Contemporary Readings in Law and Social Justice
ISSN: 1948-9137, e-ISSN: 2162-2752
Vol 16(1), 2024
pp. 2036 - 2042

Determining factors of the probability that an enterprise implements innovations

[1]Naranjo, William Guillermo, [2]Vera Calderón, José Alejandro, [3]Diaz Diaz, Roberto Adolfo.

[1]University of Tolima, Master in administration; Specialization in management for the development of public management; Economist.

[2] University of Tolima, Master in Administration; Specialization in project management; Business administrator

[3] University of Tolima, Master in Economics; Economist.

ABSTRACT: This research addresses the relevance of entrepreneurship, innovation, and competitiveness as strategic pillars for developing microenterprises in the beauty sector, particularly in contexts of emerging economies such as Colombia. The study focuses on the need to understand how endogenous factors influence the ability of firms to innovate and sustain competitive advantages in a dynamic market. It focuses specifically on identifying the key determinants that influence the probability of innovation of micro-enterprises in the beauty sector in the Department of Tolima. For this purpose, the influence of the R&D Capacity, the level of Formal Education, the Initial Capital (logarithmically transformed), and the Age of Technology on the propensity to innovate is evaluated. The analysis was conducted using a quantitative approach, employing a Probit econometric model to estimate the probability of innovation. The results reveal that R&D Capability is the most significant factor positively associated with the probability of innovation.

Keywords : Innovation, competitiveness, dolor, emerging economies.

Received: 06/05/2024 **Received:** 22/06/2024 **Accepted:** 29/06/2024

1. Introduction

In recent years, the tertiary sector has consolidated its relevance as a structural component of Ibagué's local economy, evidencing a sustained increase in its share of regional value added. According to figures from the National Administrative Department of Statistics (DANE, 2022), this sector accounted for 75.1% of value added in 2019, subsequently experiencing an adjustment to 63% in 2020 as a consequence of the economic disruptions associated with the pandemic. However, its preponderance in the local productive structure remains unquestionable, now, within this framework, hairdressing and beauty establishments emerge as dynamic players within the service sector, in that sense, a study by the National Federation of Merchants of Colombia (FENALCO, 2021) reveals that such businesses generate an approximate annual economic movement of 500 million pesos, highlighting their contribution to commercial activity and their capacity to generate employment. Beauty salons have transcended their traditional function as spaces for aesthetic care, becoming centers for social interaction, wellness, and personal self-management.

This article proposes a multidimensional innovation model that addresses the adoption of ICTs to the optimization of administrative processes, seeking to strengthen innovative capacities through specialized training, promote formalization with tax incentives, foster inter-enterprise cooperation, develop digital marketing strategies, and implement accessible quality management systems. The model is based on the need to adapt these improvements to the scale of the predominant microenterprises, generating a virtuous circle that increases profitability, attracts new entrepreneurs, and contributes to local economic development, particularly relevant in labor-intensive sectors such as beauty.

2. Theoretical Overview of the Main Concepts

The analysis of the beauty sector can be understood from a theoretical perspective that articulates three conceptual axes: entrepreneurship, innovation, and competitiveness. Entrepreneurship has evolved from the classical notion of the entrepreneur as a risk taker (Cantillon, 1755) to the figure of the innovator who drives creative destruction (Schumpeter, 1934), subsequently integrating functions of resource coordination (Marshall, 1880) and value generation through systematic innovation (Drucker, 1985). Today, it is conceived as a contextualized process that requires formative and strategic capabilities to identify and take advantage of market opportunities (Stevenson, 2000; GEM, 2023). This conceptualization allows differentiating between necessity entrepreneurship, oriented to subsistence, and opportunity entrepreneurship, more resilient and growth-oriented, even in crisis contexts (Fairlie and Fossen, 2019; Moreno, 2021). Entrepreneurial stage models, such as those proposed by Pretorius (2005) and Hisrich and Peters (2002), provide analytical frameworks to assess the entrepreneurial life cycle, from opportunity identification to growth consolidation.

Innovation, as the second theoretical pillar, represents the strategic mechanism through which ventures generate sustainable competitive advantages. From its origin in Schumpeterian theory to contemporary systemic approaches (COM, 1995; OECD, 2018), innovation has broadened its scope to include technological, organizational, and business transformations. Robotiker's (2001) typology, complemented by the Oslo Manual (2018), allows it to be classified according to object (product/process), degree of novelty (incremental/radical), scope of impact (local/global), effect (continuist/rupturist), and origin (technology-push vs. market-pull), which evidences its multidimensional nature. In contexts such as Colombia, structural factors such as limited technological adoption and low social capital (IDE, 2022) restrict the exploitation of innovative potential, especially in knowledge-intensive sectors such as beauty services.

Business competitiveness is thus configured as a result of the interaction between entrepreneurial and innovative capabilities. In this sense, the Resources and Capabilities Theory (Barney, 1991; Wernerfelt, 1984) explains how the strategic combination of tangible and intangible resources (including knowledge) translates into distinctive competencies that support sustainable competitive advantages. Dynamic capabilities (Teece et al., 1997) allow organizations to reconfigure their resources in response to changes in the environment, which is particularly relevant for microenterprises in the beauty sector in regions such as the city of Ibagué in the Department of Tolima, where low innovation indicators (IDC, 2023) demand organizational transformation strategies oriented to added value. In summary, competitive sustainability in this sector depends on the integrated management of innovation as a strategic capacity, articulated with opportunity-oriented entrepreneurship and an adaptive vision of the competitive environment.

3. Methodology

This study adopts a quantitative approach with a non-experimental, cross-sectional, and correlational design (Hernández et al.,2018; Kerlinger & Lee, 2002), aimed at identifying and empirically analyzing the relationships between entrepreneurship, innovation, and competitiveness in the beauty services sector. Data collection was carried out through structured surveys applied to formal entrepreneurs registered in the Chamber of Commerce of Ibagué (CCI) and municipalities within its jurisdiction. This methodological approach, based on Hernández et al. (2013, 2018), allows the validation of hypotheses through statistical techniques and the recognition of relevant sectoral patterns, generating a robust characterization of entrepreneurial dynamics in specific territorial contexts.

The unit of analysis focused on establishments with main economic activity S9602 (hairdressing and other beauty treatments according to ISIC), under inclusion criteria that considered business formality, territorial location, minimum labor conditions, and an age range of the owner between 18 and 64 years old. Based on a universe of 2675 formally constituted companies between 2018 and 2022, a non-proportional stratified probability sampling was implemented. The final sample consisted of 382 units distributed between Ibagué and ten additional municipalities, using differentiated sampling fractions (between 20 % and 50 % in municipalities with lower density, and 1/8 for Ibagué), guaranteeing geographic and sectoral representativeness.

4. Discussion

The empirical findings of the Probit model are integrated coherently with the theoretical framework and the background reviewed, allowing a deeper understanding of the factors that affect the probability of innovation within the beauty sector in Colombia. The R&D Capacity variable (X1) is positioned as the most solid and statistically significant predictor ($p < 0.001$), with an average marginal effect of 4.32 %, which reinforces the determinant role of intangible capabilities in innovation processes. This result validates Schumpeter's (1934) premises regarding the dynamizing role of innovation, and aligns with the Resources and Capabilities Theory (Barney, 1991; Teece et al., 1997), by highlighting how R&D acts as a strategic resource in sectors with high competition and low differentiation barriers such as personal services.

The result also finds empirical support in studies such as Lyver and Lu (2018), which demonstrate the positive influence of strategic capabilities on innovative performance, even in non-technology-intensive sectors such as beauty. The ability to systematize knowledge, adapt techniques, and incorporate differentiating elements to services constitutes a key factor for microenterprises to respond to changes in demand, aesthetic trends, and market dynamics. In this context, innovation is more of an incremental and adaptive process than a technological disruption.

In contrast, the variables Formal Education (X2), Initial Capital (ln_X3), and Age of Technology (X4) showed no significant effects in the model. The non-significance of formal education can be interpreted in light of the practical nature of the trade in the beauty sector, where experiential learning, market intuition, and tacit knowledge play a more relevant role than formal academic training (Maya-Carrillo et al., 2016). This result suggests that education does not always translate into higher levels of innovation when the environment privileges practical skill over theoretical training.

As for initial capital, its lack of significance could be due to the limited investment capacity or the widespread use of informal sources of financing, which dilutes its direct relationship with innovation. This situation is consistent with studies by the Instituto de Desarrollo Empresarial (IDE, 2022), which warn about the restrictions on access to venture capital and structured financing in Colombian microenterprises. Similarly, the age of the technology also did not prove to be a significant determinant, possibly because in the beauty services sector innovation occurs not so much by technological replacement, but by creative combinations of processes, management, and marketing, as suggested by the Oslo Manual (2018).

From an econometric perspective, the Probit model shows adequate explanatory and predictive capacity. The pseudo R^2 (McFadden = 0.188; Nagelkerke = 0.306) indicates a reasonable fit, while the likelihood ratio test ($p < 0.001$) confirms the significant improvement over a null model. The Hosmer-Lemeshow test ($p = 0.1754$) supports the validity of the fit, and the AUC of 0.743 indicates good discriminatory power. Furthermore, the econometric diagnostics revealed no multicollinearity or functional specification problems, and the robust standard errors adequately controlled for possible heteroscedasticities.

Taken together, these results provide empirical evidence for the literature on innovation in microenterprises, particularly in emerging economies. The emphasis on R&D capability as a central driver of innovation in these types of organizations highlights the importance of fostering internal capabilities and collective learning networks. This finding offers both theoretical and practical implications, suggesting that public policies and entrepreneurship support programs should prioritize knowledge transfer, specific technical training, and the strengthening of endogenous capabilities as strategic axes for improving competitiveness and innovation in sectors traditionally excluded from the technological agenda.

5. Synopsis of the Main Research Outcomes

The results of estimating a probabilistic model to analyze innovation in the beauty sector are presented below. The Probit Model will be used to identify the key determinants that increase the probability that a venture in the beauty sector implements innovation. This approach is particularly suitable for analyzing binary outcomes, where the dependent variable can only take two values (in this case, 1 if the venture implemented innovation and 0 if it did not, derived from the information on innovation implementation). The choice of the Probit model is based on the idea that the underlying latent variable (the propensity to innovate) follows a standard normal distribution, and the probability of observing an innovation is modeled through the standard normal cumulative distribution function (Φ). The general equation for the probability of implementing innovation is as follows:

$$P(Y_i=1)=\Phi(\beta_0+\beta_1 Capacidad\_I+D+\beta_2 Educación\_Formal+LN\beta_3 Capital\_Inicial+\beta_4 Tecnología+\epsilon_i)$$

Where:

- Yi: Is the binary dependent variable for venture i, taking the value 1 if it implemented innovation (according to the innovation data recorded) and 0 if it did not.
- Φ: Represents the cumulative distribution function of a standard normal random variable.
- β_0: Is the intercept of the model.
- $\beta_1,\beta_2,\beta_3,\beta_4$: These are the coefficients that quantify the effect of each independent variable on the probability of innovation.
- I&D Capacity: It will be constructed as the sum of the answers to the questions on research and development capacity (Likert scale), reflecting the strength in this area.
- Formal Education: Represents the educational level of the entrepreneur, obtained from demographic information on education.
- Start-up Capital: Corresponds to the natural logarithm of the value of the reported start-up capital.
- Technology: Is a dichotomous variable recoded from the question on Technological Age, where 1 indicates an age of less than 2 years and 0 an age of 2 years or more, indicating technological modernity.
- ϵ_i: Is the random error term.

The probability of innovation (Y) was estimated through a Probit regression model, using R&D Capacity (X1), Formal Education (X2), the natural logarithm of the Initial Capital (ln_X3), and the Age of Technology (X4) as explanatory variables. The results of the model estimation are presented in Table 1, while the average marginal effects (AME), which allow a direct interpretation of the impact on probability, are shown in Table 2.

Table 1: Summary of Probit Model Estimation

Variable	Coefficient	Standard Error	Z-value	P-value
(Intercept)	-0.60075	1.81616	-0.331	0.741
I&D capacity (X1)	0.13601	0.03196	4.256	0.001
Formal Education (X2)	0.06134	0.15989	0.384	0.701

Initial Capital (ln_X3)	-0.04637	0.12974	-0.357	0.721
Age Technology (X4)	-0.19399	0.27461	-0.706	0.48

Source: own elaboration.

Table 2. Average Marginal Effects (AME) of the Probit Model

I&D capacity (X1)	0.0432	Positive (+)	***	A one-unit increase in R&D Capacity increases the probability of innovating by 4.32 percentage points (pp).
Formal Education (X2)	0.0195	Positive (+)	Not significant	Positive effect (1.95 pp) but not statistically significant (p=0.701).
Capital Inicial (ln_X3)	-0.0147	Negative (-)	Not significant	Each 1% increase in capital reduces the probability by 0.015 pp (p=0.721).
Age Technology (X4)	-0.0616	Negative (-)	Not significant	A greater technological age reduces the probability by 6.16 pp (p=0.480).

Source: own elaboration

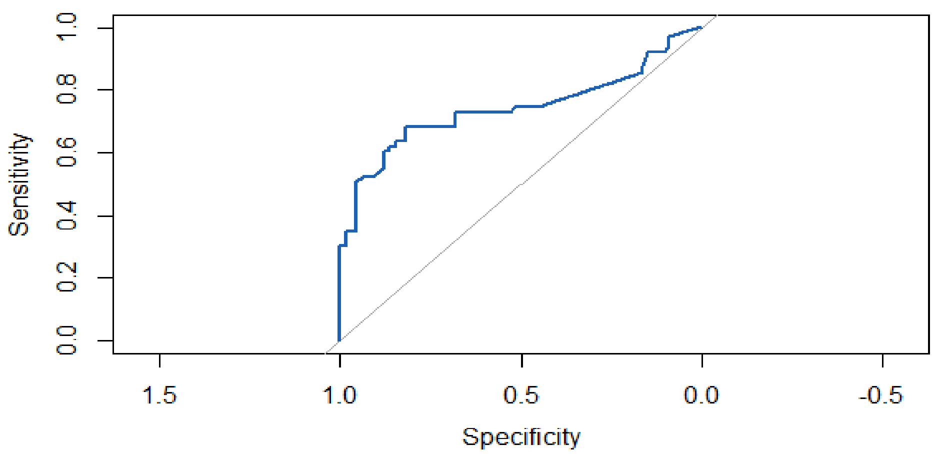
Once the model has been estimated, it is important to validate the assumptions for a probit model. Initially, the evaluation of the goodness of fit of the probit model was carried out by calculating the pseudo R-squared, since the traditional R-squared does not apply to this type of model. The results indicate a McFadden pseudo R-squared of 0.188 and a Cragg-Uhler (Nagelkerke) pseudo R-squared of 0.306. These values, although not interpreted as the proportion of variance explained, suggest that the model has a moderate fit and reasonable explanatory power compared to a null model that does not include predictor variables. The McFadden value, close to 0.2, is generally considered acceptable for binary response models, indicating that the variables included contribute to improving the prediction of the probability of innovation.

The Likelihood Ratio Test (LRT) was used to evaluate the joint significance of the predictor variables included in the Probit model. This test compares the goodness-of-fit of the full model ($Y \sim X1 + X2 + ln\_X3 + X4$) versus a null model containing only the intercept ($Y \sim 1$). The results revealed a p-value of 8.991e-07, which is highly significant ($p < 0.001$). This statistical evidence allows us to reject the null hypothesis that all the coefficients of the predictor variables are simultaneously zero. Therefore, it is concluded that the variables R&D Capacity, Formal Education, Initial Capital (logarithmic), and Age of Technology, as a whole, contribute significantly to explaining the probability of innovation.

The goodness-of-fit of the Probit model was assessed using the Hosmer-Lemeshow Test, implemented by Tabachnick & Fidell (2019), Hosmer & Sturdivant (2013), and Peng et al. (2002), which contrasts the observed frequencies with the frequencies expected by the model in different risk deciles. With a null hypothesis that the model adequately fits the data, the results yielded a Chi-square statistic of 10.24 with 7 degrees of freedom and a p-value of 0.1754. Since the p-value is greater than the conventional significance level (p > 0.05), the null hypothesis is not rejected. This indicates that there is no statistically significant evidence of miscalibration, suggesting that the model fits the observed data well. It should be noted that, although grouping into 10 deciles was requested, the structure of the data led to an automatic fit to 7 degrees of freedom, which is a normal test fit.

To evaluate the correct predictive ability of the Probit model, a ROC Curve was generated, and the Area Under the Curve (AUC) was calculated. The model obtained an AUC of 0.743. This value indicates a good, correct predictive ability, as the model can adequately distinguish between companies that innovate (Y=1) and those that do not innovate (Y=0) with an accuracy higher than that of a random classification (AUC of 0.5). An AUC greater than 0.7 is generally considered an indicator of useful predictive power in classification models.

Figure 1. ROC curve of the Probit model



Source: Own elaboration based on R

The findings of the Probit model reveal that R&D Capacity (X1) is the only variable that exerts a positive and statistically significant effect on the probability that firms innovate. Specifically, a one-unit increase in R&D Capability is associated with an average increase of approximately 4.32 percentage points in the probability of innovating. On the other hand, Formal Education (X2), Initial Capital (ln_X3), and Technology Age (X4) did not show statistically significant effects on the probability of innovation in this model. For Initial Capital, although transformed to its natural logarithm to capture possible non-linear relationships, no significant relationship with innovation was found. The absence of significance for these variables suggests that their influence on the probability of innovation is not distinguishable from chance in the specific geographic-temporal context of the data analyzed.

6. Conclusions

At a practical level, the study's findings indicate that strategies to promote innovation in the beauty sector in Tolima should prioritize the strengthening of internal research and development (R&D) capabilities over the simple acquisition of technologies or the increase of start-up capital. In this context, innovation is associated more with processes of continuous improvement, creative adaptation, and differentiation in services than with disruptive technological changes. Therefore, it is advisable to promote specialized technical training programs, access to knowledge networks, and mechanisms to support experimentation. For entrepreneurs, investing in the systematization of knowledge and process improvement is an effective way to innovate, while public policy should focus efforts on the creation of enabling environments for the development of R&D capabilities in microenterprises, as suggested in the IDE reports (2022) and the recommendations of Camargo et al. (2020) on specific government interventions.

However, the study has some limitations that should be considered. The cross-sectional nature of the data limits the possibility of establishing causal relationships between the variables analyzed, so it is recommended that we move towards longitudinal designs that allow us to observe the evolution of innovation capabilities over time. In addition, the focus on microenterprises in the beauty sector restricts the generalization of the results to other industries or business sizes. Future research could explore the heterogeneity of the effects among different company profiles, incorporate qualitative variables related to knowledge management, and analyze the role of collaboration networks as a driver of innovation. It would also be pertinent to further study the different types of innovation in services (management, marketing, customer experience), to better capture the multifaceted nature of innovative change in sectors such as beauty, where innovation goes beyond technology.

References

[1] Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labo

[2] Barney, J. (1991). Firm resources and sustained competitive advantage. Journal of Management, 17, 99-120.

[3] DANE. (2022, septiembre 30). Press Release: Labor Market Indicators - August 2022.

[4] Fairlie, R. W., y Fossen, F. M. (2019, Octubre). Defining Opportunity versus Necessity Entrepreneurship: Two Components of Business Creation. National Bureau of Economic Research, 26377(23). https://www.nber.org/system/files/working_papers/w26377/w26377.pdf

[5] Hernández Sampieri, R., Fernández Collado, C. & Baptista Lucio, P. (2018). Research Methodology (6th ed.). McGraw-Hill.

[6] Hernández, R., Fernández, C., & Baptista, M. del P. (2003). Research Methodology (3rd ed.). McGraw-Hill.

[7] Hosmer, D. W., Lemeshow, S., & Sturdivant, R. X. (2013). Applied logistic regression (3ª ed.). Wiley.

[8] Kerlinger, F. N. & Lee, H. B. (2002). Behavioral Research: Research Methods in the Social Sciences (4th ed.). McGraw-Hill

[9] Maya Carrillo, M., Pila Jaramillo, B., y Ramos Ramos, V. (2022, enero-junio). Relationship between innovation and competitiveness of non-financial sector ventures in the popular and solidarity economy. International Journal of Administration, (11), 91-119. https://doi.org/10.32719/25506641.2022.11.2

[10] Moreno, A. (2021). Opportunity-driven entrepreneurship vs. necessity-driven entrepreneurship: An analysis in the Colombian context.

[11] OCDE. (2018). Oslo Manual: Guide to collecting and interpreting data on innovation.

[12] Peng, C.-Y. J., Lee, K. L. & Ingersoll, G. M. (2002). An introduction to logistic regression analysis and reporting. The Journal of Educational Research, 96(1), 3–14. https://doi.org/10.1080/00220670209598786

[13] Private Competitiveness Council (Colombia). (2023). Departmental Competitiveness Index 2023. Universidad del Rosario. https://compite.com.co/indice-departamental-de-competitividad/

[14] Schumpeter, J. A. (1934). The theory of economic development: An inquiry into profits, capital, credit, interest, and the business cycle. Harvard University Press.

[15] Tabachnick, B. G. & Fidell, L. S. (2019). Using multivariate statistics (7ª ed.). Pearson.

[16] Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. Strategic Management Journal, 18(7), 509-533.

[17] Wernerfelt, B. (1984). A resource-based view of the firm. Strategic Management Journal, 5(2), 171-180.