sample consisted of 13,296 responses. After excluding cases with missing data and students who were already self-employed, the final sample comprised 3,183 Colombian female university students.

Sample characteristics were as follows: age M = 22.65 years (SD = 5.60); 34.09% had entrepreneurial parents; 79.70% were undergraduate students, 1.04% master's students, 0.22% doctoral students, and 19.04% were enrolled in technical or technological programs. Fields of study included Business/Management (29.85%), Engineering (21.61%), and Economics (13.07%), with representation from 12 academic disciplines.

Measurement of Variables

The constructs analyzed in this study were measured using scales previously developed and validated in international research. For their

application in the Colombian context, the Spanish versions officially provided by the Global University Entrepreneurial Spirit Students' Survey (GUESSS) were used as part of its standardized international measurement protocol, thereby supporting the conceptual consistency and international comparability of the data.

Dependent Variable

Entrepreneurial intention was measured using the six-item scale developed by Liñán and Chen (2009). Responses were recorded on a 7-point Likert scale and averaged into a composite index ($\alpha = 0.954$), indicating excellent reliability.

Independent Variables

Perceived university environment was assessed with a four-item scale adapted from Franke and Lüthje (2004) ($\alpha = 0.883$). Entrepreneurial self-efficacy was measured using a four-item scale based on Zhao et al. (2005) ($\alpha = 0.914$). Resilience was captured through a four-item scale adapted from Sinclair and Wallston (2004) ($\alpha = 0.890$). All items were measured on 7-point Likert scales and aggregated into mean scores, with higher values indicating stronger perceptions or capabilities.

Control Variables

Control variables included age (continuous), entrepreneurial parents (binary), level of study (ordinal), and field of study (categorical, with arts and humanities as the reference category). These variables were incorporated to account for demographic and academic influences on entrepreneurial intention.

Age has been identified as a relevant predictor in certain contexts (Aydin et al., 2024; Sahinidis et al., 2021); an entrepreneurial family environment represents an early socialization mechanism that shapes entrepreneurial attitudes (Liñán & Chen, 2009); and both the level and field of study influence exposure to entrepreneurship education and the perception of opportunity structures (Bergmann et al., 2016). Educational level was coded as a categorical variable with four levels: 1 = Undergraduate/Bachelor's degree (79.70%, n = 2,537, reference category), 2 = Master's degree (1.04%, n = 33), 3 = Doctoral degree (0.22%, n = 7), and 4 = Other (19.04%, n = 606). The "Other" category includes students enrolled in professional technical programs, technological programs, and

other vocational or professional certifications that do not fit within the traditional undergraduate/postgraduate classification of the Colombian higher education system. This category represents non-traditional yet legitimate educational pathways that are prevalent in the Colombian context, where technical and technological education constitutes an important pillar of the higher education system.

Field of study was coded using 11 dummy variables following the Global University Entrepreneurial Spirit Students' Survey (GUESSS) classification: Business/Management (29.85%, n = 950), Engineering (21.61%, n = 688), Economics (13.07%, n = 416), Other (8.95%, n = 285), Social Sciences (7.32%, n = 233), Law (6.47%, n = 206), Medicine/Health Sciences (4.08%, n = 130), Arts and Humanities (3.42%, n = 109, reference category), Art Sciences (1.82%, n = 58), Natural Sciences (1.57%, n = 50), Computer Science/IT (1.51%, n = 48), and Mathematics (0.31%, n = 10). This distribution reflects the typical composition of university enrollment in Colombia, with a predominance of programs in Business, Engineering, and Economics.

Data Analysis Techniques

To examine the effects of self-efficacy, resilience, and university environment on entrepreneurial intention, multiple linear regression models were estimated using Ordinary Least Squares (OLS). The model specification is:

$$EI_i = \beta_0 + \beta_1 SE_i + \beta_2 RES_i + \beta_3 UE_i + \beta_4 AGE_i + \beta_5 PARENT_i + \beta_6 LEVEL_i + \Sigma\beta_j FIELD_{ji} + \varepsilon_i \quad (1)$$

Hierarchical regression was employed to assess incremental explanatory power. Control variables were introduced in the baseline model, followed by the inclusion of psychological and contextual variables, allowing evaluation of changes in explained variance (ΔR^2).

Robust standard errors were applied to address potential heteroscedasticity. Standard diagnostic tests confirmed that the assumptions of linear regression, including multicollinearity and residual normality, were satisfied. All analyses were conducted using Stata 14.2.

Results

Table 1 reports the correlation matrix. Entrepreneurial self-efficacy, resilience, and university environment are positively and significantly associated with entrepreneurial intention, providing preliminary support for the hypotheses. Entrepreneurial self-efficacy shows the strongest relationship ($r = 0.483$, $p < 0.001$), reinforcing its central role as a cognitive–motivational determinant, consistent with the Theory of Planned Behavior (Ajzen, 1991; Newman et al., 2019). Resilience also demonstrates a positive and significant association ($r = 0.370$, $p < 0.001$), supporting its role as a key psychological resource in uncertain contexts (Barrera-Verdugo et al., 2024; Margaça et al., 2021). Similarly, the university environment shows a moderate positive relationship ($r = 0.289$, $p < 0.001$), in line with studies highlighting the role of institutional support in shaping entrepreneurial dispositions (Çera et al., 2021; Mustafa et al., 2023).

Correlations among predictors are moderate, with the highest between self-efficacy and resilience ($r = 0.669$), and remain below multicollinearity thresholds, supporting their joint inclusion in multivariate models. Control variables show weak or non-significant associations with entrepreneurial intention, consistent with research suggesting that demographic factors play a secondary role relative to cognitive determinants (Ajzen, 1991; Liñán & Chen, 2009).

Table 1: Correlation Matrix of Study Variables

Variable	1	2	3	4	5	6
1.Entrepreneurial Intention	—					
2. Entrepreneurial Self-Efficacy	0.483***	—				
3. Resilience	0.370***	0.669***	—			
4.University Environment	0.289***	0.502***	0.466***	—		
5. Age	-0.010	0.049*	0.136***	0.080***	—	
6.Entrepreneurial Parents	0.025	0.041*	0.022	-0.008	-0.119***	—

Source: Authors' calculations based on GUESSS Colombia (2023–2024)

Note: N = 3,183. $p < .05$. **$p < .001$. Lower triangular matrix reported. The highest correlation among independent variables is $r = .669$ (self-efficacy–resilience).

Table 2 presents hierarchical OLS regression models. Model 1 (controls only) explains a limited proportion of variance ($R^2 = 0.051$), reinforcing the relatively low explanatory power of demographic and academic characteristics compared to proximal psychological factors (Ajzen, 1991; Liñán & Chen, 2009). Having entrepreneurial parents is initially significant, consistent with prior evidence on family socialization effects (Koellinger et al., 2011), whereas higher educational levels are associated with lower entrepreneurial intention, suggesting potential opportunity-cost effects (Langowitz & Minniti, 2007).

The inclusion of psychological and contextual variables in Model 2 substantially increases explanatory power ($R^2 = 0.269$; $\Delta R^2 = 0.218$, $p < 0.001$), highlighting their dominant role in explaining entrepreneurial intention. Entrepreneurial self-efficacy emerges as the strongest predictor ($\beta = 0.460$, $p < 0.001$), consistent with its well-established role in entrepreneurship research (Zhao et al., 2005; Newman et al., 2019). Resilience also shows a significant positive effect ($\beta = 0.131$, $p < 0.001$), supporting its contribution to managing uncertainty (Ayala & Manzano, 2014; Bullough et al., 2014). The university environment shows a positive but smaller effect ($\beta = 0.044$, $p < 0.05$), aligning with the literature that conceptualizes institutional context as an enabling rather than a primary determinant (Çera et al., 2021; Mustafa et al., 2023).

With the inclusion of psychological variables, the effect of entrepreneurial parents becomes non-significant, suggesting an indirect influence through cognitive mechanisms, particularly perceived behavioral control (Liñán & Fayolle, 2015; Ajzen, 1991). Age exhibits a small negative effect, consistent with life-cycle explanations of entrepreneurial intention (Langowitz & Minniti, 2007).

Model 3, estimated with robust standard errors, confirms the stability of the results. Self-efficacy and resilience remain strong and significant predictors, while the effect of university environment becomes marginally significant, reinforcing its secondary role relative to individual psychological resources.

Hypothesis testing confirms H1 and H2, while H3 is only partially supported, consistent with prior findings that emphasize the facilitating rather than determining role of institutional environments (Çera et al., 2021; Mustafa et al., 2023).

Diagnostic tests indicate no multicollinearity issues (VIF < 2.5). Heteroskedasticity is addressed through robust standard errors, and despite

non-normal residuals, the large sample size ensures valid inference under the Central Limit Theorem. No substantial common method bias is detected, consistent with accepted thresholds in survey-based entrepreneurship research.

Table 2: Predictors of Entrepreneurial Intention among Female University Students

Variable	Model 1	Model 2	Model 3
Control Variables			
Age	-0.002 (0.005)	-0.013** (0.005)	-0.013** (0.005)
Entrepreneurial Parents	0.123* (0.059)	0.038 (0.052)	0.038 (0.053)
Educational Level			
Master's Degree (ref: Undergraduate)	-0.879** (.280)	-0.727** (.246)	-0.727** (0.246)
PhD	-1.636** (0.600)	-1.309* (0.527)	-1.309* (0.527)
Other	0.280*** (.072)	0.212*** (.064)	0.212*** (.064)
Field of Study	11 dummies including	11 dummies including	11 dummies including
Independent Variables			
Entrepreneurial Self-Efficacy(H1)	—	0.460*** (0.026)	0.460*** (0.031)
Resilience (H2)	—	0.131*** (0.029)	0.131*** (0.033)
University Environment (H3)	—	0.044* (0.021)	0.044† (0.025)
Model Fit			
R^2	0.051	0.269	0.269
Adjusted R^2	0.046	0.264	0.264
ΔR^2	—	0.218***	—
F	10.60***	61.13***	57.10***
N	**3,183**	**3,183**	**3,183**
Standard errors (robust)	No	No	Yes

Source: Authors' calculations based on GUESSS Colombia (2023–2024)

Note: Unstandardized coefficients reported. Standard errors in parentheses. Model 1 = controls; Model 2 = controls + independent variables; Model 3 = Model 2 estimated with White's heteroskedasticity-robust standard errors (Breusch–Pagan $\chi^2 = 55.66$, $p < 0.001$). N = 3,183 in all models (listwise deletion). Field of study included as 11 dummy variables (reference category: Arts and Humanities). †p < .10. *p < .05. **p < .01. ***p < .001.

Discussion and Conclusions

This study provides robust evidence that entrepreneurial intention among Colombian female university students is primarily associated with meaningful and developable psychological resources, with entrepreneurial self-efficacy emerging as the variable showing the strongest statistical association with entrepreneurial intention ($\beta = 0.460$, $p < 0.001$). This finding reinforces and extends previous literature positioning self-efficacy as the most consistent psychological determinant of entrepreneurial behavior (Newman et al., 2019; Zhao et al., 2005), by demonstrating that this pattern also holds in a Latin American emerging economy and within a large, exclusively female sample. Importantly, the magnitude of this effect highlights that confidence in entrepreneurial competencies, such as opportunity recognition, idea generation, and venture creation, is central to the development of entrepreneurial aspirations. Furthermore, consistent with Chen et al. (1998), the results underscore the malleable nature of self-efficacy, suggesting that it can be strengthened through targeted educational interventions, with important theoretical and practical implications for entrepreneurship education aimed at female university students.

Resilience emerged as a secondary, yet statistically significant, predictor ($\beta = 0.131$, $p < 0.001$), contributing independently to entrepreneurial intention. This finding supports previous research emphasizing its role in enabling individuals to reinterpret uncertainty and risk as manageable challenges (Ayala & Manzano, 2014; Bullough et al., 2014), while also extending this evidence by examining resilience alongside self-efficacy within the same empirical model focused on female university students in an emerging economy. From a theoretical perspective, this finding complements the predominant role of self-efficacy by highlighting resilience as an additional psychological resource associated with higher levels of entrepreneurial intention, suggesting that both resources should be more systematically incorporated into the design of entrepreneurship programs for women.

In contrast, the perceived university environment exhibited only a marginal direct effect ($\beta = 0.044$, $p = 0.074$), suggesting a more nuanced role. Rather than acting as a primary driver, the university environment appears to be associated with institutional conditions that may foster the development of key psychological resources. This finding is consistent with Fayolle and Liñán (2014), who argue that educational institutions may

influence entrepreneurial intention indirectly by creating enabling conditions rather than exerting a direct effect on behavioral outcomes. By simultaneously examining the university environment, self-efficacy, and resilience, the findings contribute to the literature by clarifying the indirect and contingent role of institutional environments, refining previous evidence that has reported stronger effects when the university context is operationalized through intensive incubation activities and entrepreneurship support initiatives specifically targeted at women.

A key theoretical contribution of this study lies in identifying the mediating role of psychological variables in the relationship between the entrepreneurial family environment and entrepreneurial intention. Although parental entrepreneurship was initially significant ($\beta = 0.123$, $p = 0.039$), its effect became non-significant after introducing self-efficacy and resilience into the model ($\beta = 0.038$, $p = 0.469$). These results suggest that the observed association with the family environment may operate through cognitive mechanisms, particularly perceived behavioral control, consistent with the TPB proposed by Ajzen (1991) and the entrepreneurial intention model developed by Liñán and Chen (2009). Thus, the study not only confirms that the family environment matters but also extends previous research by empirically demonstrating that structural background factors are not determinative in themselves but are mediated by developable psychological constructs, thereby creating opportunities for educational intervention even when family conditions are less favorable.

Additionally, the analysis of the control variables revealed that age has a small but statistically significant negative effect on entrepreneurial intention ($\beta = -0.013$, $p = 0.007$), while higher educational levels are associated with lower entrepreneurial intentions. These findings suggest the existence of a "specialization trap," whereby greater investment in human capital and increased awareness of opportunity costs are associated with lower entrepreneurial intention. By introducing this interpretation in the context of female university students, the study contributes to the literature by offering a more nuanced perspective on the role of education and life-cycle effects in shaping entrepreneurial behavior, while encouraging a reconsideration of the timing and design of interventions aimed at fostering women's entrepreneurship throughout the educational trajectory.

This study contributes to the growing body of research on gender and entrepreneurship in Latin America by documenting relatively high levels of entrepreneurial intention among Colombian women (mean = 5.03/7),

supporting the notion of gender convergence in the region (Contreras-Barraza et al., 2021; Martínez-Gregorio et al., 2023; Torres et al., 2017). These findings challenge traditional assumptions derived from studies conducted in developed economies (Haus et al., 2013; Santos et al., 2016) and suggest that, under favorable institutional conditions, gender gaps in entrepreneurial intention may be narrowing. By integrating this evidence with the roles of self-efficacy, resilience, and the university environment, the study reinforces and extends the journal's body of research on women's entrepreneurial intention, demonstrating that patterns identified in other regions are also observed, albeit with context-specific nuances, in a Latin American emerging economy.

However, the study is not without limitations. Due to the study's cross-sectional design and methodological constraints, the results should be interpreted as statistical associations rather than as evidence of causal relationships. Although the theoretical framework posits directional relationships among the variables analyzed, the data do not permit the establishment of temporal precedence or the confirmation of causal mechanisms among self-efficacy, resilience, the university environment, and entrepreneurial intention.

An additional limitation concerns the model's scope. Although the psychological variables explain a substantial increase in variance ($\Delta R^2 = 0.218$, $p < .001$), resulting in a total R^2 of 0.269, a considerable value in the behavioral sciences, the remaining unexplained variance offers opportunities for future research to further enrich understanding of the phenomenon. The incorporation of other components of the Theory of Planned Behavior, such as attitude toward entrepreneurship and subjective norms (Ajzen, 1991; Liñán & Chen, 2009), as well as social capital and entrepreneurial networks, perceived business opportunities, and macroeconomic contextual factors such as access to financing and regulatory conditions, could significantly expand the explanatory power of the model.

Likewise, longitudinal designs would allow examination of the transition toward entrepreneurial behavior, multilevel approaches would facilitate differentiation between individual and institutional effects, and mediation analyses would help clarify the indirect role of the family environment.

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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.

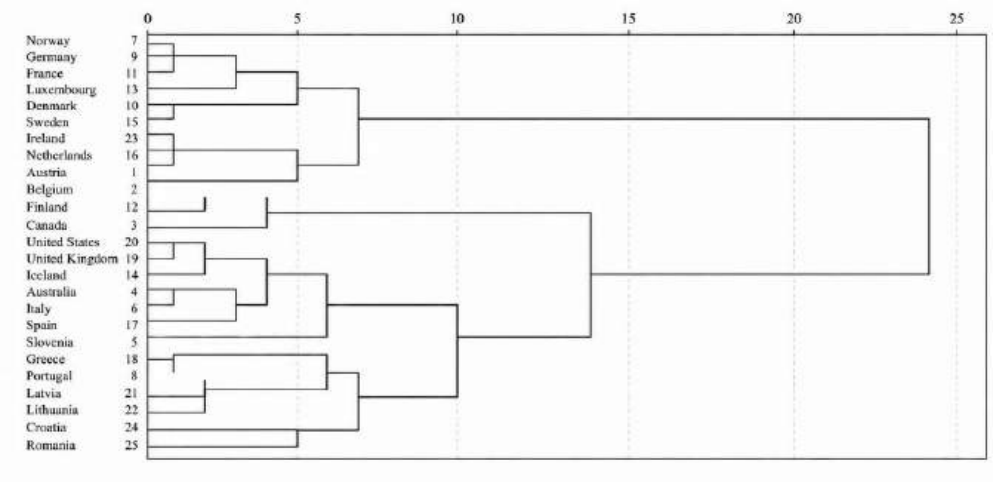
Hierarchical cluster analysis was applied as a preliminary method for identifying the potential number of clusters, with the decision based on the examination of a sharp increase in

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.

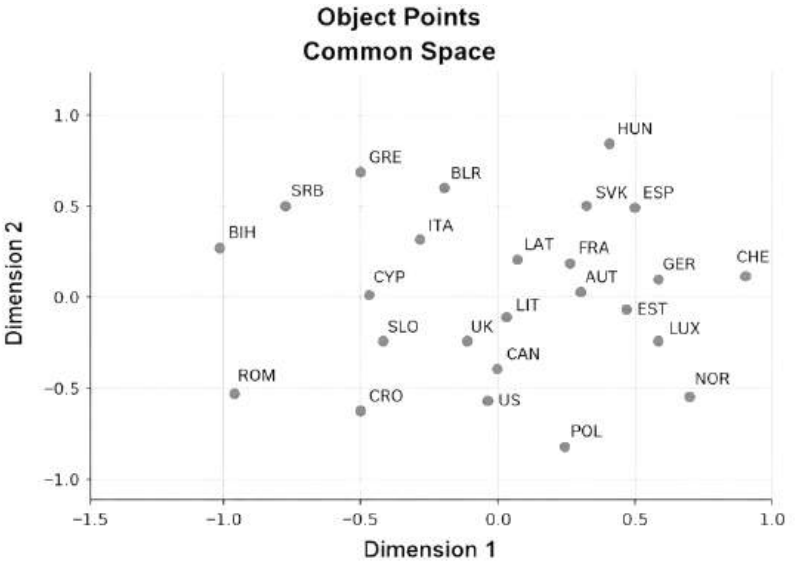
Multidimensional Scaling (MDS)

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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ORIGINAL SCIENTIFIC PAPER

Accelerating Distribution Channels Through a Digital Entrepreneurship Ecosystem: Women's Entrepreneurship



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A B S T R A C T

Conventional distribution has many stages, including manufacturers, wholesalers, retailers, end users, and returns. Although several independent firms work hard through conventional distribution channels to reach consumers, the use of digital entrepreneurship platforms is poorly organized, so engaging the local workforce in distribution cannot flourish. A supply chain with an effective distribution network can be cost-effective, timely, and reliable in reaching all consumers. This qualitative case study is based on Accelerating Bangladesh, which provides education, meetings, and training to women-led digital business entrepreneurs, enabling them to expand in sales, delivery, and distribution. The study examines women's digital entrepreneurship, in which digital entrepreneurs reach consumers through a socially beneficial distribution ecosystem. The study results show that embracing digital entrepreneurship creates a working opportunity for the community workforce in a delivery partnership. Through this business practice, entrepreneurs contribute socially by creating business value.

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Introduction

The process of creating new job opportunities in local communities is complex and challenging. These difficulties stem from a confluence of social factors, a lack of training and specialized knowledge, and institutional problems, such as poor infrastructure and scarce resources. Although significant gaps persist in many sectors, St-Denis and Hollister (2024) stress that experience and awareness are crucial to overcoming these obstacles. Opportunities and services in developing countries are frequently grouped according to competence, which may unintentionally restrict access for the workforce, which makes up about half of the population. Despite the enormous potential of this workforce to drive socioeconomic advancement, structural limitations often result in its underutilization. MacKenzie and McLachlan (2023) list several major obstacles to advancement, including restrictive laws, environmental issues, cultural standards, and unequal access to resources. These obstacles not only prevent certain industries from expanding but also produce inequalities that exacerbate social inequality. To tackle these issues, the government must adopt a proactive, all-encompassing strategy that can be crucial in improving the economic and non-economic facets of community development. Initiatives to improve the socioeconomic structure, such as infrastructure, education, and legal reforms, can foster an environment more conducive to job growth. Furthermore, as Loza and Roscoe (2024) noted, acquiring a substantial amount of cash is crucial but insufficient to promote sustainable development. Employees must be given opportunities that match their abilities and potential. Establishing training pathways for the workforce, encouraging entrepreneurship, and guaranteeing fair access to resources and support networks are all part of this. Labor has yet to realize its full potential in advancing the country in the absence of these complementary policies.

A good way to meet customer requirements, socially helpful distribution departs from conventional approaches by emphasizing inclusivity and acknowledging people's varied tastes. The fundamental idea behind this notion is the integration of community involvement into supply chain operations, which not only promotes economic empowerment but also fosters a sustainable environment for resource distribution. This framework is further strengthened by digital entrepreneurship, which leverages

technology to connect underserved markets and expand distribution channels, thereby ensuring local communities' financial sustainability (Bresciani et al., 2021; Colbert et al., 2016). Market-driven distribution networks make products and services accessible to a larger audience by leveraging community members' skills to overcome important accessibility barriers. Including local labor in these networks offers a practical way to fight unemployment, especially in places with few economic prospects. Research indicates that strengthening community resilience and promoting economic independence are two benefits of empowering people through involvement in distribution networks (Amany, 2025; Rolando & Mulyono, 2025; Wang et al., 2025). Entrepreneurship education, which equips people with the skills, know-how, and confidence to launch and run profitable businesses, is another vital component of community development. Evidence from earlier studies highlights the significant influence of entrepreneurship training, with participants frequently reporting better outcomes and greater creativity in their business endeavors (Boldureanu et al., 2020; Lopes et al., 2025). Therefore, encouraging entrepreneurship education is an ideal way to build prosperous, self-sufficient communities.

The growth of women entrepreneurs has been examined in several earlier studies that used conventional platforms to foster community connections. In several instances, entrepreneurs have founded businesses and inspired community members to pursue entrepreneurship. One of the well-known subjects in the realm of entrepreneurship is education. To inspire people, the entrepreneurship education revolution continues to spread from the general public to higher education institutions. However, there has not been enough research done on how digital entrepreneurship education may support women entrepreneurs in building entrepreneurial platforms for community workers. This study investigates the Accelerating Bangladesh program, which is part of Bangladesh's ICT Division and guides women entrepreneurs through digital entrepreneurship education, serving as a distribution platform that links community members within an ecosystem. In the distribution process, intangible resources are added through skills, knowledge, awareness, and confidence, while tangible resources are added through capital, income, savings, investment, and assets. Adopting digital entrepreneurship does not alter distribution operations; rather, it involves multiple workforces within a single distribution network to reach all consumers.

More specifically, the objectives of the study are as follows:

- To investigate online-based business development through expert entrepreneurs.
- To explore the role of digital entrepreneurship in distribution channels.
- To investigate the benefits of the community workforce from online-based distribution.

Literature Review

Conventional Distribution

For products to move smoothly from raw materials to final customers, distribution management is essential. Throughout the supply chain, it establishes connections between suppliers and customers that generate value. This process, which includes several steps such as planning, sourcing, warehousing, and distribution, is crucial for enabling the flow of products and services. While preserving operational effectiveness, every link in the chain helps to meet customer demand (Croxton et al., 2001; Mentzer et al., 2001). Businesses must ensure that the supply chain connects each step efficiently while also aligning their products with consumer expectations. Customers are guaranteed to obtain the appropriate products at the appropriate time and location due to this alignment (Christopher, 1992). Companies can increase customer loyalty and confidence by achieving supply-and-demand synchronization. The SCOR model, created by the Supply Chain Council (2008), is a well-known framework for comprehending supply chain operations. Plan, Source, Make, Deliver, and Return are the five main phases that are described in the paradigm. From planning and acquiring materials to delivering the finished product and managing returns, every step is essential to preserving the flow of goods and services (Singh & Kumar Singh, 2025; Yuenyong et al., 2026). To ensure a competitive and effective supply chain, businesses must manage these phases effectively. Despite its significance, many businesses struggle with distribution, particularly due to labor shortages, financial constraints, limited market access, and regulatory barriers. To overcome these obstacles, businesses often turn to distribution channels, which act as intermediaries between producers and customers. According to Du (2025), these channels enable businesses to reach a wider audience and distribute their goods more effectively, even in situations where they lack the infrastructure or resources

they need. Additionally, technology has become a vital tool for businesses seeking to enhance their distribution plans. Businesses may create robust distribution networks and maintain their competitiveness through technological integration (Shen et al., 2025; Witosari et al., 2025). Businesses frequently encounter increased competition from regional suppliers and distributors in areas with weak institutional contexts, such as those experiencing economic instability, a lack of infrastructure, or regulatory restrictions. Strong community relationships can provide a strategic advantage despite these obstacles. Businesses can use regional networks and bolster their market presence by establishing strong ties with area distributors and suppliers (Wang et al., 2025; Zhu, 2020).

Digital Entrepreneurship

According to Khrais and Gabbori (2023), digital entrepreneurship is a creative and dynamic approach to starting and running companies that are largely powered by digital tools, social media, mobile applications, and the internet. To communicate with clients, provide products and services, and conduct international operations from almost anywhere in the world, this entrepreneurial model leverages the enormous potential of digital platforms. Digital entrepreneurship, in contrast to the traditional company, frequently flourishes in a virtual ecosystem where companies can function with little overhead expenses, depending on automation and digital tools to maximize customer experience, increase productivity, and streamline procedures (Boom-Cárcamo et al., 2024; Keyhani et al., 2022; König et al., 2019). One of the main benefits of digital entrepreneurship is its ability to scale quickly and reach a global audience, removing regional barriers that would otherwise prevent traditional enterprises from accessing markets (Biswas & Pandey, 2025; Lakshmi & Manasa, 2025). This growth is often achieved through social media platforms, mobile applications, and e-commerce websites, which enable business owners to interact directly with their target audience, conduct transactions, and cultivate a devoted following. The world of digital enterprise is not without its difficulties, despite these advantages. Entrepreneurs must manage the risks related to digital security, privacy, and intellectual property while simultaneously adapting to rapid technological change, shifting customer habits, and intensifying market competition. To compete at the local and international levels, successful digital entrepreneurs frequently use technology and digital tools to develop distinctive value propositions, remain flexible in a volatile market, and

capitalize on emerging trends (Putra, 2025; Steininger, 2019; Wulandari et al., 2025).

Digital Entrepreneurship Education

Universities offer specialized courses that enable students to engage in structured learning and interact with lecturers, as noted by Idrus et al. (2014). However, Liu et al. (2021) indicate that integrating long-term reflection is a more successful strategy that helps students gain a deeper comprehension of entrepreneurship and strengthen their mental framework for overcoming obstacles. Entrepreneurial success requires not only theoretical knowledge but also technical abilities like inventory management, cash flow management, and marketing (Stamboulis & Barlas, 2014). Work-integrated learning, as suggested by Adeinat & Abdulfatah (2019), links classroom learning to real-world business situations, helping students bridge the gap between theory and practice and develop practical skills directly applicable to entrepreneurial endeavors. Ahmed et al. (2020) suggest that entrepreneurial learning is an experiential process that involves reflection, action, and critical thinking, where students create knowledge through real-life experiences and apply theory to practice. Jena (2020) argues that entrepreneurship education must reflect the dynamic challenges entrepreneurs face in their daily lives, suggesting that an ideal curriculum incorporates real-world experiences and complexities. Interactive techniques such as storytelling, dialogue, and experience sharing provide students with more opportunities to learn from peers' and successful business owners' experiences (Elenurm & Reino, 2013; Weerakoon et al., 2020). Through these techniques, students are able to understand the human aspect of entrepreneurship and the individual narratives that accompany entrepreneurial endeavors. To ensure that students have the technical skills, resilience, mindset, and understanding necessary to succeed in the entrepreneurial world, students can develop their entrepreneurial identity by practicing through difficulties and overcoming obstacles (Salavou et al., 2021; Soares et al., 2021). Financial, physical, intellectual, and human factors affect the adoption of digital technology, with intellectual capital having the greatest significance in technology adoption (Feranita et al., 2024). Students' confidence and knowledge do not align in digital entrepreneurship; rather, tests, feedback, and reflection help minimize skill gaps (Veselinović et al., 2026).

Figure 1 shows a value delivery model. Entrepreneurs can focus on targeting a wider range of consumers to gain an advantage in selling more products. Therefore, this market could be vast. Digital entrepreneurship broadens opportunities for distribution by sustainably and profitably engaging the community workforce in the supply chain.

Figure 1: Conventional distribution



Source: Authors

Methodology

Research Strategy

The investigation is carried out using a qualitative research method. Case study analysis provides sufficient help to comprehend real phenomena (Yin, 2018). The goal of qualitative research is to capture the perspectives, knowledge, and experiences of individuals worldwide (Merriam & Tisdell, 2015). MAXQDA is used for coding to perform the analysis (Silver, 2017). Semi-structured questionnaires are used to guide the in-person interviews. Entrepreneurs and the community workforce are interviewed. Observation and secondary data sources are taken into account as part of data triangulation. Additionally, several publications, websites, and brochures are

studied to investigate workforce acceleration through skilled digital entrepreneurs (Maxwell, 2012).

Data Collection

Two types of data are considered. For the primary data, we organized interviews and observations. For the secondary data, we analyzed journals and web data. Around forty-minute individual interviews were conducted between August and October 2025. Table 1 shows the number of participants interviewed during the study. Interviews were conducted using a semi-structured questionnaire. Their profile, past and current feelings, and conditions of work were considered when asking questions. After consulting with Accelerating Bangladesh, 12 women entrepreneurs, 2 courier companies, 2 delivery partners, and 4 consumers were selected through judgmental sampling, based on their marketability and level of achievement. The questionnaires were distributed to learn more about the benefits of digital entrepreneurship education, their entrepreneurial paths, their experiences connecting with the community workforce, and, ultimately, their progress as entrepreneurs. To improve the results, interview data were both recorded and transcribed.

Table 1: Study participants and areas

Organizations	**Entrepreneurs**		**Consumers**		**Courier company**		**Delivery partner/ person**	
	No	Area	No	Area	No	Area	No	Area
Accelerating Bangladesh	12	Dhaka, Chittagong, Rajshahi, Khulna	4	All over Bangladesh	2	Dhaka, Chittagong	2	All over Bangladesh
Total = 20		12		4		2		2

Source: Authors

Twenty interviews were conducted to analyze the data. To analyze the interview questions and answers, the data were converted into Microsoft Word by carefully reviewing the interviews. The interviews were transcribed, anonymized, and imported into MAXQDA. A member of the research team coded the transcripts. Related codes were grouped into the themes and dimensions presented in the Appendix (Table A1), and the coding structure was reviewed and agreed upon by the authors. A large

amount of data on entrepreneurship and community members emerged, and key phrases were extracted to identify the necessary concepts based on interviewees' statements.

There are three different kinds of coding. The original idea of categories is found in open coding. Axial coding is the process of combining the initial-level categories with certain significant and relevant categories. Ultimately, the dimension changes to core categories in selective coding. The concept is first categorized using first-order coding, which is then combined with the major category for the theoretical dimension. All open codes are considered in first-order coding to obtain the second-order build, which guides the gradual expansion of the ecosystem for digital women entrepreneurs. Figure 2 shows the word cluster in which digital educational activities promote the workforce's continuous growth and entrepreneurs' success. It is beneficial to understand the role of digital entrepreneurship in engaging community members in supply chain distribution channels.

Figure 2: Word cluster of entrepreneurship and educational training among digital entrepreneurs



Source: Authors

Case Organizations: Accelerating Bangladesh

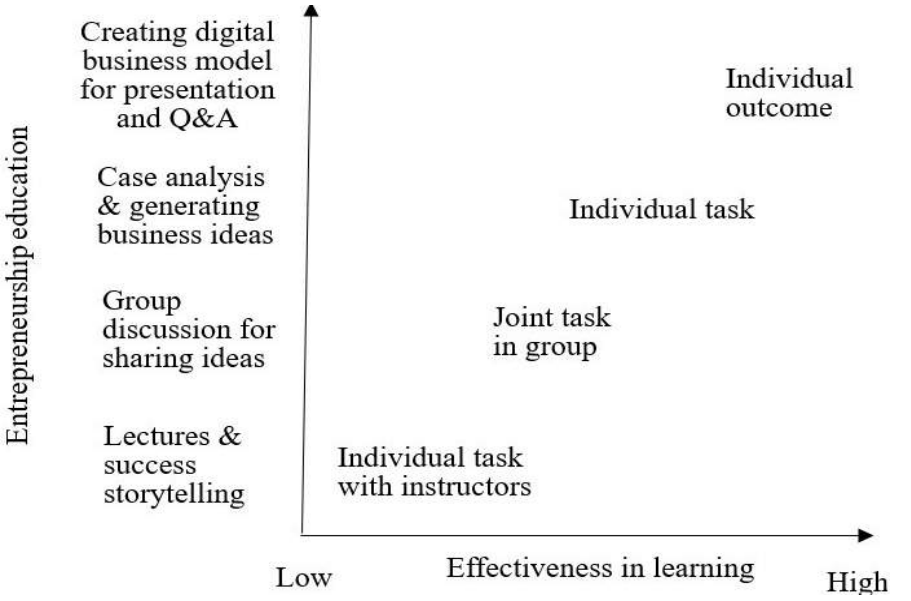
Accelerating Bangladesh began offering online entrepreneurship courses.

- Participating in early-stage cohorts should have a Minimum Viable Product (MVP) or a feasible company idea. At this point, neither business registration nor revenue is necessary.

- Applicants must be women entrepreneurs or cofounders of early-stage digital businesses with a Minimum Viable Product (MVP) or a workable digital business idea.
- If the applicants' registered businesses have full-time staff, a clear scalability plan, and consistent revenue streams, they are invited to join growth-stage cohorts.

Figure 3 shows the steps of education, including joint and individual tasks, by indicating the effectiveness of learning. Participants receive mentoring, business plan assistance, and training for a month. Through its web platform, it offers candidates and trainees 24/7 information services because current knowledge is essential for making decisions. Through backward- and forward-linking operations, graduates who had launched their own firms were given creative opportunities to participate in the supply and distribution of essential goods. Additionally, Accelerating Bangladesh has helped its successful graduates by sharing advice with the appropriate authorities and making stimulus loans easier to obtain.

Figure 3: Application of entrepreneurship education



Source: Authors

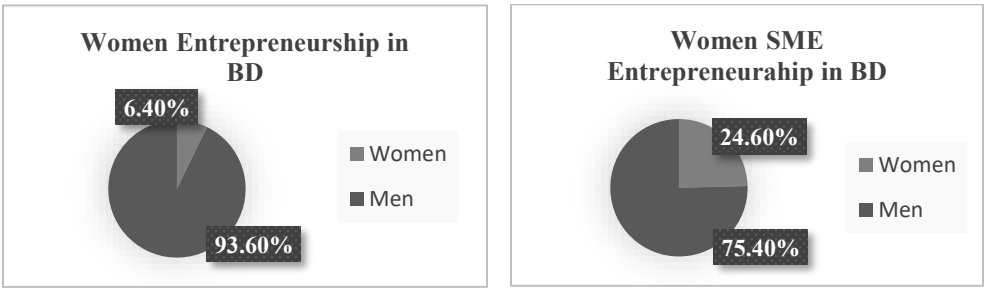
Analysis and Discussion

Participation of Women in Entrepreneurship

The goal of women entrepreneurs is to improve their lives and promote prosperity. They thereby refine their entrepreneurial abilities and knowledge. Through new employment opportunities, women entrepreneurs validate their social, economic, and personal accomplishments. Every day, they overcome obstacles to active engaging in revenue-generating activities. Their professional entrepreneurship certification helped them deepen their business knowledge. Entrepreneurs work together and share their traits. Entrepreneurs share and exchange their opportunities, challenges, successes, and scope for learning and improvement.

One of the entrepreneurs said, "Knowing the process of trade license, account preparation, VAT, etc. helps to start a new business, as well as distribution, digital marketing, and digital communication knowledge to support dealing with customers. We were struggling to pursue our career as an entrepreneur because of our little knowledge about entrepreneurship."

Figure 4: Participation of women in entrepreneurship



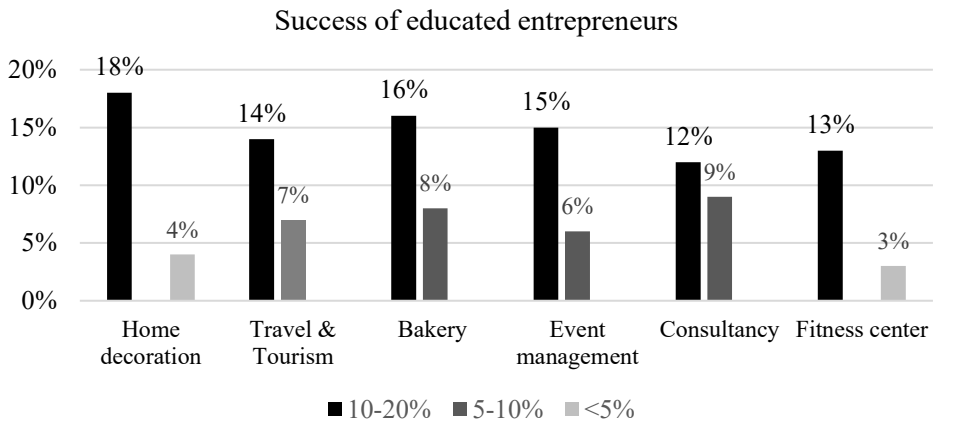
Source: Bangladesh Bureau of Statistics (BBS, 2024) and Labor Force Survey (LFS, 2022)

To gain privileges in their personal lives, women entrepreneurs gain control of their social and financial lives. Opportunities for self-employment help people become self-reliant, independent, and confident. Figure 4 shows that women entrepreneurs average 6.40%, whereas men are 93.60%, but because of the vast online business opportunities, involvement in SME is remarkable. For women, the percentage is 24.60%, compared with 75.40% for men.

Digital Entrepreneurship Expansion

Online delivery-based business distribution has enabled products to be sold in any region. Digital entrepreneurship, courier services, and delivery partners have become more effective across various areas. Entrepreneurs have been able to reach the unserved market through the supply chain networks. Digital entrepreneurship platforms sought to address distribution challenges in many areas where consumers lacked access to a variety of products. Many consumers lacked the opportunity to get the desired products. This digital business model distributes daily use of luxury goods to any consumer by engaging the workforce as couriers and delivery partners. The broader distribution network shows collaboration between production and distribution. The community workforce struggles with various barriers, including government initiatives, knowledge, skills, and more. To overcome all the barriers, digital entrepreneurship contributed to developing the present situation.

Figure 5: Business condition of digital entrepreneurship for educated entrepreneurs



Source: Authors

Figure 5 shows the net income of 12 entrepreneurs. A net profit margin of 10–20% is considered good, a margin of 5–10% is considered healthy on average, and a profit margin of less than 5% is considered inadequate. Based on the aforementioned factors, entrepreneurs' net profit is allocated. 33% of

entrepreneurs have an average profit margin, 17% have a low profit margin, and 50% of entrepreneurs have a high profit margin. The interview data indicate that courses on digital entrepreneurship affect business owners and their associated supply chains.

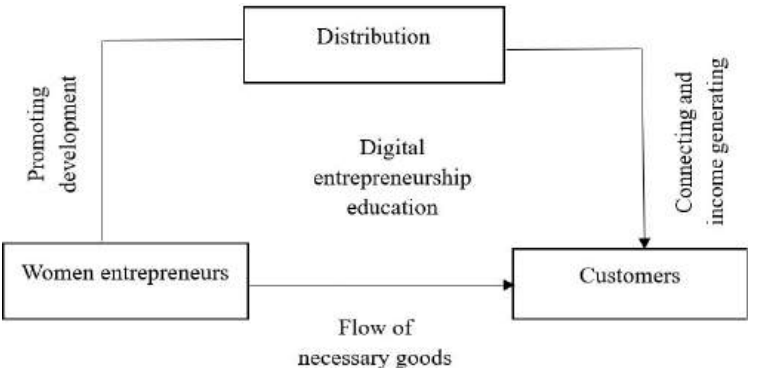
One consumer quoted, "Getting all types of products is very difficult because various types of products are not available everywhere, always. So, because of digital entrepreneurship and its intense distribution, we can get products in accordance with our demand."

A supply chain needs to involve many parties for procurement, production, and distribution. Digital entrepreneurship-based distribution has broadened the scope of networking to ensure reachability. This new communication has improved quality, collaboration, and skills.

Economic Benefits for the Workforce from Online-based Distribution

The courier company sends the product to the local courier hub, and then a delivery person from the courier or delivery partner company picks it up to complete the final delivery. It creates many job opportunities, and the developing market benefits from improved product delivery services and opportunities for the community workforce in the delivery service. Many digital entrepreneurs also build their own distribution networks. In this instance, these business owners employ their own personal distribution network and hire delivery personnel from the local workforce. The community has several areas where many young men face unemployment. These men are facing many opportunities, yet unemployment and lack of opportunity have left them depressed. Figure 6 shows that women who participate in digital entrepreneurship education improve the skills they can use in their businesses. They can inform similar companies about their experiences. Women entrepreneurs develop their competence, knowledge, and self-efficacy. They run their business autonomously, which improves their business expertise and effectiveness. Through the efforts of the local workforce as delivery partners and couriers, customers are linked to the distribution chain.

Figure 6: Interaction among all parties

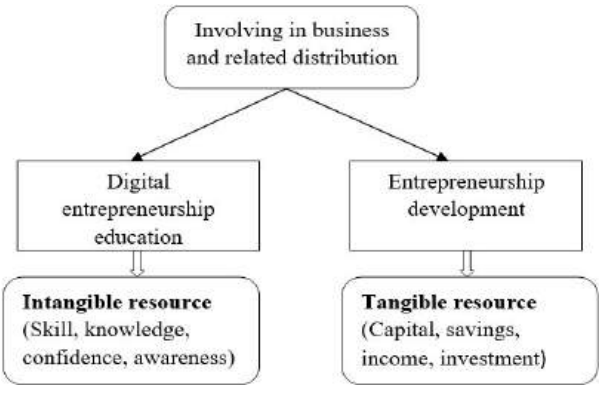


Source: Authors

One courier company owner said, "We provide the product to the delivery partner/person. We are expanding our business and providing employment opportunities to many employees from the local community. It is a good opportunity to have the scope for unemployed people."

Through income-generating activities, the broader distribution model enables entrepreneurs to expand their reach into unserved markets. Figure 7 shows that engaging in entrepreneurship education provides intangible resources. The primary goals are to acquire skills, knowledge, awareness, confidence, and capability. Entrepreneurship in distribution generates tangible resources, where the primary concerns are capital income, savings from income, investments, and assets from savings.

Figure 7: Way of building resources



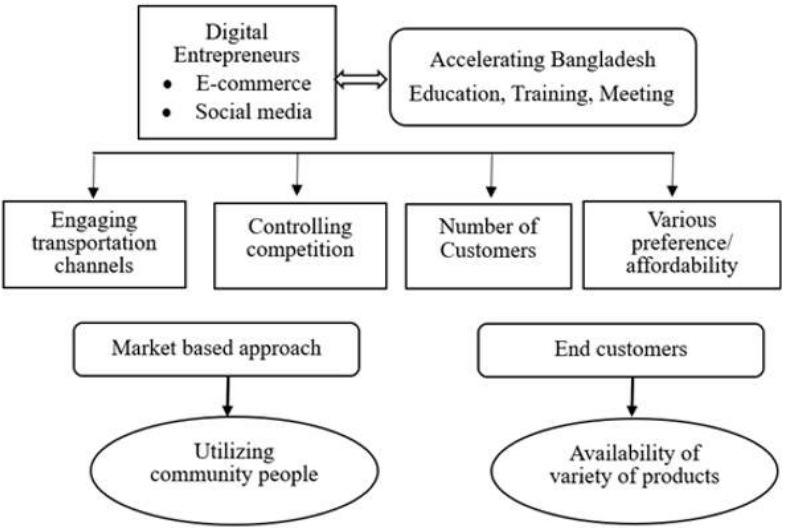
Source: Authors

The delivery person mentioned, "I deliver the necessary consumer items to the customers as a part of my main job. A variety of products are delivered within a reasonable time. My financial situation has improved compared to before; I utilize my earnings for my own well-being."

This is an important driver in this distribution network. Community workers earn an income and invest it in their family's purpose or other profit-making activities. On the other hand, digital entrepreneurship has transformed transportation channels by expanding market reach, reducing costs, and streamlining logistics. Bypassing conventional middlemen, companies can now sell directly to customers. Digital distribution has made businesses more scalable, accessible, and competitive across the country, enabling faster delivery.

Entrepreneurs stated, "We gain both practical and theoretical knowledge. There is scope to understand and consult about our own limitations. It helps us to analyze the risk of business. Gaining capabilities modernizes the business and enables us to identify construction errors. By analyzing challenges and problems through entrepreneurship education, we find real-life possible solutions to start and survive in the business."

Figure 8: Role of digital entrepreneurship ecosystem in distribution



Source: Authors

Figure 8 shows the interaction process through a digital entrepreneurship platform. Consumers are connected to the distribution system, where the community workforce gets income-generating opportunities. The digital entrepreneurship platform works as a collaborator and coordinator in the network. Intensive distribution increases efficiency, which helps improve entrepreneurs' coordination and communication. The development of the community people's lifestyle is also one of the important objectives.

Implications, Limitations, and Future Directions

Digital entrepreneurs make products available and reduce the costs of various consumer goods in the market. A wide variety of goods is a necessary good for all consumers, which increases the standard of living (Abdullah, 2023; Husain & Al Mubarak, 2024; Sagayaraj et al., 2020). Digital entrepreneurship distribution in the supply chain ensures a portfolio of the most usable as well as fancy goods for the market (Syahchari, 2025; Wulandari et al., 2025). Because of this full-coverage distribution system, the lack of employment opportunities is reduced, and community members get the financial opportunity to maintain and support their existence (Richter et al., 2017; Zaheer et al., 2019).

The working conditions and market are determined more creatively with new products and services that can fulfill the needs of the masses (Ballı, 2020). The community people are not excluded; all people are considered prospective individuals (Taskin et al., 2023). So, a digital entrepreneurship platform created a working scope among community people to better reach the market. So, the number of people became engaged in the delivery business (Loza & Roscoe, 2024; MacKenzie & McLachlan, 2023). This delivery system connects the overall market with the intensive supply chain system. Nambisan et al. (2019) mentioned that by focusing on digital entrepreneurship, one country can boost industrialization, innovation, and market formation. While only 20 interviewees were selected using the judgmental sampling technique, additional interviewees could be included to obtain a more comprehensive outcome.

Conclusion

In the traditional approach, community members cannot help themselves, so they usually need charity or public funding. In digital

entrepreneurship, community members are not excluded; all people are considered valuable consumers, producers, and entrepreneurs. To provide economic value, such as competitiveness and profit maximization, self-employment and community development in ecosystems involve many entrepreneurs. Every company wants to have both social and economic value, and this strategy helps businesses be more sustainable. In the long-term, education can help the state of business. Entrepreneurship education is seen as a social good, where the sustainability process has been demonstrated to be an effective approach. Accelerating Bangladesh is providing entrepreneurship education to achieve social responsibility. In addition to increasing economic competitiveness and profit maximization, it also enhances social and communal well-being.

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Appendix

Table A1: Open, axial, and selective coding

1st-order concepts Open coding	**2nd-order themes Axial coding**	**Theoretical dimensions Selective coding**
Entrepreneurship barriers due to lack of digital knowledge, idea generation, information, etc.	Need for entrepreneurship education	Digital education
Gaining both practical and theoretical knowledge helps entrepreneurs to analyse the risk of business and gain capabilities	Need to get all rights	Equality
New circle to present oneself that removes barriers and interacts to make the business successful	Necessary working environment	Economic growth
Education enables one to analyse challenges and find construction errors along with solutions in difficult situations for long survival	Remove social & business barriers	Entrepreneurship development
Savings from operation, economic benefit, investing in business, freedom	Opportunities for personal development	Opportunities
Engaging in distribution channels with personal financial interest	Enhancing scope for financial interest	Community acceleration
Collaboration with entrepreneurs for various goods and necessary goods	Ensuring supply of goods	Collaboration
Ensuring network, product, coordination, self-employment facilities	Business communication	Networking
Conventional flow of goods and conventional purchasing behaviour create barriers in getting products	Defining basic barriers in distribution	Supply chain
Limited working scope with unorganized distribution	Barrier in supply chain	Distribution

1st-order concepts **Open coding**	**2nd-order themes** **Axial coding**	**Theoretical dimensions** **Selective coding**
Enrich the community with the presence of digital entrepreneurship	Integration of digital entrepreneurship	Digital entrepreneurship

Source: Authors

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ORIGINAL SCIENTIFIC PAPER

Female Leadership in Mexican Agricultural Firms and Its Impact on Sustainability



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A B S T R A C T

Women-led agricultural enterprises are critical to environmental sustainability and rural development. However, national generalizations obscure how regional disparities, land tenure constraints, and business maturity shape women's strategic environmental choices. Integrating the Natural Resource-Based View (NRBV) with literature on female leadership and regional economic resilience, this study examines subnational typologies of women-led agricultural enterprises in Mexico to address three core questions: (1) how regional structural conditions constrain environmental practice adoption; (2) what leadership

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strategies women deploy across regions; and (3) how NRBV strategies are operationalized subnationally. Utilizing state-level data from the 2022 Mexican National Agricultural Census (INEGI across 32 federal entities), we performed Principal Component Analysis, Ward's hierarchical clustering, and K-means clustering. The empirical results reveal significant subnational heterogeneity and identify three distinct territorial typologies: I. Diversified Environmental Practice Territories, characterized by Product Stewardship via adaptive diversification; II. Transitioning Territories, focused on operational Pollution Prevention under capital constraints; and III. Strategic Leadership Territories, aligned with Sustainable Development through long-term risk management. This research extends Hart's NRBV to subnational rural contexts in emerging economies, demonstrating that female leadership acts as an adaptive mechanism that transforms structural constraints into place-based capabilities. Policy-wise, these typologies provide an empirical framework for designing targeted, regionally differentiated rural development interventions.

KEYWORDS: *agricultural businesses, female leadership, women, sustainability, Mexico*

Introduction

Navigating economic uncertainty in the agricultural sector requires strategically managing internal resources and dynamic capabilities to maintain long-term competitiveness (Ramírez Molina et al., 2024). Internal control and administrative management must align with sustainable development demands, specifically mitigating lifecycle impacts, optimizing inputs, and reducing waste (Carrasquero Ferrer, 2024; Mesco-Valeriano, 2024). Within this operational context, female leadership has emerged as a key driver of agricultural sustainability through innovation and resource optimization (Arintyas, 2024; Pierli et al., 2022).

In Mexico, agriculture constitutes a vital economic and sociocultural pillar, yet it faces severe threats from climate change, ecosystem degradation, aquifer overexploitation, and soil depletion (SEMARNAT, 2015; Vargas Aguilar, 2025). However, these pressures manifest unevenly across a deeply heterogeneous territory: a capital-intensive, export-oriented northern region contrasts sharply with the southern and central zones, which are dominated by small-scale producers, *ejido* structures, and subsistence farming (Medina, 2025). Gender gaps in asset ownership exacerbate this territorial disparity; historically marginalized from land tenure frameworks, women hold official titles to only 26% of *ejido* and communal plots

(Sobrino-García, 2023), severely restricting their access to formal credit, technical assistance, and advanced technologies (Hernandez, 2024; Medina, 2025). Paradoxically, data from the 2022 Agricultural Census reveal that women actively manage thousands of production units, make strategic decisions, and implement conservation practices despite facing acute capital shortages (INEGI, 2023). Thus, Mexico offers an ideal empirical setting to analyze how female leadership counters structural constraints through subnational environmental strategies. While previous research has examined rural women's leadership, empowerment, and sustainability in emerging economies (Díaz-García et al., 2016; Kabir et al., 2022; Vujadinović & Marjanović, 2025; Stevandić et al., 2026), gaps remain. Qualitative or localized studies often treat women producers as a homogeneous group, overlooking how spatial structures, land tenure systems, and regional business maturity shape environmental decisions. Furthermore, a disconnect persists between Hart's (1995) Natural-Resource-Based View (NRBV) and studies on gender-focused leadership; this leaves unexamined how women entrepreneurs operationalize NRBV dimensions, pollution prevention, responsible product stewardship, and sustainable development in contexts of severe resource scarcity. Additionally, subnational quantitative typologies that can inform spatially differentiated public policy interventions tailored to each state's or region's specific capacities are lacking. To address these gaps, this study resolves three core research questions:

Q1: How do regional structural conditions and business maturity across Mexican states limit or condition the adoption of environmental practices among women-led agricultural enterprises?

Q2: What types of leadership strategies do women adopt regarding agricultural practices across the various regions of Mexico?

Q3: How are the strategies of NRBV operationalized within the different subnational typologies of female agricultural leadership?

Accordingly, this research aims to construct and analyze a subnational typology of women-led agricultural enterprises in Mexico based on their environmental practices. This study provides empirical evidence on the strategic heterogeneity of female agricultural leadership. Theoretically, this research extends Hart's (1995) NRBV framework to subnational rural contexts in emerging markets, demonstrating that female leadership serves as an adaptive mechanism that transforms institutional constraints into place-based capabilities. In practice, it provides an empirical framework for policymakers to design targeted, regionally differentiated interventions that

foster both sustainable agricultural development and female economic empowerment.

Theoretical Framework

Female leadership is widely associated with participatory, collaborative, and creative management, as well as a strong orientation toward social and environmental performance (Eagly et al., 2007; Álvarez Hernández et al., 2025). In small and medium-sized enterprises (SMEs), female leaders foster organizational ambidexterity, balancing operational efficiency with eco-innovation practices to achieve sustainability goals (Veiga et al., 2025).

In agri-food value chains, these leadership attributes matter because business operations are directly linked to natural resource governance (World Farmers' Organization, 2025). Female leaders act as catalysts for the transition to a circular economy and for sustainable supply chain management (García-Sánchez & Enciso-Alfaro, 2025). However, female agency remains conditioned by broader socioeconomic ecosystems, such as institutional infrastructure and regulatory frameworks (Stevandić et al., 2026). In emerging economies, women-led agricultural enterprises foster economic diversification, reduce poverty, and empower communities (Kabir et al., 2022; Vujadinović & Marjanović, 2025).

Rural women entrepreneurs face deeply rooted structural barriers that limit the scale and scope of their operations, including restricted access to credit markets, financial services, advanced technologies, and specialized technical assistance (Díaz-García et al., 2016; Medina, 2025). Disproportionate domestic responsibilities reduce the time and energy women can devote to business management (Hernandez, 2024). They are underrepresented in rural producer organizations, irrigation boards, and cooperatives (Sánchez Gómez et al., 2022). Cultural norms often assign management authority to male family members, limiting women's operational autonomy (Vega-García et al., 2024). Customary inheritance practices widen this gap by favoring male heirs, restricting access to land titles. In Mexico, women hold legal title to only 26% of *ejido* and communal land plots (Sobrino-García, 2023).

The Natural Resource-Based View (NRBV) and Regional Resilience

To assess the development of environmental capabilities in women-led agricultural enterprises, this study draws on Hart's (1995) NRBV framework, which grounds competitive advantage in an organization's relationship with the natural environment through three strategic pillars: I. pollution prevention, II. product stewardship, and III. sustainable development. In agri-food SMEs, operationalizing NRBV capabilities strengthens market reputation, operational resilience, and competitive differentiation (Johnson-Hall & Hall, 2022; Royer & Simon, 2024).

However, environmental capabilities do not develop uniformly across space. Evolutionary economic geography highlights that business practices and regional resilience-defined as a territory's capacity to adapt and forge new growth trajectories-are path-dependent and conditioned by local structural and institutional legacies (Boschma, 2015). The NRBV framework has recently been extended to rural SMEs, circular economy adoption, and emerging markets (Hart & Dowell, 2011; Darmandieu et al., 2022). In resource-constrained rural settings, deploying the strategic capabilities proposed by Hart relies heavily on intangible organizational assets, such as dynamic adaptability, community leadership, and local ecological knowledge, to offset deficits in formal capital (Debasmita et al., 2026; Manono, 2025).

By integrating female leadership, the NRBV, and regional economic resilience, this study posits that female leadership acts as an adaptive moderating mechanism. Faced with various territorial constraints, women-led agricultural enterprises implement specific NRBV strategies, giving rise to sub-national business typologies.

Characterization of the Agricultural Sector in Mexico and Female Entrepreneurship

Mexico's primary sector exemplifies a heterogeneous landscape in which capital-intensive commercial operations coexist with subsistence smallholders. While primary activities contribute 3.2% to national GDP (INEGI, 2026), the sector underpins rural livelihoods for approximately 27 million people (INEGI, 2023). Decadal structural shifts, driven by trade liberalization (Schwentesius et al., 2012), climate variability, migration, and land reform, have altered production unit dynamics (Semerena & Catalán, 2008), elevating the strategic importance of women's leadership (WFO,

2025) and its characteristically participatory, resource-sensitive management style (Eagly et al., 2007; Álvarez Hernández et al., 2025).

In Mexico, 13.6 million women inhabit rural areas, 21.1% of the national female population (INMujeres, 2020), and head 876,456 production units, or 19.0% of the national total (INEGI, 2023). However, an acute paradox persists between female operational presence and institutional authority. Female heads face severe asset gaps: only 84.4% hold legal land titles, 5.2% access productive credit, 6.5% own machinery, and 19.8% lack formal education (INEGI, 2023), severely constraining business formalization and scaling (FAO, NRI & AWARD, 2026).

Methodology

This study employed a cross-sectional, exploratory quantitative design based on secondary data from the 2022 Agricultural Census conducted by the National Institute of Statistics and Geography (INEGI, 2023). The unit of analysis comprised the 32 Mexican federal entities and included women-managed agricultural production units that reported environmental actions. INEGI (2023, p. 5) defined a production unit as one or more plots in the same municipality, managed by the same female producer, and using common production resources. The analysis considered only agricultural and livestock production units; it excluded large-scale producers and forestry operations.

Variables and Operationalization

The analysis included 11 variables: eight environmental-practice variables and three structural variables. The environmental variables were derived from the Environment section of the Basic Questionnaire for Agricultural Production Units and captured resource conservation, environmental management, preventive actions, ecosystem management, and waste management. The structural variables were total agricultural units, women-managed units, and units reporting environmental actions. Table 1 presents the variables included in the analysis.

Table 1: Variables included in the analysis

Variable	Type	Environmental dimension/measure
General environmental action	Environmental practice	Overall environmental engagement
Energy conservation	Environmental practice	Resource efficiency
Water conservation	Environmental practice	Resource efficiency
Living fences	Environmental practice	Ecosystem and land management
Fire prevention	Environmental practice	Environmental risk prevention
Pest control	Environmental practice	Environmental management
Packaging separation	Environmental practice	Waste management
Other environmental actions	Environmental practice	Other environmental practices
Total agricultural units	Structural	Business structure
Women-managed units	Structural	Women's participation in agricultural activity
Units reporting environmental actions	Structural	Environmental business structure

Source: Authors' elaboration based on INEGI (2023)

Data Transformation and Standardization

INEGI reported the environmental-practice variables as percentages at the federal-entity level. To facilitate comparison among states, these variables were categorized into five ranges: 0–20% (very low), > 20–40% (low), > 40– 60% (medium), > 60–80% (high), and > 80–100% (very high adoption). We applied this categorization only to the eight environmental variables; it does not represent a conventional Likert scale because we derived the categories from aggregated census percentages. We retained the three structural variables as quantitative counts. We then standardized all 11 variables using Z-scores before PCA and cluster analysis.

Table 2: Categorization of environmental-practice variables based on census percentages

Percentage range	Code	Interpretation
0–20%	1	Very low adoption
> 20–40%	2	Low adoption
> 40–60%	3	Medium adoption
> 60–80%	4	High adoption
> 80–100%	5	Very high adoption

Source: Authors' elaboration based on the 2022 Agricultural Census (INEGI, 2023)

Statistical Analysis

We conducted the analyses using SPSS Statistics version 26. We applied a multivariate strategy combining Principal Component Analysis (PCA) and cluster analysis to identify territorial profiles based on business structure and environmental practices. First, we conducted PCA using the 11 standardized variables to identify underlying dimensions of the environmental-practice structure. We assessed sampling adequacy using the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test of sphericity. We retained components with eigenvalues >1 and examined factor loadings, communalities, and explained variance.

Second, hierarchical cluster analysis using Ward's method and squared Euclidean distance explored the grouping structure of the 32 federal entities. We then applied K-means clustering to the same standardized variables. We compared solutions with K=2, K=3, and K=4. We retained the three-cluster solution because it produced more differentiated and substantively interpretable territorial profiles, despite the lower silhouette coefficient than K=2. We used cluster centers and descriptive F-statistics to characterize the resulting groups. We interpreted the F-statistics descriptively because the clustering procedure maximizes between-group differences.

Results

Principal Component Analysis (PCA)

The principal component analysis (PCA) identified four components with eigenvalues greater than 1, explaining 76.38% of the total variance.

The KMO value was 0.601, indicating marginal but acceptable sampling adequacy for an exploratory analysis, while Bartlett's test of sphericity was significant ($\chi^2 = 277.879$, df = 55, $p < .001$). These results supported the exploratory PCA, although the KMO value suggests interpreting the component structure with caution.

Table 3: Principal component analysis: rotated component loadings and explained variance

Variable	PC1	PC2	PC3	PC4
Total enterprises	**.970**	.109	.086	.009
Women-managed enterprises	**.979**	.122	.075	.043
Environmental enterprises	**.973**	.147	.070	.040
Environmental action	.180	**.777**	.198	.328
Energy saving	.032	-.244	**-.742**	-.225
Water saving	-.268	-.175	**-.777**	.231
Living fences	.283	-.063	**.525**	.022
Fire prevention	.253	**.736**	.193	-.439
Pest control	.027	**.795**	-.137	-.022
Packaging separation	.097	.024	.079	**.965**
Other actions	-.290	-.251	**.582**	.066
Eigenvalue	**3.780**	**1.764**	**1.568**	**1.289**
Variance explained (%)	**34.366**	**16.036**	**14.259**	**11.716**
Cumulative variance (%)	**34.366**	**50.402**	**64.661**	**76.377**

Note: Extraction method: Principal Component Analysis. Rotation method: Varimax with Kaiser normalization. Rotation converged in five iterations.

Source: Authors' elaboration

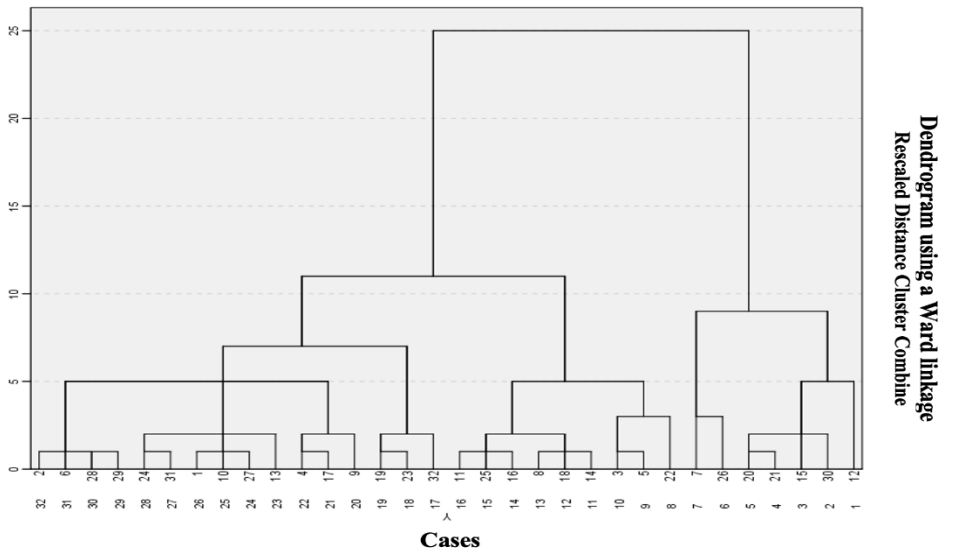
The first component explained 34.37% of the variance and was strongly associated with total enterprises, women-managed enterprises, and environmental enterprises. The second component explained 16.04% of the variance and was primarily associated with pest control, environmental actions, and fire prevention. The third component explained 14.26% and was characterized mainly by water and energy saving, together with living fences and other environmental actions. The fourth component explained 11.72% and was dominated by packaging separation. Overall, the components indicate that environmental engagement is multidimensional,

encompassing business structure, preventive practices, resource management, and waste handling.

Cluster Analysis

Hierarchical clustering using Ward's method revealed a differentiated grouping structure among the 32 federal entities and supported a three-cluster solution (Figure 1). K-means clustering was subsequently applied to obtain the final territorial classification.

Figure 1: Dendrogram of the hierarchical cluster analysis (Ward's method)



Source: Authors' elaboration based on the 2022 Agricultural Census (INEGI, 2023)

The final K-means solution identified three territorial clusters with 14, 6, and 12 federal entities, respectively. Table 4 presents the standardized cluster centers. Positive values indicate scores above the overall mean, whereas negative values indicate scores below it.

Table 4: Final cluster centers obtained from the K-means analysis (K = 3)

Variable	Cluster 1	Cluster 2	Cluster 3
Total enterprises	-0.53706	**1.84451**	-0.29568
Women-managed enterprises	-0.50776	**1.90338**	-0.35931
Environmental enterprises	-0.49461	**1.92814**	-0.38702
Environmental action	0.40018	**0.72624**	-0.82999
Energy saving	-0.39549	-0.18456	**0.55368**
Water saving	-0.09342	-0.59167	**0.40482**
Living fences	0.07987	**0.66074**	-0.42355
Fire prevention	0.25514	**0.85992**	-0.72763
Pest control	0.32277	**0.53271**	-0.64292
Packaging separation	0.09342	0.09342	-0.15570
Other actions	**0.44776**	-0.42355	-0.31061

Note: Values represent standardized Z-score cluster centers. Positive values indicate scores above the overall mean, whereas negative values indicate scores below the overall mean.

Source: Authors' elaboration

Territorial Profiles

Cluster 1: Lower business structure and diversified environmental practices

This cluster comprises 14 federal entities and shows below-average values for total enterprises, women-managed enterprises, and environmental enterprises. Nevertheless, environmental action, living fences, fire prevention, pest control, and other environmental actions are at or above the overall mean. Water and energy saving remain below the mean. The profile therefore reflects relatively diversified environmental engagement despite a smaller business structure.

Cluster 2: Stronger business structure and broader environmental engagement

This cluster includes six federal entities and presents the highest values for total enterprises, women-managed enterprises, and environmental enterprises. It also shows above-average environmental action, living fences, fire prevention, and pest control. However, water saving, energy saving, and other environmental actions remain below the overall mean. The

profile combines stronger business structure with broader engagement in environmental and preventive practices.

Cluster 3: Lower business structure with emphasis on resource efficiency

This cluster comprises 12 federal entities and presents below-average values for the three structural variables. In contrast, energy and water saving are above the overall mean, while environmental action, living fences, fire prevention, pest control, and other actions are below average. The profile is therefore characterized primarily by resource-efficiency practices rather than preventive or land-management actions.

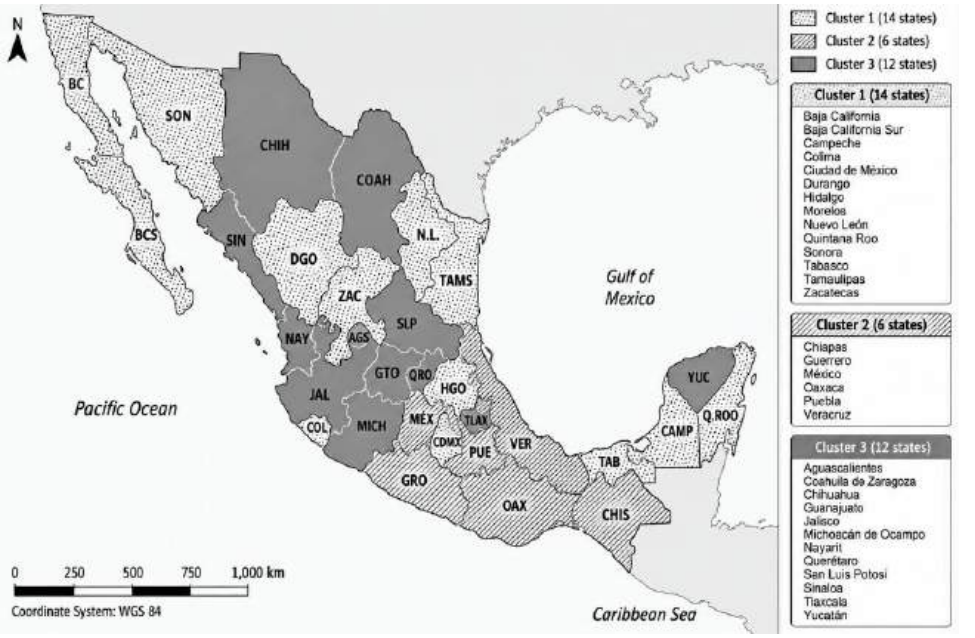
Table 5: Summary of territorial cluster profiles

Cluster	Federal entities	Territorial profile
Cluster 1 (n = 14)	Baja California; Baja California Sur; Campeche; Colima; Durango; Hidalgo; Mexico City; Morelos; Nuevo León; Quintana Roo; Sonora; Tabasco; Tamaulipas; Zacatecas	Lower business structure and moderate preventive environmental practices.
Cluster 2 (n = 6)	Chiapas; Guerrero; State of Mexico; Oaxaca; Puebla; Veracruz	Stronger business structure and broader environmental engagement.
Cluster 3 (n = 12)	Aguascalientes; Coahuila; Chihuahua; Guanajuato; Jalisco; Michoacán; Nayarit; Querétaro; San Luis Potosí; Sinaloa; Tlaxcala; Yucatán	Lower business structure with emphasis on water and energy saving.

Note: Cluster profiles are based on standardized Z-score centers and each cluster's relative position with respect to the overall sample mean.

Source: Authors' elaboration

Figure 2: Territorial distribution of the three environmental-business clusters in Mexico



Note: Clusters were obtained via K-means clustering (K = 3) using 11 standardized business and environmental variables across the 32 Mexican federal entities.

Source: Own elaboration

The spatial distribution confirms substantial heterogeneity among Mexican federal entities. The results indicate that business structure and environmental practices do not follow a uniform territorial pattern. In particular, Cluster 2 links stronger business structure with broader environmental engagement, whereas Cluster 3 links smaller business structures with specific resource-efficiency practices.

Sensitivity and Descriptive Differentiation

We examined alternative K-means solutions to assess the robustness of the three-cluster solution. K=2 produced highly unbalanced groups (7/25) despite a higher silhouette coefficient (0.316), while K=4 generated excessive fragmentation, including a cluster of only two entities. K=3 produced groups of 14, 6, and 12 entities and, although its silhouette

coefficient was lower (0.165), provided the most differentiated and substantively interpretable territorial profiles. Therefore, we retained K=3 as the principal solution, while treating K=2 and K=4 as sensitivity checks.

Table 6: Sensitivity analysis of alternative cluster solutions

Number of clusters	Cluster sizes	Silhouette coefficient	Interpretation
K = 2	7 / 25	**0.316**	High internal separation, but highly unbalanced.
K = 3	**14 / 6 / 12**	0.165	**More differentiated and interpretable territorial profiles.**
K = 4	14 / 5 / 11 / 2	Not calculated	Excessive fragmentation; one cluster contains only 2 entities.

Note: Cluster sizes refer to the 32 federal entities included in the analysis. The silhouette coefficient was calculated for the available alternative solutions.

Source: Own elaboration

The variables showing the greatest descriptive differentiation among clusters were environmental enterprises (F = 42.660), women-managed enterprises (F = 37.823), fire prevention (F = 22.237), and total enterprises (F = 20.008). Living fences, water saving, energy saving, and environmental action also contributed to the differentiation, whereas pest control, packaging separation, and other actions showed lower F-statistics. These values are reported descriptively and should not be interpreted as conventional inferential tests.

Table 7: Descriptive F-statistics for variables differentiating the clusters

Variable	F
Environmental enterprises	**42.660**
Women-managed enterprises	**37.823**
Fire prevention	**22.237**
Total enterprises	**20.008**
Living fences	**10.834**
Water saving	**9.010**
Energy saving	**6.494**

Variable	F
Environmental action	**4.661**
Pest control	1.185
Other actions	1.818
Packaging separation	2.337

Note: F-statistics are reported for descriptive purposes only because the clusters were formed to maximize between-cluster differences. Therefore, do not interpret the associated significance levels as conventional hypothesis tests.

Source: Own elaboration

Discussion

The findings show that female leadership in Mexican agricultural enterprises is territorially heterogeneous and shaped by interactions among business structure, organizational capacity, and environmental practices. Regarding Q1, the cluster with the strongest business structure also showed the highest concentration of women-managed and environmentally active enterprises, together with broader preventive practices. This pattern is consistent with research associating female leadership with innovation, operational efficiency, sustainability-oriented decision-making, and environmental management (Li & Tong, 2023; Pierli et al., 2022; García-Sánchez & Enciso-Alfaro, 2025), as well as with international evidence emphasizing women's role in advancing sustainable agricultural systems (World Farmers' Organization, 2025; FAO, 2026).

However, these results should not be interpreted as evidence that female leadership alone determines environmental performance. Rural women entrepreneurs continue to face structural constraints related to access to finance, technology, productive assets, institutional support, and decision-making autonomy (Díaz-García et al., 2016; Hernández Herrera, 2024; Karami et al., 2024). At the same time, women may respond to these constraints through diversification, resource efficiency, environmental knowledge, and adaptive practices (Karami et al., 2024; Álvarez Hernández et al., 2025; De Marco Larrauri et al., 2016; Acevedo-Ortiz et al., 2024). Thus, the results support an interpretation in which environmental sustainability emerges from the interaction between organizational capabilities and territorial conditions rather than from business size or female leadership in isolation, consistent with the NRBV and evolutionary

regional resilience perspectives (Hart, 1995; Boschma, 2015; Royer & Simon, 2024).

Regarding Q2 and Q3, the three territorial profiles reveal differentiated environmental strategies. The manuscript interprets *Cluster 1*, characterized by a smaller business structure and diversified environmental practices, through Hart's (1995) product stewardship perspective. Its combination of preventive, adaptive, and land-management practices is consistent with evidence that small-scale producers can use diversification and local environmental knowledge to respond to economic, technological, institutional, and environmental constraints (Shi et al., 2012; Karami et al., 2024; Álvarez-Hernández et al., 2025; Acevedo-Ortiz et al., 2024). These practices can therefore be understood as expressions of strategic flexibility and entrepreneurial adaptation (Boschma, 2015).

Cluster 2, which presents the strongest business structure and broader environmental engagement, is associated in the manuscript with Hart's (1995) pollution prevention strategy. This interpretation emphasizes environmental practices as mechanisms to improve operational efficiency and reduce costs, particularly under constraints related to land ownership, production costs, and access to formal credit. Previous studies indicate that pollution prevention and environmental efficiency can constitute an initial strategic response among resource-constrained SMEs (Darmandieu et al., 2022; Sobrino-García, 2023; Medina, 2025; Royer & Simon, 2024). Evidence from rural contexts also shows that women entrepreneurs can transform resource limitations into operational capabilities through innovation and conservation practices (Vujadinović & Marjanović, 2025; Lashitew & Werker, 2020; Lashitew et al., 2020).

Cluster 3 presents a different configuration: although its business structure is below the overall mean, it records above-average water- and energy-saving practices. This pattern suggests that environmental adaptation does not necessarily depend on organizational scale and that resource efficiency may represent a specific pathway for responding to territorial and resource constraints (Karami et al., 2024; Álvarez Hernández et al., 2025; Royer & Simon, 2024). From an evolutionary regional resilience perspective, territories may develop different environmental trajectories based on their existing structural and institutional conditions (Boschma, 2015). Consequently, the lower levels of preventive and land-management practices observed in this cluster should not automatically be interpreted as lower sustainability.

From a theoretical perspective, the findings support applying the NRBV to subnational agricultural contexts by showing that environmental strategies vary with organizational and territorial configurations. The results also reinforce the relevance of female leadership as an adaptive mechanism, while avoiding the assumption that women-led enterprises constitute a homogeneous category. Nevertheless, this study did not directly measure resilience; therefore, references to resilience should be understood as a theoretical interpretation rather than empirical evidence that one cluster is more resilient than another.

Conclusion

The results demonstrate that female leadership in Mexican agriculture is territorially heterogeneous and that the interaction between business structure, organizational capabilities, and regional conditions shapes environmental practices. The three-cluster typology reveals differentiated pathways of environmental engagement rather than a uniform relationship between business size and sustainability. While Cluster 2 combines stronger business structure with broader environmental and preventive practices, Cluster 1 shows diversified environmental engagement despite a smaller business structure, and Cluster 3 emphasizes water and energy efficiency despite a below-average business structure.

These findings extend the NRBV perspective by suggesting that environmental capabilities may develop through different organizational and territorial pathways. Female leadership should therefore not be considered an isolated determinant of environmental sustainability; its contribution is embedded in access to resources, organizational capabilities, and territorial conditions.

From a policy perspective, the identified typology suggests that environmental interventions for women-led agricultural enterprises should avoid standardized approaches. Territories with stronger business structures may benefit from support for technological innovation and consolidation of environmental practices. In contrast, territories characterized by resource-efficiency strategies may require greater access to water- and energy-saving technologies, financing, technical assistance, and training.

The study is limited by its reliance on secondary cross-sectional data, which restricts analysis of women's experiences, motivations, and leadership dynamics. Future research should incorporate primary and longitudinal data,

as well as variables explicitly constructed from the NRBV framework, to examine causal relationships and multilevel territorial effects. Because the analysis focuses on Mexico, comparative studies across countries would also help identify how institutional, cultural, and territorial contexts shape these dynamics.

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ORIGINAL SCIENTIFIC PAPER

Entrepreneurial Skills and Women's Empowerment: A Bibliometric and Content Analysis of Capability Formation in Entrepreneurship Research



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A B S T R A C T

Research on women's entrepreneurship has grown rapidly, especially around empowerment, financial inclusion and development policy. However, the literature has yet to provide a comprehensive understanding of how entrepreneurial skills contribute to women's empowerment. This study examines how research on women's entrepreneurial empowerment has developed intellectually and thematically, with particular attention to the role of entrepreneurial skills. Using 447 peer-reviewed journal articles indexed in Scopus and Web of Science (2000–2025), it combines bibliometric mapping with a theory-informed content analysis of 50 purposively diversified articles. Bibliometric results show a field anchored by broad entrepreneurship and empowerment themes; skill development is visible but remains weakly integrated with the central entrepreneurship–empowerment structure. Content analysis shows recurring links from training to capability formation and from entrepreneurial capabilities to enterprise outcomes, while links from capabilities to agency and from enterprise achievement to multidimensional empowerment are less consistently developed. The findings therefore refine the capability gap: capability-oriented research is present, but the conversion mechanisms linking resources, capabilities, agency and empowerment remain fragmented. The study develops a theory-informed framework that treats entrepreneurial skills as potential, context-dependent conversion factors rather than as a fixed causal mechanism.

KEYWORDS: *women entrepreneurship, entrepreneurial skills, empowerment, capability approach, bibliometric analysis, content analysis*

Introduction

Entrepreneurship is widely recognised as a driver of inclusive growth, poverty alleviation and socio-economic transformation, especially where formal employment is limited. Women's entrepreneurship has therefore attracted increasing academic and policy attention because it contributes to economic independence, social mobility, household bargaining power and economic decision-making. It may also support empowerment, community resilience and social inclusion (Audretsch & Belitski, 2021; Feng et al., 2023; Tasnim, 2021). Yet this potential is constrained by persistent barriers in finance, markets, institutions, digital infrastructure and networks (Auguste, 2022; Corrêa et al., 2024; Mbowa et al., 2023; Mensah & Derera, 2023; Robb & Coleman, 2010). Thus, the link between women's

entrepreneurship and empowerment cannot be assumed to be simple or linear.

The literature has largely explained women's entrepreneurial empowerment through structural and institutional perspectives, particularly finance, microcredit, government programmes, training and business support (Tengeh & Nkem, 2017; Welsh et al., 2016). This emphasis is valuable because it locates women's constraints in economic systems, social norms and institutional arrangements rather than in individual weakness. However, it often assumes that resource access leads directly to empowerment, although support does not automatically produce agency, confidence, market participation, decision-making authority or enterprise sustainability (Abuhussein & Koburtay, 2021; Radović-Marković & Achakpa, 2018; Nziku & Henry, 2021; Yadav et al., 2022).

This points to a conceptual limitation. Research has paid extensive attention to resource access, institutional barriers and individual characteristics, but less attention to how women develop and mobilise entrepreneurial capacities under constraint. Entrepreneurial competence is still often interpreted narrowly as technical, managerial or administrative skill, whereas women entrepreneurs also require adaptive, relational and agency-based capacities to identify opportunities, navigate uncertainty, build networks, mobilise support and create value from limited resources (Crittenden et al., 2019; Tasnim, 2021; Marín et al., 2024; Niu et al., 2024; Welter, 2020). The present review therefore treats the extent of this limitation as an empirical question rather than assuming in advance that capability-oriented explanations are absent.

Knowledge production is also epistemically uneven. Reviews of gender and entrepreneurship research have identified methodological limitations in the field and the need for more context-sensitive approaches (Henry et al., 2016). Evidence from Ghana and Bangladesh shows that empowerment is shaped by local labour relations, ethnic inclusion, policy design and gendered institutions(Tasnim, 2021; Mensah & Derera, 2023), reinforcing the need for context-sensitive mapping.

This study therefore shifts the debate from a resource-based explanation to a capability-oriented perspective. Drawing on the capability approach (Sen, 1999), empowerment theory (Kabeer, 1999), social capital theory (Nahapiet & Ghoshal, 1998), and institutional theory (North, 1990), it conceptualises entrepreneurial competence as a socially embedded and institutionally mediated conversion factor. Entrepreneurial competence is

understood not only as the technical capacity to run a business, but as the ability to identify opportunities, build networks, work within institutional constraints, make strategic decisions and translate resources into empowering outcomes. A bibliometric review is appropriate because it can identify publication trends, knowledge clusters, thematic evolution, collaboration patterns and geographical distribution across the interdisciplinary field. The capability approach has already been applied to entrepreneurship (e.g., Gries & Naudé, 2011); the novelty here lies in systematically mapping and synthesising how entrepreneurial skills are positioned within women's entrepreneurial empowerment research.

Methodologically, the study combines bibliometric mapping and theory-informed content analysis of Scopus and Web of Science publications. It identifies dominant themes, geographical patterns and theoretical gaps, and interprets how the literature explains entrepreneurial competence, empowerment processes, social capital and institutional conditions. The study contributes by developing an integrated view of entrepreneurial competence as a set of potential conversion factors through which resources may be translated into agency and empowerment. The bibliometric evidence is also used to identify dominant and peripheral areas for full-text analysis and to compare field-level patterns with article-level mechanisms.

Theoretical Background

Women's entrepreneurial empowerment emerges from the interaction of resources, capabilities, relations and institutions rather than from resource access alone. This study therefore integrates empowerment theory, social capital theory, institutional theory and the capability approach to examine how entrepreneurial skills may function as context-dependent conversion factors between structural conditions and empowerment outcomes.

Empowerment as a Multidimensional Process

Kabeer (1999) conceptualises empowerment as a multidimensional process involving resources, agency and achievements. In women's entrepreneurship, empowerment therefore includes not only income generation or business ownership, but also decision-making power, control over resources, social recognition and the capacity to challenge constraining gender norms.

Much entrepreneurship research nevertheless implies a linear movement from participation to empowerment. This overlooks the fact that women in similar economic conditions may experience different empowerment outcomes depending on their capacity to mobilise resources, negotiate constraints and exercise agency. Empowerment must therefore be examined as a process, not only as an outcome indicator

Social Capital as a Relational Mechanism

Social capital theory explains how relational structures enable or constrain entrepreneurial activity. Social capital refers to resources embedded in networks, including structural ties, trust-based relations and shared meanings (Nahapiet & Ghoshal, 1998). Relational and contextual conditions can shape how entrepreneurial activity is pursued in constrained settings (Baikovich et al., 2022; Gaddefors & Anderson, 2019). Evidence from women-owned beauty parlours in Dhaka also shows how socially embedded entrepreneurship can support employment, inclusion and empowerment among marginalised women workers (Tasnim, 2021).

Institutions as Enabling and Constraining Structures

Institutional theory views entrepreneurial activity as embedded in formal and informal rules governing economic and social interaction (North, 1990). Formal institutions include laws, regulations and policy regimes; informal institutions include cultural norms, gender roles and social expectations. These rules affect women's access to resources, entrepreneurial legitimacy and capacity to scale and sustain ventures (Fayaz et al., 2022; Raman et al., 2022).

Women entrepreneurs often operate in institutional environments that are not fully responsive to their needs. They may face discriminatory lending practices, limited property rights, restrictive norms, unequal caregiving responsibilities and weak implementation of supportive policy (Abuhussein & Koburtay, 2021; Mensah & Derera, 2023). Gender-sensitive institutional reform can expand opportunity, but only when formal support addresses the social norms that shape women's everyday entrepreneurial choices.

Entrepreneurial Skills as Conversion Factors

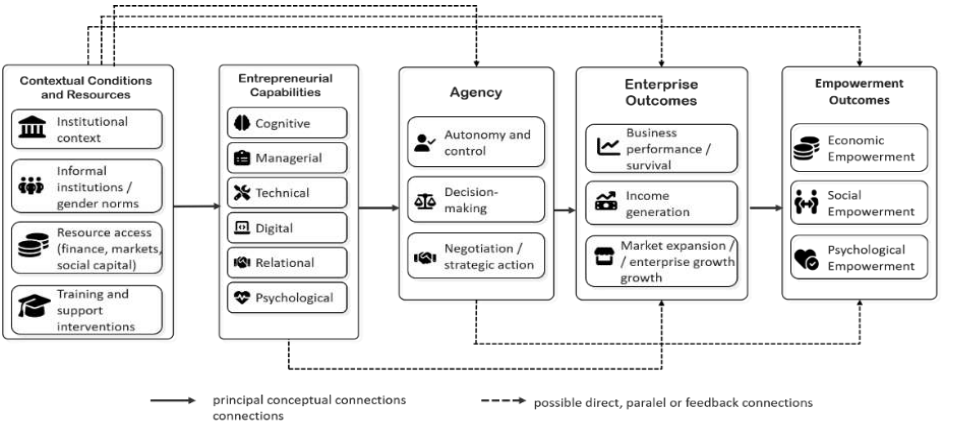
Drawing on Sen's (1999) capability approach, this study reconceptualises entrepreneurial skills as conversion factors that shape how women transform available resources into valuable outcomes. Skills are not static inputs; they are situational capabilities that help women identify opportunities, negotiate constraints, build networks and sustain entrepreneurial activity.

Entrepreneurial skills are conceptualised as multidimensional capabilities spanning cognitive, managerial, technical, relational, digital and psychological domains. Their relationships with context, agency and empowerment are examined as possible direct, parallel or sequential pathways rather than as a fixed causal sequence.

Theory-Informed Analytical Framework

Drawing on Sen (1999), Kabeer (1999), Nahapiet and Ghoshal (1998), and North (1990), the framework positions institutional context and social capital as conditional enablers and entrepreneurial skills as potential conversion factors (Figure 1). Skills span cognitive, managerial, technical, relational, digital and psychological domains, while agency captures autonomy, decision-making, control and negotiation. Enterprise achievements and economic, social and psychological empowerment are kept analytically distinct. The arrows indicate plausible direct, parallel or sequential relationships rather than a fixed causal chain; agency is not assumed to be a necessary mediator. For coding, agency processes were distinguished from realised autonomy or control outcomes.

Figure 1: Theory-Informed Analytical Framework



Source: Authors' own elaboration based on the theoretical synthesis

Methodology

This study combines bibliometric mapping with theory-informed content analysis. Bibliometric analysis identifies dominant and peripheral themes and patterns of knowledge production, while full-text content analysis examines article-level relationships among resources, institutional conditions, social capital, entrepreneurial capabilities, agency, enterprise outcomes and empowerment. The bibliometric results informed the areas examined qualitatively, but no single resources–capabilities–agency–empowerment sequence was imposed during coding.

Data Collection and Preparation

The dataset was drawn from Web of Science and Scopus because of their broad disciplinary and bibliometric coverage (Baas et al., 2020; Birkle et al., 2020). Searches combined entrepreneur*, women OR woman OR female, skill OR ability OR capacity OR capability OR competen*, and empower*. Scopus used TITLE-ABS-KEY(entrepreneur*) AND TITLE-ABS-KEY(women OR woman OR female) AND TITLE-ABS-KEY(skill OR ability OR capacity OR capability OR competen*) AND TITLE-ABS-KEY(empower*); Web of Science used TS=(entrepreneur*) AND TS=(women OR woman OR female) AND TS=(skill OR ability OR capacity OR capability OR competen*) AND TS=(empower*). Because the

Web of Science Topic field also includes Keywords Plus, record-level screening assessed substantive relevance.

Only peer-reviewed English-language journal articles were eligible. Searches returned 294 Web of Science and 342 Scopus records; DOI and normalised-title deduplication yielded 456 unique records. Structural audit excluded eight book chapters and one institutional newsletter, producing the final 447-article bibliometric corpus (2000–2025). Three concatenated Scopus records were reconstructed without changing corpus size; the apparent 1997 starting year belonged to the excluded newsletter.

Eligibility and Screening

Articles were retained when women's entrepreneurship, women-owned enterprise or self-employment was substantive and the study examined empowerment, agency, entrepreneurial skills or capabilities, social capital or networks, or institutional conditions. Incidental women's-entrepreneurship mentions and ineligible document types, languages or subjects were excluded; uncertain title–abstract records proceeded to full text.

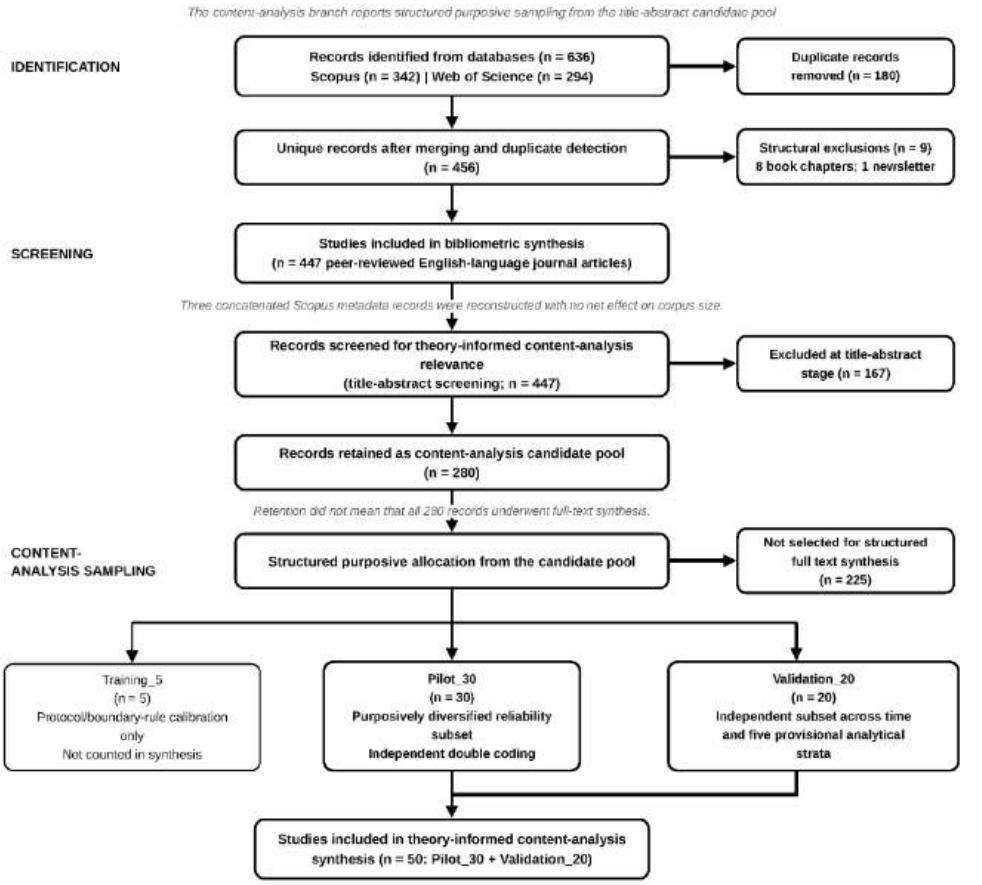
Four reviewers first assessed 30 records independently; initial agreement was 40.0% (Fleiss' $\kappa = 0.353$), prompting clarification of eligibility boundaries and blinded full-text adjudication of two unresolved cases. The remaining 426 records were independently screened by two reviewer pairs: Pair 1 agreed on 168/213 records (78.9%; $\kappa = 0.409$) and Pair 2 on 149/213 (70.0%; $\kappa = 0.443$). Original decisions were retained for reliability audit; disagreements were resolved against predefined criteria, with borderline cases adjudicated by the lead researcher. Final allocation and eligibility details are in Supplementary File S3.

After structural correction, 167 of 447 articles were excluded at title–abstract screening and 280 formed the content-analysis candidate pool. Five articles were used for codebook training (Training_5), 30 for formal intercoder reliability (Pilot_30), and a separate 20 for independent validation (Validation_20). Training_5 was calibration-only; Pilot_30 and Validation_20 formed the 50-article structured synthesis (Figure 2; Supplementary File S3).

Keyword variants were harmonised before conceptual-structure analysis. A thesaurus was applied to the co-word network, thematic map and thematic evolution; equivalent harmonisation was applied directly to the dataset for the three-field plot. Conceptually distinct terms were retained.

Synonym mappings and removed terms are documented in Supplementary Files S1–S2.

Figure 2: PRISMA 2020-Style Flow Diagram of Study Identification, Screening, and Selection for Bibliometric and Content Analysis



Source: Adapted from Page et al. (2021)

Bibliometric Analysis

Bibliometric analysis used RStudio using R version 4.2.3 (2023-03-15) with bibliometrix and Biblioshiny to examine co-word structure, thematic centrality and density, thematic evolution, and author–keyword–country relationships. These outputs identified central and peripheral topics and provided field-level context for the full-text synthesis.

All analyses used author keywords (DE). Co-word analysis used up to 40 nodes, association normalisation, Louvain clustering and repulsion 0.3. The thematic map used up to 250 terms, minimum frequency 2, Louvain clustering and three labels per cluster; thematic evolution used up to 250 terms, minimum frequency 5 and Walktrap across 2000–2015, 2016–2020 and 2021–2025. The three-field plot displayed up to 10 authors, keywords and countries.

Content Analysis

Content analysis examined how the 280 candidate articles represented resources, institutions, social capital, capabilities, agency, enterprise outcomes and empowerment. Codebook v2.1 (Supplementary File S4) was fixed after two coders independently applied the provisional scheme to five training articles, clarifying boundaries between training and capability, enterprise performance and empowerment, and recommendations and empirical evidence. Pilot_30 and Validation_20 were selected for temporal and conceptual diversity rather than statistical representativeness.

Purposeful diversification prioritised relevant variation and trustworthiness rather than statistical representativeness (Elo et al., 2014; Suri, 2011). Two coders independently coded Pilot_30 across 19 binary codes; this subset represented 10.7% of the candidate pool, within the 10–25% range described for multiply coded qualitative data (O'Connor & Joffe, 2020).

Reliability was computed from the original independent decisions: across 570 paired judgements, agreement was 85.1%, with median Cohen's $\kappa = 0.648$ (range 0.333–0.918). Seven codes below $\kappa = 0.60$ generated 46 focused boundary-review flags against Codebook v2.1; original reliability statistics were retained. Code-level results appear in Supplementary File S5.

A third researcher independently reviewed a non-overlapping 20-article validation set, blinded to Pilot_30 coding and lead adjudication, and completed full-text eligibility verification and structured evidence extraction. Validation_20 assessed interpretive robustness rather than a second κ statistic; its documentation is provided in Supplementary File S6.

Article-level mechanisms were extracted separately. An edge was retained only for an explicit directional relationship supported by a tested path, mediation or moderation, before–after change or clear qualitative mechanism; co-occurrence alone was insufficient, and non-significant paths

were recorded as unsupported. Related edges were grouped into theory-informed categories. Because articles could contribute to multiple categories, frequencies indicate recurrence within the 50-article purposive synthesis, not prevalence in the 280-record pool or 447-article corpus (Supplementary File S7).

Results

Descriptive Overview

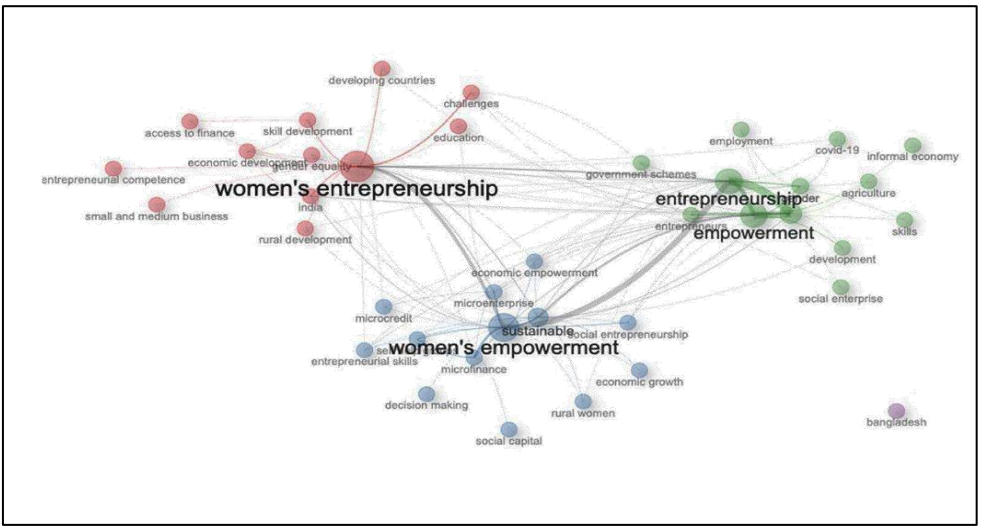
The final corpus comprised 447 English-language journal articles published in 2000–2025, with growth accelerating after 2019. Keyword analyses were dominated by women's entrepreneurship, women's empowerment, entrepreneurship, empowerment, women and gender; finance-, development- and skill-related terms were distributed around these broader themes.

Co-word Network: Thematic Clusters and Conceptual Dominance

Figure 3 shows three interconnected areas centred on women's entrepreneurship, women's empowerment, and broader entrepreneurship/empowerment concepts. The women's entrepreneurship cluster connects with education, skill development, gender equality, economic development, finance, and developing-country contexts; the women's empowerment cluster links microfinance or microcredit, microenterprise, social capital, decision-making, entrepreneurial skills, and rural women.

Entrepreneurial skills and skill development are visible but less central than the dominant entrepreneurship and empowerment nodes. Rather than a finance-dominant structure, the network shows structural, relational, development and capability-related themes distributed around the field's core concepts, motivating article-level examination of how these elements are connected.

Figure 3: Co-word Network of Research Themes in Women's Entrepreneurial Empowerment



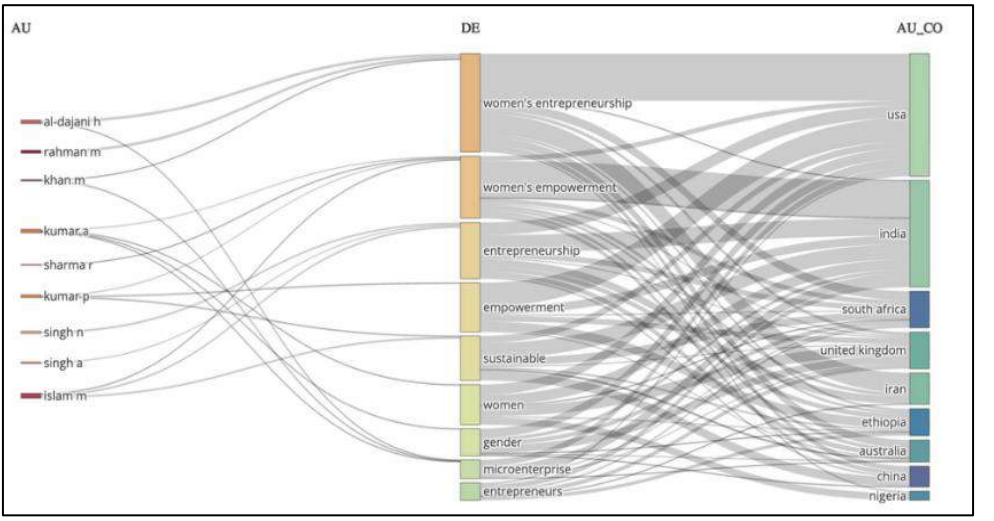
Source: Bibliometrix result

Three-Field Plot: Geographic and Intellectual Embedding

Figure 4 shows geographically diverse contributions, led among the displayed countries by the United States and India, followed by South Africa, the United Kingdom, Iran, Ethiopia, Australia, China and Nigeria. Broad terms such as women coexist with more specific terms including women entrepreneurs, women's entrepreneurship, empowerment and gender.

Leading keywords connect across several countries rather than forming distinct country-specific thematic blocks. Because the plot displays only the top 10 authors, keywords and countries, it indicates the strongest author–keyword–country links rather than a complete geographic profile and does not support assigning themes rigidly to particular regions.

Figure 4: Three-Field Plot of Authors, Keywords, and Contributing Countries in Women's Entrepreneurial Empowerment Research



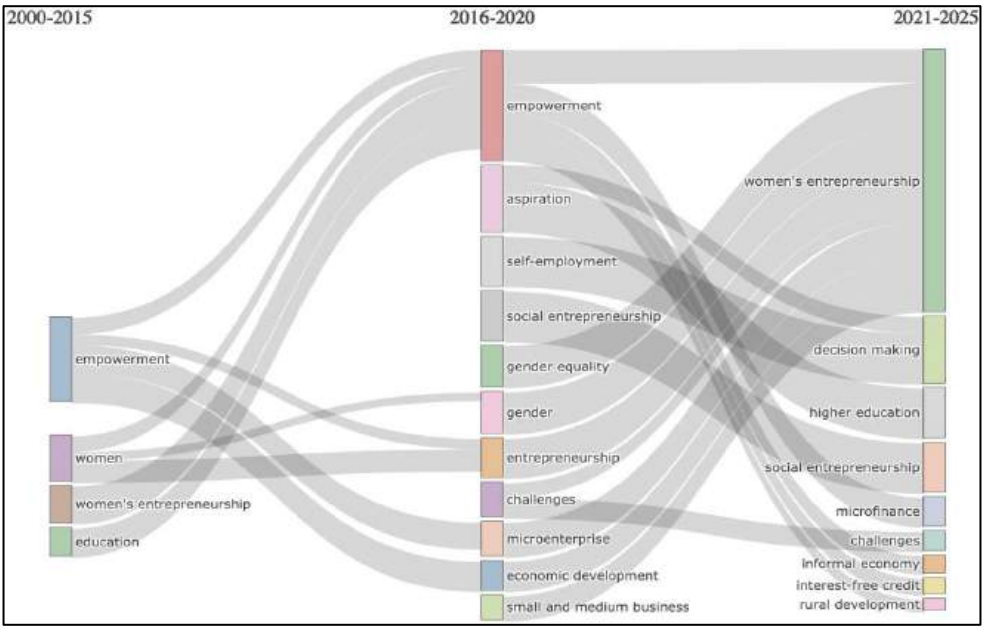
Source: Bibliometrix result

Thematic Evolution and Research Priorities

Figure 5 shows gradual thematic diversification. In 2000–2015, the field centred on empowerment, women, women's entrepreneurship and education; in 2016–2020 it expanded toward self-employment, social entrepreneurship, gender equality, microenterprise and economic development. By 2021–2025, women's entrepreneurship became the main integrative theme, alongside decision-making, higher education, microfinance, the informal economy and rural development.

Decision-making increases the visibility of agency and higher education suggests capability formation, but explicit entrepreneurial-skills and capability-development terms remain outside the dominant recent streams.

Figure 5: Thematic Evolution of Research on Women's Entrepreneurial Empowerment (2000–2025)



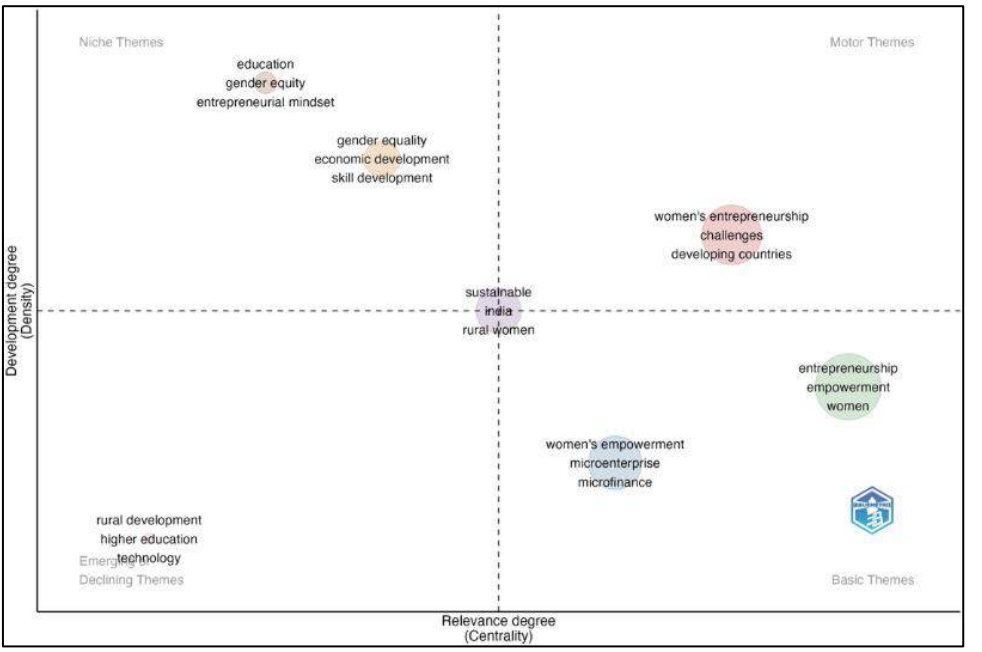
Source: Bibliometrix result

Thematic Map: Centrality and Development of Major Themes

Figure 6 reinforces this uneven development. Women's entrepreneurship, challenges and developing countries are motor themes; entrepreneurship, empowerment and women are basic themes, alongside a separate women's empowerment–microenterprise–microfinance cluster.

Education, gender equity and entrepreneurial mindset, together with gender equality, economic development and skill development, occupy niche positions, while rural development, higher education and technology are emerging or declining. Thus, capability-oriented themes are present but remain weakly connected to the field's core entrepreneurship–empowerment structure.

Figure 6: Thematic Map: Centrality and Development of Major Research Themes



Source: Bibliometrix result

Content Analysis

The structured synthesis comprised 50 non-overlapping articles (Pilot_30 and Validation_20) and yielded 69 explicit directional edges. Thirty-eight articles contained at least one supported edge; 12 were valid zero-edge cases. For continuity with the analytical framework, evidence is reported across four non-mutually exclusive theory-informed domains. Counts indicate recurrence within this purposively diversified sample, not prevalence in the 280-article candidate pool or 447-article corpus.

Domain 1: Financial and Structural Approaches to Women's Empowerment

Financial and structural approaches connect resources with multiple stages rather than a single pathway: conditions or resources were linked to agency in six articles (3 Pilot_30; 3 Validation_20), capabilities in five (3; 2), enterprise outcomes in five (2; 3), and empowerment in five (3; 2). These studies identify structural constraints that limit women's entrepreneurship in

low-resource environments. The coded evidence, however, does not support a single linear route from resource access to empowerment. In India, self-help-group participation and microcredit were associated with improved financial and entrepreneurial knowledge, greater control and decision-making, and stronger economic empowerment (Zaei et al., 2018). In Uganda, small-scale cooperatives expanded market relationships, strengthened business and financial capabilities, increased decision-making power and income control, and supported economic emancipation (Theeuwen et al., 2021).

These findings retain the importance of capital and institutional support but reject an automatic resource-to-empowerment progression. Empowering effects depend on how women mobilise resources within socio-institutional contexts; structural and relational resources may support capability formation, agency, enterprise achievement or empowerment through direct and parallel routes.

Domain 2: Development and Sustainability Perspectives

Development and sustainability studies broaden empowerment beyond income toward poverty reduction, inclusion, mobility, resilience and gender-inclusive growth. Yet explicit mechanisms linking entrepreneurial activity to wider development outcomes were scarceClick or tap here to enter text..

Only one enterprise-outcome-to-development-outcome edge appeared in Pilot_30 and none in Validation_20. The gap is therefore not the absence of development goals, but weak article-level articulation of how capability formation, agency and enterprise achievements extend into wider social or community change.

Domain 3: Capability and Skill Development

Capability and skill development produced the clearest capability-oriented pattern: capabilities linked to enterprise outcomes in 11 articles (7 Pilot_30; 4 Validation_20), training to capability formation in nine (6; 3), and training directly to enterprise outcomes in five (3; 2).

Representative studies show that capability formation extends beyond a single type of skill. Farmer Business School participation improved women vegetable growers' cognitive, managerial and technical business capabilities (Naval et al., 2021). Agency-based empowerment training in Kenya substantially increased sales and business commitment among female energy entrepreneurs (Shankar et al., 2015), while strategic management,

planning, opportunity recognition, adaptability and risk management were linked to enterprise resilience among rural women entrepreneurs in Iran (Rezaei-Moghaddam et al., 2023).

These pathways support treating entrepreneurial skills as potential conversion factors rather than a fixed sequence. Their strongest recurrent link was to enterprise achievement, not directly to multidimensional empowerment; business survival, performance, income and market expansion were therefore kept distinct from empowerment outcomes.

Domain 4: Psychological and Relational Dimensions

Psychological and relational evidence highlights confidence, control, persistence and network embeddedness. Social capital linked with agency or autonomy across both samples and with economic empowerment, showing that networks and collective arrangements can shape access, capability formation and women's room for actionClick or tap here to enter text..

Women's empowerment is therefore not only socio-economic or structural, but also psychological and relational. Wu's (2022) study of Vietnamese marriage immigrant women in Taiwan illustrates this broader process: entrepreneurial activities were shaped by family expectations, institutionalised learning, customer networks and resilience, while running a business strengthened self-identity, social integration and family position. Such evidence shows that enterprise participation can be connected with psychological and social empowerment, but these links are context-specific rather than automatic.

Fragmentation nevertheless remained clear. The link between capability and agency appeared in only two articles, both from Pilot_30, and not once in Validation_20. The link between agency and enterprise achievement showed the reverse pattern: two articles in Validation_20, none in Pilot_30. And the link between enterprise achievement and empowerment surfaced in two Pilot_30 articles but was absent from Validation_20. Accordingly, the content analysis does not support a strict universal sequence in which resources lead to capabilities, capabilities to agency, and agency to empowerment. Capability-oriented research is substantive, especially for enterprise achievement, but explanations of how capabilities become agency and how agency or enterprise achievements translate into multidimensional empowerment remain fragmented.

Discussion

Across bibliometric and content analyses, the field has broadened beyond resource access toward capability, relational embeddedness and context, but integration remains incomplete: finance, development, gender and skill-related concerns still orbit broader entrepreneurship and empowerment themes.

This emphasis is understandable because finance, microfinance, training and institutional support are central issues for women entrepreneurs in resource-constrained economies (e.g., Robb & Coleman, 2010; Tengeh & Nkem, 2017; Welsh et al., 2016). However, access does not automatically produce agency, decision-making power or long-term entrepreneurial sustainability (Abuhussein & Koburtay, 2021; Radović-Marković & Achakpa, 2018; Kabeer, 1999). Empowerment depends on how women mobilise resources, negotiate constraints and exercise agency in specific contexts (Kabeer, 1999; Sen, 1999; Welter, 2020). Entrepreneurial skills matter as cognitive, relational, digital, adaptive and psychological capabilities, but the synthesis shows that their connection with agency and multidimensional empowerment remains incomplete.

The results further suggest that social capital and institutional conditions are relevant but not consistently integrated with capability-based explanations. Networks, trust and community support appear in the literature, but their links to entrepreneurial skills and agency are not always explicit (Baikovich et al., 2022; Gaddefors & Anderson, 2019; Nahapiet & Ghoshal, 1998). Likewise, the three-field plot shows that core themes circulate across diverse national contexts, cautioning against assuming a single universal empowerment pathway or assigning themes too rigidly to particular regions.

The framework addresses this fragmentation by integrating institutional, social capital, empowerment and capability perspectives without imposing a fixed causal model. Entrepreneurial skills are treated as potential conversion factors, while agency, enterprise outcomes and empowerment remain distinct. For policy and practice, support should complement credit and training with mentoring, networks, digital literacy, adaptive learning, leadership and confidence-building.

Conclusion

This review combined bibliometric mapping of 447 Scopus and Web of Science articles with theory-informed content analysis of 50 purposively diversified articles. Resource access remains important, but capability-oriented explanations are also present; the more specific gap is the fragmented conversion of resources and capabilities into agency and multidimensional empowerment.

The framework therefore treats entrepreneurial skills, relational, adaptive, digital, cognitive, managerial, technical and psychological, as context-dependent conversion factors while keeping agency, enterprise achievements and empowerment distinct. It implies complementing finance, training and institutional support with capability-building strategies and testing when enterprise achievements translate into broader empowerment across contexts. The review is limited to English-language journal articles in Scopus and Web of Science; multilingual and grey-literature reviews should extend this evidence base.

Acknowledgments

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ORIGINAL SCIENTIFIC PAPER

Determinants of Entrepreneurial Behavior among Female University Students: The Mediating Role of Entrepreneurial Intention



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A B S T R A C T

Entrepreneurship in the university setting has gained increasing relevance as an engine of economic and social development; however, further evidence is needed to better understand how individual and contextual factors jointly influence entrepreneurial behavior among female university students. This study aims to analyze the mediating role of entrepreneurial intention in the relationship between attitude, self-efficacy, and institutional support in shaping entrepreneurial behavior in female university students. To test the hypotheses, a quantitative

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approach using partial least squares structural equation modeling (PLS-SEM) was employed with a sample of 380 female university students from an institution with campuses in Peru, Paraguay, and the United States. The results show that entrepreneurial intention has the strongest effect on entrepreneurial behavior, while self-efficacy influences it both directly and indirectly, and attitude is primarily linked to it through intention. Likewise, institutional support has an indirect impact through its effect on attitude and self-efficacy. The mediating role of intention is confirmed, with partial mediation for entrepreneurial behavior and full mediation in the relationships involving institutional support. The study contributes to the extension of TPB-based research by integrating individual and contextual determinants of entrepreneurial behavior among female university students in the Latin American higher education context.

KEYWORDS: *entrepreneurial intention, entrepreneurial behavior, self-efficacy, institutional support, female university students*

Introduction

Entrepreneurship has become central to economic and social development, especially in environments where sustainable growth depends on job creation and innovation (Calanchez et al., 2022; Zaidan et al., 2024). In this context, higher education institutions have begun to play a prominent role in training individuals with skills geared towards creating new initiatives, not only through the generation of technical knowledge but also through competencies related to decision-making and opportunity identification (Adesola & Datta, 2020; Valenzuela-Keller et al., 2021). Along these lines, academic interest has focused on explaining the factors that lead some students to show a greater inclination towards entrepreneurship, with entrepreneurial intention being the most prominent construct in the pre-action phase (Uzkurt et al., 2025).

From a theoretical perspective, entrepreneurial intention has been extensively explained by the Theory of Planned Behavior (TPB), which proposes that human behavior is preceded by an intentional disposition resulting from cognitive appraisals (Ajzen, 1991; Ajzen, 2020). Thus, attitudes toward entrepreneurial behavior, subjective norms, and perceived behavioral control constitute the main antecedents of intention, allowing us to understand how the possibilities of undertaking entrepreneurship and the capacity to do so are valued (Krishna & Agrawal, 2026; Li, 2025). Within academia, this theory has been used on numerous occasions to study

entrepreneurial intention, as it explains how individual perceptions are shaped into a predisposition that leads to action (Uzkurt et al., 2025). Building on this theoretical foundation, subsequent entrepreneurship research has also incorporated complementary contextual variables to extend the explanatory scope of the TPB in specific educational settings, particularly when examining entrepreneurship among university students (Rahman et al., 2022).

From this perspective, the literature has focused on analyzing the determinants of entrepreneurial intention, highlighting attitude and self-efficacy as key determinants in this process (Anjum et al., 2023). Attitude toward entrepreneurship refers to how individuals evaluate the desirability of starting a business (Jena, 2020), while self-efficacy is linked to the belief in one's ability to undertake an entrepreneurial venture (Elnadi & Gheith, 2021), which helps explain the extent to which students feel they possess the necessary skills to embark on an entrepreneurial experience (Heinemann et al., 2022).

For its part, the educational context, through institutional support, also builds these values, helping to develop positive attitudes and increase self-confidence (Frolova et al., 2021). In this regard, institutional support has increasingly been examined as a contextual factor that complements the individual determinants proposed by the TPB by fostering favorable entrepreneurial attitudes and strengthening entrepreneurial self-efficacy within higher education environments (Gonzalez-Tamayo et al., 2024). Accordingly, institutional support is conceptualized in this study as a contextual antecedent that complements, rather than replaces, the original TPB constructs.

In this sense, the analysis of entrepreneurship among women pursuing university studies acquires particular relevance, given that this type of entrepreneur presents specific conditions that influence how they make decisions related to entrepreneurship (Cunha et al., 2024). Several studies indicate that, although women's participation in entrepreneurship has been steadily increasing in recent years, gaps persist due to social, cultural, and resource access factors that can limit the development of entrepreneurial initiatives (Adesola & Datta, 2020; Drakpa et al., 2022). At the same time, the university context emerges as a key space where these perceptions can be formed, as it allows for learning, networking, and offers incentives that could contribute to the consolidation of entrepreneurial intentions in women (Messikh, 2021; Yuan et al., 2025). In this sense, studying how women's

entrepreneurship behaves within the university context allows us to examine the phenomenon in a more contextualized way.

While previous studies have substantially advanced the understanding of entrepreneurial intention and its determinants, they have predominantly examined individual antecedents or partial relationships derived from the Theory of Planned Behavior (Adu et al., 2020; Rueda et al., 2022). However, although the literature has independently addressed how attitude, self-efficacy, and institutional support are associated with entrepreneurial intention, comparatively fewer studies have simultaneously integrated these individual and contextual determinants to explain entrepreneurial behavior through entrepreneurial intention within a single explanatory framework (Bao & Xiao, 2026; Nessel et al., 2024). Accordingly, the contribution of the present study does not lie in proposing new theoretical constructs but in extending existing TPB-based research by integrating these complementary dimensions into a unified explanatory model focused on female university students in the Latin American higher education context.

Likewise, there is a limited number of studies that specifically address female entrepreneurship in the university setting, particularly in the Latin American context, where social and educational dynamics have their own characteristics (Gallegos et al., 2024). Although evidence on female entrepreneurial intention has expanded considerably in recent years, studies integrating individual and contextual determinants within Latin American university settings remain comparatively limited. In this regard, it is necessary to approach the reality of how the determinants of entrepreneurial intention are integrated and their relationship with possible entrepreneurial behavior in female university students from a perspective that articulates individual and contextual dimensions (Abbasianchavari & Moritz, 2021; Sleiman et al., 2026).

In this context, the present study aims to analyze the mediating role of entrepreneurial intention in explaining the relationships among the individual and contextual factors associated with entrepreneurial behavior among female university students. Specifically, it examines the relationships among attitude, self-efficacy, and institutional support, considering the mediating role of intention in the proposed model. From a theoretical perspective, the study extends prior TPB-based entrepreneurship research by integrating individual and contextual determinants into a single explanatory model for female university students. Rather than proposing a new theoretical framework, the study contributes by providing empirical

evidence on how these complementary dimensions are jointly associated with entrepreneurial behavior in the Latin American higher education context. Furthermore, from a contextual perspective, it provides empirical evidence within the Latin American university setting, where social and educational dynamics present specific characteristics that shape the development of female entrepreneurship.

Theoretical Framework and Hypotheses

Theory of Planned Behavior (TPB)

TPB posits that behavior is preceded by intention, which is understood as a person's disposition to carry out an action (Ajzen, 1991). In the field of entrepreneurship, this theory provides a robust framework for explaining the cognitive antecedents of entrepreneurial intention and behavior (Galvão et al., 2024; Heinemann et al., 2022). Within this framework, entrepreneurial intention enables us to link individual perceptions to action (Ahmed et al., 2025; Zovko et al., 2020).

The intention does not appear spontaneously, but rather originates from cognitive appraisals such as attitude toward entrepreneurship, which refers to the individual's assessment of the possibility of undertaking a business, and self-efficacy, which involves the perception of one's own ability to do so (Lyu et al., 2024). Because the university environment can influence both, the TPB is suitable for examining entrepreneurial behavior in female university students.

Recent studies have further demonstrated the applicability of the TPB for explaining entrepreneurial intention among female university students across different higher education contexts (Rahman et al., 2022). In the present study, institutional support is incorporated as a contextual antecedent that complements, rather than replaces, the original TPB constructs, thereby extending the theory's explanatory scope within the university environment.

Entrepreneurial Attitude and Self-efficacy in the Formation of Intention and Behavior

Attitudes toward entrepreneurship are one of the main cognitive appraisals involved in shaping entrepreneurial intentions (Heinemann et al., 2022; Jena, 2020). A favorable attitude toward the possibility of

entrepreneurship tends to increase an individual's inclination to consider this option (Anjum et al., 2023; Nessel et al., 2024). In the university setting, attitudes are influenced by educational experiences and exposure to environments that value entrepreneurial activity. Thus, a positive attitude facilitates the generation of intention and can influence the likelihood of taking action (Vamvaka et al., 2020; Ye & Kang, 2025).

On the other hand, entrepreneurial self-efficacy reflects how individuals perceive their ability to perform tasks associated with entrepreneurship, and can explain how prepared a person feels to undertake an action or activity that leads to the creation of a new business (Abaho et al., 2015). Greater self-efficacy increases entrepreneurial intention by reducing the uncertainty linked to the action and, sometimes, can also influence entrepreneurial behavior (Elnadi & Gheith, 2021; Ghouse et al., 2024).

Attitude and self-efficacy influence the intention to undertake entrepreneurial action, which is considered the immediate antecedent of behavior (Ključnikov et al., 2025). Furthermore, self-efficacy can directly influence action, although its effect is less significant than that mediated by intention (Caputo et al., 2025). Based on this, the following hypotheses are proposed:

H1: Entrepreneurial attitude has a positive effect on entrepreneurial intention in female university students.

H2: Entrepreneurial intention has a positive effect on entrepreneurial behavior in female university students.

H3: Entrepreneurial self-efficacy has a positive effect on entrepreneurial behavior in female university students.

H4: Entrepreneurial self-efficacy has a positive effect on entrepreneurial intention in female university students.

Institutional Support and Development of Entrepreneurial Perceptions

Institutional support plays a crucial role in the university setting, as it shapes the context in which students begin to develop an understanding of entrepreneurship (Anjum et al., 2023; Dieguez & Gomes, 2025). It is not only the availability of resources, but also the way in which the institution articulates experiences, spaces, and dynamics that bring students closer to entrepreneurial activity (Frolova et al., 2021; Gonzalez-Tamayo et al.,

2024). Thus, the environment can influence how entrepreneurship is perceived, potentially fostering a greater appreciation for this alternative (Ip, 2024; Yi, 2021).

On the one hand, this support is also related to entrepreneurial self-efficacy, as it strengthens the perception of the ability to carry out specific actions related to business creation (Ciptono et al., 2023; Zhang & Chen, 2024). Participation in training activities, access to tools, and contact with contexts that foster innovation allow students to reduce some initial doubts (Nowiński et al., 2019). This does not imply that the action will materialize, but it does mean that students feel more prepared to consider it as a real possibility (Atmono et al., 2023; Mahfud et al., 2025).

In short, institutional support is expected to influence entrepreneurial perceptions through the ways in which students interpret their own resources and value entrepreneurship (Yi, 2021). In this sense, it is reasonable to suggest that institutional support is associated with both entrepreneurial attitude and self-efficacy, leading to the following hypotheses:

H5: Institutional support has a positive effect on entrepreneurial attitude in female university students.

H6: Institutional support has a positive effect on entrepreneurial self-efficacy in female university students.

Mediating role of Entrepreneurial Intention

Entrepreneurial intention is widely recognized within the TPB as the most immediate antecedent of entrepreneurial behavior (Anjum et al., 2023). From a theoretical perspective, it represents the mechanism through which entrepreneurial attitude and self-efficacy are expected to be associated with entrepreneurial behavior (Asad et al., 2025; Delzenne et al., 2026; Heteș et al., 2025).

Accordingly, entrepreneurial intention is theoretically expected to mediate the relationship between individual entrepreneurial perceptions and entrepreneurial behavior (Aliedan et al., 2022; Nwibe & Ogbuanya, 2024). Individuals with more favorable entrepreneurial attitudes or stronger entrepreneurial self-efficacy are expected to report higher entrepreneurial intention, which, in turn, is associated with entrepreneurial behavior (Shandilya, 2022).

Similarly, the effects of institutional support are expected to operate indirectly by strengthening entrepreneurial attitudes and self-efficacy, which are theoretically associated with entrepreneurial intention (Bao & Xiao, 2026; Rueda et al., 2022). Therefore, entrepreneurial intention is proposed as the theoretical mediating mechanism linking these antecedents with entrepreneurial behavior (Alvarez-Risco et al., 2021; Barba-Sánchez et al., 2022). Based on the above, the following hypotheses are proposed:

H7: Entrepreneurial intention mediates the relationship between entrepreneurial attitude and entrepreneurial behavior in female university students.

H8: Entrepreneurial intention mediates the relationship between entrepreneurial self-efficacy and entrepreneurial behavior in female university students.

H9: Entrepreneurial attitude mediates the relationship between institutional support and entrepreneurial intention in female university students.

H10: Entrepreneurial self-efficacy mediates the relationship between institutional support and entrepreneurial intention in female university students.

Methodology

The research employed a quantitative approach to examine the relationships among institutional support, entrepreneurial attitude, entrepreneurial self-efficacy, entrepreneurial intention, and entrepreneurial behavior among female university students. The research design was cross-sectional, explanatory, and predictive, as it sought to evaluate both the direct and mediating effects of the proposed model. Data were collected at a single point in time, allowing for an analysis of participants' perceptions of the entrepreneurial process within the university context.

The study population consisted of female university students from a Peruvian higher education institution with campuses located in Peru, Paraguay, and the United States. The sample was drawn using non-probability convenience sampling, considering accessibility and participant availability. A total of 380 students were surveyed who met the criteria of being female, of legal age, and enrolled in university studies at one of the campuses at the time of data collection. This type of sampling is appropriate

for studies conducted in educational contexts, where the population is generally determined by institutional and logistical factors.

The instrument used for data collection consisted of a structured questionnaire with closed-ended questions, designed to measure the constructs considered in the research model. The items were developed based on a review of the specialized literature and adapted to the university context. The initial version of the instrument comprised 32 items; however, after evaluating external biases in the measurement model, those that did not meet the established criteria were eliminated, leaving 27 items. The entrepreneurial behavior construct was operationalized through self-reported preparatory entrepreneurial activities and behaviors associated with business creation rather than the creation and management of an established business.

All items were measured using a five-point Likert scale, where 1 corresponded to "strongly disagree" and 5 to "strongly agree." To ensure content validity, the instrument was reviewed by five experts who assessed the clarity, relevance, and coherence of the items. A pilot test was also conducted to verify participants' understanding of the instrument.

Data collection took place between August and December 2025. The questionnaire was administered using the Google Forms platform. Participants were informed in advance about the study's objectives, confidentiality, and data processing, ensuring anonymity and the academic use of the information. Since the research involved adult participants, the information was collected anonymously using a low-risk questionnaire; therefore, formal approval from an ethics committee was not required, in accordance with institutional guidelines. Participation was voluntary, and informed consent was obtained from all participants before data collection.

Data evaluation was performed using partial least squares structural equation modeling (PLS-SEM) with SmartPLS. Although the proposed model was theoretically grounded in the TPB, PLS-SEM was considered the most appropriate analytical approach because the study simultaneously examined multiple direct and indirect relationships with a predictive orientation and aimed to explain and predict variance in entrepreneurial behavior. Furthermore, PLS-SEM provides robust parameter estimates for complex path models while maintaining high statistical power in prediction-oriented research (Hair et al., 2022; Sarstedt et al., 2022).

The procedure followed was developed in two stages. First, the measurement model was evaluated, considering the reliability indicators, internal consistency, convergent and discriminant validity, as well as the

absence of collinearity problems using VIF values (Sarstedt et al., 2022). Additionally, common method bias was assessed using the full collinearity approach proposed by Kock (2015). The obtained VIF values were below the recommended threshold of 3.3, indicating that common method bias was unlikely to affect the findings.

Second, the structural model was examined, contrasting the proposed relationships and evaluating the path coefficients, the coefficient of determination (R^2), and the predictive relevance (Q^2). Thus, the bootstrapping technique was applied to 5,000 subsamples to evaluate the significance of the coefficients, as well as their confidence intervals. Finally, the mediating effect of entrepreneurial intention on relationships was analyzed in order to understand its role within the model.

Results

The participants were predominantly between 21 and 23 years old, representing 45.53% of the sample, whereas 28.68% were between 18 and 20 years old. In terms of academic progression, a greater proportion of students were concentrated in the first to third academic cycles (37.37%), followed by those enrolled in the fourth to sixth cycles (33.68%). Although most respondents reported no prior entrepreneurial experience (63.95%), a considerable percentage reported having received some form of entrepreneurship education (83.95%).

With respect to the descriptive indicators, entrepreneurial attitude reached the highest average value (M = 3.24; SD = 0.96), while entrepreneurial self-efficacy also showed relatively favorable levels (M = 3.20; SD = 1.05). By comparison, institutional support presented the lowest average value (M = 3.05; SD = 1.12), which may reflect a less consolidated perception of institutional backing for entrepreneurial development among the participants.

The indicators reported in Table 1 suggest an adequate performance of the measurement model. The factor loadings remained above the commonly accepted reference values, and the reliability coefficients were satisfactory across the constructs examined. In the same way, the AVE results supported the convergent validity of the model. Additionally, the VIF values did not indicate relevant collinearity among the variables.

Table 1: Measurement model evaluation: reliability and convergent validity

Construct	Loading range	α	CR	AVE
Entrepreneurial Attitude (EA)	0.795–0.847	0.881	0.913	0.678
Entrepreneurial Behavior (EB)	0.817–0.873	0.895	0.922	0.704
Entrepreneurial Intention (EI)	0.783–0.854	0.907	0.928	0.684
Entrepreneurial Self-efficacy (ESE)	0.771–0.848	0.896	0.920	0.659
Institutional Support (IS)	0.772–0.857	0.868	0.905	0.655

Source: Authors' own elaboration

The discriminant validity of the model is evident in Table 2. On the diagonal, the values exceed the correlations between constructs, indicating that each variable is distinct from the others. The HTMT indices also remain below the recommended threshold. No problematic crossovers between constructs are observed. In this respect, the differentiation between variables is adequate.

Table 2: Discriminant validity (Fornell–Larcker criterion and HTMT ratio)

Construct	EA	EB	EI	ESE	IS
Entrepreneurial Attitude (EA)	**0.824**	0.314	0.481	0.176	0.528
Entrepreneurial Behavior (EB)	0.281	**0.839**	0.637	0.417	0.328
Entrepreneurial Intention (EI)	0.432	0.576	**0.827**	0.420	0.304
Entrepreneurial Self-efficacy (ESE)	0.158	0.375	0.380	**0.812**	0.514
Institutional Support (IS)	0.464	0.288	0.271	0.453	**0.809**

Note: Diagonal elements (bold) represent the square root of AVE (Fornell–Larcker criterion). The upper triangle shows HTMT values; the lower triangle shows correlations.

Source: Authors' own elaboration

The structural relationships indicate that all proposed paths are statistically significant and exhibit positive coefficients. Entrepreneurial intention exhibited the strongest positive association with entrepreneurial behavior, whereas entrepreneurial self-efficacy showed both direct and indirect statistically significant relationships with entrepreneurial behavior. Institutional support was positively associated with entrepreneurial attitude

and entrepreneurial self-efficacy, supporting its proposed role within the conceptual model. These results are shown in Table 3.

Table 3: Structural model results

Hypothesis	Path	β	t- value	p- value	95% CI	Result
H1	EA → EI	0.381	8.772	0.000	[0.300; 0.461]	Supported
H2	EI → EB	0.507	12.461	0.000	[0.428; 0.579]	Supported
H3	ESE → EB	0.182	3.916	0.000	[0.087; 0.267]	Supported
H4	ESE → EI	0.320	8.067	0.000	[0.242; 0.394]	Supported
H5	IS → EA	0.464	12.154	0.000	[0.389; 0.533]	Supported
H6	IS → ESE	0.453	11.641	0.000	[0.378; 0.528]	Supported

Source: Authors' own elaboration

As shown in Table 4, the findings provide statistical support for the proposed indirect relationships. Specifically, partial mediation was observed in the relationships leading to entrepreneurial behavior, whereas full mediation was identified for the indirect relationships between institutional support and entrepreneurial intention. Overall, these results support the mediating structure proposed in the conceptual model.

Table 4: Mediation analysis

Hypothesis	Path	β	t- value	p-value	95% CI	Interpretation
H7	EA → EI → EB	0.193	6.634	0.000	[0.139; 0.247]	Partial mediation supported
H8	ESE → EI → EB	0.162	7.102	0.000	[0.122; 0.207]	Partial mediation supported
H9	IS → EA → EI	0.177	6.903	0.000	[0.130; 0.227]	Full mediation supported
H10	IS → ESE → EI	0.145	7.001	0.000	[0.106; 0.184]	Full mediation supported

Source: Authors' own elaboration

The model's quality indicators, as shown in Table 5, indicate moderate levels of explanatory power for entrepreneurial intention and behavior. Predictive capacity was also supported. In terms of effect size, entrepreneurial intention had the largest effect on entrepreneurial behavior, while the remaining structural relationships exhibited small-to-medium effect sizes.

Table 5: Model quality assessment (R^2, Q^2 and f^2)

Construct / Path	**R^2**	**R^2 Adjusted**	**Q^2**	**f^2**	**Effect size**
Entrepreneurial Attitude (EA)	0.215	0.213	0.178	—	—
Entrepreneurial Self-efficacy (ESE)	0.205	0.203	0.169	—	—
Entrepreneurial Intention (EI)	0.421	0.418	0.312	—	—
Entrepreneurial Behavior (EB)	0.359	0.356	0.268	—	—
EA → EI	—	—	—	0.176	Medium
ESE → EI	—	—	—	0.102	Small
EI → EB	—	—	—	0.344	Large
ESE → EB	—	—	—	0.051	Small
IS → EA	—	—	—	0.274	Medium
IS → ESE	—	—	—	0.258	Medium

Source: Authors' own elaboration

Discussion

Overall, the findings reveal a coherent pattern of relationships among the individual and contextual factors considered in the proposed model, supporting the theoretical assumptions of the Theory of Planned Behavior (Ajzen, 1991). Rather than suggesting a temporal developmental process, the observed associations indicate that entrepreneurial intention constitutes the principal theoretical mechanism linking entrepreneurial attitude and self-efficacy with entrepreneurial behavior within the proposed framework (Barba-Sánchez et al., 2022). This pattern is consistent with recent evidence showing that entrepreneurial intention remains the central explanatory construct for understanding entrepreneurial behavior among female university students, even when complementary contextual factors are incorporated into the analytical model (Ključnikov et al., 2025; Kola et al.,

2026). Consequently, the findings extend previous TPB-based research by highlighting the complementary role of institutional support in explaining entrepreneurial behavior within the Latin American university context.

One of the main findings of this study is that entrepreneurial intention was the strongest predictor of entrepreneurial behavior, reinforcing its central role within the TPB framework (Ching, 2024). This finding suggests that favorable entrepreneurial attitudes and confidence in one's entrepreneurial capabilities are more likely to be reflected in entrepreneurial behavior when they are accompanied by a clear intentional disposition toward entrepreneurship (Ciptono et al., 2023). Rather than indicating a temporal sequence, this pattern supports the theoretical proposition that entrepreneurial intention represents the most immediate cognitive antecedent of entrepreneurial behavior (Heteș et al., 2025). These findings are consistent with previous evidence reported by Rahman et al. (2022) and Nwibe and Ogbuanya (2024), who similarly identified entrepreneurial intention as the principal explanatory mechanism linking individual entrepreneurial perceptions with entrepreneurial behavior.

Entrepreneurial attitude showed a significant effect on entrepreneurial intention, suggesting that a favorable evaluation of entrepreneurship increases the likelihood that female university students will develop a stronger entrepreneurial intention (Anjum et al., 2023; Ye & Kang, 2025). This finding reinforces the importance of entrepreneurial attitude as a cognitive antecedent of intention rather than as a direct determinant of entrepreneurial behavior. Consequently, the results indicate that positive evaluations of entrepreneurship contribute to shaping entrepreneurial intention, which subsequently explains its association with entrepreneurial behavior within the proposed model (Vamvaka et al., 2020). This interpretation is consistent with previous evidence reported by Heinemann et al. (2022) and Drakpa et al. (2022), who found that entrepreneurial attitude is a principal factor associated with entrepreneurial intention among female university students across diverse higher education contexts.

Entrepreneurial self-efficacy exhibited significant effects on both entrepreneurial intention and entrepreneurial behavior. This pattern suggests that entrepreneurial self-efficacy constitutes one of the key cognitive resources associated with entrepreneurial behavior, as students who perceive themselves as capable of undertaking entrepreneurial activities are more likely to develop entrepreneurial intention while also reporting higher levels of entrepreneurial behavior (Ye & Kang, 2025; Zaidan et al., 2024). The

coexistence of direct and indirect effects indicates that entrepreneurial self-efficacy is associated with entrepreneurial behavior both independently and through entrepreneurial intention, highlighting its complementary role within the proposed TPB-based model (Ghouse et al., 2024; Uzkurt et al., 2025). These findings are consistent with previous studies indicating that entrepreneurial self-efficacy is a key element in entrepreneurial decision-making because it influences how individuals evaluate their capability to perform entrepreneurial tasks and respond to entrepreneurial challenges (Abaho et al., 2015; Elnadi & Gheith, 2021).

Institutional support was not directly associated with entrepreneurial intention or entrepreneurial behavior; instead, its influence was reflected through entrepreneurial attitude and entrepreneurial self-efficacy (Gonzalez-Tamayo et al., 2024). This finding reinforces the conceptualization of institutional support as a complementary contextual antecedent within the extended TPB framework, suggesting that the university environment contributes to entrepreneurship primarily by strengthening students' entrepreneurial perceptions rather than directly influencing entrepreneurial behavior (Anjum et al., 2023; Dieguez & Gomes, 2025). This interpretation is consistent with previous evidence indicating that supportive educational environments foster entrepreneurial attitudes and self-efficacy among female university students (Frolova et al., 2021; Messikh, 2021). Accordingly, the present findings suggest that institutional support contributes indirectly to entrepreneurial behavior by reinforcing the cognitive antecedents proposed by the TPB (Rahman et al., 2022; Yi, 2021).

The significant indirect effects observed in the model are consistent with the mediating relationships proposed in the theoretical framework. Specifically, entrepreneurial intention was associated with the relationships between entrepreneurial attitude, entrepreneurial self-efficacy, and entrepreneurial behavior, supporting its central role within the TPB (Aliedan et al., 2022; Zovko et al., 2020). These findings are consistent with previous studies suggesting that entrepreneurial intention represents the principal cognitive mechanism linking entrepreneurial perceptions with entrepreneurial behavior (Nwibe & Ogbuanya, 2024; Rahman et al., 2022). Accordingly, the indirect effects identified in this study reinforce the theoretical relevance of entrepreneurial intention in explaining the association between individual entrepreneurial perceptions and entrepreneurial behavior among female university students.

This study has several limitations that should be considered when interpreting the findings. First, the cross-sectional design does not allow causal or temporal relationships among the variables to be established, although it provides evidence of the statistical associations proposed in the theoretical model. Second, the use of non-probability convenience sampling limits the generalizability of the findings. In addition, the sample was drawn from a single higher education institution with campuses located in different countries; therefore, the results should not be interpreted as representative of all female university students in Latin America. Future studies could employ longitudinal designs, probability sampling, and more diverse institutional settings to further examine the proposed relationships.

Taken together, these findings reinforce the TPB's suitability for explaining entrepreneurial behavior among female university students and show that institutional support provides a complementary contextual perspective. Consequently, the proposed model contributes to a broader understanding of entrepreneurship in higher education by integrating both individual and contextual determinants within a single explanatory framework.

Conclusion

The research findings suggest that entrepreneurial behavior in this group of female university students is explained by the relationships among entrepreneurial intention, entrepreneurial attitude, entrepreneurial self-efficacy, and institutional support within the proposed TPB-based model. In this sense, entrepreneurial intention emerges as the primary driver of behavior, demonstrating that taking action depends not only on the perceived value of entrepreneurship or on one's perceived competence, but also on the development of an intentional disposition associated with these individual and contextual perceptions.

These findings indicate that entrepreneurial behavior among female university students is associated with the interaction of individual and contextual factors rather than being explained by a single determinant. Within the proposed model, entrepreneurial intention represents the principal theoretical construct through which entrepreneurial attitude and entrepreneurial self-efficacy are associated with entrepreneurial behavior, whereas institutional support contributes by strengthening these cognitive antecedents.

Similarly, self-efficacy and entrepreneurial attitude significantly influence intention; however, their associations with entrepreneurial behavior are primarily indirect, reinforcing their enabling role within the model. Self-efficacy plays a more significant role, as it influences both intention and behavior, suggesting that students with higher entrepreneurial self-efficacy are more likely to report entrepreneurial intention and entrepreneurial behavior. Institutional support does not directly influence behavior but rather shapes the context and the set of perceptions that students use to construct their interpretation of entrepreneurship.

Finally, the results support the mediating role of entrepreneurial intention, reinforcing the theoretical relationships proposed in the model. This finding enriches our understanding of entrepreneurial behavior among female university students by indicating that entrepreneurial intention is associated with the relationship between entrepreneurial attitude, entrepreneurial self-efficacy, and entrepreneurial behavior. From this perspective, the study contributes to highlighting the role of the university educational environment as a space that fosters the development of entrepreneurial perceptions and capabilities that, through entrepreneurial intention, may be reflected in entrepreneurial behavior.

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ORIGINAL SCIENTIFIC PAPER

Women, Education, and Occupational Segregation in Serbia: Evidence from LFS Data



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A B S T R A C T

Rising female employment and educational attainment do not necessarily reduce occupational gender segregation because changes in the gender composition of occupations may be reinforced or offset by shifts in occupational structure. We examine the evolution and sources of occupational gender segregation in Serbia using annually weighted Labour Force Survey repeated cross-sections for 2010–2024. We estimate Duncan dissimilarity indices across broad and detailed occupational levels, decompose their changes into within-occupation gender composition, occupational structure, and women's aggregate employment share, and quantify uncertainty using a bootstrap adapted to the available clustering identifiers. The results show that broad occupational segregation remained relatively stable after 2014, but that this stability concealed substantial opposing movements during 2014–2020. A more balanced gender

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composition within major occupational groups reduced segregation, while the redistribution of employment across those groups produced an almost equal increase. Over the same period, segregation increased across three-digit occupations, showing that stability at the broad level can coexist with increasing separation at a finer occupational resolution. We also identify divergent patterns across education groups. Secondary-educated workers consistently displayed the highest segregation, while tertiary-educated workers had lower levels but no statistically distinguishable decline. Among low-educated workers, detailed segregation increased in both post-2014 windows, and both increases were statistically larger than the corresponding changes among secondary- and tertiary-educated workers. Overall, occupational integration in Serbia was partial, scale-dependent, and educationally uneven, demonstrating that aggregate stability cannot be interpreted without examining its underlying components and occupational resolution.

KEYWORDS: *occupational gender segregation, occupational restructuring, educational attainment, Duncan dissimilarity index, Shapley decomposition*

Introduction

Occupational gender segregation, the unequal distribution of women and men across occupations, is one of the most durable features of modern labour markets and an important mechanism through which inequalities in pay, authority, and career progression are sustained (Charles & Grusky, 2004; Duncan & Duncan, 1955). Its aggregate stability, however, can be misleading. Segregation can change because the gender composition of occupations changes, because occupations with different gender compositions expand or contract, or because women's aggregate share of employment changes. It is also sensitive to occupational resolution: movement towards a more similar distribution across major occupational groups can coexist with continued or increasing separation across the narrower occupations nested within them. Distinguishing these processes is therefore necessary before stability or change in a segregation index can be interpreted as labour market integration.

Serbia provides an informative setting for examining these processes. Between 2010 and 2024, the labour market recovered from the post-2008 downturn while employment shifted away from agriculture and traditional industry, women's employment increased, the educational composition of the workforce improved, and demographic contraction continued to reshape the size and regional distribution of the working-age population (Paunović

Radulović & Vladisavljević, 2024). These changes need not have operated in the same direction. The growth or decline of already gender-typed occupations may alter segregation without changing their internal gender composition, while educational upgrading may broaden access to employment without dissolving gendered fields of study and occupation-specific pathways. Serbia therefore allows us to examine how structural and compositional change interacted in a post-transition and European Union (EU) accession economy undergoing employment recovery and educational transformation.

Research on Serbia has documented women's position in the post-transition labour market, persistent gender differences in employment and earnings, and horizontal segregation in education (Anić & Krstić, 2019; Babović & Petrović, 2021; Reva, 2012). However, there are no credible studies that systematically examine occupational gender segregation in Serbia. Therefore, it is still unknown how segregation evolved over an extended period, whether trends at the broad occupational level also hold across detailed occupations, which structural and compositional processes accounted for changes in segregation, and whether levels and trajectories differed across education groups. These questions are important because international evidence shows that rising female employment and educational attainment do not necessarily reduce occupational segregation, and that change can be slow and uneven across education groups (Blau, Brummund, & Liu, 2013; Borrowman & Klasen, 2020; Eurofound & European Commission Joint Research Centre, 2021). Comparable transition and EU-accession economies are under-represented in research that jointly examines occupational resolution, mechanisms of change, and educational heterogeneity.

In this study, we address that gap using harmonised, annually weighted Serbian Labour Force Survey (LFS) repeated cross-sections for 2010–2024. We estimate Duncan dissimilarity indices for the ten International Standard Classification of Occupations (ISCO) major groups over the full period and for three-digit occupations within survey- and classification-consistent analytical windows. We then apply a Shapley decomposition of changes in segregation (Deutsch, Flückiger, & Silber, 2009; Salardi, 2016) and use a bootstrap adapted to the available clustering identifiers to quantify sampling uncertainty. Finally, we estimate education-specific indices and directly test differences in their changes. Our contribution is empirical and interpretative: applying established methods to Serbia, we show how offsetting

components, occupational resolution, and educational heterogeneity jointly qualify aggregate stability. This extends the international discussion of uneven occupational integration to a post-transition economy experiencing employment recovery and educational upgrading.

Research Background

Structural and Educational Transformation in Serbia

Serbia entered the analysed period with weak post-crisis employment and a sizeable gender employment gap. Published LFS indicators show that the employment rate among people aged 15–64 was 40.1% for women and 54.4% for men in 2010, compared with 60.8% and 71.7%, respectively, in 2024 (Statistical Office of the Republic of Serbia [SORS], 2011, 2025). Because these endpoints span changes in survey methodology, they are contextual indicators rather than a fully comparable series, but they nevertheless indicate that women's employment expanded and that the reported gap narrowed from 14.3 to 10.9 percentage points. At the same time, the decline of agricultural employment and changes in industry and services altered the occupational mix. During the recovery between 2014 and 2017, employers' expectations also pointed to growing demand for service, sales, craft, and related trade occupations (Ognjenović, 2018). This matters for segregation because the redistribution of employment towards growing occupations can either reinforce or offset changes in the representation of women and men within occupations.

The workforce also became more highly educated, with women accounting for approximately 57% of students and 59% of graduates in Serbia (Official Gazette of the Republic of Serbia, 2021). Higher attainment, however, has coexisted with persistent gender differentiation by field of study. Women are more strongly represented in education, health, social sciences, and the humanities, while men are more strongly represented in engineering and technical fields. In information and communication technology (ICT), for example, women accounted for 28.6% of graduates and 21.6% of professionals in the available Serbian indicators (Babović & Petrović, 2021). A similar differentiation is visible within scientific research, where highly educated women and men are unevenly distributed across disciplines. Analysing Serbian data for 2012–2022, Lazarević-Moravčević et al. (2023) found that women formed a majority of researchers

in the humanities and medical and health sciences, whereas men predominated in engineering and technology. Educational expansion may therefore change the relative size of education groups without producing equivalent integration in the fields and occupational pathways through which qualifications are converted into employment.

Education and Occupational Segregation

Education may be related to the level and the dynamics of occupational segregation through mechanisms operating at different stages. Educational attainment defines the groups compared in this paper; the pathways from education into employment help explain the occupational distributions observed within those groups. Gendered expectations can shape field-of-study choices, while vocational and technical programmes link those choices closely to particular occupations (Heiniger & Imdorf, 2018; Gutfleisch & Nennstiel, 2025). Among tertiary-educated workers, fields of study explain part of occupational segregation, alongside sorting after education (Zheng & Weeden, 2023). The transition into employment adds another distinction: participation shapes which women and men at each educational level are represented among workers, while occupational sorting shapes the jobs of those who enter. Hiring is one part of this sorting process: experimental evidence shows that discrimination varies with an occupation's gender composition (Adamovic & Leibbrandt, 2023). Crowding into a limited set of occupations and the devaluation of female-dominated work may further reproduce existing boundaries, while family-related constraints can shape later transitions even after initial entry (Borrowman & Klasen, 2020; Charles & Grusky, 2004).

These mechanisms imply neither a monotonic education gradient nor uniform change over time. Secondary-educated workers may be highly segregated where vocational, technical, administrative, and service pathways lead directly to gender-typed occupations. A shrinking low-education group may become more segregated if its remaining employment becomes concentrated in a narrower set of male-dominated manual and female-dominated service jobs. Tertiary-educated workers may be less segregated without becoming progressively more integrated, while movement into the same major occupational groups may coexist with continued separation across detailed occupations within them. Finally, structural transformation may reinforce or offset within-occupation integration by changing the relative employment weight of differently

gendered occupations. The empirical analysis therefore treats education not simply as a hierarchy of attainment, but as a set of pathways whose occupational consequences may differ in both level and direction over time.

Methodology

Data

The analysis is based on Serbian LFS microdata for 2010–2024 collected and provided by SORS, organised as annual repeated cross-sections. The LFS is Serbia's standard instrument for labour market measurement and produces internationally comparable estimates based on harmonised definitions (SORS, 2016). The survey covers residents of private households in Serbia excluding Kosovo and Metohija, using a two-stage stratified sample of enumeration areas and households drawn from population-census frames (SORS, 2016, 2025). Data are collected through face-to-face and telephone interviews (SORS, n.d.). All estimates use LFS weights and represent employed individuals aged 15–64 with a valid occupation code. Annual unweighted samples range from roughly 13,000 in the earlier years to nearly 49,000 in the most recent, corresponding to weighted employed populations of about 2.1–2.7 million. Year-specific observation counts, including women and men separately, and weighted employment totals are reported in Supplementary Material, Table S1, Panel A. Women's share of employment rises from 42.8% in 2010 to 45.9% in 2024.

Comparisons account for survey breaks and occupational reclassification. Occupations were coded to ISCO-88 in 2010–2012 and to ISCO-08 from 2013 onward. Because three-digit codes are not comparable across this transition, 2013 is retained in the broad 2010–2013 window but excluded from the detailed 2010–2012 window. We treat the ten ISCO major groups as sufficiently comparable for reporting the broad annual index over 2010–2024, but restrict detailed comparisons to survey- and classification-consistent windows: 2010–2012, 2014–2020, and 2021–2024. All decompositions and inferential contrasts use endpoints within one of these windows. The first boundary reflects the move from twice-yearly to quarterly collection in 2014 and to continuous weekly collection in 2015, together with sample redesign, sample expansion, and changes in estimation. The 2014 data were subsequently revised using the estimation

system introduced in 2015. The second boundary reflects the redesigned LFS introduced in 2021 under Regulation (EU) 2019/1700, which revised concepts, definitions, and questionnaire content. Because the pre-2021 series was revised only for selected basic indicators, comparability could not be restored for the detailed occupational analyses used here (SORS, 2016, 2022). Detailed harmonisation rules, analytical-sample validation, and numerical quality-control checks are reported in Supplementary Material, Table S8.

Occupational Detail and Education Groups

Occupations are analysed at the broad level of ten ISCO major groups (one-digit) and the detailed level of three-digit minor groups, of which approximately 112–129 are observed annually; two-digit point estimates provide an intermediate resolution. Education is grouped as low (primary education or less), secondary, and tertiary. Segregation measures are estimated for the full workforce and separately within each education group.

Measuring Occupational Segregation

We measure segregation using the Duncan and Duncan (1955) index of dissimilarity, the most widely used measure of occupational gender segregation. For a year with J occupations, the index is

$$D = \frac{1}{2} \sum_{j=1}^{J} \left| \frac{w_j}{W} - \frac{m_j}{M} \right| \qquad (1)$$

where w_j and m_j are the weighted numbers of women and men in occupation j, and W and M are their weighted totals across all occupations. The index ranges from 0, when the occupational distributions of women and men coincide, to 1, when no occupation contains both. It can also be interpreted as the share of women, or men, who would have to change occupations for the two distributions to coincide. Because the index tends to increase as occupations are divided more finely, we report it at broad and detailed levels and compare changes only within a fixed classification. Each occupation's contribution is one-half of the absolute difference between its share of employed women and its share of employed men; these contributions identify the occupations driving aggregate movements.

Decomposing Changes in Segregation

Changes in the index are decomposed by Shapley decomposition, following Deutsch, Flückiger, and Silber (2009) and Salardi (2016). Three components describe changes in the joint distribution of sex and occupation: within-occupation gender composition, occupational structure (the distribution of total employment across occupations), and women's aggregate employment share. For each comparison, counterfactual two-by-J tables are generated by iterative proportional fitting, moving one component from its start-year to its end-year value while holding the others fixed. The Shapley value averages each component's marginal contribution across all possible switching orders. The three contributions therefore sum exactly to the observed change, without a residual. An integrating within-occupation contribution indicates reduced gender sorting after standardising occupational size and women's overall employment share; integration refers to more similar occupational distributions, not necessarily a 50:50 gender balance. A positive structural contribution can arise when strongly gender-typed occupations expand relative to more balanced occupations, or when the latter contract.

We use endpoint and chained decompositions. The endpoint decomposition compares the first and last year of a window. The chained decomposition sums the components from successive one-year transitions; comparing gross annual movement with the net endpoint change shows how much movement is self-cancelling. We examine six endpoint contrasts: 2010–2013, 2014–2020, and 2021–2024 at the broad level, and 2010–2012, 2014–2020, and 2021–2024 at the detailed level. These are complemented by the 23 one-year transitions within the corresponding windows.

Statistical Inference

Uncertainty is quantified using 5,000 bootstrap replications adapted to the clustering identifiers available in each period. Within each year, households are resampled with replacement for 2014–2024; because household identifiers are unavailable in the earlier files, records are resampled for 2010–2013. Households provide the broadest clustering unit identified in these files, making household resampling the closest feasible approximation to the dependence structure for 2014–2024. Every index, decomposition, and contrast is recomputed in each replicate, propagating sampling variability through all analytical stages. Two-sided 95%

confidence intervals are the 2.5th and 97.5th percentiles of the replicate distribution. Changes over time and differences between groups are calculated within each replicate before the percentiles are taken, thereby accounting for dependence between estimates based on shared within-year resampled units. A change or difference is considered statistically distinguishable from zero when its interval excludes zero. A fixed random-number seed ensures reproducibility.

Segregation by Education

Indices and endpoint changes are estimated separately for the three education groups using the same occupational levels, analytical windows, and bootstrap design. Within a year, common resampled units are used across education groups and occupational resolutions. We also calculate three direct contrasts between education-specific endpoint changes: secondary minus low, tertiary minus low, and tertiary minus secondary. These contrasts are differenced within each replicate, allowing differences in change to be tested directly rather than inferred from separate group-specific significance tests.

Data Analysis

All analyses were performed in R version 4.5.2 (R Core Team, 2025). Data import, harmonisation, and computation used the *haven*, *dplyr*, *tidyr*, *purrr*, *tibble*, *stringr*, *readr*, and *Matrix* packages, while figures were produced using *ggplot2*, *scales*, *patchwork*, and *ragg*. The Duncan indices, Shapley decompositions, and bootstrap procedures adapted to the available clustering identifiers were implemented in R functions created for this purpose.

Results

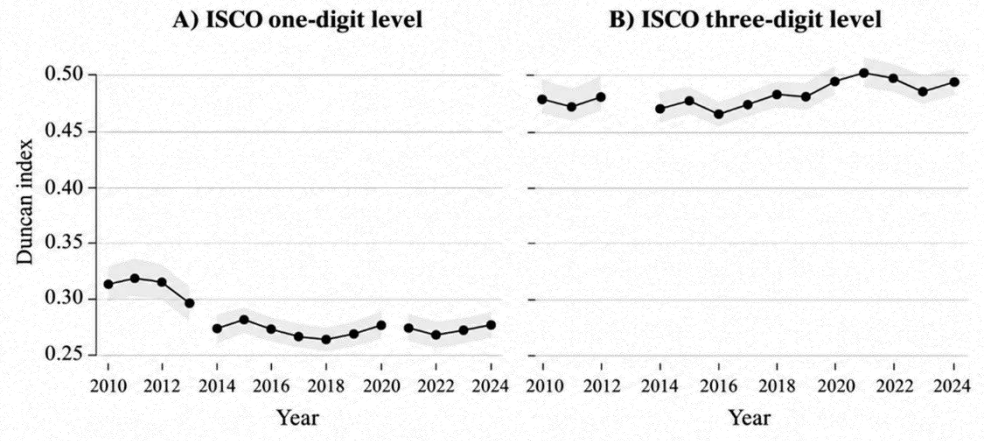
Overall Trends Across Occupational Resolutions

Figure 1 displays annual Duncan dissimilarity indices at two levels of occupational resolution. Panel A shows segregation across the ten ISCO major groups, whereas Panel B traces segregation across three-digit occupations within the three survey- and classification-consistent analytical

windows. Lines are interrupted at the survey and classification boundaries to avoid implying continuity across non-comparable observations.

At the one-digit level, segregation declined descriptively between 2010 and 2013, from 0.312 to 0.295, but the endpoint change was not statistically distinguishable from zero. After 2014, the index remained within a narrow range of 0.264 to 0.281, with no statistically distinguishable endpoint change in either post-2014 window. The broad occupational distribution of women and men therefore shows relative stability rather than a sustained process of integration.

Figure 1: Overall trends in occupational gender segregation



Source: Authors' calculations based on weighted Serbian LFS microdata

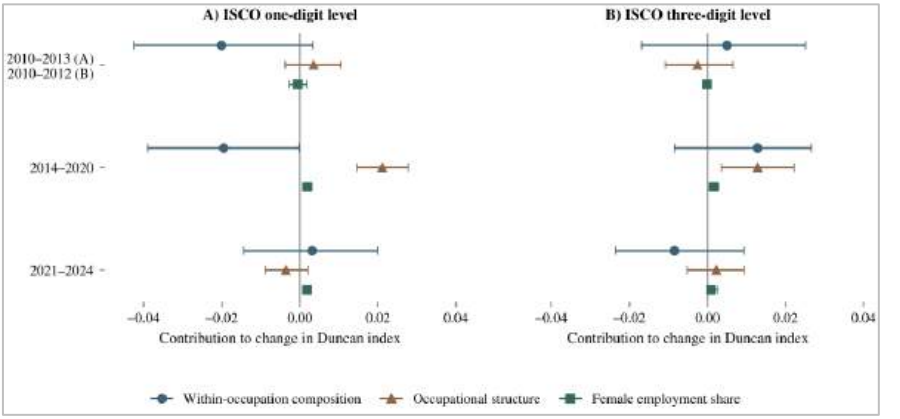
A different pattern emerges at the three-digit level. Detailed segregation was essentially unchanged during 2010–2012 but increased from 0.470 to 0.497 during 2014–2020. The resulting change of 0.027 was statistically distinguishable from zero (95% confidence interval (CI) [0.004, 0.042]) and was the only overall endpoint change supported by the bootstrap intervals. During 2021–2024, the index fluctuated without producing a statistically distinguishable endpoint change. Because Duncan indices mechanically increase with occupational detail, their levels should not be compared across resolutions. The relevant result is the divergence in within-resolution trajectories: during 2014–2020, stability across major occupational groups coincided with increasing segregation across the narrower occupations within them. Complete annual estimates at one-, two-, and three-digit levels and endpoint changes are reported in Supplementary Material, Table S2.

Sources of Change in Segregation

Figure 2 decomposes each endpoint change into three components: changes in gender composition within occupations, changes in occupational structure, and changes in women's aggregate employment share. Negative contributions indicate integration, whereas positive contributions increase segregation. By construction, the three components sum to the observed change in the Duncan index.

The central result is the decomposition of the one-digit index during 2014–2020. Its small net increase of 0.004 was not the product of underlying stability, but of two sizeable movements in opposite directions. Changes in gender composition within major occupational groups reduced segregation by 0.020, while changes in the relative size of those groups increased it by 0.021. The corresponding intervals placed the structural contribution clearly above zero and the integrating contribution narrowly below zero. The increase in women's aggregate employment share added a statistically distinguishable but substantively small contribution of 0.002. This small contribution reflects the distinction between women's overall representation and their occupational distribution: the index compares distributions within each sex, so increased female employment need not translate into occupational integration. Thus, integration within major occupational groups was almost exactly neutralised by employment growth and contraction across groups with different gender compositions.

Figure 2: Sources of change in occupational segregation: Endpoint Shapley decomposition



Source: Authors' calculations based on weighted Serbian LFS microdata

The decomposition at the three-digit level reveals a different configuration during the same period. Both the within-occupation and occupational-structure point estimates increased segregation, each contributing approximately 0.013, while the female-share component again remained small. The structural contribution was statistically distinguishable from zero (95% CI [0.004, 0.022]), whereas the interval for the within-occupation component included zero. The contrast across resolutions is therefore substantive rather than merely numerical. Gender composition became more balanced within major occupational groups, but this integrating movement did not extend to the narrower occupations contained within them. Meanwhile, changes in occupational structure operated in a segregation-increasing direction at both resolutions.

No comparably clear decomposition pattern emerged in the other analytical windows. The descriptive reduction in the one-digit index during 2010–2013 was associated mainly with an integrating within-occupation contribution, but all component intervals included zero. The detailed change during 2010–2012 was negligible, while the small one- and three-digit endpoint changes during 2021–2024 reflected opposing and imprecisely estimated within-occupation and structural contributions. Women's aggregate employment share made small positive contributions in the post-2014 windows, but it never accounted for a substantial share of the total movement.

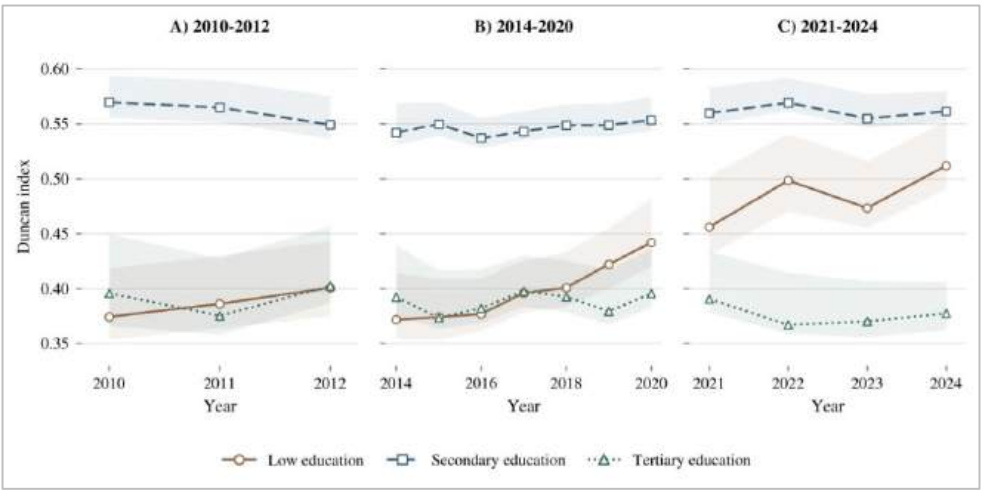
Figure 2 therefore shows that changes in segregation were governed primarily by gender re-composition within occupations and by the redistribution of employment across occupations, rather than by the changing aggregate representation of women in employment. These two processes could either reinforce one another or operate in opposite directions. Their near-complete cancellation at the one-digit level during 2014–2020 explains why aggregate stability concealed substantial underlying change. The chained decompositions yielded the same substantive interpretation (for details, see Supplementary Material, Table S3).

Education-specific Patterns

Figure 3 presents three-digit Duncan indices separately for workers with low, secondary, and tertiary education. The education-specific pattern differs depending on whether the comparison concerns the level or the trajectory of segregation. Secondary-educated workers consistently

displayed the highest level, whereas the clearest post-2014 increase occurred among low-educated workers.

Figure 3: Occupational segregation by education



Source: Authors' calculations based on weighted Serbian LFS microdata

The relative position of the three groups was already visible during 2010–2012. Segregation among secondary-educated workers remained substantially higher than among the low- and tertiary-educated, despite a descriptive decline over the window. The other two groups displayed lower and broadly similar levels, and none of the education-specific endpoint changes was statistically distinguishable from zero.

After 2014, the trajectories became more clearly differentiated. Segregation among secondary-educated workers remained persistently high but showed little net movement within either analytical window. Tertiary-educated workers continued to display lower segregation, but their annual indices reveal fluctuation rather than a sustained process of integration. Low-educated workers followed a different trajectory: their three-digit index increased from 0.372 to 0.442 during 2014–2020 and from 0.456 to 0.512 during 2021–2024. By the end of the period, their segregation had moved considerably closer to the consistently high level observed among secondary-educated workers.

The education-specific results therefore identify three distinct patterns rather than a simple gradient by attainment: (1) high and persistent

segregation among secondary-educated workers, (2) lower but non-declining segregation among tertiary-educated workers, and (3) increasing segregation among low-educated workers. In particular, the narrowing difference between the low- and secondary-education groups resulted from increasing segregation among the former, not from integration among the latter.

This divergence is specific to detailed occupations. At the one-digit level, secondary-educated workers remained the most segregated, but none of the education-specific endpoint changes was statistically distinguishable from zero, and low-educated workers did not show the same sustained post-2014 increase. Their divergence therefore occurred primarily across narrower occupations within major occupational groups rather than through redistribution across the major groups themselves. Figure 3 thus extends the scale-dependent pattern observed for the workforce as a whole: educational differences in the evolution of segregation become substantially more visible at a finer occupational resolution. The complete one-digit results are reported in Supplementary Material, Figure S1 and Table S4.

Direct Comparisons of Education-specific Changes

Table 1 formalises the divergence visible in Figure 3 by comparing education-specific endpoint changes during the two post-2014 analytical windows. In both periods, the three-digit index increased among low-educated workers, while the corresponding changes among secondary- and tertiary-educated workers were small and not statistically distinguishable from zero.

More importantly, the direct contrasts show that the increase among low-educated workers was statistically larger than the changes in each of the other two education groups. This result was reproduced in both 2014–2020 and 2021–2024. The post-2014 divergence of the low-education group therefore does not rest on comparing a statistically distinguishable change in one group with statistically indistinguishable changes in others. The between-group differences in change were themselves supported by the bootstrap intervals. Table 1 thus strengthens the descriptive pattern in Figure 3 in two respects. First, it identifies increasing segregation among low-educated workers as the only education-specific change consistently supported across both post-2014 windows. Second, it shows that this trajectory differed from both the persistent high segregation of secondary-educated workers and the lower, comparatively stable segregation of

tertiary-educated workers. The results therefore indicate a repeated and education-specific divergence concentrated among workers with the lowest educational attainment.

Table 1: Education-Specific Changes in Occupational Segregation at the ISCO Three-Digit Level

Education group	Starting Duncan index	Ending Duncan index	Change (95% CI)	Change minus low-education change (95% CI)
2014-2020				
Low (primary or less)	.372	.442	.070 [.024, .109]	Reference
Secondary	.542	.554	.011 [−.015, .033]	−.059 [−.107, −.010]
Tertiary	.392	.395	.003 [−.039, .044]	−.067 [−.124, −.005]
2021-2024				
Low (primary or less)	.456	.512	.056 [.009, .103]	Reference
Secondary	.560	.561	.001 [−.022, .021]	−.054 [−.107, −.006]
Tertiary	.390	.377	−.013 [−.057, .013]	−.069 [−.135, −.021]

Note: Values are survey-weighted Duncan dissimilarity indices calculated at the ISCO three-digit level. Changes equal the ending index minus the starting index. Direct contrasts equal the change for the listed group minus the change for the low-education group. Percentile 95% confidence intervals are based on 5,000 bootstrap replications. CI = confidence interval; ISCO = International Standard Classification of Occupations.

Source: Authors' calculations based on weighted Serbian LFS microdata

Robustness and Occupational Contributions

The complete set of pairwise contrasts showed that statistically distinguishable differences in change were confined to comparisons involving low-educated workers at the three-digit level in the two post-2014 windows. No corresponding difference was identified at the one-digit level, during 2010–2012 at the detailed level, or between secondary- and tertiary-

educated workers in any analytical window (Supplementary Material, Table S5).

The increase among low-educated workers was robust across all 12 sensitivity estimates for sparse and non-overlapping occupations. Every estimate was positive and every confidence interval excluded zero. The result persisted when the analysis was restricted to common occupational support, occupations satisfying progressively higher sample-size thresholds, and occupations containing both women and men at both endpoints. The employment shares represented by one-sex and small-sample occupations also declined across both post-2014 windows, providing no evidence that the increase was an artefact of sparse or changing occupational support (Supplementary Material, Table S6).

The occupational composition of the increase differed between periods. During 2014–2020, the largest segregation-reinforcing contributions came from subsistence crop farmers, mining and construction labourers, and building trades, while creative and performing artists made the largest integrating contribution. During 2021–2024, cleaners and helpers and shop salespersons made the largest segregation-reinforcing contributions, whereas building trades made the largest integrating contribution. The five largest absolute movements accounted for 36.6% and 42.1% of gross occupational movement, respectively. The repeated increase among low-educated workers thus reflected different period-specific configurations of occupation-level change rather than a stable ranking and direction of occupational contributors (Supplementary Material, Table S7).

Discussion

Serbia's labour market recovery and educational upgrading did not generate a uniform process of occupational gender integration. Across the separate analytical series, broad segregation was descriptively lower in the later series than in the earliest series, a pattern consistent with a longer-run downward tendency but not with a single comparable 2010–2024 change. Three findings qualify this pattern: post-2014 broad stability reflected the cancellation of opposing processes; broad stability coexisted with increasing detailed segregation during 2014–2020; and educational trajectories diverged, with secondary-educated workers remaining the most segregated and low-educated workers recording the clearest increases.

The 2014–2020 broad decomposition provides the clearest evidence of cancellation. A more balanced gender composition within major groups reduced segregation, but employment redistribution across those groups produced an almost equal increase. The larger gross movements in the chained decomposition confirm that the small endpoint change resulted from competing processes rather than structural persistence (Deutsch, Flückiger, & Silber, 2009).

Occupational resolution changes this interpretation. During 2014–2020, the three-digit index increased significantly while the one-digit index remained nearly unchanged. This divergence concerns within-resolution changes, not the mechanically higher level of indices based on more detailed classifications, and it was not driven by increasing numbers of sparse or single-sex occupations. Broad stability can therefore coexist with growing separation across narrower occupations. This interpretation is consistent with complementary evidence for Serbia showing that three-digit occupational reallocation substantially exceeds reallocation across major groups, so that broad classifications can obscure sizeable offsetting movements within categories (Blau et al., 2013; Charles & Grusky, 2004; Ognjenović et al., 2026; Strawiński et al., 2018).

The educational pattern was also non-linear. Secondary-educated workers remained the most segregated, tertiary-educated workers had lower but non-declining segregation, and low-educated workers recorded statistically distinguishable increases in both post-2014 windows that exceeded the changes in the other groups. This does not support a simple gradient in which more education uniformly produces integration. Vocational routes may sustain segregation among secondary-educated workers, while gendered fields of study may constrain integration among tertiary-educated workers. Serbian evidence on researchers also shows that women's strong overall representation can coexist with pronounced gender differentiation across scientific disciplines (Lazarević-Moravčević et al., 2023). For the shrinking low-education group, changes in participation may alter who is employed, alongside changes in sorting into gender-typed manual, elementary, and service jobs. These mechanisms offer a possible interpretation of the contrasting educational trajectories.

The Duncan index measures differences between the occupational distributions of women and men, not occupational hierarchy, earnings, authority, or job quality. This distinction is important in the Serbian context, where evidence from the public sector identifies gender differences in

perceived barriers to career progression, mentorship, work-family reconciliation, stereotypes, and discrimination (Stanišić & Ječmenica, 2025). A larger contribution from a professional occupation may reflect increasing female concentration and therefore raise measured segregation, even when women's entry into that occupation represents an improvement in status or pay. Changes in occupational dissimilarity should consequently not be interpreted automatically as improvements or deteriorations in women's labour market position.

The small contribution of women's aggregate employment share also shows that increased female employment and greater similarity in occupational distributions are distinct dimensions of gender equality. Ognjenović (2018) reported nearly equal employment rates for tertiary-educated women and men in Serbia in 2017. Considered alongside our findings, this illustrates how near parity in employment rates can coexist with persistent occupational segregation within the same educational group. European evidence similarly shows that women's employment can rise without a corresponding expansion of gender-balanced jobs (Bettio & Verashchagina, 2009; Eurofound & European Commission Joint Research Centre, 2021). Occupational segregation may contribute to gender pay differentials, but it remains analytically distinct from the wage gap and its unexplained component (Anić & Krstić, 2019; Blau & Kahn, 2017; Ognjenović, 2021, 2025).

Employment and educational gains were therefore insufficient for uniform occupational integration. Monitoring only employment rates or broad sectors can conceal sorting across detailed occupations and education groups. Gender-equality policy should monitor finer occupational distributions and gendered education-to-occupation pathways, particularly in vocational, technical, engineering, and ICT fields (Babović & Petrović, 2021).

Several limitations qualify the conclusions. Repeated cross-sections cannot trace individual careers, occupational transitions, or cohort replacement. The overall Duncan index is not a weighted average of the education-specific indices, so the declining size and increasing segregation of the low-education group are concurrent processes, not a formally decomposed mediation mechanism. Comparisons are restricted to survey- and classification-consistent windows. Because primary sample units (PSU) and stratum identifiers were unavailable, the bootstrap was adapted to the available clustering identifiers and does not reproduce the full complex

survey design. The resulting confidence intervals are approximate: unobserved clustering may increase sampling variance, whereas stratification and calibration can reduce it, so the net effect on interval width is uncertain. Results close to the zero-exclusion threshold should therefore be interpreted in light of this design approximation. Finally, the Duncan index is sensitive to occupational resolution and does not measure earnings or job quality. The proposed occupational and educational mechanisms therefore remain interpretations requiring longitudinal data and complementary measures of vertical inequality.

Conclusion

Using Serbian LFS data for 2010–2024, we find that occupational integration was partial, uneven, and dependent on occupational resolution and education. Across the separate analytical series, broad segregation was descriptively lower in the later series than in the earliest series, a pattern consistent with a longer-run downward tendency but not with a single comparable 2010–2024 change. Within the 2014–2020 analytical window, broad stability concealed an integrating change in gender composition within major groups that was offset by segregation-increasing employment redistribution. Detailed segregation showed a statistically distinguishable increase during 2014–2020, while education-specific trajectories diverged: secondary-educated workers remained the most segregated, tertiary-educated workers showed lower but non-declining segregation, and segregation among low-educated workers increased in both post-2014 windows.

The main contribution is empirical and interpretative: the Serbian evidence shows that aggregate stability must be interpreted through its components, occupational resolution, and educational heterogeneity. Weighted indices establish the trajectories, endpoint and chained Shapley decompositions reveal offsetting movements, and education-specific estimates with direct contrasts identify divergent group trajectories. Together, these stages support an account of integration shaped by occupational and educational pathways alongside changes in women's employment and qualifications. Policies should therefore monitor detailed occupational distributions and address gendered education-to-occupation pathways. In practice, reporting trends separately by educational attainment would make the repeated increase among low-educated workers visible

alongside aggregate indicators. Longitudinal research should distinguish individual mobility from cohort and compositional change, connect segregation to earnings and job quality, and test the mechanisms underlying the divergent educational trajectories. Comparative research could examine whether the same combination of offsetting change and educational divergence occurs in other post-transition economies.

Open Science and Data Availability

The anonymised Serbian LFS microdata used in this study cannot be shared by the authors because they were obtained under restricted-access conditions. Eligible research organisations and institutions may independently request access to the relevant 2010–2024 microdata from the SORS, subject to its approval and the applicable access agreement. Reproducibility materials are available on the Open Science Framework at https://osf.io/ujgx7.

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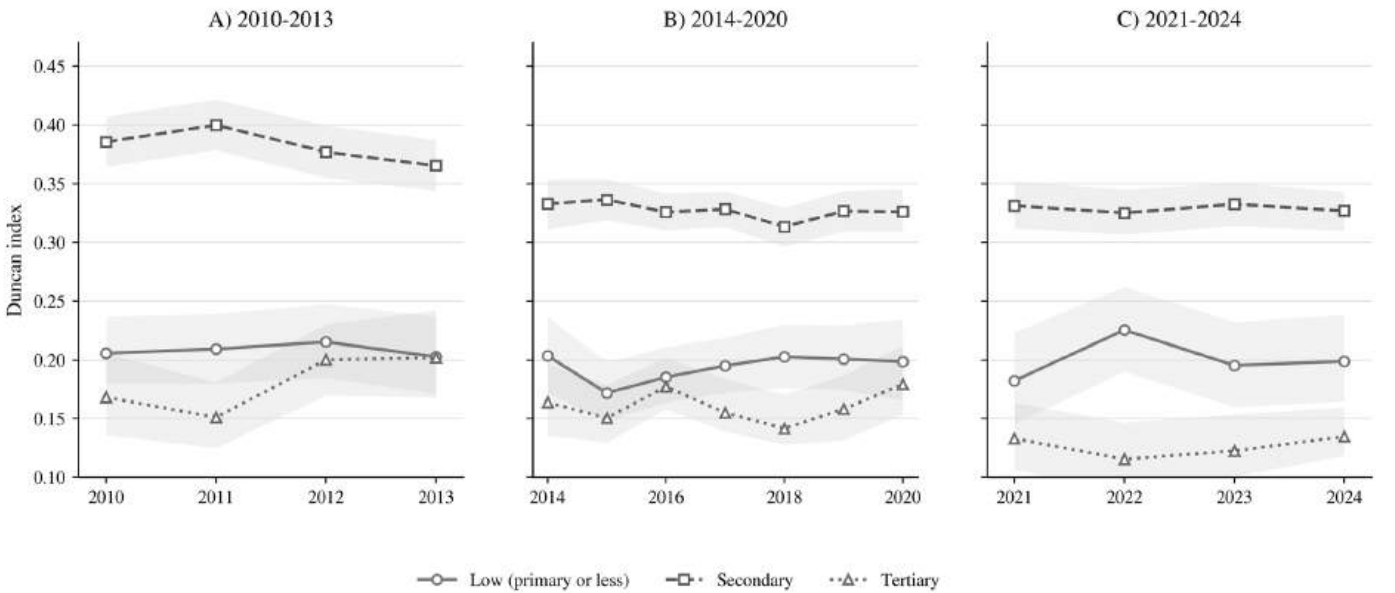
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Supplementary Material

Women, Education, and Occupational Segregation in Serbia: Evidence from LFS Data

Figure S1. Broad Occupational Segregation by Education



Note. Lines show survey-weighted Duncan dissimilarity indices at the ISCO one-digit level; shaded bands are pointwise percentile 95% confidence intervals based on 5,000 bootstrap replications adapted to the available clustering identifiers. Lines connect estimates only within survey-consistent periods. ISCO = International Standard Classification of Occupations.

Table S1. Analytical Samples and Coverage

Panel A. Analytical sample by year

Year	Survey period	Unweighted N	Women	Men	Weighted employment (000s)	Female share (%)	Broad groups	Detailed occupations	Bootstrap units
2010	2010-2013	13,546	5,719	7,827	2,268.6	42.8	10	112	13,546
2011	2010-2013	13,571	5,677	7,894	2,156.9	42.2	10	112	13,571
2012	2010-2013	13,371	5,570	7,801	2,138.6	42.0	10	114	13,371
2013	2010-2013	15,057	6,276	8,781	2,196.3	42.5	10	128	15,057
2014	2014-2020	31,182	13,312	17,870	2,439.3	43.3	10	127	10,476
2015	2014-2020	37,508	16,139	21,369	2,465.7	43.4	10	127	14,330
2016	2014-2020	46,236	20,183	26,053	2,577.5	44.0	10	128	16,983
2017	2014-2020	45,966	20,255	25,711	2,647.6	44.4	10	127	17,146
2018	2014-2020	46,625	20,535	26,090	2,685.1	44.3	10	127	17,339
2019	2014-2020	43,866	19,446	24,420	2,733.5	44.7	10	129	16,982
2020	2014-2020	38,796	17,257	21,539	2,724.2	44.7	10	126	15,434
2021	2021-2024	37,351	16,344	21,007	2,643.3	44.5	10	123	14,726
2022	2021-2024	37,197	16,516	20,681	2,706.6	45.0	10	123	14,259
2023	2021-2024	41,134	18,638	22,496	2,710.9	45.6	10	123	15,796
2024	2021-2024	48,770	22,276	26,494	2,747.9	45.9	10	124	18,246

Panel B. Sample and weighted employment by education

Year	Low N	Low employment (000s)	Secondary N	Secondary employment (000s)	Tertiary N	Tertiary employment (000s)
2010	2,844	445.0	8,093	1,338.8	2,609	484.8
2011	2,660	411.9	8,079	1,266.0	2,832	479.0
2012	2,484	387.7	7,994	1,253.9	2,893	496.9
2013	2,968	396.9	8,973	1,287.7	3,116	511.7
2014	5,878	389.3	18,614	1,452.0	6,690	597.9
2015	6,536	379.6	22,402	1,455.9	8,570	630.2
2016	8,342	406.1	27,498	1,513.5	10,396	657.9
2017	8,244	406.8	27,172	1,550.0	10,550	690.7
2018	7,896	387.0	27,721	1,574.5	11,008	723.6
2019	7,371	389.0	26,130	1,602.9	10,365	741.6
2020	6,031	358.9	23,473	1,626.5	9,292	738.8
2021	5,213	326.3	22,817	1,548.9	9,321	768.0
2022	4,905	314.4	22,935	1,585.5	9,357	806.6
2023	5,179	298.7	25,125	1,585.7	10,830	826.5
2024	5,828	289.1	29,231	1,590.1	13,711	868.7

Panel C. Occupational coverage and support

Year	ISCO standard	Detailed level retained	Broad groups	ISCO-2 occupations	ISCO-3 occupations	One-sex ISCO-3 occupations	Employment in one-sex occupations (%)	Employment in ISCO-3 cells with n < 30 (%)
2010	ISCO-88	Yes	10	28	112	12	2.9	3.6
2011	ISCO-88	Yes	10	28	112	19	4.2	4.2
2012	ISCO-88	Yes	10	28	114	18	2.0	4.4
2013	ISCO-08 transition year; detailed level not used	No	10	—	—	—	—	—
2014	ISCO-08	Yes	10	43	127	8	4.0	0.5
2015	ISCO-08	Yes	10	43	127	5	0.6	0.5
2016	ISCO-08	Yes	10	43	128	3	0.1	0.2
2017	ISCO-08	Yes	10	43	127	5	0.1	0.2
2018	ISCO-08	Yes	10	43	127	6	0.8	0.2
2019	ISCO-08	Yes	10	43	129	6	0.2	0.2
2020	ISCO-08	Yes	10	43	126	5	0.2	0.2
2021	ISCO-08	Yes	10	42	123	2	0.1	0.4
2022	ISCO-08	Yes	10	42	123	2	0.0	0.3
2023	ISCO-08	Yes	10	42	123	7	0.6	0.3
2024	ISCO-08	Yes	10	42	124	5	0.1	0.2

Note. Weighted employment is shown in thousands. Detailed occupational estimates are not retained for the 2013 transition year. For 2010-2013, bootstrap units are records because household identifiers are unavailable; for 2014-2024, household-within-year clusters are used.

Table S2. Overall Duncan Indices and Endpoint Changes

Panel A. Annual estimates by occupational resolution

Year	ISCO one-digit: D (SE) [95% CI]	ISCO two-digit: D	ISCO three-digit: D (SE) [95% CI]
2010	.312 (.009) [.295, .329]	.386	.479 (.008) [.470, .502]
2011	.317 (.009) [.299, .334]	.392	.473 (.008) [.465, .495]
2012	.313 (.009) [.295, .331]	.380	.482 (.008) [.472, .504]
2013	.295 (.009) [.278, .312]	—	—
2014	.273 (.008) [.258, .289]	.412	.470 (.008) [.462, .492]
2015	.280 (.006) [.268, .293]	.420	.476 (.006) [.469, .493]
2016	.273 (.006) [.261, .284]	.405	.465 (.006) [.459, .480]
2017	.268 (.006) [.257, .279]	.408	.475 (.006) [.467, .489]
2018	.264 (.006) [.252, .276]	.416	.484 (.006) [.476, .499]
2019	.269 (.006) [.256, .281]	.413	.483 (.006) [.475, .498]
2020	.277 (.007) [.263, .290]	.423	.497 (.006) [.487, .513]
2021	.275 (.007) [.262, .290]	.425	.501 (.007) [.491, .518]
2022	.269 (.007) [.255, .283]	.423	.497 (.007) [.489, .516]
2023	.272 (.007) [.259, .285]	.419	.487 (.007) [.480, .505]
2024	.277 (.006) [.265, .289]	.432	.496 (.006) [.489, .511]

Panel B. Survey-consistent endpoint changes

Resolution	Period	Start year	End year	Start D	End D	Change	SE	95% CI	CI excludes zero
ISCO one-digit	2010-2013 broad	2010	2013	.312	.295	−.017	.012	[−.041, .007]	No
ISCO one-digit	2014-2020 broad	2014	2020	.273	.277	.004	.010	[−.017, .024]	No
ISCO one-digit	2021-2024 broad	2021	2024	.275	.277	.001	.009	[−.017, .019]	No
ISCO three-digit	2010-2012 ISCO-3	2010	2012	.479	.482	.002	.012	[−.020, .025]	No
ISCO three-digit	2014-2020 ISCO-3	2014	2020	.470	.497	.027	.010	[.004, .042]	Yes
ISCO three-digit	2021-2024 ISCO-3	2021	2024	.501	.496	−.005	.009	[−.021, .014]	No

Note. D = Duncan dissimilarity index; SE = bootstrap standard error; CI = confidence interval. ISCO two-digit estimates are included as diagnostic point estimates and were not used for the main inferential comparisons. Percentile intervals are based on 5,000 bootstrap replications.

Table S3. Full Shapley Decomposition Results

Panel A. Endpoint Shapley decompositions

Resolution	Period	Component	Contribution	SE	95% CI	CI excludes zero	Endpoint change
ISCO one-digit	2010-2013 broad	Within-occupation composition	−.020	.012	[−.043, .003]	No	−.017
ISCO one-digit	2010-2013 broad	Occupational structure	.004	.004	[−.004, .011]	No	−.017
ISCO one-digit	2010-2013 broad	Overall female share	−.000	.001	[−.003, .002]	No	−.017
ISCO one-digit	2014-2020 broad	Within-occupation composition	−.020	.010	[−.039, −.000]	Yes	.004
ISCO one-digit	2014-2020 broad	Occupational structure	.021	.003	[.015, .028]	Yes	.004
ISCO one-digit	2014-2020 broad	Overall female share	.002	.001	[.001, .003]	Yes	.004
ISCO one-digit	2021-2024 broad	Within-occupation composition	.003	.009	[−.014, .020]	No	.001
ISCO one-digit	2021-2024 broad	Occupational structure	−.004	.003	[−.009, .002]	No	.001
ISCO one-digit	2021-2024 broad	Overall female share	.002	.001	[.001, .003]	Yes	.001
ISCO three-digit	2010-2012 ISCO-3	Within-occupation composition	.005	.011	[−.017, .025]	No	.002
ISCO three-digit	2010-2012 ISCO-3	Occupational structure	−.003	.004	[−.011, .007]	No	.002

Resolution	Period	Component	Contribution	SE	95% CI	CI excludes zero	Endpoint change
ISCO three-digit	2010-2012 ISCO-3	Overall female share	−.000	.000	[−.001, .001]	No	.002
ISCO three-digit	2014-2020 ISCO-3	Within-occupation composition	.013	.009	[−.008, .027]	No	.027
ISCO three-digit	2014-2020 ISCO-3	Occupational structure	.013	.005	[.004, .022]	Yes	.027
ISCO three-digit	2014-2020 ISCO-3	Overall female share	.002	.001	[.000, .003]	Yes	.027
ISCO three-digit	2021-2024 ISCO-3	Within-occupation composition	−.008	.008	[−.023, .009]	No	−.005
ISCO three-digit	2021-2024 ISCO-3	Occupational structure	.002	.004	[−.005, .009]	No	−.005
ISCO three-digit	2021-2024 ISCO-3	Overall female share	.001	.001	[.000, .002]	Yes	−.005

Panel B. Chained Shapley components summarized by period

Resolution	Period	Component	Chained contribution	SE	95% CI	Endpoint contribution	Chained minus endpoint
ISCO one-digit	2010-2013 broad	Within-occupation composition	−.020	.012	[−.042, .004]	−.020	.000
ISCO one-digit	2010-2013 broad	Occupational structure	.003	.004	[−.004, .010]	.004	−.000
ISCO one-digit	2010-2013 broad	Overall female share	−.001	.001	[−.003, .002]	−.000	−.000
ISCO one-digit	2014-2020 broad	Within-occupation composition	−.019	.010	[−.039, .000]	−.020	.001
ISCO one-digit	2014-2020 broad	Occupational structure	.021	.003	[.014, .027]	.021	−.000
ISCO one-digit	2014-2020 broad	Overall female share	.002	.001	[.001, .003]	.002	−.000
ISCO one-digit	2021-2024 broad	Within-occupation composition	.003	.009	[−.014, .020]	.003	.000
ISCO one-digit	2021-2024 broad	Occupational structure	−.004	.003	[−.009, .002]	−.004	−.000
ISCO one-digit	2021-2024 broad	Overall female share	.002	.001	[.001, .003]	.002	.000
ISCO three-digit	2010-2012 ISCO-3	Within-occupation composition	.004	.011	[−.017, .025]	.005	−.001
ISCO three-digit	2010-2012 ISCO-3	Occupational structure	−.002	.005	[−.010, .008]	−.003	.001
ISCO three-digit	2010-2012 ISCO-3	Overall female share	−.000	.000	[−.001, .001]	−.000	−.000

Resolution	Period	Component	Chained contribution	SE	95% CI	Endpoint contribution	Chained minus endpoint
ISCO three-digit	2014-2020 ISCO-3	Within-occupation composition	.012	.009	[−.010, .025]	.013	−.001
ISCO three-digit	2014-2020 ISCO-3	Occupational structure	.015	.005	[.005, .024]	.013	.002
ISCO three-digit	2014-2020 ISCO-3	Overall female share	.001	.001	[−.000, .002]	.002	−.001
ISCO three-digit	2021-2024 ISCO-3	Within-occupation composition	−.007	.008	[−.022, .011]	−.008	.002
ISCO three-digit	2021-2024 ISCO-3	Occupational structure	−.000	.004	[−.008, .008]	.002	−.002
ISCO three-digit	2021-2024 ISCO-3	Overall female share	.002	.001	[.001, .003]	.001	.001

Panel C. Annual chained components

Resolution	Transition	Observed change	Within-occupation contribution [95% CI]	Structure contribution [95% CI]	Female-share contribution [95% CI]
ISCO one-digit	2010-2011	.005	.001 [−.022, .024]	.005 [−.002, .012]	−.001 [−.003, .001]
ISCO one-digit	2011-2012	−.004	−.002 [−.026, .022]	−.001 [−.008, .005]	−.000 [−.002, .002]
ISCO one-digit	2012-2013	−.018	−.018 [−.042, .005]	−.001 [−.008, .006]	.001 [−.001, .003]
ISCO one-digit	2014-2015	.007	.008 [−.011, .026]	−.001 [−.006, .005]	.000 [−.001, .001]
ISCO one-digit	2015-2016	−.008	−.012 [−.028, .005]	.003 [−.002, .008]	.001 [−.000, .002]
ISCO one-digit	2016-2017	−.005	−.007 [−.022, .008]	.002 [−.003, .007]	.000 [−.000, .001]
ISCO one-digit	2017-2018	−.004	−.010 [−.025, .005]	.006 [.001, .011]	−.000 [−.001, .001]
ISCO one-digit	2018-2019	.005	.000 [−.016, .016]	.004 [−.001, .009]	.001 [−.000, .001]
ISCO one-digit	2019-2020	.008	.002 [−.015, .019]	.006 [.001, .012]	.000 [−.001, .001]
ISCO one-digit	2021-2022	−.007	−.008 [−.028, .011]	.001 [−.005, .007]	.001 [−.000, .002]
ISCO one-digit	2022-2023	.003	.007 [−.013, .025]	−.004 [−.010, .002]	.001 [−.000, .002]
ISCO one-digit	2023-2024	.005	.005 [−.012, .022]	−.001 [−.006, .005]	.000 [−.001, .002]
ISCO three-digit	2010-2011	−.007	−.012 [−.031, .009]	.005 [−.003, .014]	−.000 [−.001, .001]
ISCO three-digit	2011-2012	.009	.016 [−.006, .035]	−.007 [−.015, .002]	.000 [−.001, .001]
ISCO three-digit	2014-2015	.007	.004 [−.015, .020]	.003 [−.006, .011]	.000 [−.001, .001]
ISCO three-digit	2015-2016	−.011	−.009 [−.024, .005]	−.003 [−.010, .005]	.000 [−.000, .001]
ISCO three-digit	2016-2017	.009	.006 [−.008, .019]	.003 [−.003, .010]	.000 [−.000, .001]
ISCO three-digit	2017-2018	.010	.007 [−.008, .020]	.003 [−.004, .010]	−.000 [−.001, .000]
ISCO three-digit	2018-2019	−.001	−.005 [−.019, .010]	.004 [−.003, .010]	.000 [−.000, .001]
ISCO three-digit	2019-2020	.013	.009 [−.007, .025]	.005 [−.002, .012]	.000 [−.001, .001]

Resolution	Transition	Observed change	Within-occupation contribution [95% CI]	Structure contribution [95% CI]	Female-share contribution [95% CI]
ISCO three-digit	2021-2022	−.004	−.003 [−.017, .017]	−.002 [−.010, .006]	.001 [−.000, .002]
ISCO three-digit	2022-2023	−.010	−.015 [−.033, .001]	.004 [−.004, .012]	.001 [−.000, .002]
ISCO three-digit	2023-2024	.009	.011 [−.006, .025]	−.002 [−.009, .005]	.000 [−.000, .001]

Note. Shapley contributions sum to the corresponding Duncan-index change, subject only to numerical rounding. Endpoint decompositions compare the first and last year of each valid survey-consistent window. Chained results sum adjacent-year decompositions within each window. CI = confidence interval. Values displayed as .000 or −.000 may represent nonzero estimates that round to three decimal places.

Table S4. Complete Education-Specific Duncan Results

Panel A. Annual ISCO one-digit estimates by education

Year	Low: D (SE) [95% CI]	Secondary: D (SE) [95% CI]	Tertiary: D (SE) [95% CI]
2010	.206 (.015) [.180, .237]	.386 (.011) [.364, .407]	.168 (.018) [.136, .206]
2011	.209 (.015) [.180, .239]	.400 (.011) [.379, .422]	.151 (.014) [.125, .181]
2012	.215 (.016) [.185, .248]	.377 (.011) [.355, .399]	.200 (.015) [.170, .230]
2013	.203 (.017) [.171, .237]	.365 (.011) [.344, .387]	.202 (.019) [.168, .242]
2014	.203 (.016) [.172, .236]	.333 (.011) [.311, .353]	.164 (.016) [.136, .197]
2015	.172 (.013) [.148, .198]	.336 (.009) [.319, .354]	.151 (.013) [.130, .179]
2016	.185 (.012) [.164, .211]	.326 (.008) [.310, .342]	.177 (.011) [.158, .202]
2017	.195 (.012) [.172, .219]	.328 (.008) [.313, .343]	.155 (.011) [.139, .184]
2018	.203 (.014) [.176, .230]	.313 (.008) [.297, .329]	.142 (.011) [.128, .170]
2019	.201 (.014) [.174, .229]	.327 (.009) [.309, .344]	.158 (.014) [.132, .187]
2020	.199 (.017) [.165, .235]	.326 (.009) [.309, .345]	.179 (.015) [.154, .212]
2021	.182 (.020) [.146, .223]	.331 (.010) [.312, .352]	.133 (.015) [.107, .163]
2022	.225 (.019) [.190, .262]	.325 (.010) [.307, .345]	.115 (.015) [.087, .147]
2023	.195 (.018) [.160, .232]	.332 (.009) [.314, .351]	.122 (.014) [.101, .154]
2024	.199 (.019) [.165, .238]	.327 (.008) [.310, .343]	.135 (.011) [.118, .160]

Panel B. Annual ISCO three-digit estimates by education

Year	Low: D (SE) [95% CI]	Secondary: D (SE) [95% CI]	Tertiary: D (SE) [95% CI]
2010	.374 (.017) [.354, .418]	.570 (.010) [.556, .594]	.396 (.021) [.366, .449]
2011	.386 (.017) [.364, .430]	.565 (.010) [.552, .590]	.375 (.018) [.358, .427]
2012	.401 (.018) [.375, .444]	.549 (.010) [.537, .575]	.402 (.018) [.387, .457]
2014	.372 (.015) [.354, .414]	.542 (.010) [.531, .568]	.392 (.016) [.376, .439]
2015	.374 (.014) [.353, .409]	.550 (.008) [.539, .570]	.373 (.013) [.364, .417]
2016	.377 (.012) [.362, .410]	.537 (.007) [.528, .555]	.382 (.012) [.369, .417]
2017	.396 (.012) [.378, .426]	.543 (.007) [.535, .562]	.398 (.012) [.384, .430]
2018	.401 (.013) [.384, .433]	.549 (.007) [.539, .568]	.393 (.012) [.378, .426]
2019	.422 (.014) [.400, .455]	.549 (.008) [.539, .568]	.379 (.013) [.368, .417]
2020	.442 (.016) [.420, .482]	.554 (.008) [.543, .574]	.395 (.014) [.383, .436]
2021	.456 (.018) [.431, .503]	.560 (.008) [.550, .583]	.390 (.014) [.378, .434]
2022	.498 (.018) [.470, .541]	.569 (.008) [.561, .592]	.367 (.014) [.359, .414]
2023	.473 (.015) [.455, .516]	.555 (.008) [.547, .577]	.370 (.013) [.356, .407]
2024	.512 (.015) [.491, .552]	.561 (.007) [.552, .580]	.377 (.011) [.362, .406]

Panel C. Endpoint changes for all available periods and resolutions

Resolution	Period	Education group	Start D	End D	Change	SE	95% CI	CI excludes zero
ISCO one-digit	2010-2013 broad	Low (primary or less)	.206	.203	−.003	.022	[−.047, .040]	No
ISCO one-digit	2010-2013 broad	Secondary	.386	.365	−.020	.015	[−.050, .011]	No
ISCO one-digit	2010-2013 broad	Tertiary	.168	.202	.034	.025	[−.016, .084]	No
ISCO one-digit	2014-2020 broad	Low (primary or less)	.203	.199	−.005	.024	[−.051, .043]	No
ISCO one-digit	2014-2020 broad	Secondary	.333	.326	−.007	.014	[−.033, .023]	No
ISCO one-digit	2014-2020 broad	Tertiary	.164	.179	.015	.021	[−.026, .058]	No
ISCO one-digit	2021-2024 broad	Low (primary or less)	.182	.199	.017	.027	[−.036, .071]	No
ISCO one-digit	2021-2024 broad	Secondary	.331	.327	−.004	.013	[−.032, .021]	No
ISCO one-digit	2021-2024 broad	Tertiary	.133	.135	.002	.018	[−.032, .039]	No
ISCO three-digit	2010-2012 ISCO-3	Low (primary or less)	.374	.401	.026	.024	[−.022, .071]	No
ISCO three-digit	2010-2012 ISCO-3	Secondary	.570	.549	−.020	.014	[−.047, .008]	No

Resolution	Period	Education group	Start D	End D	Change	SE	95% CI	CI excludes zero
ISCO three-digit	2010-2012 ISCO-3	Tertiary	.396	.402	.007	.028	[−.041, .071]	No
ISCO three-digit	2014-2020 ISCO-3	Low (primary or less)	.372	.442	.070	.022	[.024, .109]	Yes
ISCO three-digit	2014-2020 ISCO-3	Secondary	.542	.554	.011	.013	[−.015, .033]	No
ISCO three-digit	2014-2020 ISCO-3	Tertiary	.392	.395	.003	.021	[−.039, .044]	No
ISCO three-digit	2021-2024 ISCO-3	Low (primary or less)	.456	.512	.056	.024	[.009, .103]	Yes
ISCO three-digit	2021-2024 ISCO-3	Secondary	.560	.561	.001	.011	[−.022, .021]	No
ISCO three-digit	2021-2024 ISCO-3	Tertiary	.390	.377	−.013	.018	[−.057, .013]	No

Note. Values are survey-weighted Duncan indices. Annual intervals are pointwise percentile 95% confidence intervals. Endpoint changes equal the ending index minus the starting index. Detailed estimates exclude the 2013 transition year.

Table S5. Complete Direct Contrasts Between Education Groups

Resolution	Period	Direct contrast	Difference in change	SE	95% CI	CI excludes zero
ISCO one-digit	2010-2013 broad	Secondary change minus low change	−.017	.027	[−.069, .037]	No
ISCO one-digit	2010-2013 broad	Tertiary change minus low change	.037	.034	[−.029, .103]	No
ISCO one-digit	2010-2013 broad	Tertiary change minus secondary change	.054	.030	[−.004, .112]	No
ISCO one-digit	2014-2020 broad	Secondary change minus low change	−.002	.028	[−.056, .053]	No
ISCO one-digit	2014-2020 broad	Tertiary change minus low change	.020	.032	[−.041, .084]	No
ISCO one-digit	2014-2020 broad	Tertiary change minus secondary change	.022	.026	[−.029, .072]	No
ISCO one-digit	2021-2024 broad	Secondary change minus low change	−.021	.030	[−.080, .038]	No
ISCO one-digit	2021-2024 broad	Tertiary change minus low change	−.015	.032	[−.077, .049]	No
ISCO one-digit	2021-2024 broad	Tertiary change minus secondary change	.006	.022	[−.036, .052]	No
ISCO three-digit	2010-2012 ISCO-3	Secondary change minus low change	−.047	.028	[−.098, .011]	No
ISCO three-digit	2010-2012 ISCO-3	Tertiary change minus low change	−.020	.037	[−.081, .063]	No

Resolution	Period	Direct contrast	Difference in change	SE	95% CI	CI excludes zero
ISCO three-digit	2010-2012 ISCO-3	Tertiary change minus secondary change	.027	.031	[−.029, .096]	No
ISCO three-digit	2014-2020 ISCO-3	Secondary change minus low change	−.059	.025	[−.107, −.010]	Yes
ISCO three-digit	2014-2020 ISCO-3	Tertiary change minus low change	−.067	.030	[−.124, −.005]	Yes
ISCO three-digit	2014-2020 ISCO-3	Tertiary change minus secondary change	−.008	.025	[−.055, .040]	No
ISCO three-digit	2021-2024 ISCO-3	Secondary change minus low change	−.054	.026	[−.107, −.006]	Yes
ISCO three-digit	2021-2024 ISCO-3	Tertiary change minus low change	−.069	.030	[−.135, −.021]	Yes
ISCO three-digit	2021-2024 ISCO-3	Tertiary change minus secondary change	−.015	.021	[−.062, .020]	No

Note. Each contrast is the endpoint change for the first listed education group minus the endpoint change for the second listed group. Tests are based on the joint bootstrap distribution of the two changes and do not infer a group difference by comparing separate significance decisions.

Table S6. Low-Education Sensitivity and Support Analyses

Panel A. Predefined sensitivity scenarios

Period	Scenario	Occupations retained	N start / end	D start / end	Change	SE	95% CI	Positive bootstrap changes (%)	Difference from full-sample change
2014-2020 ISCO-3	All observed occupations	87	5,878 / 6,031	.372 / .442	.070	.022	[.024, .109]	99.8	.000
2014-2020 ISCO-3	Occupations observed at both endpoints	72	5,862 / 6,015	.370 / .439	.069	.022	[.022, .109]	99.9	−.001
2014-2020 ISCO-3	Common occupations with n >= 10 at both endpoints	49	5,704 / 5,888	.354 / .439	.084	.022	[.034, .122]	100.0	.014
2014-2020 ISCO-3	Common occupations with n >= 20 at both endpoints	37	5,529 / 5,632	.342 / .432	.090	.023	[.039, .128]	100.0	.020
2014-2020 ISCO-3	Common occupations with n >= 30 at both endpoints	28	5,302 / 5,253	.320 / .429	.109	.024	[.056, .148]	100.0	.039
2014-2020 ISCO-3	Common occupations containing both sexes at both endpoints	39	5,100 / 5,035	.268 / .348	.080	.025	[.033, .129]	100.0	.010
2021-2024 ISCO-3	All observed occupations	91	5,213 / 5,828	.456 / .512	.056	.024	[.009, .103]	98.9	.000
2021-2024 ISCO-3	Occupations observed at both endpoints	74	5,200 / 5,807	.455 / .512	.057	.024	[.007, .102]	99.0	.001

Period	Scenario	Occupations retained	N start / end	D start / end	Change	SE	95% CI	Positive bootstrap changes (%)	Difference from full-sample change
2021-2024 ISCO-3	Common occupations with n >= 10 at both endpoints	48	5,078 / 5,655	.449 / .506	.057	.024	[.008, .104]	98.9	.001
2021-2024 ISCO-3	Common occupations with n >= 20 at both endpoints	41	4,981 / 5,533	.446 / .505	.059	.025	[.008, .106]	99.0	.003
2021-2024 ISCO-3	Common occupations with n >= 30 at both endpoints	34	4,811 / 5,292	.436 / .505	.070	.025	[.014, .114]	99.5	.014
2021-2024 ISCO-3	Common occupations containing both sexes at both endpoints	45	4,417 / 4,927	.334 / .410	.076	.025	[.025, .123]	99.8	.020

Panel B. Endpoint support and sparse-occupation diagnostics

Period	Year	N	Occupations	Both sexes	One sex only	Employment in one-sex occupations (%)	n < 10: occupations (employment %)	n < 20: occupations (employment %)	n < 30: occupations (employment %)	Minimum sex n < 5: occupations (employment %)
2014-2020 ISCO-3	2014	5,878	79	46	33	12.9	28 (2.4%)	41 (6.1%)	48 (8.8%)	58 (22.7%)
2014-2020 ISCO-3	2020	6,031	80	51	29	11.9	27 (1.9%)	35 (3.9%)	45 (8.2%)	49 (21.3%)
2021-2024 ISCO-3	2021	5,213	82	54	28	9.9	32 (2.2%)	41 (4.7%)	48 (8.0%)	55 (27.9%)
2021-2024 ISCO-3	2024	5,828	83	54	29	8.6	30 (1.7%)	39 (4.3%)	44 (6.5%)	54 (22.9%)

Note. All 12 predefined sensitivity estimates use the same low-education population and endpoint windows as the primary analysis. Positive bootstrap changes (%) is the share of valid bootstrap replications with a positive endpoint change. Parentheses in Panel B show the weighted employment share represented by the corresponding sparse-occupation category.

Table S7. Occupational Contributions

Panel A. ISCO three-digit occupation drivers among low-educated workers, 2014-2020

Net change = .070; top five absolute movements = 36.6% of gross absolute movement.

Absolute rank	ISCO-3	Occupation	Contribution change	Exploratory 95% CI	P(point direction)	Driver role	Employment share start / end (%)	Female share start / end (%)	Common support
1	631	Subsistence Crop Farmers	.022	[.012, .033]	1.000	Reinforcing	4.0 / 5.6	52.1 / 69.7	Yes
2	931	Mining and Construction Labourers	.013	[.006, .021]	1.000	Reinforcing	1.7 / 3.2	0.0 / 0.0	Yes
3	711	Building Frame and Related Trades Workers	.012	[.004, .020]	.999	Reinforcing	1.4 / 2.7	0.0 / 0.0	Yes
4	265	Creative and Performing Artists	−.006	[−.010, −.002]	.998	Integrating	0.7 / 0.2	1.3 / 27.6	Yes
5	753	Garment and Related Trades Workers	.006	[−.002, .014]	.933	Reinforcing	1.4 / 1.8	78.6 / 86.1	Yes
6	815	Textile, Fur and Leather Products Machine Operators	.005	[−.000, .011]	.972	Reinforcing	0.3 / 1.2	92.3 / 80.7	Yes
7	632	Subsistence Livestock Farmers	−.005	[−.011, .000]	.973	Integrating	1.7 / 0.5	63.6 / 61.7	Yes
8	613	Mixed Crop and Animal Producers	.005	[−.009, .015]	.681	Reinforcing	15.5 / 15.1	43.6 / 45.9	Yes

Absolute rank	ISCO-3	Occupation	Contribution change	Exploratory 95% CI	P(point direction)	Driver role	Employment share start / end (%)	Female share start / end (%)	Common support
9	833	Heavy Truck and Bus Drivers	.005	[−.001, .012]	.944	Reinforcing	1.5 / 2.1	0.0 / 0.0	Yes
10	722	Blacksmiths, Toolmakers and Related Trades Workers	.004	[−.002, .010]	.899	Reinforcing	0.7 / 1.4	4.9 / 8.8	Yes
11	932	Manufacturing Labourers	.004	[−.003, .008]	.781	Reinforcing	1.3 / 2.3	44.6 / 51.9	Yes
12	522	Shop Salespersons	.003	[−.007, .014]	.721	Reinforcing	2.6 / 3.2	72.8 / 73.2	Yes
13	532	Personal Care Workers in Health Services	.003	[−.001, .007]	.915	Reinforcing	0.3 / 0.6	82.2 / 90.6	Yes
14	921	Agricultural, Forestry and Fishery Labourers	.003	[−.008, .012]	.638	Reinforcing	5.9 / 5.3	40.6 / 38.1	Yes
15	751	Food Processing and Related Trades Workers	.003	[−.006, .007]	.588	Reinforcing	1.9 / 1.7	43.6 / 33.9	Yes
16	541	Protective Services Workers	−.003	[−.008, .002]	.857	Integrating	1.3 / 1.0	0.0 / 1.4	Yes
17	713	Painters, Building Structure Cleaners and Related Trades Workers	−.003	[−.012, .005]	.744	Integrating	1.9 / 1.6	0.7 / 1.1	Yes
18	814	Rubber, Plastic and Paper Products Machine Operators	−.002	[−.005, .001]	.841	Integrating	0.4 / 0.4	12.9 / 44.0	Yes

Absolute rank	ISCO-3	Occupation	Contribution change	Exploratory 95% CI	P(point direction)	Driver role	Employment share start / end (%)	Female share start / end (%)	Common support
19	612	Animal Producers	−.002	[−.016, .011]	.625	Integrating	8.0 / 8.9	50.9 / 49.5	Yes
20	524	Other Sales Workers	.002	[−.001, .005]	.863	Reinforcing	0.2 / 0.5	40.4 / 21.6	Yes
21	422	Client Information Workers	−.002	[−.005, .000]	.933	Integrating	0.4 / 0.1	6.1 / 100.0	Yes
22	831	Locomotive Engine Drivers and Related Workers	−.002	[−.005, .001]	.897	Integrating	0.4 / 0.2	0.0 / 0.0	Yes
23	512	Cooks	.002	[−.003, .007]	.755	Reinforcing	0.6 / 0.7	85.5 / 94.8	Yes
24	741	Electrical Equipment Installers and Repairers	.002	[−.001, .004]	.892	Reinforcing	0.2 / 0.3	30.3 / 5.5	Yes
25	817	Wood Processing and Papermaking Plant Operators	.002	[−.002, .003]	.734	Reinforcing	0.3 / 0.3	43.0 / 17.8	Yes
26	821	Assemblers	−.002	[−.004, .006]	.547	Integrating	0.3 / 2.0	92.1 / 46.3	Yes
27	723	Machinery Mechanics and Repairers	−.002	[−.006, .003]	.759	Integrating	0.7 / 0.5	0.0 / 0.0	Yes
28	611	Market Gardeners and Crop Growers	−.002	[−.015, .013]	.577	Integrating	12.0 / 8.4	46.9 / 38.6	Yes
29	933	Transport and Storage Labourers	.002	[−.002, .005]	.792	Reinforcing	0.6 / 0.8	4.4 / 2.4	Yes

Absolute rank	ISCO-3	Occupation	Contribution change	Exploratory 95% CI	P(point direction)	Driver role	Employment share start / end (%)	Female share start / end (%)	Common support
30	941	Food Preparation Assistants	.002	[−.002, .006]	.772	Reinforcing	0.2 / 0.5	100.0 / 80.6	Yes
31	413	Keyboard Operators	−.001	[−.005, .002]	.785	Integrating	0.2 / 0.1	100.0 / 92.3	Yes
32	216	Architects, Planners, Surveyors and Designers	.001	[.000, .004]	.641	Reinforcing	0.0 / 0.2	— / 0.0	No
33	513	Waiters and Bartenders	.001	[−.005, .007]	.674	Reinforcing	0.9 / 1.0	75.5 / 78.6	Yes
34	523	Cashiers and Ticket Clerks	.001	[−.001, .004]	.862	Reinforcing	0.1 / 0.2	64.7 / 100.0	Yes
35	754	Other Craft and Related Workers	−.001	[−.004, .001]	.839	Integrating	0.2 / 0.1	100.0 / 69.9	Yes
36	952	Street Vendors (excluding Food)	−.001	[−.004, .000]	.868	Integrating	0.1 / 0.0	100.0 / —	No
37	911	Domestic, Hotel and Office Cleaners and Helpers	.001	[−.015, .018]	.551	Reinforcing	6.6 / 7.1	92.3 / 90.4	Yes
38	721	Sheet and Structural Metal Workers, Moulders and Welders, and Related Workers	.001	[−.003, .006]	.658	Reinforcing	0.6 / 0.9	1.6 / 10.7	Yes

Panel A. ISCO three-digit occupation drivers among low-educated workers, 2014-2020 (continued)

Absolute rank	ISCO-3	Occupation	Contribution change	Exploratory 95% CI	P(point direction)	Driver role	Employment share start / end (%)	Female share start / end (%)	Common support
39	811	Mining and Mineral Processing Plant Operators	−.001	[−.004, .002]	.768	Integrating	0.4 / 0.3	0.0 / 7.5	Yes
40	516	Other Personal Services Workers	.001	[−.001, .003]	.739	Reinforcing	0.1 / 0.1	40.4 / 0.0	Yes
41	132	Manufacturing, Mining, Construction and Distribution Managers	.001	[.000, .002]	.982	Reinforcing	0.0 / 0.1	— / 0.0	No
42	515	Building and Housekeeping Supervisors	.001	[−.001, .003]	.798	Reinforcing	0.3 / 0.3	17.4 / 4.0	Yes
43	712	Building Finishers and Related Trades Workers	.001	[−.004, .006]	.645	Reinforcing	1.0 / 1.1	0.0 / 0.0	Yes
44	752	Wood Treaters, Cabinet-makers and Related Trades Workers	.001	[−.003, .005]	.690	Reinforcing	0.5 / 0.7	3.7 / 11.4	Yes
45	031	Armed Forces Occupations, Other Ranks	−.001	[−.002, .000]	.918	Integrating	0.1 / 0.0	0.0 / 0.0	Yes
46	634	Subsistence Fishers, Hunters, Trappers and Gatherers	−.001	[−.002, .000]	.951	Integrating	0.2 / 0.0	23.7 / —	No

Absolute rank	ISCO-3	Occupation	Contribution change	Exploratory 95% CI	P(point direction)	Driver role	Employment share start / end (%)	Female share start / end (%)	Common support
47	816	Food and Related Products Machine Operators	−.001	[−.003, .003]	.556	Integrating	0.3 / 0.5	17.4 / 49.8	Yes
48	961	Refuse Workers	−.001	[−.009, .008]	.572	Integrating	2.6 / 2.1	16.2 / 11.5	Yes
49	514	Hairdressers, Beauticians and Related Workers	−.001	[−.004, .003]	.579	Integrating	0.3 / 0.5	75.6 / 55.9	Yes
50	441	Other Clerical Support Workers	−.001	[−.002, .002]	.507	Integrating	0.1 / 0.3	0.0 / 40.1	Yes
51	235	Other Teaching Professionals	−.001	[−.002, .000]	.628	Integrating	0.1 / 0.0	0.0 / —	No
52	834	Mobile Plant Operators	−.001	[−.009, .007]	.571	Integrating	1.9 / 1.9	0.0 / 2.0	Yes
53	832	Car, Van and Motorcycle Drivers	.001	[−.003, .004]	.627	Reinforcing	0.6 / 0.7	0.0 / 0.0	Yes
54	421	Tellers, Money Collectors and Related Clerks	−.001	[−.002, .000]	.791	Integrating	0.2 / 0.0	62.0 / 0.0	Yes
55	143	Other Services Managers	.001	[−.001, .003]	.686	Reinforcing	0.0 / 0.1	100.0 / 81.9	Yes
56	835	Ships' Deck Crews and Related Workers	−.000	[−.001, .000]	.964	Integrating	0.1 / 0.0	0.0 / 0.0	Yes
57	962	Other Elementary Workers	.000	[−.003, .004]	.602	Reinforcing	0.6 / 0.4	26.3 / 16.2	Yes

Absolute rank	ISCO-3	Occupation	Contribution change	Exploratory 95% CI	P(point direction)	Driver role	Employment share start / end (%)	Female share start / end (%)	Common support
58	731	Handicraft Workers	.000	[−.001, .002]	.609	Reinforcing	0.1 / 0.1	29.0 / 74.7	Yes
59	141	Hotel and Restaurant Managers	−.000	[−.002, .001]	.645	Integrating	0.1 / 0.1	0.0 / 63.2	Yes
60	742	Electronics and Telecommunications Installers and Repairers	−.000	[−.002, .000]	.957	Integrating	0.1 / 0.0	27.9 / 100.0	Yes
61	912	Vehicle, Window, Laundry and Other Hand Cleaning Workers	−.000	[−.004, .002]	.630	Integrating	0.7 / 0.4	52.3 / 31.3	Yes
62	633	Subsistence Mixed Crop and Livestock Farmers	.000	[−.012, .012]	.529	Reinforcing	9.1 / 3.3	51.1 / 66.8	Yes
63	622	Fishery Workers, Hunters and Trappers	−.000	[−.001, .002]	.377	Integrating	0.1 / 0.1	23.9 / 45.8	Yes
64	251	Software and Applications Developers and Analysts	.000	[.000, .001]	.649	Reinforcing	0.0 / 0.0	— / 0.0	No
65	432	Material Recording and Transport Clerks	.000	[−.004, .005]	.553	Reinforcing	0.4 / 0.8	0.0 / 18.6	Yes
66	951	Street and Related Services Workers	−.000	[−.001, .001]	.693	Integrating	0.1 / 0.0	0.0 / 0.0	Yes
67	131	Production Managers in Agriculture, Forestry and Fisheries	.000	[−.000, .001]	.603	Reinforcing	0.0 / 0.0	100.0 / 100.0	Yes

Absolute rank	ISCO-3	Occupation	Contribution change	Exploratory 95% CI	P(point direction)	Driver role	Employment share start / end (%)	Female share start / end (%)	Common support
68	222	Nursing and Midwifery Professionals	−.000	[−.001, .000]	.631	Integrating	0.0 / 0.0	100.0 / —	No
69	311	Physical and Engineering Science Technicians	.000	[.000, .001]	.641	Reinforcing	0.0 / 0.0	— / 0.0	No
70	511	Travel Attendants, Conductors and Guides	.000	[.000, .001]	.643	Reinforcing	0.0 / 0.0	— / 0.0	No
71	812	Metal Processing and Finishing Plant Operators	.000	[−.003, .005]	.531	Reinforcing	0.3 / 0.4	12.8 / 68.3	Yes
72	112	Managing Directors and Chief Executives	.000	[.000, .001]	.630	Reinforcing	0.0 / 0.0	— / 0.0	No

Panel A. ISCO three-digit occupation drivers among low-educated workers, 2014-2020 (continued)

Absolute rank	ISCO-3	Occupation	Contribution change	Exploratory 95% CI	P(point direction)	Driver role	Employment share start / end (%)	Female share start / end (%)	Common support
73	813	Chemical and Photographic Products Plant and Machine Operators	−.000	[−.002, .002]	.427	Integrating	0.1 / 0.3	22.6 / 50.6	Yes
74	732	Printing Trades Workers	−.000	[−.000, .002]	.189	Integrating	0.0 / 0.2	0.0 / 43.1	Yes
75	431	Numerical Clerks	−.000	[−.002, .001]	.578	Integrating	0.1 / 0.1	100.0 / 100.0	Yes
76	621	Forestry and Related Workers	−.000	[−.004, .003]	.528	Integrating	0.4 / 0.4	2.3 / 0.0	Yes
77	142	Retail and Wholesale Trade Managers	.000	[.000, .000]	.632	Reinforcing	0.0 / 0.0	— / 0.0	No
78	531	Child Care Workers and Teachers' Aides	−.000	[−.003, .002]	.550	Integrating	0.2 / 0.1	100.0 / 100.0	Yes
79	331	Financial and Mathematical Associate Professionals	.000	[.000, .000]	.650	Reinforcing	0.0 / 0.0	— / 0.0	No
80	818	Other Stationary Plant and Machine Operators	.000	[−.003, .004]	.565	Reinforcing	0.4 / 0.7	22.4 / 32.5	Yes
81	264	Authors, Journalists and Linguists	−.000	[−.000, .000]	.642	Integrating	0.0 / 0.0	100.0 / —	No

Absolute rank	ISCO-3	Occupation	Contribution change	Exploratory 95% CI	P(point direction)	Driver role	Employment share start / end (%)	Female share start / end (%)	Common support
82	111	Legislators and Senior Officials	−.000	[−.000, .000]	.627	Integrating	0.0 / 0.0	0.0 / —	No
83	412	Secretaries (general)	−.000	[−.001, .001]	.516	Integrating	0.0 / 0.0	100.0 / 100.0	Yes
84	411	General Office Clerks	−.000	[−.001, .001]	.545	Integrating	0.0 / 0.0	100.0 / 86.6	Yes
85	021	Non-commissioned Armed Forces Officers	−.000	[−.000, .000]	.632	Integrating	0.0 / 0.0	0.0 / —	No
86	342	Sports and Fitness Workers	.000	[−.000, .001]	.513	Reinforcing	0.0 / 0.0	0.0 / 0.0	Yes
87	521	Street and Market Salespersons	.000	[−.005, .004]	.509	Reinforcing	1.0 / 0.7	30.9 / 26.0	Yes

Panel B. ISCO three-digit occupation drivers among low-educated workers, 2021-2024

Net change = .056; top five absolute movements = 42.1% of gross absolute movement.

Absolute rank	ISCO-3	Occupation	Contribution change	Exploratory 95% CI	P(point direction)	Driver role	Employment share start / end (%)	Female share start / end (%)	Common support
1	911	Domestic, Hotel and Office Cleaners and Helpers	.034	[.016, .050]	1.000	Reinforcing	5.7 / 9.0	92.8 / 93.9	Yes
2	522	Shop Salespersons	.012	[.000, .025]	.977	Reinforcing	3.3 / 4.0	78.0 / 88.4	Yes
3	711	Building Frame and Related Trades Workers	−.010	[−.019, −.001]	.988	Integrating	3.5 / 2.0	3.0 / 0.0	Yes
4	921	Agricultural, Forestry and Fishery Labourers	.008	[−.005, .016]	.875	Reinforcing	6.0 / 5.6	42.5 / 32.8	Yes
5	753	Garment and Related Trades Workers	−.006	[−.014, .001]	.966	Integrating	1.6 / 1.0	81.0 / 74.3	Yes
6	521	Street and Market Salespersons	.005	[−.001, .010]	.938	Reinforcing	0.8 / 1.4	37.5 / 22.2	Yes
7	751	Food Processing and Related Trades Workers	.005	[−.005, .012]	.764	Reinforcing	1.9 / 2.6	41.7 / 52.0	Yes
8	931	Mining and Construction Labourers	.005	[−.007, .016]	.790	Reinforcing	4.8 / 5.3	0.7 / 1.6	Yes
9	932	Manufacturing Labourers	−.005	[−.014, .005]	.800	Integrating	2.9 / 2.2	54.2 / 33.9	Yes

Absolute rank	ISCO-3	Occupation	Contribution change	Exploratory 95% CI	P(point direction)	Driver role	Employment share start / end (%)	Female share start / end (%)	Common support
10	833	Heavy Truck and Bus Drivers	.004	[−.004, .012]	.851	Reinforcing	2.5 / 3.0	0.0 / 0.7	Yes
11	941	Food Preparation Assistants	.004	[−.002, .010]	.897	Reinforcing	0.8 / 1.0	71.1 / 85.8	Yes
12	961	Refuse Workers	.003	[−.006, .014]	.755	Reinforcing	3.6 / 2.7	26.4 / 16.6	Yes
13	523	Cashiers and Ticket Clerks	.003	[.001, .007]	.999	Reinforcing	0.0 / 0.3	100.0 / 100.0	Yes
14	815	Textile, Fur and Leather Products Machine Operators	−.003	[−.014, .006]	.683	Integrating	1.5 / 1.5	91.7 / 84.6	Yes
15	821	Assemblers	.003	[−.008, .013]	.698	Reinforcing	1.8 / 2.9	71.5 / 65.6	Yes
16	531	Child Care Workers and Teachers' Aides	−.003	[−.009, .004]	.778	Integrating	0.6 / 0.4	100.0 / 98.2	Yes
17	722	Blacksmiths, Toolmakers and Related Trades Workers	.003	[−.004, .007]	.727	Reinforcing	1.5 / 1.0	30.8 / 14.4	Yes
18	933	Transport and Storage Labourers	−.002	[−.009, .004]	.785	Integrating	1.5 / 1.0	5.4 / 0.6	Yes

Absolute rank	ISCO-3	Occupation	Contribution change	Exploratory 95% CI	P(point direction)	Driver role	Employment share start / end (%)	Female share start / end (%)	Common support
19	721	Sheet and Structural Metal Workers, Moulders and Welders, and Related Workers	.002	[−.003, .007]	.802	Reinforcing	1.0 / 1.0	10.4 / 1.4	Yes
20	516	Other Personal Services Workers	−.002	[−.004, .000]	.951	Integrating	0.2 / 0.1	0.0 / 38.8	Yes
21	752	Wood Treaters, Cabinet-makers and Related Trades Workers	−.002	[−.007, .004]	.717	Integrating	1.2 / 1.0	16.6 / 21.5	Yes
22	514	Hairdressers, Beauticians and Related Workers	−.002	[−.004, .001]	.849	Integrating	0.4 / 0.3	66.1 / 41.3	Yes
23	513	Waiters and Bartenders	−.002	[−.008, .004]	.697	Integrating	0.9 / 1.1	77.3 / 65.1	Yes
24	811	Mining and Mineral Processing Plant Operators	.002	[−.001, .004]	.894	Reinforcing	0.3 / 0.5	6.2 / 5.5	Yes
25	814	Rubber, Plastic and Paper Products Machine Operators	.002	[−.004, .007]	.707	Reinforcing	0.8 / 1.1	23.0 / 21.1	Yes
26	143	Other Services Managers	.002	[−.000, .004]	.932	Reinforcing	0.0 / 0.3	18.0 / 10.9	Yes
27	613	Mixed Crop and Animal Producers	−.001	[−.019, .016]	.562	Integrating	15.6 / 12.5	46.3 / 48.6	Yes

Absolute rank	ISCO-3	Occupation	Contribution change	Exploratory 95% CI	P(point direction)	Driver role	Employment share start / end (%)	Female share start / end (%)	Common support
28	912	Vehicle, Window, Laundry and Other Hand Cleaning Workers	.001	[−.002, .006]	.724	Reinforcing	0.5 / 0.9	34.9 / 30.3	Yes
29	741	Electrical Equipment Installers and Repairers	.001	[−.001, .004]	.880	Reinforcing	0.2 / 0.3	0.0 / 0.0	Yes
30	612	Animal Producers	−.001	[−.015, .012]	.580	Integrating	7.8 / 6.2	47.1 / 49.3	Yes
31	411	General Office Clerks	.001	[−.001, .004]	.868	Reinforcing	0.1 / 0.3	59.5 / 75.3	Yes
32	817	Wood Processing and Papermaking Plant Operators	−.001	[−.004, .003]	.591	Integrating	0.4 / 0.6	11.5 / 33.9	Yes
33	713	Painters, Building Structure Cleaners and Related Trades Workers	−.001	[−.009, .006]	.635	Integrating	2.1 / 1.9	0.0 / 0.5	Yes
34	712	Building Finishers and Related Trades Workers	−.001	[−.009, .006]	.606	Integrating	1.6 / 1.5	0.0 / 0.0	Yes
35	342	Sports and Fitness Workers	.001	[−.001, .004]	.793	Reinforcing	0.1 / 0.3	0.0 / 16.3	Yes
36	818	Other Stationary Plant and Machine Operators	.001	[−.003, .005]	.642	Reinforcing	0.6 / 1.1	50.0 / 52.2	Yes
37	951	Street and Related Services Workers	.001	[−.000, .003]	.907	Reinforcing	0.0 / 0.1	0.0 / 0.0	Yes

Absolute rank	ISCO-3	Occupation	Contribution change	Exploratory 95% CI	P(point direction)	Driver role	Employment share start / end (%)	Female share start / end (%)	Common support
38	413	Keyboard Operators	−.001	[−.003, .000]	.900	Integrating	0.2 / 0.0	73.4 / 100.0	Yes
39	334	Administrative and Specialized Secretaries	.001	[.000, .003]	.636	Reinforcing	0.0 / 0.1	— / 100.0	No
40	512	Cooks	.001	[−.006, .007]	.627	Reinforcing	0.8 / 0.9	93.3 / 89.3	Yes
41	431	Numerical Clerks	−.001	[−.002, .000]	.862	Integrating	0.1 / 0.0	100.0 / —	No
42	816	Food and Related Products Machine Operators	−.001	[−.004, .006]	.467	Integrating	0.6 / 1.1	53.9 / 37.9	Yes
43	732	Printing Trades Workers	−.001	[−.003, .001]	.770	Integrating	0.1 / 0.1	89.1 / 66.1	Yes
44	524	Other Sales Workers	−.001	[−.004, .003]	.550	Integrating	0.6 / 0.7	32.1 / 43.6	Yes
45	441	Other Clerical Support Workers	−.001	[−.003, .001]	.789	Integrating	0.2 / 0.1	68.8 / 0.0	Yes
46	313	Process Control Technicians	−.001	[−.002, .000]	.867	Integrating	0.1 / 0.0	100.0 / —	No
47	832	Car, Van and Motorcycle Drivers	.001	[−.004, .006]	.606	Reinforcing	0.9 / 1.0	0.0 / 0.0	Yes
48	432	Material Recording and Transport Clerks	−.001	[−.005, .005]	.565	Integrating	0.7 / 1.1	17.0 / 29.0	Yes

Absolute rank	ISCO-3	Occupation	Contribution change	Exploratory 95% CI	P(point direction)	Driver role	Employment share start / end (%)	Female share start / end (%)	Common support
49	332	Sales and Purchasing Agents and Brokers	.001	[−.000, .002]	.855	Reinforcing	0.0 / 0.1	100.0 / 100.0	Yes
50	511	Travel Attendants, Conductors and Guides	−.001	[−.002, .000]	.630	Integrating	0.1 / 0.0	0.0 / 0.0	Yes
51	731	Handicraft Workers	−.001	[−.002, .001]	.583	Integrating	0.2 / 0.2	58.6 / 45.5	Yes
52	831	Locomotive Engine Drivers and Related Workers	−.001	[−.003, .001]	.751	Integrating	0.2 / 0.1	3.7 / 0.0	Yes
53	834	Mobile Plant Operators	.001	[−.008, .009]	.545	Reinforcing	2.2 / 1.9	6.7 / 0.0	Yes
54	742	Electronics and Telecommunications Installers and Repairers	.001	[−.001, .002]	.737	Reinforcing	0.1 / 0.1	18.3 / 0.0	Yes
55	611	Market Gardeners and Crop Growers	−.001	[−.015, .012]	.545	Integrating	9.5 / 8.7	45.0 / 46.6	Yes
56	351	Information and Communications Technology Operations and User Support Technicians	−.001	[−.002, .000]	.628	Integrating	0.0 / 0.0	100.0 / —	No
57	322	Nursing and Midwifery Associate Professionals	.001	[.000, .001]	.953	Reinforcing	0.0 / 0.0	— / 100.0	No
58	422	Client Information Workers	−.000	[−.002, .001]	.712	Integrating	0.1 / 0.0	82.1 / 80.9	Yes

Absolute rank	ISCO-3	Occupation	Contribution change	Exploratory 95% CI	P(point direction)	Driver role	Employment share start / end (%)	Female share start / end (%)	Common support
59	314	Life Science Technicians and Related Associate Professionals	.000	[.000, .001]	.872	Reinforcing	0.0 / 0.1	— / 0.0	No
60	265	Creative and Performing Artists	.000	[−.003, .004]	.591	Reinforcing	0.4 / 0.4	9.4 / 8.1	Yes
61	421	Tellers, Money Collectors and Related Clerks	−.000	[−.001, .000]	.801	Integrating	0.0 / 0.0	0.0 / 42.8	Yes
62	251	Software and Applications Developers and Analysts	.000	[.000, .001]	.619	Reinforcing	0.0 / 0.0	— / 100.0	No
63	754	Other Craft and Related Workers	−.000	[−.002, .001]	.633	Integrating	0.2 / 0.2	54.7 / 49.1	Yes
64	723	Machinery Mechanics and Repairers	.000	[−.003, .004]	.581	Reinforcing	0.6 / 0.6	1.6 / 0.0	Yes
65	131	Production Managers in Agriculture, Forestry and Fisheries	−.000	[−.001, .000]	.640	Integrating	0.0 / 0.0	100.0 / —	No
66	532	Personal Care Workers in Health Services	−.000	[−.004, .004]	.568	Integrating	0.5 / 0.5	97.6 / 97.1	Yes
67	962	Other Elementary Workers	−.000	[−.004, .004]	.553	Integrating	0.6 / 0.9	4.9 / 18.7	Yes
68	812	Metal Processing and Finishing Plant Operators	.000	[−.002, .003]	.589	Reinforcing	0.2 / 0.4	50.2 / 34.2	Yes

Absolute rank	ISCO-3	Occupation	Contribution change	Exploratory 95% CI	P(point direction)	Driver role	Employment share start / end (%)	Female share start / end (%)	Common support
69	112	Managing Directors and Chief Executives	−.000	[−.001, .000]	.859	Integrating	0.0 / 0.0	0.0 / —	No
70	312	Mining, Manufacturing and Construction Supervisors	.000	[−.000, .001]	.852	Reinforcing	0.0 / 0.1	0.0 / 25.3	Yes
71	216	Architects, Planners, Surveyors and Designers	.000	[.000, .001]	.857	Reinforcing	0.0 / 0.0	— / 0.0	No
72	212	Mathematicians, Actuaries and Statisticians	−.000	[−.001, .000]	.637	Integrating	0.0 / 0.0	0.0 / —	No
73	142	Retail and Wholesale Trade Managers	.000	[−.001, .001]	.619	Reinforcing	0.0 / 0.1	0.0 / 100.0	Yes
74	325	Other Health Associate Professionals	−.000	[−.002, .001]	.589	Integrating	0.1 / 0.0	100.0 / 100.0	Yes
75	311	Physical and Engineering Science Technicians	.000	[−.000, .001]	.729	Reinforcing	0.0 / 0.1	21.7 / 25.3	Yes
76	952	Street Vendors (excluding Food)	.000	[.000, .000]	.650	Reinforcing	0.0 / 0.0	— / 0.0	No
77	132	Manufacturing, Mining, Construction and Distribution Managers	−.000	[−.002, .002]	.511	Integrating	0.1 / 0.3	0.7 / 25.9	Yes
78	321	Medical and Pharmaceutical Technicians	−.000	[−.000, .000]	.623	Integrating	0.0 / 0.0	100.0 / —	No

Absolute rank	ISCO-3	Occupation	Contribution change	Exploratory 95% CI	P(point direction)	Driver role	Employment share start / end (%)	Female share start / end (%)	Common support
79	835	Ships' Deck Crews and Related Workers	−.000	[−.000, .000]	.631	Integrating	0.0 / 0.0	0.0 / —	No
80	031	Armed Forces Occupations, Other Ranks	.000	[−.001, .001]	.608	Reinforcing	0.0 / 0.1	0.0 / 0.0	Yes
81	622	Fishery Workers, Hunters and Trappers	.000	[−.002, .001]	.284	Reinforcing	0.1 / 0.0	46.8 / 0.0	Yes
82	813	Chemical and Photographic Products Plant and Machine Operators	−.000	[−.003, .001]	.633	Integrating	0.1 / 0.0	61.1 / 100.0	Yes
83	141	Hotel and Restaurant Managers	−.000	[−.001, .000]	.810	Integrating	0.1 / 0.0	45.6 / 46.1	Yes
84	515	Building and Housekeeping Supervisors	−.000	[−.003, .003]	.502	Integrating	0.3 / 0.4	8.0 / 16.9	Yes
85	121	Business Services and Administration Managers	.000	[.000, .000]	.635	Reinforcing	0.0 / 0.0	— / 0.0	No
86	343	Artistic, Cultural and Culinary Associate Professionals	.000	[.000, .002]	.982	Reinforcing	0.0 / 0.2	— / 41.0	No
87	235	Other Teaching Professionals	.000	[−.001, .001]	.514	Reinforcing	0.0 / 0.0	0.0 / 0.0	Yes
88	335	Government Regulatory Associate Professionals	−.000	[−.000, .000]	.521	Integrating	0.0 / 0.0	0.0 / 0.0	Yes

Absolute rank	ISCO-3	Occupation	Contribution change	Exploratory 95% CI	P(point direction)	Driver role	Employment share start / end (%)	Female share start / end (%)	Common support
89	315	Ship and Aircraft Controllers and Technicians	.000	[.000, .000]	.637	Reinforcing	0.0 / 0.0	— / 0.0	No
90	541	Protective Services Workers	−.000	[−.005, .005]	.506	Integrating	0.9 / 0.9	0.0 / 1.8	Yes
91	621	Forestry and Related Workers	.000	[−.003, .003]	.511	Reinforcing	0.4 / 0.5	2.5 / 5.6	Yes

Panel C. Descriptive ISCO one-digit contribution analysis, 2010-2024

ISCO major group	Occupation	2010 contribution	2024 contribution	Change	Women's distribution share 2010 (%)	Women's distribution share 2024 (%)	Men's distribution share 2010 (%)	Men's distribution share 2024 (%)
0	Armed Forces Occupations	.004	.004	.000	0.0	0.1	0.8	1.0
1	Managers	.010	.011	.000	4.3	2.9	6.3	5.1
2	Professionals	.040	.045	.005	16.5	23.1	8.6	14.1
3	Technicians and Associate Professionals	.044	.027	−.017	20.4	15.8	11.6	10.3
4	Clerical Support Workers	.018	.022	.004	8.7	11.4	5.0	7.0
5	Service and Sales Workers	.037	.037	.000	18.8	19.4	11.4	11.9
6	Skilled Agricultural, Forestry and Fishery Workers	.011	.007	−.004	14.5	7.4	16.7	8.9
7	Craft and Related Trades Workers	.076	.068	−.009	4.6	4.3	19.9	17.9
8	Plant and Machine Operators and Assemblers	.054	.048	−.006	1.9	6.6	12.7	16.3
9	Elementary Occupations	.017	.007	−.010	10.3	8.9	7.0	7.5

Note. Panels A and B decompose the low-education endpoint change additively across ISCO three-digit occupations. Occupation-specific intervals are exploratory percentile intervals and are not adjusted for multiple comparisons; P(point direction) is the bootstrap probability of the point-estimate direction. Panel C is descriptive and crosses survey and classification periods; it is not an inferential endpoint comparison.

Table S8. Harmonisation and Quality-Control Summary

Panel A. Harmonisation rules and survey/classification breaks

Years	Occupational classification and use	Employment variable	Age variable	Weight	Education harmonisation	Bootstrap unit
2010-2012	ISCO-88; detailed results retained	PSTATUS1	AgeGroups	pon_lica	HATLEVEL 1-4 low; 5-6 secondary; 7-10 tertiary	Record
2013	ISCO-08 transition year; broad results only	PSTATUS1	AgeGroups	pon_lica	HATLEVEL 1-4 low; 5-6 secondary; 7-10 tertiary	Record
2014-2018	ISCO-08; first post-break detailed window; 2014 weights revised under the 2015 estimation system	PSTATUS1	AgeGroups	pon_lica	HATLEVEL 1-4 low; 5-9 secondary; 10-13 tertiary	Household within year
2019-2020	ISCO-08; first post-break survey window	PSTATUS	AgeGroups	pon_lica	HATLEVEL 1-4 low; 5-9 secondary; 10-13 tertiary	Household within year
2021-2024	ISCO-08; redesigned survey window	EMPSTAT	AGE	COEFFY	HATLEVEL 1-4 low; 5-9 secondary; 10-13 tertiary	Household within year

Panel B. Selection and analytical-sample validity by survey period

Survey period	Raw records	Employed aged 15-64	Missing/999/invalid ISCO excluded	Analytical records	Invalid analytical fields	Duplicate year-source rows	Expected years present
2010-2013	179,927	55,690	145	55,545	0	0	Yes
2014-2020	838,969	290,387	208	290,179	0	0	Yes
2021-2024	455,011	164,452	0	164,452	0	0	Yes

Panel C. Key numerical and reproducibility checks

Quality-control check	Result	Status
Broad/detailed Duncan cell contributions reconcile to total indices	Maximum absolute difference = 0.00e+00	Pass
Shapley contributions satisfy the efficiency identity	Maximum absolute residual = 1.73e-17	Pass
Education-specific point estimates reconcile with overall calculation inputs	Maximum absolute difference = 0.00e+00	Pass
Low-education sensitivity point estimates reconcile with primary education-specific results	1.6653e-16	Pass
Valid low-education endpoint bootstrap replicates	5000	Pass
Occupation-level contribution changes sum to the low-education endpoint change	4.4409e-16	Pass
Annual occupation-level contributions sum to the annual low-education Duncan index	1.249e-16	Pass
Occupation-level bootstrap changes reconcile with the low-education endpoint changes	0e+00	Pass
Occupation-level endpoint contributions sum to the reported endpoint change	1.249e-16	Pass

Quality-control check	Result	Status
Official ISCO-08 minor-group title count	130	Pass
Verified key ISCO-08 titles	6/6	Pass
ISCO-08 titles missing for used codes	0	Pass

Note. The table reports publication-readable harmonisation and QC summaries. Complete mapping tables, intermediate objects, bootstrap replicate files, and execution logs remain part of the reproducibility package rather than the Supplementary Material. Bootstrap resampling is adapted to the available clustering identifiers and does not reproduce the full complex survey design because PSU and stratum identifiers are unavailable.

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